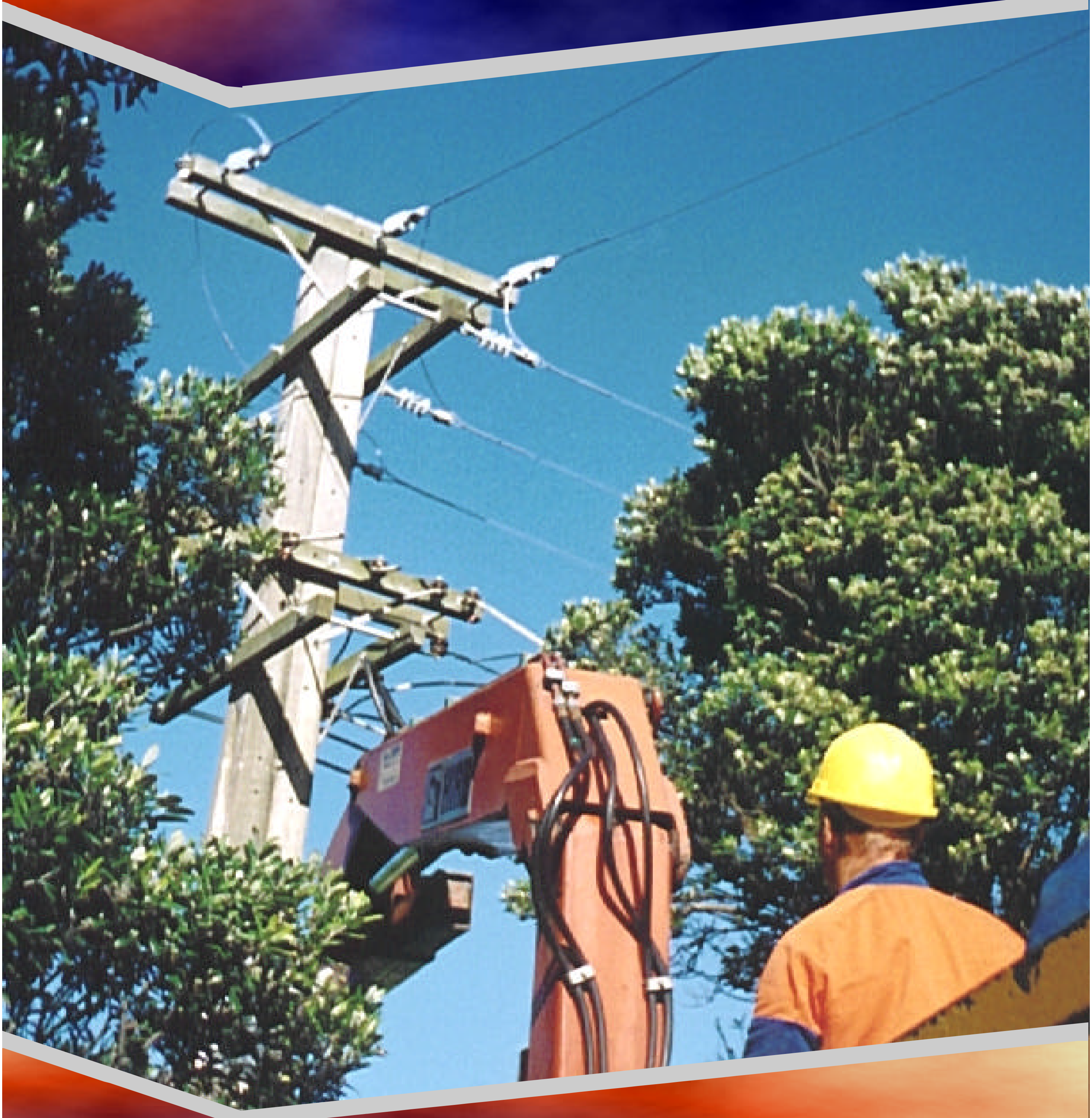
Asset Management Plan 2003



Westpower

Executive Summary

The Asset Management Plan is a foundation document, which summarises the work undertaken on all of 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) Regulations 1999 and is continually improved in both content and layout.

Period Covered

This particular plan was completed in March 2003 and covers a planning period from 1 April 2003 through to 31 March 2013. 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.

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 and provide 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 recently implemented GIS (Geographic Information System) has allowed 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 lightning strikes within the network area. This helps to speed up the recovery of lightning related faults and indentify 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.
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.

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

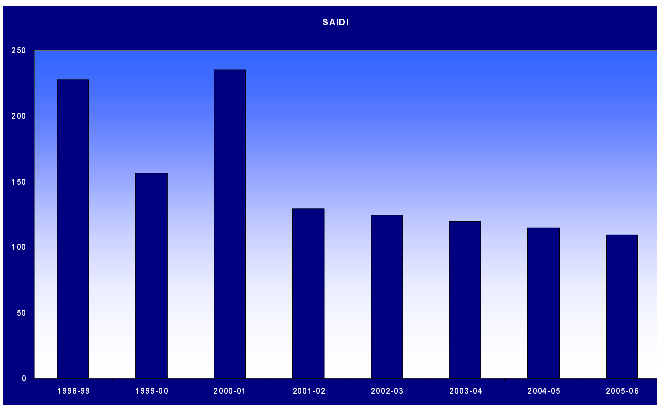
Westpower's distribution lines comprise 1970 circuit kilometres of high voltage AC distribution lines of varying line capacities, which are dependent upon local demands and geographical considerations. Operating voltages include 66 kilovolt (kV), 33 kV, and 11 kV. These lines involve a large population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

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

Service Level Objectives

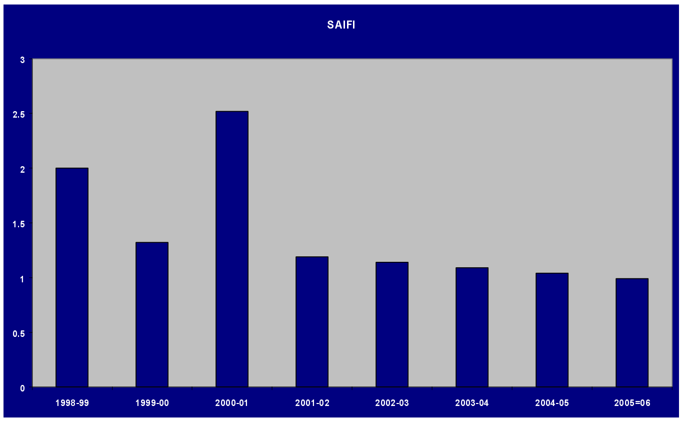
While ultimately it is customers' requirements and financial commitments that drive work that might alter system reliability, the asset management plan is based upon maintaining the target of 130 system-minutes lost per year for 2002/2003 reducing to 110 system minutes by 2004/2005. After this date it is intended to maintain a constant level of service.

SAIDI



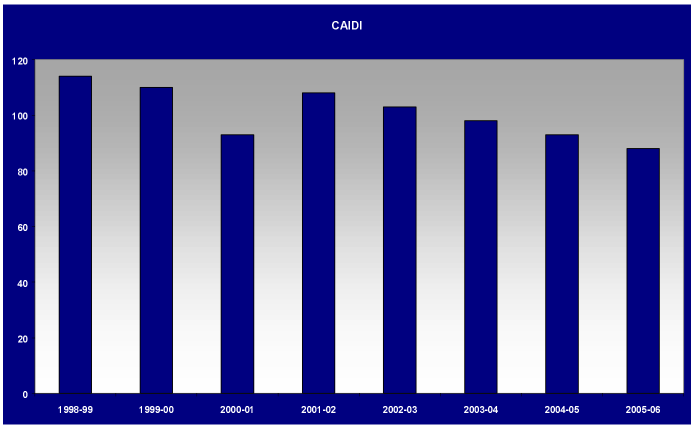
SAIDI - System Average Interruption Duration Index
This gives the average total time in minutes per year that each customer is without supply. A SAIDI of say 100 minutes means that every customer on a particular network experiences an average total time without electricity of 100 minutes per year.

SAIFI



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



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.Either Westpower or Transpower will need to reinforce transmission to meet the needs of the West Coast's load growth of industrial and tourism based loads. TrustPower are carrying out studies on the feasibility of a new 60 MW generation station at Dobson. Should this proceed TrustPower will be constrained in being able to export the excess generation from the West Coast if transmission is not improved.

Studies have determined the most economical transmission solution is for Westpower to build a single circuit 110 kV line from Inangahua to Dobson and interconnect with Transpower substations at both ends.

This investment will be the major Westpower project for 2002-2003, with a projected capital cost of 10.4 million dollars.

Final commitment on this project is awaiting the reaching of an acceptable connection agreement with Transpower and confirmation of capital funding.

Reefton Gold Project Supply (RGPS)

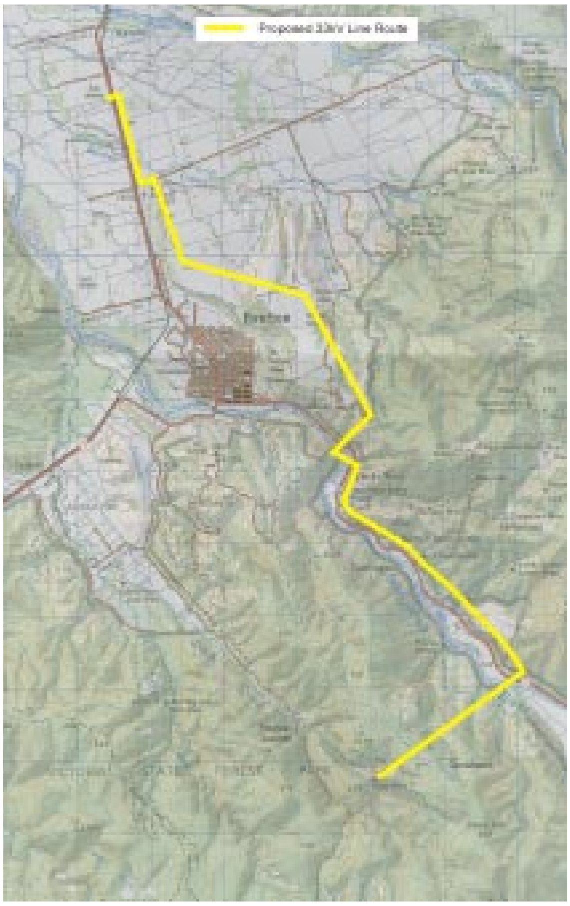
Macraes, now given the green light to proceed with the mine development at Globe Hill, will require a 5 MW supply necessitating a 110/33 kV supply point at Reefton. This also involves the construction of a new 33 kV line to the mine site (as shown in the attached figure) followed by a 33/11 kV substation and 11 kV reticulation around the site itself.

Westpower will gain some collateral benefit through the construction of a new 33 kV supply point at Reefton as this will improve the security of supply to the whole area. At present, Reefton is fed by a long single circuit 33 kV line from Dobson and any fault on this line results in an outage for Reefton. The new supply point will allow the 33 kV line and loads to be fed from both ends, greatly enhancing capacity and reliability.

A 12 km 33 kV line will be constructed from the Reefton Substation site at Waitahu through to the Globe Hill mine site. Some of this route will have to be 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.

GRD Macraes have indicated that supply will be required at the Globe Hill site late 2003 - mid 2004.



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

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inspection, Service & Testing	1653	1538	1437	1439	1277	1309	1282	1311	1271	1311
Faults	293	293	293	293	293	293	294	294	294	294
Repairs	368	338	318	298	298	298	298	298	298	298
Replace	1325	1145	850	360	215	180	525	130	110	30
Enhancement	2072	595	533	711	458	368	333	213	183	0
Development	6622	4887	552	292	742	242	742	742	4277	115
Total	12333	8796	3983	3393	3283	2690	3474	2988	6433	2048

Summary by Asset Type

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Subtransmission	2101	1598	1448	1178	1123	1038	1063	1018	968	978
Distribution	600	455	440	395	395	395	395	395	395	295
Reticulation	627	397	327	327	277	277	312	312	312	137
Services	614	369	354	154	109	109	109	109	109	67
Zone Substations	35	35	35	35	35	35	535	535	535	35
Distribution Substations	393	197	216	258	81	153	83	82	57	57
MV Switchgear	484	719	319	119	119	129	119	119	119	69
SCADA, Comms, Protection	99	99	99	99	99	99	99	99	99	99
Distribution Transformers	2839	4599	442	455	182	212	162	192	162	184
Other	4542	329	304	374	864	244	598	128	3678	127
Total	12333	8796	3983	3393	3283	2690	3474	2988	6433	2048

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 five 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. By doing this, future maintenance may be targeted toward life extension of ageing assets.

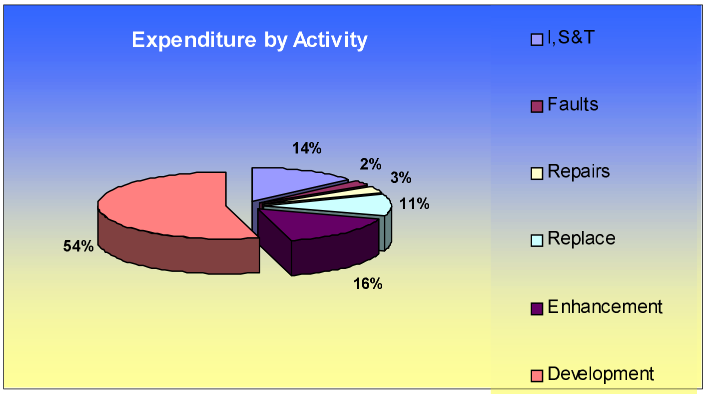


Figure A Expenditure by Activity

The enhancement expenditure also reflects a continued emphasis on distribution automation as reclosers and disconnectors are progressively automated. By doing this, 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 the adjacent chart. As would be expected, the bulk of the expenditure involves subtransmission and zone substation assets related to the major projects discussed above.

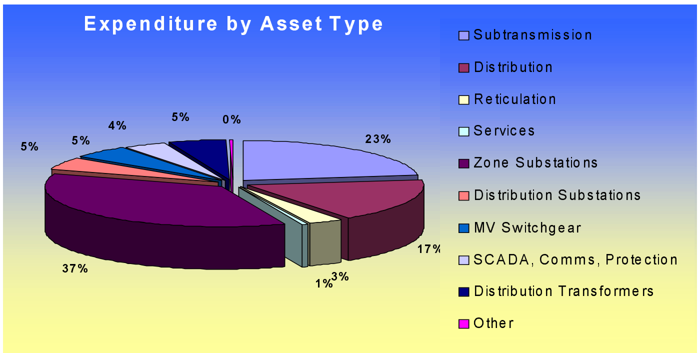


Figure B Expenditure by Asset Type

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, 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 eleventh 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

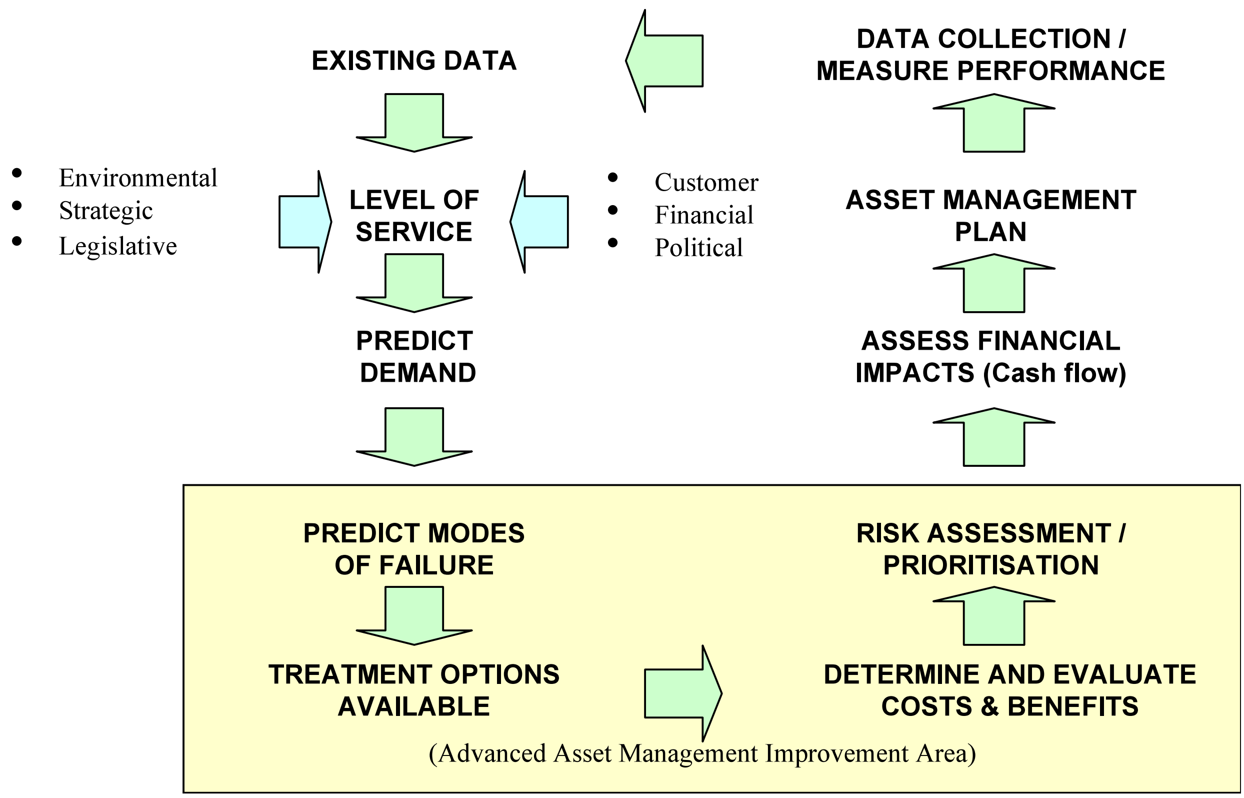


Figure 1: Asset Management Plan Process

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 new Company structure is shown below.

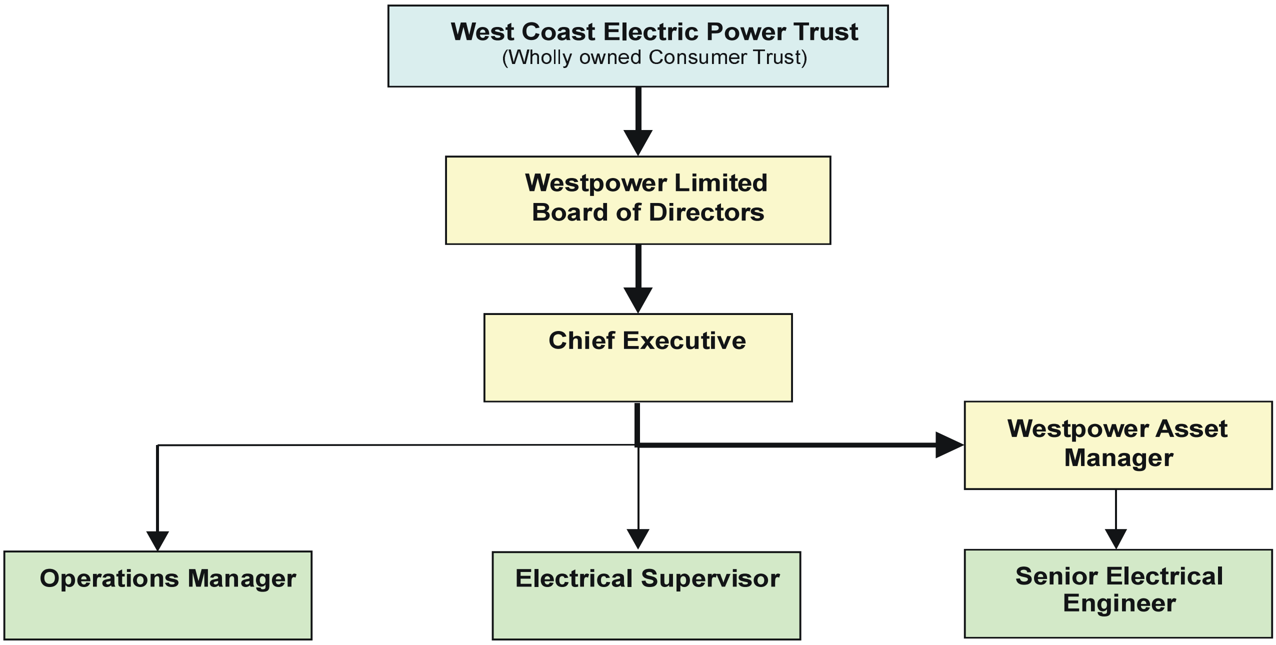


Figure 2 : Organisation Chart

The key functions of the groups are:

- ***Chief Executive Officer***

Financial accounting of Network Assets, management and company secretariat, attaining of revenue streams and key contact point with Energy and Generation Companies wishing to use the Westpower network for the distribution of electricity.

- ***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.

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 kilometres of the West Coast from the Lyell in the North to Paringa in South Westland

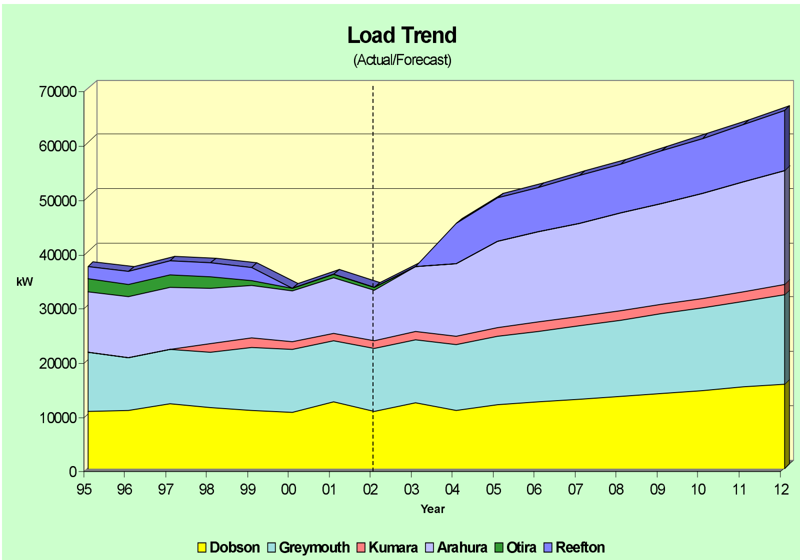
The distribution system comprises 1,970 kilometres of high voltage AC distribution lines, 14 zone substations and switch-yards, 1,822 distribution substations, 1 control room, and a telecommunications network.

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 69,048 kW 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.

It is assumed that all of these customers wish to receive a safe, adequate and suitably reliable distribution service and to be assured of being able to receive this over the long term, at minimum cost.

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.

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 2003 until the year ended 31 March 2013. 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 Hokitika 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:

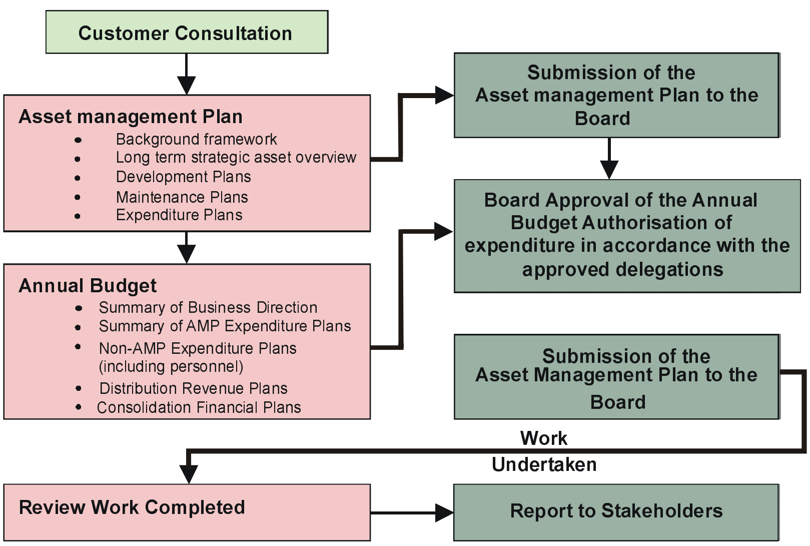
- The plan interacts with other Westpower working plans. Of particular importance are the annual budgets, which set out the specific resources required for asset management activities. Those parts of the annual estimates relating to the management of the system are closely based on the annual Asset Management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

The figure below shows the interaction of the different Westpower plans.

Asset Management Plan – Relationship with Other Plans and Approval Process



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). The introduction of Live Line Work the incidents 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.

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.

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 8% per annum real discount rate after tax.

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

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.

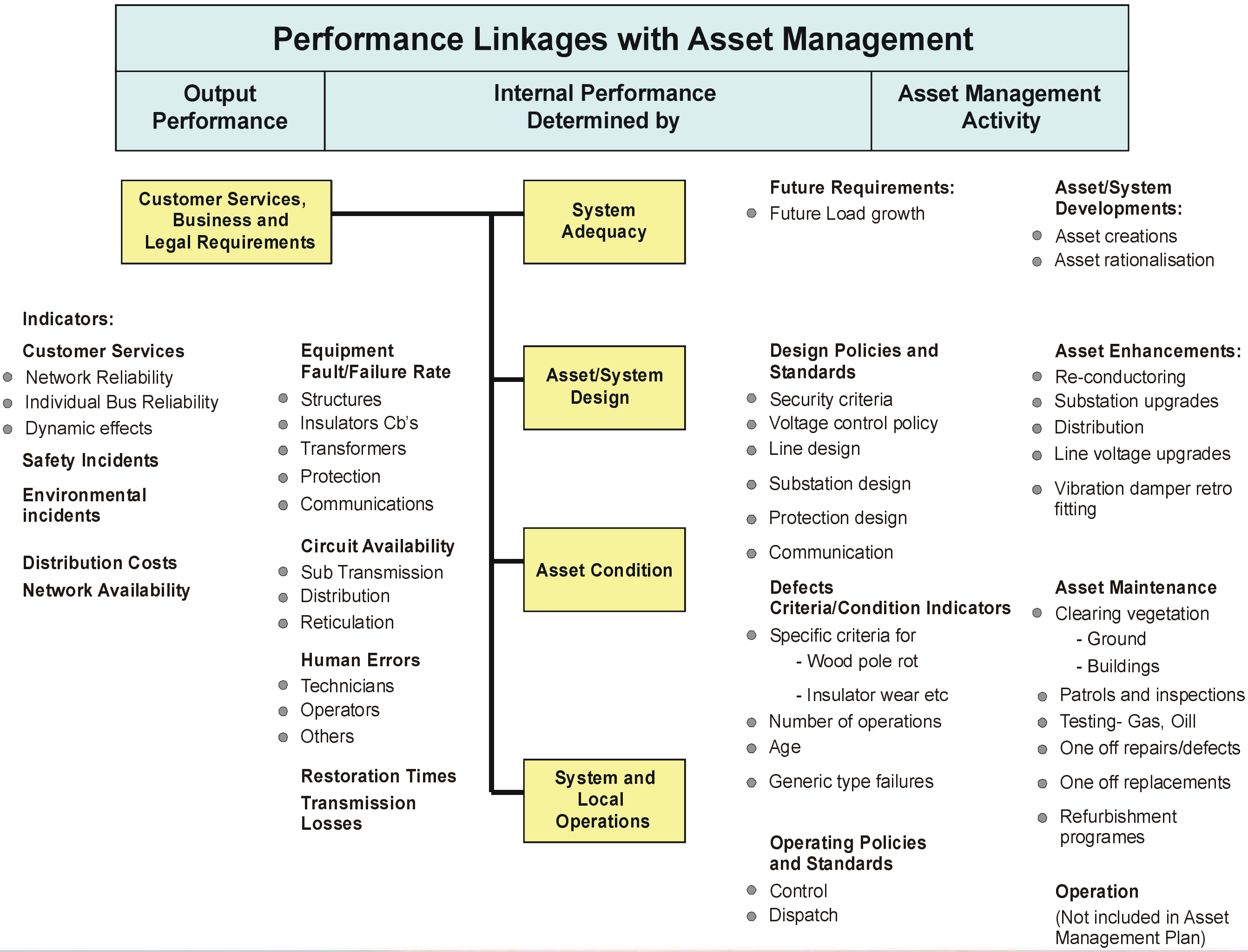
1.7.5 Corporate Profile

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

Rodger to comment on Westpower's compliance methods incl:

- Electricity Reform Act
- Electricity Act
- Electricity Regulations
- OSH
- Building Act
- Any other Act or Regulation the may be applicable.



1.8 Asset Management Linkage with Westpower Performance

The following figure 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 section 1.3 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.

2.0 LEVELS OF SERVICE

2.1 Introduction

Amendments to the Electricity (Information Disclosure) Regulations 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 regulations 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 are now common-place in many homes and have greatly increased the sensitivity of householders to power outages and minor interruptions.

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 liase 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 December 2002 the Commerce Commission released its Draft Decision 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
3. Profitability.

At present, the proposed price path involves an annual adjustment of Consumer Price Index (CPI) – 5% per annum, effectively resulting in a 5% revenue drop in real terms over each year of a five year period beginning in 2003.

If this price path is adopted in the final decision, the resulting reduction in revenue will require 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.

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 have been the placing of overhead conductors underground 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 neutral 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 kilometre.

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.

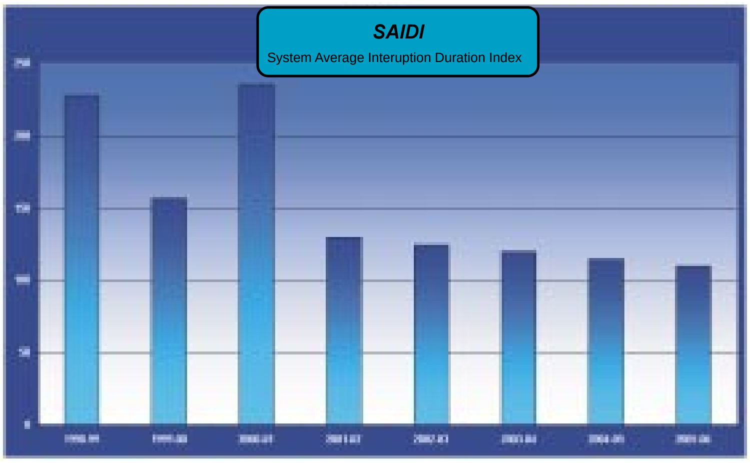
Network performance, as measured by SAIDI will be one of the key indices in determining whether sufficient maintenance expenditure is provided to sustain the continued levels of operation of the network.

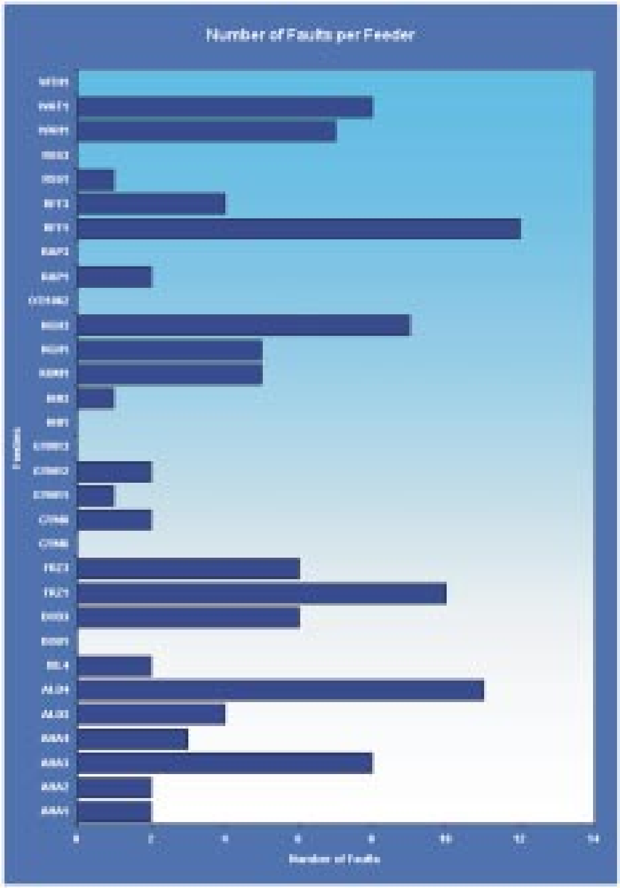
2.5 Target Levels of Service

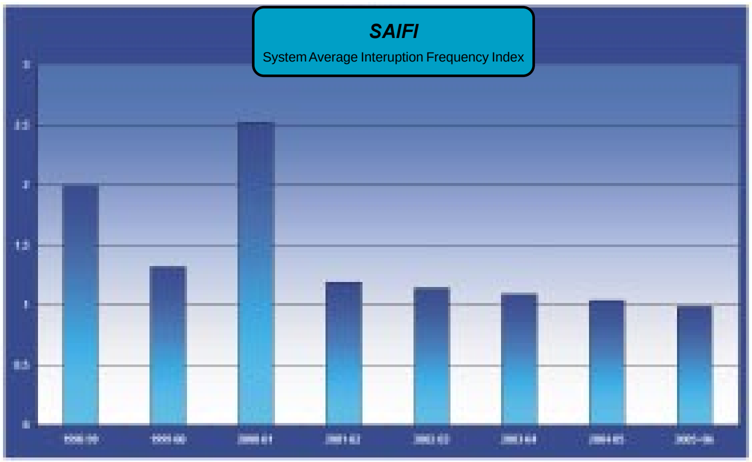
While ultimately it is customer requirements and financial commitments that drive work that might alter system reliability, the asset management plan is based upon maintaining the target of 120 system-minutes per year for 2003/2004 reducing to 110 system minutes by 2004/2005. After this date it is intended to maintain a constant level of service.

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 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 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.







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.

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.

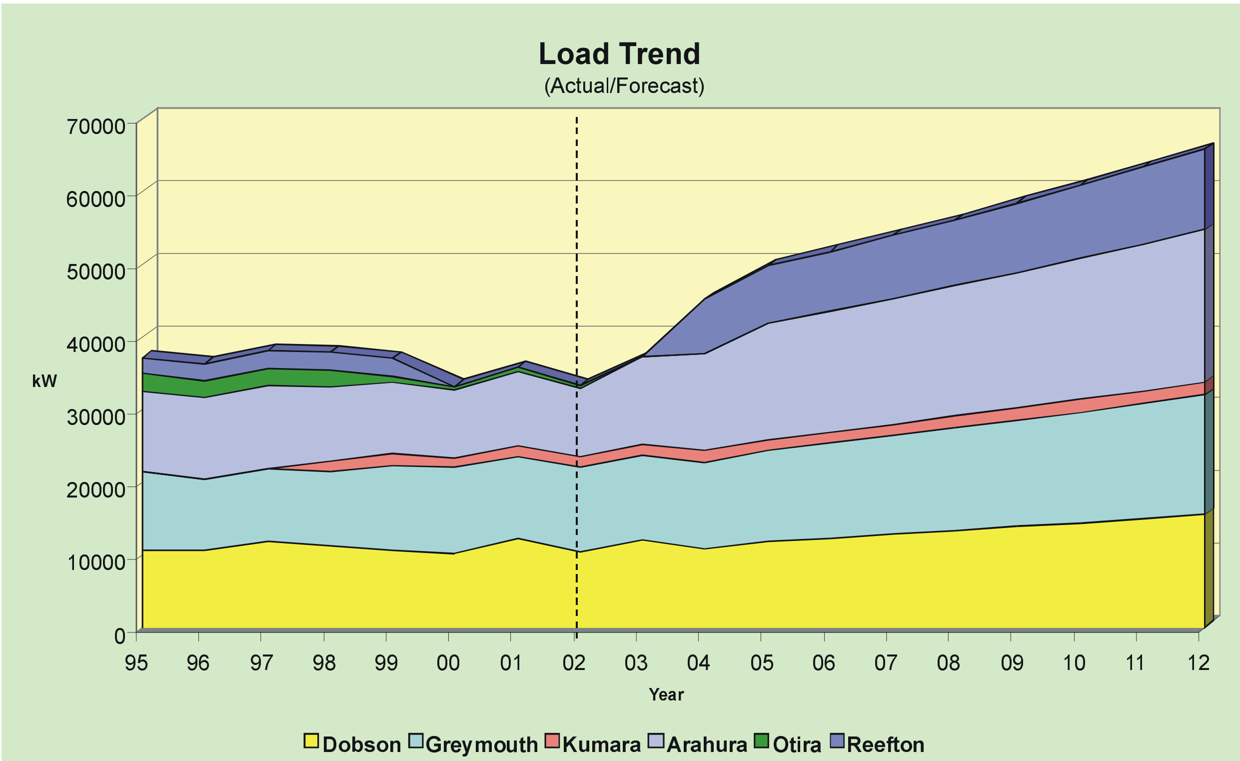


Figure 3.1 Load Trends

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

Load Trends and Forcasts to 2009/10

PERCENT INCREASE OR DECREASE	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Reefton	7.84%	6.55%	2.67%	-4.90%	----------	----------	----------	----------	----------	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Blackwater	-1.72%	24.29%	-100.00%	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Dobson 33 Delivered	-0.54%	11.41%	4.48%	-4.42%	25.48%	19.89%	-15.05%	15.00%	10.00%	10.00%	4.00%	4.00%	4.00%	4.00%	4.00%
Dobson 33 Received	----------	----------	----------	----------	2.27%	-93.83%	----------	----------	----------	----------	----------	----------	----------	----------	----------
Greymouth Delivered	4.04%	2.91%	8.50%	-11.59%	3.90%	2.60%	-1.21%	4.00%	4.00%	4.00%	4.00%	4.00%	4.00%	4.00%	4.00%
Greymouth Received	-10.76%	6.73%	-0.75%	7.21%	-6.27%	-36.35%	----------	----------	----------	----------	----------	----------	----------	----------	----------
Kumara Delivered	----------	----------	----------	----------	----------	----------	3.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Kumara Received	----------	----------	----------	----------	----------	----------	3.18%	-0.04%	-0.04%	-0.04%	-0.04%	-0.04%	-0.04%	-0.04%	-0.04%
Arahura	-1.13%	8.99%	2.70%	2.29%	1.53%	-11.43%	-3.74%	30.00%	10.00%	20.00%	4.00%	4.00%	4.00%	4.00%	4.00%
Otira	----------	-6.48%	1.98%	-4.77%	-3.87%	-2.70%	-63.22%	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%	0.00%	-------------	0.00%	0.00%	5.00%	5.00%	5.00%	5.00%
Total Load ex TPNZ	**8.42%**	**-1.73%**	**3.86%**	**10.02%**	**-8.33%**	**3.34%**	**-6.37%**	**11.49%**	**27.71%**	**13.53%**	**5.26%**	**5.20%**	**5.15%**	**5.10%**	**5.06%**
Total System Load	**6.58%**	**10.72%**	**1.03%**	**6.03%**	**1.34%**	**-4.18%**	**-2.73%**	**7.72%**	**19.28%**	**10.08%**	**4.04%**	**4.04%**	**4.05%**	**4.05%**	**4.06%**

PEAKS ON SYSTEM LINKED TO TRANSPOWER	Actual kW 1994/95	Actual kW 1995/96	Actual kW 1996/97	Actual kW 1997/98	Actual kW 1998/99	Actual kW 1999/00	Actual kW 2000/01	Actual kW 2001/02	Forecast kW 2002/03	Forecast kW 2003/04	Forecast kW 2004/05	Forecast kW 2005/06	Forecast kW 2006/07	Forecast kW 2007/08	Forecast kW 2008/09	Forecast kW 2009/10
Reefton	2180	2351	2505	2572	2446	0	0	0	0	7500	7875	8269	8682	9116	9572	10051
Blackwater	930	914	1136	0	0	0	0	0	0	0	0	0	0	0	0	0
Dobson 33 Delivered	7392	7352	8191	8558	8180	10264	12306	10454	12022	10724	11797	12269	12759	13270	13801	14353
Dobson 33 Received	0	-1166	-666	-562	-792	-810	-50	0	-771	-749	-727	-705	-683	-660	-638	-615
Greymouth Delivered	10949	9680	10058	10320	11736	11740	11240	11594	11594	12058	12540	13042	13563	14106	14670	15257
Greymouth Received	-6592	-7067	-6624	-4216	0	0	0	0	0	0	0	0	0	0	0	0
Kumara Delivered	0	0	0	1536	1582	1382	1364	1526	1526	1557	1588	1619	1652	1685	1719	1753
Kumara Received	0	0	0	-9184	-9476	-9632	-9912	-9064	-9472	-9442	-9411	-9379	-9346	-9313	-9280	-9245
Arahura Delivered	11056	11309	11482	10170	9790	9274	10246	9290	12077	13285	15942	16579	17242	17932	18649	19395
Arahura Received	2472	2354	2263	2202	810	544	-612	-426	0	0	0	0	0	0	0	0
Otira	2472	2354	2263	2202	810	544	570	520	500	500	500	500	500	500	500	500
Total Load ex TP	**24453**	**26902**	**24660**	**25484**	**23860**	**22642**	**23714**	**23968**	**26721**	**34125**	**38743**	**40780**	**42901**	**45111**	**47413**	**49810**
Total System Load	**33403**	**35418**	**35894**	**34395**	**33336**	**33791**	**34559**	**35655**	**38408**	**45812**	**50430**	**52467**	**54588**	**56798**	**59100**	**61497**

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
- gold prices
- coal export markets
- 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 slowly take effect over the medium term.

With the relatively small overall demand of 35 MW, it is the major step load changes that have the greatest 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.

3.1.3 Future Load Projections

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

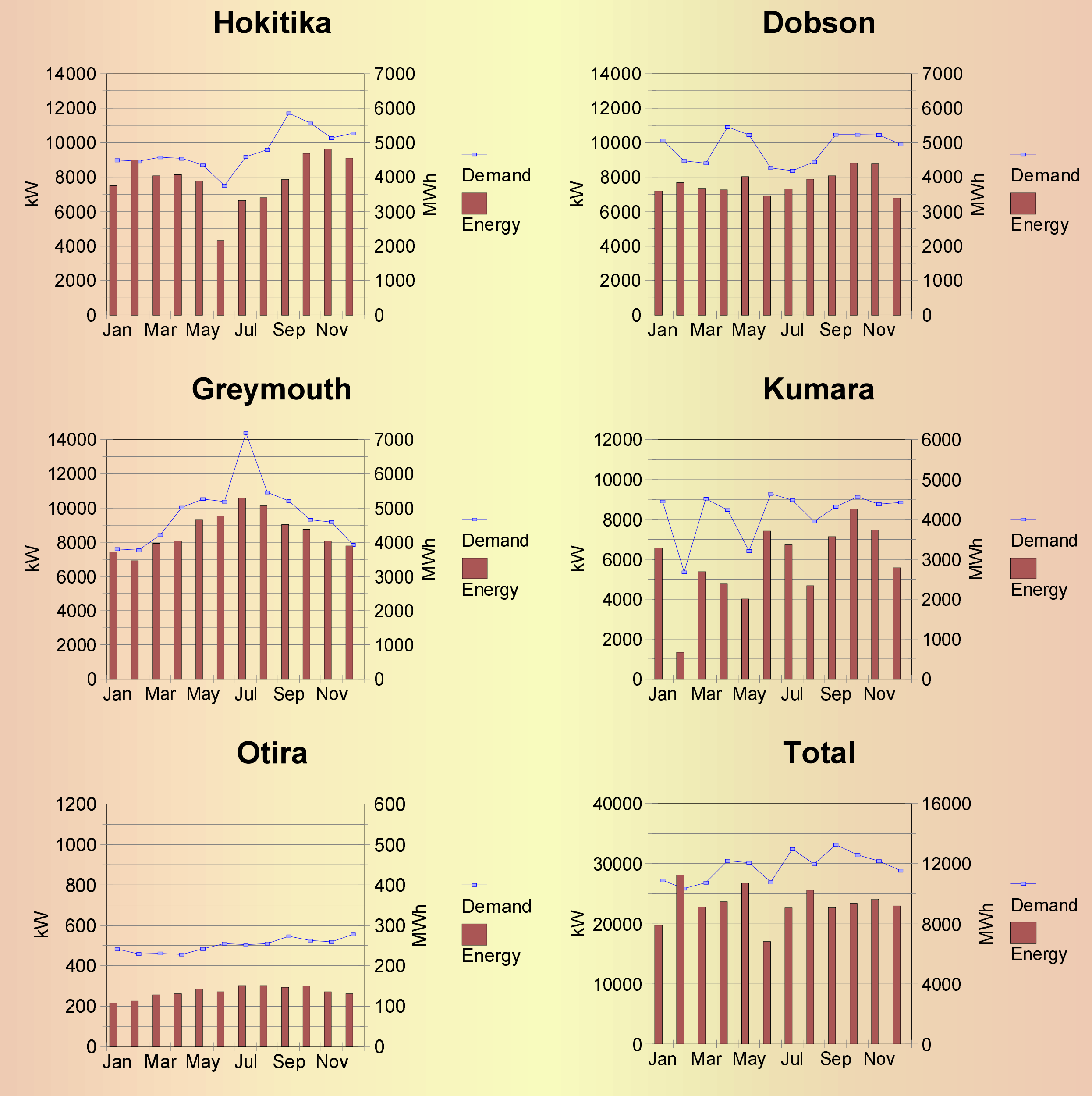
Firstly, load trends at each Grid Exit Point over the previous 7 years are studied to try and identify historic baseline changes. The effects of known step load increases are extracted leaving the underlying long-term historic load profile.

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.

The West Coast in general has been suffering from an economic downturn over the last two years, and combined with warm winter temperatures, this has resulted in negative annual load growth of -4% and -3% respectively over this period. There are now signs that this trend has been arrested with a recent upturn in new connection and an improved economic outlook. For these reasons, a 1% load growth figure has been adopted for most Grid Exit Points throughout the planning period. An exception to this is Otira, which consists of a 400 kW load and a small, diminishing domestic load, which is likely to have a flat to negative outlook

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.



Projected and known step load changes for Westpower include

- development of a new coal mine by Greymouth Coal Limited (1.0 MW gain)
- possible development of Pike River coal mine (5.0 MW gain)
- likely development Macraes Globe Hill gold mine (5.0 MW gain)
- confirmed increase at Westland Dairy Company (3.0 MW gain)

These changes have been included in the load projections for the appropriate Grid Exit Points.

The resulting load projections are shown on Table 3.1.

3.1.4 Options for Handling Load Increases

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

- Economic tariff structure models
- Demand Side Management
- Line Drop Compensation
- Voltage Regulation/Support
- System Reconfiguration
- Reactive Compensation (Capacitors)
- Reconductoring
- Overlaying with a higher voltage

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.

Very large load increases are unlikely to be handled by the present Transpower transmission infrastructure, which is already voltage constrained. To provide for such load increments, either further local generation or a major upgrade to the Transmission Network will be required. This is likely to involve both the upgrade of the Transpower Dobson-Inangahua Circuit to 110 kV and for Westpower to construct its own 110 kV Transmission Line from Inangahua to Dobson along with a 110/33/11 kV Substation at Reefton.

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 non-essential 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.

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.

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 below.

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	

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 customer 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.

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 demand of 2.3 MW can increase to 3.0 MW before further voltage support measures such as reactive compensation are required.

Development of the 5 MW Macraes Gold Project at Reefton will require significant strengthening of the supply into the Reefton area. After considerable investigation, the solution chosen is for Westpower to construct a 110 kV spur from Inangahua to Reefton with a 20 MVA 110/33/11 kV Zone Substation at Reefton. This work will be carried out in such a way as to be compatible with Transpower's own transmission development in the area to ensure that asset ownership does not get in the way of a superior technical and economic solution. The likelihood of the Macraes project proceeding is perceived to be relatively high, with the developer planning to start site construction in September 2003.

The future 11 kV distribution capacity to the Ikamatua area is limited by voltage support considerations. A new Zone Substation will be required at Ikamatua, when load growth of around 200 kW is realised. Based on current trends it is expected this will occur around 2007.

3.3.2 Greymouth Network

Several significant coal-mining projects are in the planning stages including Pike River and the Grey Coal Company at Rapahoe. The estimated loads for these projects are 5 MW for Pike River and 1 MW for Grey Coal (after allowing for the decommissioning of the existing Strongman II Mine). In addition, base load growth, and continuing improvement in the exotic timber milling and tourism industries will require significant capacity increases in the short term. The existing 33 kV transmission network can support these loads, however, this does not also hold true for the existing 66 kV transmission network into the West Coast, which is severely constrained.

Accordingly, the 66 kV transmission network on the West Coast will need upgrading immediately if any of the major new loads proceed, and certainly within three years just to cover base load growth. To achieve this, after commissioning of the new Reefton Substation, the Westpower 110 kV line will be extended down to Dobson. Contemporaneously, Transpower are planning the conversion of their 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 110 kV transmission lines into the area to the whole central West Coast region.

This development has been allowed for in the design of the Transpower Dobson Substation.

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.

3.3.3 Hokitika Network

The recent completion of the Westland Dairy Factory Supply, comprising a new Westpower 30 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.

With the exception of some additional strengthening required in the Kokatahi/Kowhiterangi and Ruatapu areas due to industrial and farming growth over the next few years, there is little 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

3.3.4 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.

To support the load growth at Fox Glacier in particular, a new 33/11 kV zone substation will be constructed in 2004 and the existing line from Franz Josef to Fox Glacier upgraded to operate at 33 kV. As the line was originally constructed for 33 kV operation, however, this is not expected to involve significant cost. Some further work will be required at Franz Josef Substation to provide a 33 kV feeder connection.

The reduction in both real and reactive power losses incurred by the current 11 kV operating voltage on this line will significantly improve voltage regulation throughout all of South Westland, and defer other more costly reinforcement projects. The construction of this substation will also facilitate expanded local hydro generation in the area resulting incollateral benefits to Westpower's network.

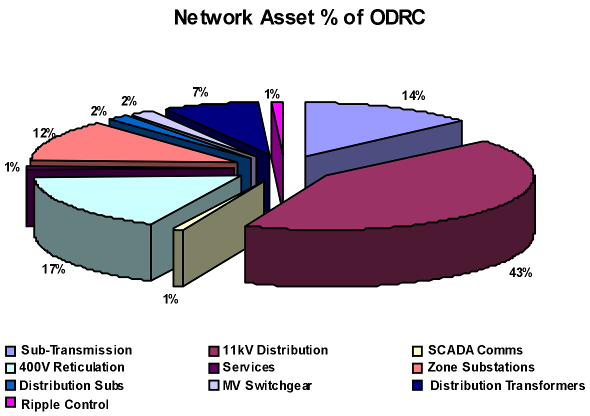
Depending upon actual load growth, it is possible that the South Westland Grid Reinforcement Project (SWGR) may be required toward the end of the planning period and this will involve upgrading the Hokitika-Harihari line to 66 kV along with converting of the Waitaha and Harihari Substations to 66 kV operation.

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 equipment, radio repeaters and fibre optic systems installed, owned and maintained by Westpower;
- *Distribution Transformers* – Standard transformers used in distribution substations ranging from 5kVA 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 com- pany 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

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

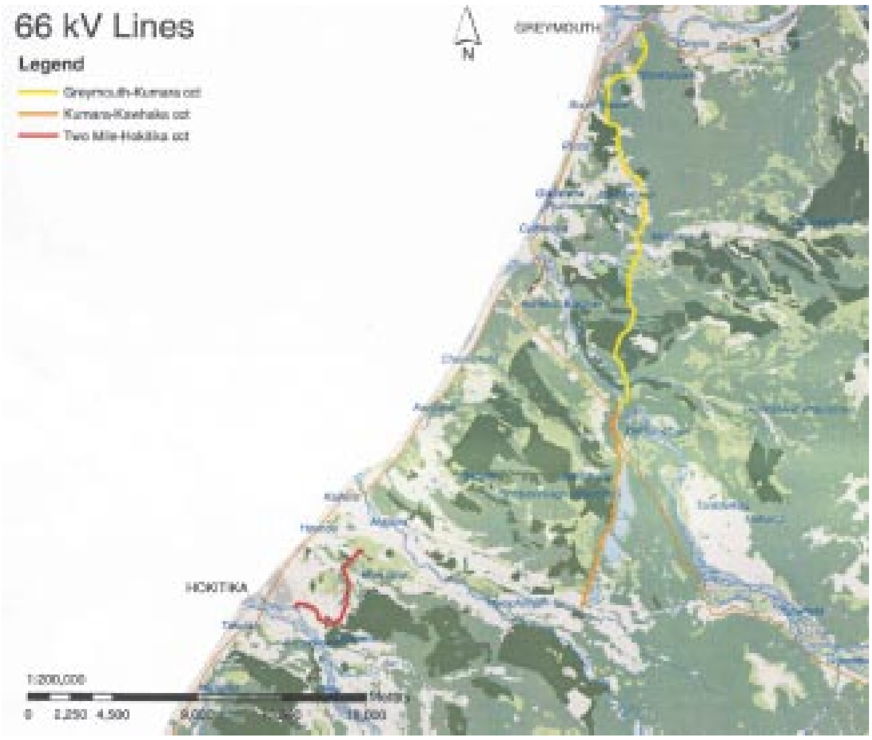


Figure 4.1a - Westpower's 66 kV Assets

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

Figure 4.1b - Kumara - Kawhaka 66kV line during construction

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.

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- stressedconcrete poles have been used to support the 7.8 km of Iodine AAACconductor.

Figure 4.1c – Northern 33kV Line

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

4.1.3 33 kV Lines and Cables

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.

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.

Figure 4.1d – Southern 33kV Line

The 33 kV sub-transmission line from Arahura to Harihari originally constructed in 1966 was recently 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 between poles and an example of this type of asset is shown in Figure 4.1e.

Figure 4.1e – Aerial Bundled Cable in South Westland

Figure 4.1f Hendrix Spacer Cable

Figure 4.1g Hendrix Spacer Cable Installation

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. Similarly, a 3.6 km section of line that traverses Lake Mapourika in South Westland was replaced with a Hendrix Cable in 2000 and is shown in Figure 4.1f. This is often called Spacer Cable construction, and uses three seperate, fully insulated conductors, held apart by insulated spacers.

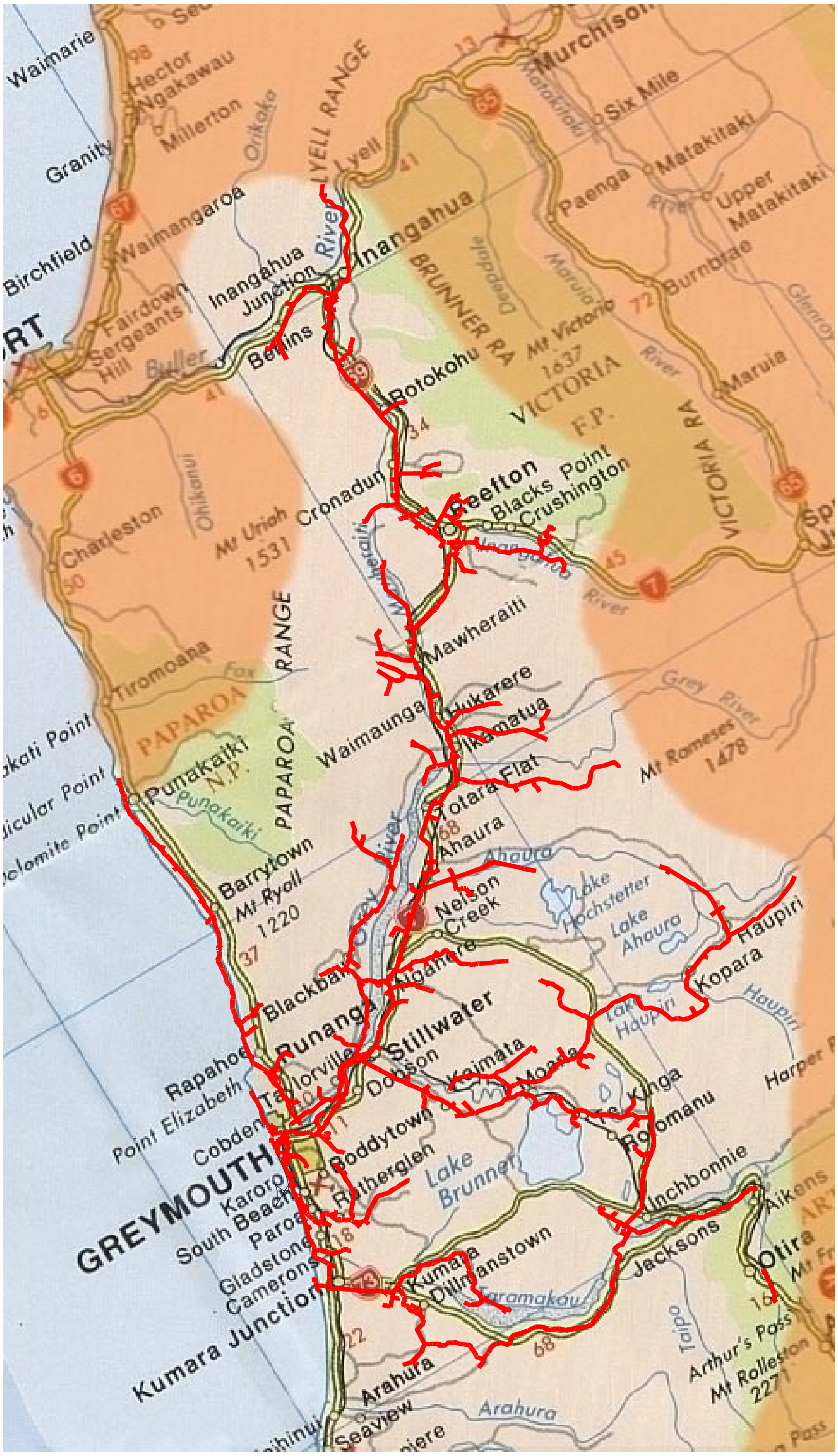


Figure 4.2a - Northern section of Westpower's distribution line assets

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

4.2 Distribution Assets

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 following 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	1057
Medium Overhead	365
Heavy Overhead	5

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 415V or 230V 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

Figure 4.2e – Modern Pole Construction

Since 1972, most of the major lines have 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 re-placement or new construction work and these types make up over 60% of the pole population. An example of a modern construction is shown

The insulators consist of porcelain pin insulators and a mixture of porcelain, glass and polymer strain insulators. 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 Summary of Distribution Line Components

Components		**No.**	**%**
Structures			
Poles-Wood	Hardwood	4806	33.5%
	Silver Pine	87	.6%
	Softwood	828	5.76%
	Treated	377	2.6%
	Larch	45	.3%
Poles-Concrete	Hokitika	3153	22.0%
	Stresscrete	4830	33.6%
	Spuncrete	10	.1%
	Buller	101	.7%
	Other	130	.9%
Total Structures		**14,367**	**100.0%**
Crossarms	66 kV	0	0.0%
	33 kV	1,996	4.4%
	11 kV	24,200	53.1%
	400 V	13,585	29.8%
	Service	5,768	12.7%
Total Crossarms		**45,549**	**100.0%**
Conductors and Accessories			
	Conductor (km)		4,854
	Earth Wires (km)		5,102
Insulators	66 kV	600	0.5%
	33 kV	7,414	5.6%
	11 kV	64,4611	48.9%
	400 V	41,037	31.1%
	Service	18,482	14.0%
Total Insulators		**131,994**	**100.0%**

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 past 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.

4.3 Reticulation Assets

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.

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

This asset consists of the equipment used to connect approximately 10,500 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

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 14 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.

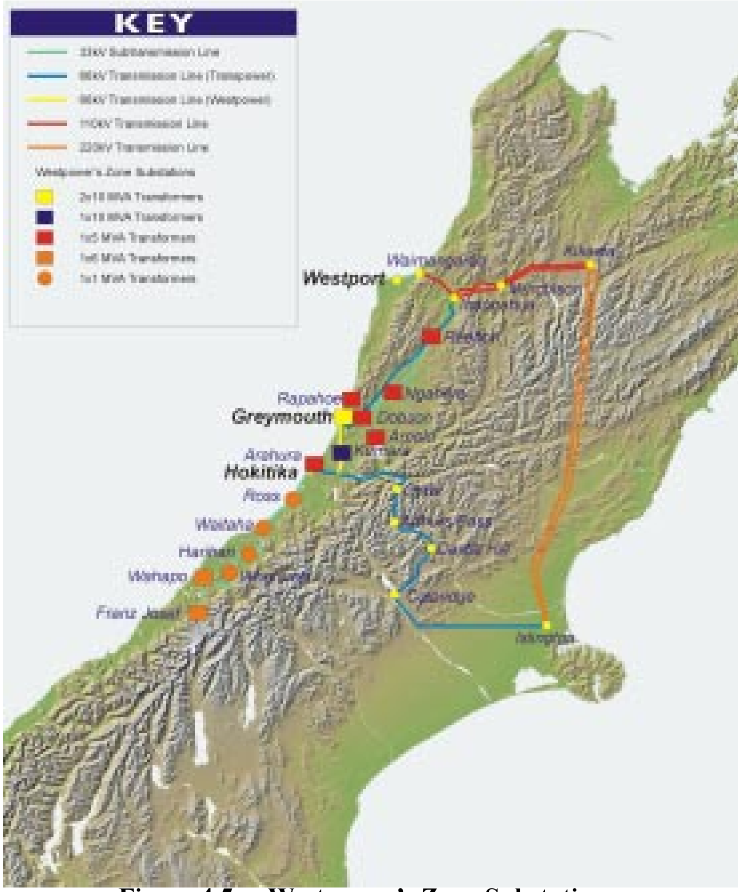


Figure 4.5a - Westpower's Zone Substations

Figure 4.5c – Whataroa Zone Substation

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, Dobson, Ngahere, Arnold, Rapahoe, Wahapo and Franz Josef.

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.

Figure 4.5b – Greymouth Zone Substation

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

Figure 4.5d – Arnold Zone Substation

4.5.1 Asset Justification

Zone Substations are required to break down subtransmission voltages (66,000 volts and 33,00 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

4.5.2 Power Transformers

Westpower has 18 power and earthing transformers installed at its Zone Substations, (as opposed to distribution transformers, which are used in Distribution Substation). Of these, 11 are fitted with on-load tapchangers.

Table 4.5a gives the general details of the power transformer population.
All 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 and provide reactance earthing for injection into the network. They also comprise a 400 V secondary to provide local service to the site.

Table 4.5a Summary of Zone Substation Transformers

Type	66 kV	33 kV	11 kV	Total Units
Power Transformers				
Supply 3 phase	5	13	0	18
Subtotal	5	13	0	18
Other Transformers				
Earthing	0	2	1	3
Regulating	0	0	5	5
Subtotal	**0**	**2**	**6**	**8**
Total Transformers	**5**	**15**	**6**	**26**

4.5.3 Switchgear

Table 4.5b summarises the present asset mix for this equipment used in Zone Substations

Table 4.7a Circuit Breakers

Type	66 kV	33 kV	11 kV	Total Units
Outdoor				
SF6	5	0	0	**5**
Minimum Oil	5	0	0	**5**
Oil Recloser	0	4	0	**4**
Vacuum Recloser	0	7	39	**46**
Total Outdoor	**10**	**11**	**39**	**60**
Indoor				
SF6	0	0	4	**4**
Vacuum	0	0	14	**14**
Metalclad Panels (Bulk Oil)	0	0	11	**11**
Total Indoor	**0**	**0**	**29**	**29**
Total Circuit Breakers	**10**	**11**	**68**	**89**

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, Kumara Wahapo and Franz Josef Substations, and further projects are planned this year for Rapahoe and Ngahere substations.

4.6 Distribution Substations

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

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

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

Figure 4.6a - Typical Distribution Substation

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.

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

Figure 4.6c - Pad Mount Substation

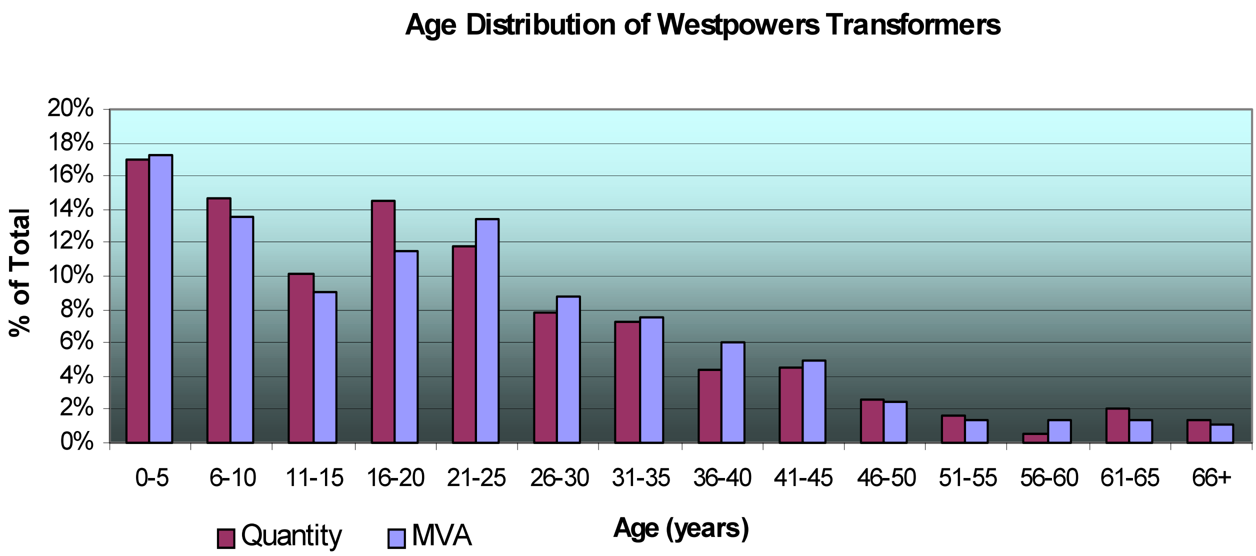


Table 4.6d - Age Distribution of Transformers

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

4.7 Medium Voltage Switchgear

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).

Line regulators are installed on long 11kV lines with significant loads near the end. Westpower has three such installations at Longford Corner (near Kokatahi), at Cronadun (north of Reefton) and at Fox Glacier.

In general, disconnectors are standard two or three post units made by Schneider (ex Canterbury Engineering), but mainly type DA2. Some units on the Kumara Village Feeder from Kumara to Gladstone 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 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.

Table 4.7a - MV Switchgear			
Type	**33 kV**	**11 kV**	**Total Units**
Disconnectors	38	441	503
Load Break Disconnectors	0	8	5
SF6 Reclosers	0	3	3
Bulk Oil Breakers	0	5	5
Vacuum Recloser	9	21	21
Oil Sectionaliser	0	12	14
Ring Main Unit	0	14	13
Fused Switch	0	7	7
Oil Switch	0	4	4
Dry Switch Unit	0	9	9
Total Units	**47**	**524**	**584**

4.8 SCADA, Communications and Protection

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)

4.8.2.1 Master Station

Plessey, now part of Siemens GEC Telecommunications, supplied Westpower's SCADA equipment.

The high level Man Machine Interface (MMI) is a Realflex system and comprises two hot standby nodes running on standard PCs under a QNX operating system. It provides full alarming, control and trending functionality along with load management, historical data collection and reporting modules.

The QNX operating system is similar to UNIX and provides a peer-to-peer network operating system (NOS) designed for real-time application such as SCADA.

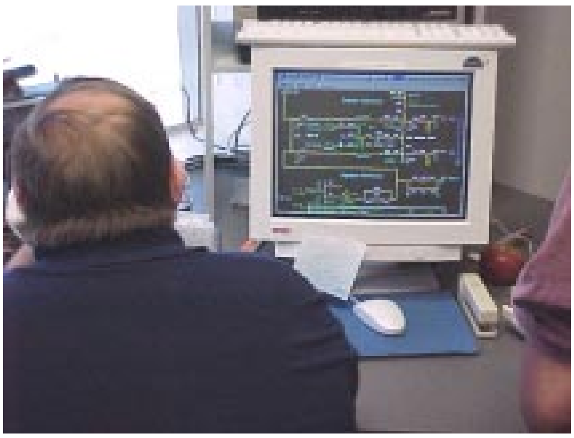


Figure 4.8a - SCADA Master Station

All of the Master Station equipment is housed in the Control Room and is powered by a 3 kVA Uninterruptible Power supply (UPS) which provides a four-hour backup in the case of a major power outage. Furthermore, a small auto-start diesel standby generator is installed to provide further backup in the case of a major disaster.
Access to the Realflex data is either via a telnet server for real-time statuses and values, or through a DDE link for access to historical data.

The Realflex system communicates with Siemens Remote Terminal Units (RTU) and the Abbey communications server.

For Hokitika Substation a new digital IP based network has been used to connect directly to station PLC's and protection relays.

Figure 4.8b - Control Room Battery Backed UPS

This secondary communications server is based on an Abbey Systems Powerlink master station which is used to communicate with low density sites via the VHF speech network. The communications server is connected to the Realflex system through a high speed serial interface running the industry standard MODBUS protocol.

4.8.3 Remote Terminal Units (RTUs)

Major Zone Substations are fitted with Siemens Dataterm RTU's. These are a proprietary unit based on the Motorola 68000 microprocessor and are a 19" rack mounted unit with slot mounted modules to provide a flexible I/O mix.

The RTU's handle digital statuses, with optional event logging to 10 ms resolution, analogues (at either 8- or 12-bit resolutions), controls, metering pulses, ripple injection plant control as well as providing a MODBUS communications port for connecting with PLC's and other intelligent devices.

Figure 4.8c - Abbey Microlink

The Dataterm RTU's are connected to the Realflex Master Station via 1200-baud UHF radio links or landlines. A proprietary communications protocol is used.

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 MODBUS port to connect to a PLC, which provides the I/O capability.

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 ability 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

Table 4.10d: Summary of Communications System Components

Assets	Number
Power Line Carriers	1
Radio Links UHF (analogue) (digital)	12 4
Aerial Communications Carriers	1
Fibre Optic Cables	1
VHF Land Mobile Network - Mobiles	3
VHF Land Mobile Network - Bases	22

4.8.5 Power Line Carrier (PLC)

A Power Line Carrier is used as a communication link between Greymouth Substation and Kumara Power Station. The age of the installed equipment is about 20 years. This link has proven very reliable and given no trouble.

4.8.6 Communication Cables

A Self-Supporting Aerial (SSA) 25 pair cable runs from the Control Room to Greymouth Substation for speech and SCADA purposes. There are plans to augment this with a fibre-optic link during 2002.

4.8.7 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 20000 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.

Possible expansion of the VHF network may be required near the middle of the planning period as the level of distribution automation places increasing loads on the existing speech channel. The single channel is able to cope with present loadings with no discernible problems however.

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

4.8.8 UHF Network

The UHF network is used exclusively to provide communication paths for the SCADA network and covers all major substation and power station sites.

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.

During 2003, the new digital radio network will be extended, to cover the Grey Valley area.

Figure 4.8f - NASAT Switch

As a result of this project, the existing UHF equipment will be gradually decommissioned.

4.8.9 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 Reclosers and FXA 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 majorities 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

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 program is in place to refurbish these units.

Table 4.11.1: Summary of Distribution Transformers				
	Primary Voltage			
Type	**66 kV**	**33 kV**	**11kV**	**Total Units**
Power Transformers				
Distribution 1 phase	0	1	772	773
Distribution 3 phase	0	3	865	868
Total Transformers	**0**	**4**	**1637**	**1641**

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.

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

Three single-phase 33 kV/400 V units supply customers in the South Westland area remote from Westpower's distribution network, but close to the Arahura-Harihari 33 kV line. The customers accepts 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

Westpower owns four ripple injection plants with one each at Reefton and Hokitika. Two plants are installed at Greymouth, with one on constant standby as a spare for the main unit.

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.

The three sites have Plessey TR series 75 kVA injection plants installed along 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 twelve years old.

In addition, the spare unit at Greymouth Substation is a 150kVA unit manufactured by Oxy Metal Industries (OMI) being the original plant installed in 1982. This was the only injection point 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 Siemens Dataterm 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.

Should the GPS system ever fail, the control system falls back to a standard slotted injection algorithm where one plant injects at a time in sequence.

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 maximize use of existing assets and avoid unnecessary asset expenditure to cover unnecessarily high peak demands

5.0 Asset Condition

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

A complete list of Westpower's system assets is contained in Appendix C. 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

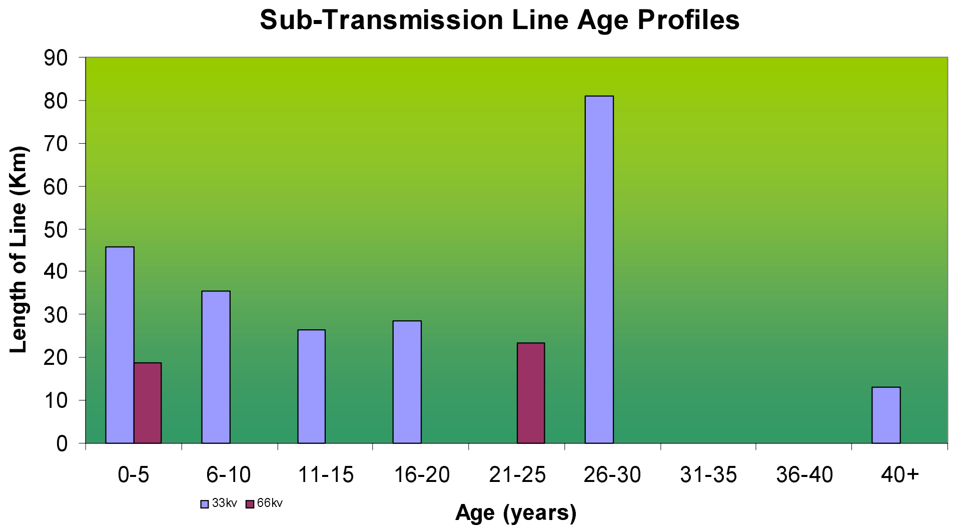
5.1 Sub-Transmission Asset Condition

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 Ages



5.1.1 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.

Westpower sub-transmission lines fall into three broad groups 66 kV wood pole lines, 33 kV pole lines and 33 kV 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 hardwood 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 type of Aerial Bundled Cable (ABC) 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. A number of minor problems with guys and insulators were noted however and a remedial project was carried out to fix up these problems.

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 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 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 seperate, 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 2004 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 a polymer disc insulator with round pins.

Problems have been noted with the 33 kV EPDM polymer deadened 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, however the oldest units currently in service are only about six years old. The risk is minimal in the meantime, although 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.

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

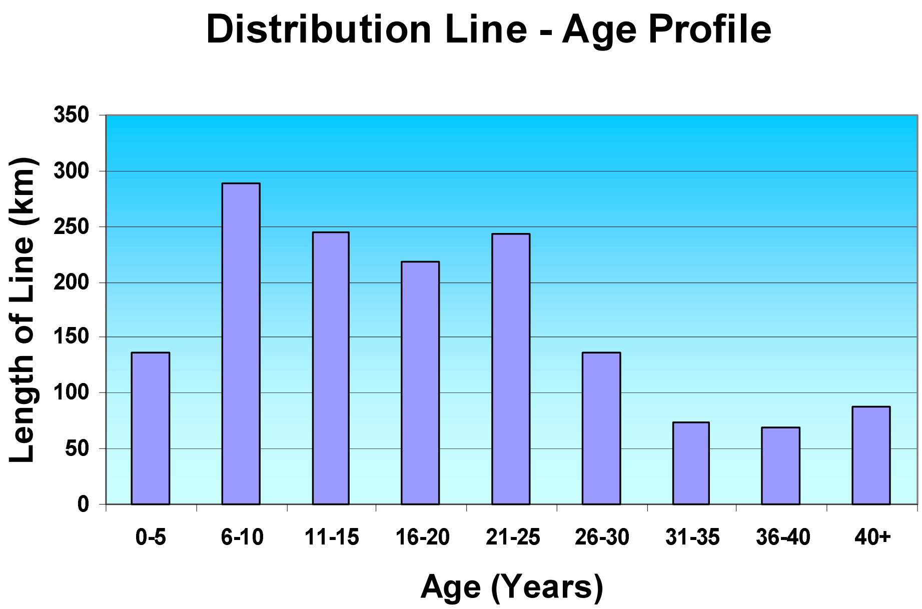


Figure 5.2a – Distribution Line Ages

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.

There are a small number of exceptions however such as the line over the Fox hills between Franz Josef and Fox Glaciers.

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 6050 wood poles in service. An estimated 350 poles (6%) are assessed to be currently at replacement criteria, or to reach it within 5 years. Approximately another 450 are estimated as needing to be replaced between 2004 and 2009.

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.

A recent investigation of conductor and fitting asset condition along the Coast Road, north of Greymouth, has identified a major corrosion problem involving galvanic action between the pre-formed make-off and the Iodine AAAC conductor. It seems that the Aluminized Steel make-off is not suitable in this enviroment and an all aluminium make-off is required.

As a result of this work, it has been determined that an urgent replacement programme is required to manage the risk of premature conductor failure and this will involve the replacement of all pre-formed make-offs on the aluminium versions.

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.

Westpower has experienced major difficulties from “pin-holed” porcelain discs, which can be very difficult to locate and replace. These have now been completely replaced by glass discs that are far easier to determine the condition of. A further group of replacements, including some discs, is necessary due to normal corrosion of the metal fittings.

There are approximately 130,000 insulators in service. Of these, 2000 have currently been identified as due for replacement over the next year due to inherent quality problems.

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 Hoikitika, 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 five 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 proposed pole testing. 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 oil interception facilities, 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 annualy for the last 3 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.

An exception to this was a 5 MVA 33/11 kV transformer at Dobson Substation that showed abnormally high levels of hydrogen, which is indicative of low energy arcing or corona discharge. Based on advice from the manufacturer, this unit was removed from service and de-tanked but no firm causal link was established. Subsequent to this, the unit was dried out and re-tested and no further significant gas creation was identifiable. The unit was put back into service and will continue to be closely monitored.

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 with additional windings. 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 and are in excellent condition.

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

5.5.4 Minimum Oil Switchgear

66kV 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.

5.5.5 Outdoor Reclosers

There are 29 outdoor reclosers in Westpower's zone substation. 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 Bulk Oil Indoor Switchgear

Westpower indoor switchgear installations comprise 22 switch units in 4 locations. Figure 5.5.6a shows the

Figure 5.5.5c - Outdoor Switchgear Ages

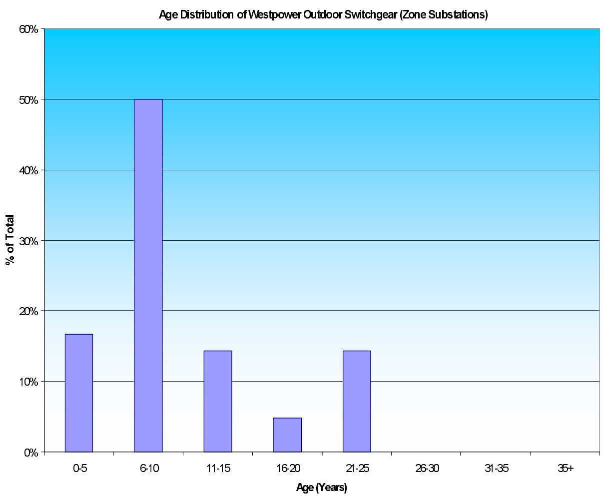
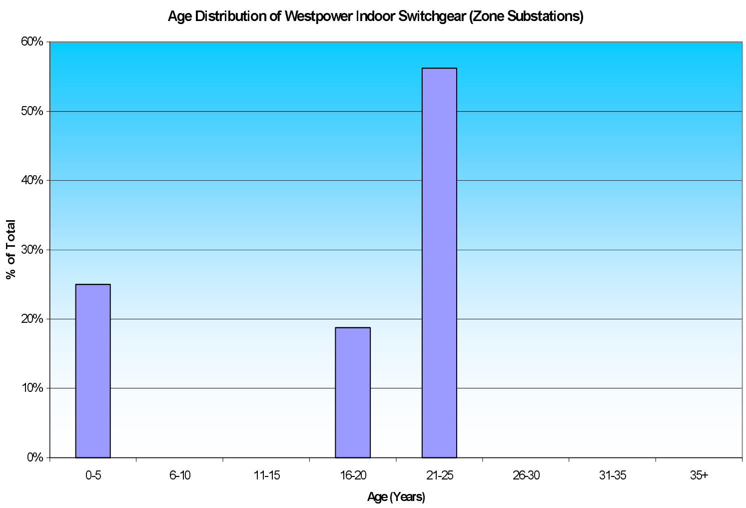


Figure 5.5.6a - Indoor Switchgear Ages



indoor switchgear age profile. The average age of the metal clad switchgear is 14 years.

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 has been identified with the indoor bulk oil switchgear at Greymouth after a recent 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. As discussed in 3.3.2, a full replacement strategy has been chosen as the best way to manage the risk, particulary in view of the health and safety impacts. Accordingly this switchboard will be 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.

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.

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.

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.

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, which 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.

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. Two remaining installations at Ngahere and Rapahoe are scheduled to have facilities installed in 2003.

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.

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 networked PLC's will take over the role of RTU's in future designs, and where possible, this will be included into the replacement programme.

5.5.13 Protection Relays

All protection relays are in excellent 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 solution to this is to initiate a cyclic replacement program of all recloser batteries every three years.

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 1600 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 substation 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. These new units are now imported from the USA and follow an international design standard. The Gough units are slowly being replaced as scheduled maintenance takes place on distribution substations.

5.6.2 Earthing Systems

The proposed 1996 Electricity Regulations suggested that all substation-earthing systems be brought up to a standard of 10 ohms by April 1 2000. 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 earth testing has begun and will continue until the total substation population has been covered. After this time, a programme of regular five-yearly tests will be 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 oldest line regulator in service is at Cronadun, and 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 1500 kVA unit is in good condition having experienced a relatively easy service life and will remain serviceable throughout the planning period.

A relatively modern set of Cooper SR32 single-phase 32-step regulators were commissioned at Fox Glacier in the early 90's and at Harihari substation shortly afterward. These units are expected to have at least twenty years of remaining life.

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

Approximately 20% of pole mounted circuit breakers are over 25 years of age and have reached the end of their reliable economic life and are programmed for replacement over the next 3 years. The remaining pole mounted circuit breakers are of the modern vacuum type.

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" 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)

The SCADA Realflex Master Station underwent a mid-life hardware and software upgrade in March 1998 followed by a more minor upgrade in 2001 and will not need further attention until 2004. At this time, a full replacement will likely be required, and a detailed investigation will need to be completed to determine suitable technical requirements, and this has been allowed for in the current year.

Ongoing problems have been experienced with the historical collection module resulting in intermittent failures of the data extraction utilities, however this is a systemic problem within the application software that the manufacturer is currently investigating. In the meantime a workaround has been devised.

The hardware is based on reputable brand name product and is proving very reliable.

Existing modems and changeover racks from the original SCADA system installed in 1982 are still in service and are still proving reliable.

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 is currently being installed to support these new sites, with Stage 2 due for completion in August 2003. Over the following three years, this network will gradually be extended to cover all major Zone Substations, replacing the existing UHF radios.

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

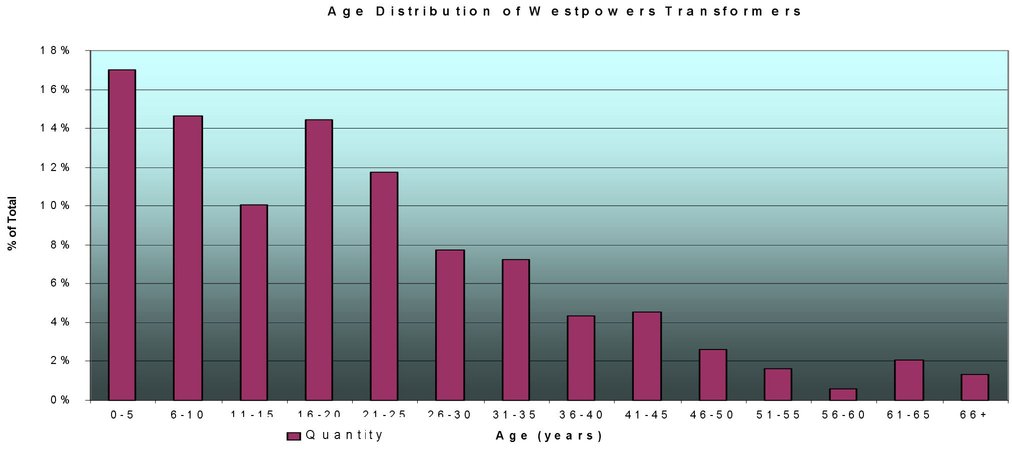
Westpower sold all of its ripple relays to the new incumbent retailer on 31 March 1999 along with exclusive use of channels existing at that time. The ripple injection plants were retained for the purpose of load control as well as providing a load switching service to retailers under contract.

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 usefull 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 one plant at Greymouth Substation with a new plant in the current year to provide a source of spare parts for the existing population.

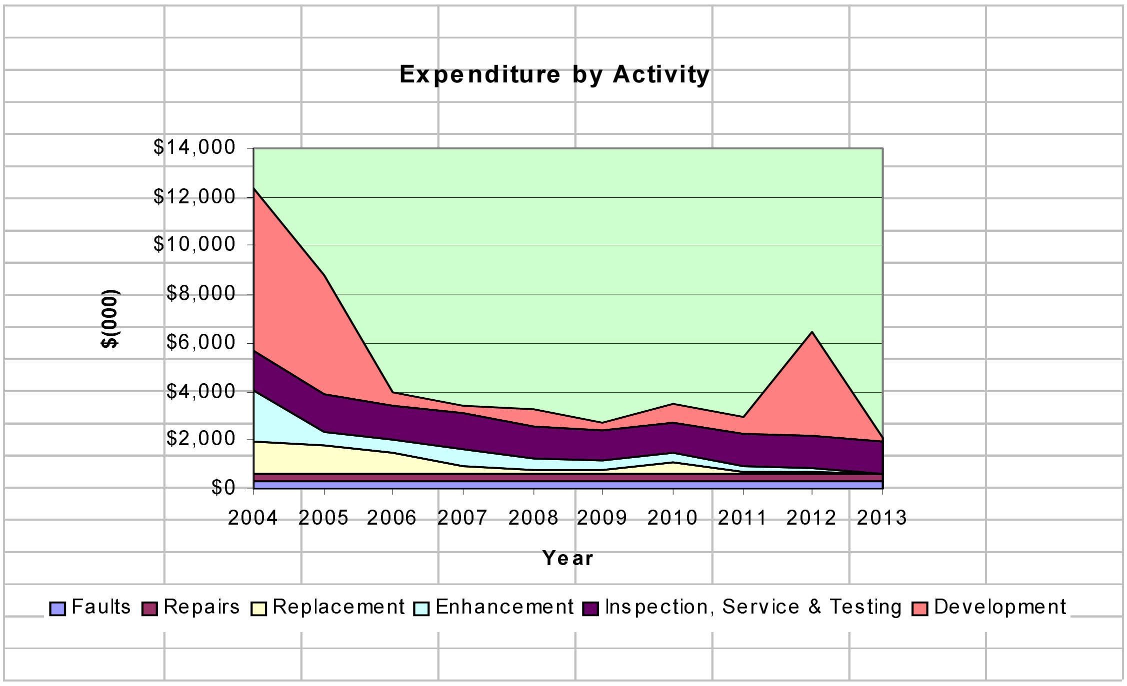

Age Distribution of Westpowers Transformers
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
% of Total
0-5
6-10
11-15
16-20
21-25
26-30
31-35
36-40
41-45
46-50
51-55
56-60
61-65
66+
Quantity
Age (years)

6.0 LIFECYCLE MANAGEMENT PLAN

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 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.

Maintenance Projects and Programmes ($'000)										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inspect Service & Test	1653	1538	1437	1439	1277	1309	1282	1311	1271	1311
Faults	293	293	293	293	293	293	294	294	294	294
Repairs	368	338	318	298	298	298	298	298	298	298
Total	**2314**	**2169**	**2048**	**2030**	**1868**	**1900**	**1874**	**1903**	**1863**	**1903**

Table 6.1.1.1

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)										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Replacements	1310	1145	850	360	215	180	525	130	110	30

(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 2 years to avoid an unnecessary risk of line drop or fault outages. These insulators have been proven to deteriorate rapidly after 5-6 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)										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Enhancements	2072	595	533	711	458	368	333	213	183	0

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)										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Development	6622	4887	552	292	742	242	742	742	4277	115

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.

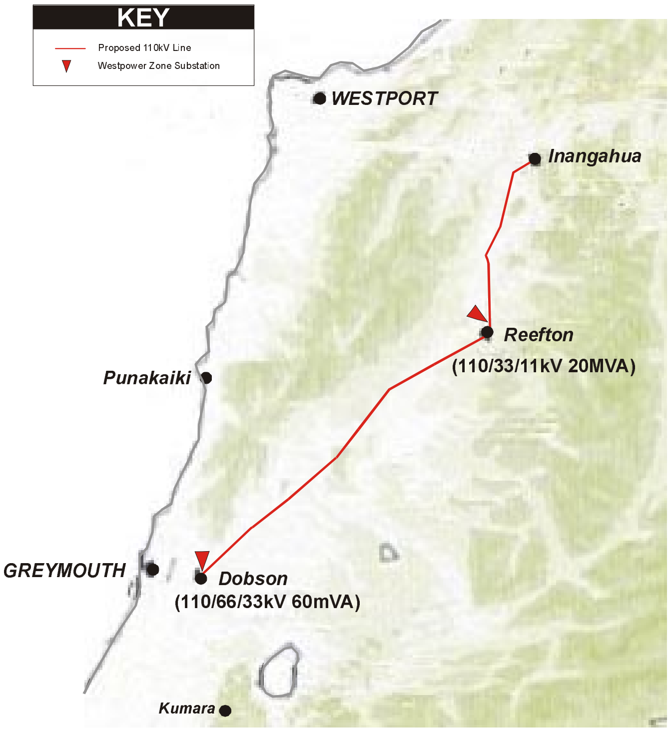
There are three specific projects anticipated however depending on the commitment of possible major new industrial projects

Project 04-6001West Coast Grid Reinforcement

It has been determined that the West Coast is nearing the end of its secure supply of electricity (measured by a single contingency) presently supplied from Transpower's Coleridge and Inangahua substations and TrustPower's local generation.

Either Westpower or Transpower will need to reinforce transmission to meet the needs of the West Coast's load growth of industrial and tourism based loads. TrustPower are carrying out studies on the feasibility of a new 72 MW generation station at Dobson. Should this proceed TrustPower will be constrained in being able to export the excess generation from the West Coast if transmission is not improved.

WCGR 110kV Lines and Substations



Studies have determined the most economical transmission enhancement is for Westpower to build a single circuit 110 kV line from Inangahua to Dobson and establish 110 to 66 kV interconnection assets at Dobson.

Three of the larger industrial clients have indicated they will draw more load.

1. Solid Energy and Grey Coal will increase their loads at various locations. This load will be met by existing infrastructure.

2. GRD have indicated they may reopen the Globe Progress mine with a 5 to 8 MW demand. This will lead to a new 110 to 33 kV substation at Reefton as the present 33 kV feeder from Dobson to Reefton does not have sufficient capacity to supply the load. This substation will connect to the new line to be built.

3. Pike River Coal are exploring the opening of a coal field at Pike River with a 5 to 6 MW demand. This will be supplied off the Dobson to Reefton 33 kV feeder via a tee off at Ahaura.

Besides the above loads there has been considerable demand increase with the tourism industry. At least four new accommodation facilities were built in the 2000/2001 which would add 1 MW to the load.

With all the above activity there will be flow on effects into the residential sector as well.

Project 04-6002 33 kV Supply to Industrial Mine Site Reefton

An enhanced 33 kV point of supply will be required from the grid at Reefton if GRD's Globe Progress mine proceeds. A dedicated 33 kV feeder to the Globe Progress mine site will be required from the new 110/33/11 kV Substation at Reefton.

33 kV Supply to Industrial Mine Site Pike River

Pike River Coal are exploring the opening of a coal field at Pike River with a 5 to 6 MW demand. This will be supplied off the Dobson to Reefton 33 kV feeder via a tee off at Ahaura.

A switching station will be required at Ahaura to allow for the Ngahere-Reefton section of the 33 kV feeder to be split at Ahaura for a fault either side allowing supply to be continued to the Tee off. A third CB will connect the spur to protect the feeder against faults on the spur.

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.

Sub-Transmission Replacement Projects and Programmes ($'000)										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inspect Service & Test	345	335	295	300	135	165	135	165	135	165
Faults	10	10	10	10	10	10	10	10	9	10
Repairs	9	9	9	9	9	9	9	9	9	9
Replacements	25	25	0	0	0	0	0	0	0	0
Enhancements	0	20	128	136	28	28	8	8	8	0
Development	2450	4200	0	0	0	0	0	0	0	0
Total	**2839**	**4599**	**442**	**455**	**182**	**212**	**162**	**192**	**162**	**184**

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.

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 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.

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

Thermograph 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 04-1002: Greymouth - Kumara 66 kV Porcelain Strain Disc Replacement

As porcelain strain disc insulators have a limited life of around 25 years, the strain insulators on the Greymouth - Kumara 66 kV line have reached the end of their operational life. There are approximately 300 porcelain strain insulators and associated hardware which will be replaced with glass strain insulators.

(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 planing period on quantitative data has been gathered on the actual condition of the current insulators.

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 progamme , with 20 percent of the line thoughly 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.

Project 04-1007: Fit Dogbone Vibration Dampers KUM-KHA 66 kV cct
To provide maximum protection to the conductor and associated fittings on the Kumara - Kawhaka cct, dogbone vibration dampers are to be fitted on spans exceeding 120m and meeting the design criteria for the installation of such dampers.

(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 three years 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.

The lightning performance of the line is difficult to judge because of the short period of time it has been operating, but should it prove necessary, lightning arrestors may be placed at the Kawhaka end of the line to prevent back-flash across to other circuits, which can result in double-circuit faults.

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 16 years. The median age of this asset group is less than five 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 implimented to renew any pole identified as defective over a five year period.

Projected Sub-Transmission Expenditure

I,S&T Sub-Transmission - Tree Trimming											
	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Dobson Arnold Line Tree Trimming	DOB1382	10	10	0	10	0	10	0	10	0	10
Dobson Rapahoe Line Tree Trimming	DOB1322	10	10	0	10	0	10	0	10	0	10
Dobson Reefton Line Tree Trimming	DOB1362	10	0	10	0	10	0	10	0	10	0
Greymouth Kumara 66kV Line Tree Trimming	GYM-KUM	5	5	5	5	5	5	5	5	5	5
Harihari Wahapo Line Tree Trimming	HKK1012	5	5	0	5	0	5	0	5	0	5
Hokitika Harihari 33kV Line Tree Trimming	HKK1012	10	10	0	10	0	10	0	10	0	10
Kumara Kawhaka 66kV Tree Trimming	KUM-KAW	10	10	0	10	0	10	0	10	0	10
Two Mile Road Hokitika 66kV Tree Trimming	HKK1012	0	0	5	0	5	0	5	0	5	0
Wahapo Franz Line Tree Trimming	HKK1012	5	5	5	5	5	5	5	5	5	5
	Total	**65**	**55**	**25**	**55**	**25**	**55**	**25**	**55**	**25**	**55**

I,S&T Sub-Transmission - Condition Assessment											
Sub-Transmission	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	10	10	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	10	10	10	10	10	10	10	10	10	10
Two Mile Hokitika 66kV Line Condition Assessment	HKK1012	10	10	10	10	10	10	10	10	10	10
Total		**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**

Sub-Transmission Projects ($'000)													
ID	Act	Project Description	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
04-6003	D	33 kV Line Franz Josef - Fox Glacier	HKK1012	100	0	0	0	0	0	0	0	0	0
-	D	WCGR 110 kV Line Dobson Reefton	IGH	0	4200	0	0	0	0	0	0	0	0
04-6001	D	WCGR 110 kV Line Ingangahua Reefton	IGH372	1800	0	0	0	0	0	0	0	0	0
04-6002	D	Macraes 33 kV Line - Reefton - Globe Hill	RFT	550	0	0	0	0	0	0	0	0	0
-	E	Dobson Reefton 33 kV Line Insulator/Xarm Replacement	DOB1362	0	0	0	8	8	8	8	8	8	0
-	E	GYM - KUM 66kV Upgrade	GYM-KUM	0	0	108	108	0	0	0	0	0	0
-	E	Hendrix Line Pole Replacement	HKK1012	0	20	20	20	20	20	0	0	0	0
04-1001	I	Dobson Arnold 33 kV Line Pole Replacement	DOB1382	15	15	15	15	0	0	0	0	0	0
04-1002	I	GYM - KUM Porcelain Strain Disc Replacement	GYM-KUM	15	15	5	5	0	0	0	0	0	0
04-1003	I	Fit new guys to structures on HHI-HKK cct	HKK1012	15	15	15	0	0	0	0	0	0	0
04-1004	I	Condemned pole replacement HKK-HHI	HKK1012	30	30	30	30	30	30	30	30	30	30
04-1005	I	Mount Hercules 33 kV Line Pole Replacement	HKK1012	15	15	15	15	0	0	0	0	0	0
04-1006	I	HKK-HHI Porcelain Disc Replacement	HKK1012	100	100	100	100	0	0	0	0	0	0
04-1007	I	Fit Dogbone Vibration Dampers KUM-KHA cct	KUM-KAW	10	10	10	0	0	0	0	0	0	0
04-4001	RPL	Replace All 33 kV EPDM Strain Insulators	SYS	25	25		0	0	0	0	0	0	0
				2675	4445	318	301	58	58	38	38	38	30

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 04-1001: Dobson - Arnold 33 kV Line Pole Replacement
With some sections of the 33 kV line between the Dobson Substation and the Arnold Substation being part the original line built in 1932, it is imparitive poles which have reached replacement criteria be renewed. Recent condition assessment programs have indicated 7 poles will require replacement in the 2003-04 financial year.

A regular annual thermograph 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 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 04-6002: New 33 kV Line from Reefton Sub to Macraes Mine Site at Globe Hill

With Macraes Mining receiving the green light to reopen an old hard rock gold mine at Globe Hill near Reefton, a processing plant will be built on this site, with an expected demand of around 5 MW. A new 12km Iodine AAAC 33 kV line will be constructed from Reefton substation to Globe Hill, with a portion to be built conjoint with an existing Westpower 11 kV line in the vicinity of Blacks Point. This is part of the Reefton Gold Supply Project (RGSP)

6.2.4 South Westland 33 kV Network

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 deteroration of poles and conductor. This line provides an essential link to South Westland, therefore demanding priority within maintenance progammes.

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 thermograph survey will be carried out on these lines to monitor the condition of joints.

Project 04-1003: Fit New Guys to Structures on the HHI-HKK cct

Of the 121 guy wires and guy insulators on the HHI-HKK cct, many require replacement. The guys on structures within 1 km of the coastline have been awarded a high priority, of which 12 have been identified for replacement in the 2003-04 financial year. The replacements will include the guy wire, insulators and all associated hardware except the deadmen and eyebolts, unless these are deemed inadequate for the job.

Project 04-1004: Condemned Pole Replacement HKK-HHI

This project will see approximately 10 poles which have been identified to have reached replacement criteria, be replaced on an on-going basis. This is a risk mitigation exercise and consideration will also be given to ensure the design standards are appropriate for 66 kV construction.

Project 04-1005: Mount Hercules 33 kV Line Pole Replacement

This project will see approximately 7 poles which have been identified to have reached replacement criteria, be replaced on an on-going basis. This is a risk mitigation exercise and consideration will also be given to ensure the design standards are appropriate for 33 kV construction.

Project 04-1006: HHI-HKK Porcelain Disc Replacement

Many the 6300 suspension insulators on the HHI-HKK 33 kV 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.

6Project 04-1008: Replace all 33 kV EPDM Strain Insulators.

The rapid deterioration of EPDM type strain insulators has forced the replacement of this type of insulator system wide. Glass Strain type insulator strings shall used as replacement discs. This is an on-going project, with investigations being completed in the 2002-03 financial 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

No replacement is foreseeable on the concrete pole lines.

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 given little margin when supplying the present tourist season peak load of 1.6 MVA.

As the load continues to grow in South Westland, a descision 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 reliven 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 be established at Harihari.

Based on current load growth projections, it is likely that the conversion will need to take place around 2007. In the meantime, additional reactive support will be required from 2003 and the conversion to 66 kV to overcome unacceptable voltage regulation, particulary when Wahapo Power Station is not running. This will likely be in the form of a mixture of fixed and switched capacitor banks.

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.

6.3 Distribution Assets

These assets comprise the majority of Westpower's asset by distance and value. As a logical result of this, the asset type also accounts for the greatest share of maintenance and enhancement expenditure.

Distribution Projects and Programmes ($'000)										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inspect, Service & Test	667	667	667	667	667	667	667	667	667	677
Faults	166	166	166	166	166	166	166	166	166	166
Repairs	135	135	135	135	135	135	135	135	135	135
Replacements	688	445	450	180	105	40	65	20	0	0
Enhancement	95	125	30	30	50	30	30	30	0	0
Development	350	60	0	0	0	0	0	0	0	0
Total	**2101**	**1598**	**1448**	**1178**	**1123**	**1038**	**1063**	**1018**	**968**	**978**

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 2003-04 financial year will see the initiation of a 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.

Inpection, Service and Testing - Condition Assessment ($'000)											
	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Arnold Feeder 3 Condition Assessment	ALD3	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Arnold Feeder 4 Condition Assessment	ALD4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Dillmans Feeder 4 Condition Assessment	DIL4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Dobson Feeder 1 Condition Assessment	DOB1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Dobson Feeder 3 Condition Assessment	DOB3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Franz Feeder 1 Condition Assessment	FRZ1	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Franz Feeder 3 Condition Assessment	FRZ3	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Greymouth Feeder 11 Condition Assessment	GYM11	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Greymouth Feeder 12 Condition Assessment	GYM12	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Greymouth Feeder 13 Condition Assessment	GYM13	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Greymouth Feeder 6 Condition Assessment	GYM6	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Greymouth Feeder 8 Condition Assessment	GYM8	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Harihari Feeder 1 Condition Assessment	HHI1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Harihari Feeder 3 Condition Assessment	HHI3	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Hokitika Feeder 10 Condition Assessment	HKK10	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Hokitika Feeder 12 Condition Assessment	HKK12	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Hokitika Feeder 4 Condition Assessment	HKK4	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Kumara Feeder 1 Condition Assessment	KUM1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ngahere Feeder 1 Condition Assessment	NGA1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ngahere Feeder 3 Condition Assessment	NGA3	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Otira Feeder 1062 Condition Assessment	OTI1062	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Rapahoe Feeder 1 Condition Assessment	RAP1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Rapahoe Feeder 3 Condition Assessment	RAP3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Reefton Feeder 1 Condition Assessment	RFT1	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Reefton Feeder 3 Condition Assessment	RFT3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Ross Feeder 1 Condition Assessment	ROS1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Ross Feeder 3 Condition Assessment	ROS3	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Wahapo Feeder 1 Condition Assessment	WAH1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Whataroa Feeder 1 Condition Assessment	WAT1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Waitaha Feeder 1 Condition Assessment	WTH1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Total	**51**	**51**	**51**	**51**	**51**	**51**	**51**	**51**	**51**	**51**

(ii) Repairs and Refurbishment

The condition assessment project discussed above 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.

(iii) Replacement

Project 04-4134: Lower Buller Gorge

This project will see the replacement of 10 poles in the section of line from the Inangahua River crossing to White cliffs. The bulk of this line is over 46 years old, therefore requiring immediate attention.

Project 04-4135: Upper Buller Gorge

The Upper Buller Gorge project includes the replacement of 7 poles identified as condemned in recent condition assessment programmes. Sections of this line will require ongoing replacement in upcoming years.

6.1.1.2 Enhancement

Project 05-5104: Upgrade 11 kV Line - Reefton Ring.

With the impending development of Macraes gold mine at Globe Hill, attention must be given to the related increases in capacity within the Reefton township. An upgrade of the 11 kV distribution ring supplying Reefton will help to alleviate any anticipated shortfall in capacity, along with the replacement of any poles not capable of withstanding new design loads.

6.3.1.3 Development

Any new development work in the Reefton area will only be required if major new loads materialise.

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 2003-04 financial year will see the initiation of a 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

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.

Distribution Tree Trimming ($'000)											
	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Arnold Feeder 3 Tree Trimming	ALD3	0	10	0	10	0	10	0	10	0	10
Arnold Feeder 4 Tree Trimming	ALD4	0	10	0	10	0	10	0	10	0	10
Dillmans Feeder 4 Tree Trimming	DIL4	10	0	10	0	10	0	10	0	10	0
Dobson Feeder 1 Tree trimming	DOB1	10	0	10	0	10	0	10	0	10	0
Dobson Feeder 3 Tree Trimming	DOB3	0	10	0	10	0	10	0	10	0	10
Franz Feeder 1 Tree Trimming	FRZ1	10	0	10	0	10	0	10	0	10	0
Franz Feeder 3 Tree Trimming	FRZ3	10	0	10	0	10	0	10	0	10	0
Greymouth Feeder 11 Tree Trimming	GYM11	0	10	0	10	0	10	0	10	0	10
Greymouth Feeder 12 Tree Trimming	GYM12	0	10	0	10	0	10	0	10	0	10
Greymouth Feeder 13 Tree Trimming	GYM13	10	0	10	0	10	0	10	0	10	0
Greymouth Feeder 6 Tree Trimming	GYM6	0	0	0	0	0	0	0	0	0	10
Greymouth Feeder 8 Tree Trimming	GYM8	0	10	0	10	0	10	0	10	0	10
Harihari Feeder 1 Tree Trimming	HHI1	10	0	10	0	10	0	10	0	10	0
Harihari Feeder 3 Tree Trimming	HHI3	0	10	0	10	0	10	0	10	0	10
Hokitika Feeder 10 Tree Trimming	HKK10	10	0	10	0	10	0	10	0	10	0
Hokitika Feeder 12 Tree Trimming	HKK12	0	5	0	5	0	5	0	5	0	5
Hokitika Feeder 4 Tree Trimming	HKK4	0	10	0	10	0	10	0	10	0	10
Kumara Feeder 1 Tree Trimming	KUM1	0	10	0	10	0	10	0	10	0	10
Ngahere Feeder 1 Tree Trimming	NGA1	10	0	10	0	10	0	10	0	10	0
Ngahere Feeder 3 Tree Trimming	NGA3	10	0	10	0	10	0	10	0	10	0
Otira Feeder 1062 Tree Trimming	OTI1062	0	5	0	5	0	5	0	5	0	5
Rapahoe Feeder 1 Tree Trimming	RAP1	10	0	10	0	10	0	10	0	10	0
Rapahoe Feeder 3 Tree Trimming	RAP3	10	0	10	0	10	0	10	0	10	0
Reefton Feeder 1 Tree Trimming	RFT1	10	0	10	0	10	0	10	0	10	0
Reefton Feeder 3 Tree Trimming	RFT3	10	0	10	0	10	0	10	0	10	0
Ross Feeder 1 Tree Trimming	ROS1	0	10	0	10	0	10	0	10	0	10
Ross Feeder 3 Tree Trimming	ROS3	0	10	0	10	0	10	0	10	0	10
Wahapo Feeder 1 Tree Trimming	WAH1	0	10	0	10	0	10	0	10	0	10
Waitaha Feeder 1 Tree Trimming	WTH1	0	10	0	10	0	10	0	10	0	10
Whataroa Feeder 1 Tree Trimming	WAT1	10	0	10	0	10	0	10	0	10	0
	Total	**140**	**140**	**140**	**140**	**140**	**140**	**140**	**140**	**140**	**150**

(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 04-4101: Deep Creek Turnoff - Blair Block Line Replacement

13 poles, conductor and associated hardware have been identified in the Blair Block area as reaching replacement criteria. The original 1 phase line was constructed in 1962, therefore has reached the end of it's economic life.

Project 04-4102: Christian Community - Kopara

The 2003-04 financial year will see the replacement of 14 poles and associated hardware between the Glorivale Christian Community and the Haupiri River. The existing ferret conductor will remain. This project is to be a staged over three years. The original hardwood line was constructed in 1964 and has reached the end of it's economic life.

Project 04-4103: Kotuku - Haupiri (east 3km)

Staged over several years, this financial year will see the continuation of this project with approximatley 20 poles and associated hardware being replaced. The existing ferret conductor will remain. The area of work covers the Rotomanu-Kopara turnoff to Birchfields. This will also provide the opportunity to realign several sections of the line.

Project 04-4104: Kopara, Birchfield to Gloriavale

This project is to be staged over two years with approximately 12 poles being replaced in the 2003-2004 financial year, with the existing conductor remaining. The existing line, built in 1964, covers approximately 4 km from Birchfields through to the Christian Community

Project 04-4105: Iveagh Bay Underground

With recent land development in the Cashmere Bay/Iveagh Bay area, a substantial amount of 11 kV underground cabling has already taken place. The installation of an additional 260 metres of underground cable would replace the current overhead line, built in 1968. This project would take place in conjunction with project 04-4201 "Iveagh Bay Underground Reticulation."

Project 04-4106: Replace 11 kV Poles Moana - Ruru

This project will include the replacement of 18 hardwood poles and 1.7 km of conductor between Moana and Ruru. Much of the current line, built in 1968, is in inhospitable terrain which will make some of the pole replacements difficult. This project will be completed over two years.

Project 04-4107: Inchbonnie Line Upgrade

Many of the older lines in the Inchbonnie area have been replaced in recent years. The 2003-04 financial year will see this area continue to be upgraded with sections of the 11 kV line, built in 1962, between the Incbonnie-Mitchells turnoff and the Jacksons Bridge be re-poled. The 2004-05 financial year will see this project complete.

Project 04-4108: Turiwhate, Pugh to Rocky Point

The 2002-03 financial year fast-tracked this pole replacement programme. The condition assessment programme helped identify poles, previously thought to meet design standards, had deteriorated to the the extent replacement was necessary. Approximately 25 poles will require replacement this year, with the existing conductor remaining. The project will run for a further two years and complete replacements of all sub standard poles in this area.

Project 04-4109: Replace 11 kV, Stillwater - Candlelight

The poles on the section of 11 kV line between the rail crossing at Stillwater and Candlelight are in a poor condition. There are a total of 10 poles with associated hardware to be replaced along with approximately 1 km 3 phase 7/.064 conductor.

Project 04-4111: Replace 11 kV Conductor to Wharf, Short St

In the event of a major fault, it has been discovered the 7/.064 conductor in the Short St area is incapable of carrying possible fault current. This had rendered the conductor a Health and Safety risk which must be mitigated. Approximatley 400 metres of conductor will be replaced.

Project 04-4112: Cobden Bridge - Kaiata

The hardwood poles and between the Cobden Bridge and Kaiata have been identified as in need of replacement. In all, 35 poles and 2700m of conductor will be included in this project, which will see the double circuit line be replaced with a single circuit. The timing of this project will be determined by Transit NZ's road re-alignment at Omoto.

Project 04-4113: Kumara Straight - Jnct to Kumara (stage 2)

Continuing on from the project which started last year, stage 2 of this project will see the replacement of another section of the existing 11 kV line from Kumara Junction through to Kumara substation. This will involve approximately 15 hardwood poles to be replaced, along with 2 km of conductor.

Project 04-4114: Taramakau Settlement Upgrade

This project is another spread over several years. The 2003-04 financial year will see the completion of the pole and conductor replacement on the Nicholas Road section of line, along with additional replacements on the line from the school east approximately 1.5 km.

Project 04-4115: Blackball/Atarau Road

The Blackball/Atarau Road project, which involves line replacement from Blackball to Moonlight, has four years remaining. The stage planned for this year includes the replacement of the section of 30 year old line (poles and conductor) from the Blackball Reservoir north approxiately 1.5 km.

Project 04-4116: Blackball-Taylorville Road

Some poles and conductor require replacement due to poor condition and in some cases instable terrain on the section of line between Taylorville and Blackball. Line recontruction has already taken place at the Blackball end of this line, therefore a continuation of this work is planned for the 2003-04 financial year. This will include the replacement of 6 poles and associated hardware, with the conductor being replaced in future stages.

Project 04-4117: Replace 11 kV Line, Rough River

The 11 kV line supplying the Rough River area requires replacement due to pole and conductor deterioration. This will be a staged project, with 7 poles to be replaced this year.

Project 04-4118: Thompsons Road, Mawheraiti

As with the project above, this 34 year old section of 11 kV line along Thompsons Road Mawheraiti has deteriorated to replacement point. This project will staged, with this years work involving the replacement of 7 poles.

Project 04-4119: Orwell Creek Rd /Carters Road

Taking place over two years, this project will see the replacement of 8 hardwood poles and 850 m 3 phase conductor along the southern end of Carters Road, and remaining hardwood poles along Orwell Creek Road.

Project 04-4120: Nelson Creek

Spread over 5 years, this project will eventually see the replacement of all sub standard hardwood poles and conductor in the Nelson creek area. This year, 8 poles are scheduled for replacement from Potts Creek towards Moores property.

Project 04-4123: Replace 11 kV Line at McCleans Pit Rd Area

The 11 kV line around the McCleans Pit turnoff area is in a state of disrepair and not aesthetically pleasing, given the location. It is planned 6 sub-standard hardwood poles with associated fittings and 500m conductor be replaced.

Distribution Projects ($'000)													
ID	Act	Description	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
04-4101	RPL	Deep Creek turnoff - Blair Block Line Replacement	ALD3	20	20	20	0	0	0	0	0	0	0
04-4102	RPL	Christian Community - Kopara	ALD4	20	0	50	0	20	20	20	20	0	0
04-4103	RPL	Kotuku - Haupiri Turnoff East 3 kms	ALD4	30	50	0	0	0	0	0	0	0	0
04-4104	RPL	Kopara Birchfield to Gloriavale	ALD4	35	20	0	0	0	0	0	0	0	0
04-4105	RPL	Iveagh Bay Underground	ALD4	30	0	0	0	0	0	0	0	0	0
04-4106	RPL	Replace 11 kV Poles Moana-Ruru	ALD4	30	30	0	0	0	0	0	0	0	0
-	RPL	William Stewart Bridge - XD4 11 kv Line Upgrade	DIL4	0	20	20	10	0	0	0	0	0	0
04-4107	RPL	Inchbonnie, Line Upgrade	DIL4	15	15	0	0	0	0	0	0	0	0
04-4108	RPL	Turawhate - Pugh to Rocky Point	DIL4	50	50	50	0	0	0	0	0	0	0
04-4109	RPL	Replace 11 kV, Stillwater - Candlelight	DOB1	15	0	0	0	0	0	0	0	0	0
-	RPL	Golf Links Rd Kaiata	DOB3	0	0	20	0	0	0	0	0	0	0
04-6101	D	Franz Josef 11 kv Ring (incl Gibb subdivision)	FRZ1	150	0	0	0	0	0	0	0	0	0
04-4110	RPL	Replace structures, Fox Hills	FRZ1	100	0	0	0	20	20	20	0	0	0
04-6102	D	Fox Glacier 11 kV Ring	FRZ1	150	0	0	0	0	0	0	0	0	0
-	RPL	Herbert St Replacement	GYM12	0	0	20	0	0	0	0	0	0	0
04-4111	RPL	Replace 11 kV conductor to wharf, Short St	GYM6	30	0	0	0	0	0	0	0	0	0
04-6103	D	Install 11kV Alternate Feed, Cobden Bridge-Coal Creek	GYM8	50	60	0	0	0	0	0	0	0	0
04-4112	RPL	Cobden Bridge - Kaiata	GYM8	80	0	0	0	0	0	0	0	0	0
-	RPL	Harihari Substation to the River	HHI1	0	0	45	0	50	0	0	0	0	0
04-5102	E	Upgrade 11kV Line La Fontaine Harihari	HHI3	10	10	0	0	0	0	0	0	0	0
-	E	Reconstruct 11kV Line Bundi Road	KUM1	0	0	0	0	20	0	0	0	0	0
-	RPL	Kumara Jnct Old School to Serpentine	KUM1	0	0	0	40	0	0	0	0	0	0
04-4113	RPL	Kumara Straight Jnct to Kumara (2 Stages)	KUM1	50	50	50	50	0	0	0	0	0	0
04-4114	RPL	Taramakau Settlement Upgrade	KUM1	20	20	0	0	0	0	0	0	0	0
04-5103	E	Upgrade Conductor - Kumara Area	KUM1	10	10	0	0	0	0	0	0	0	0
04-4115	RPL	Blackball/Atarau Rd	NGA1	25	25	25	25	0	0	0	0	0	0
-	E	Ngahere Dredge reconfiguration	NGA1	0	30	0	0	0	0	0	0	0	0
04-4116	RPL	Blackball - Taylorville Rd	NGA1	10	10	25	25	0	0	0	0	0	0
04-4117	RPL	Replace 11 kV line, Rough River.	NGA3	10	10	10	0	0	0	0	0	0	0
04-4118	RPL	Thompsons Road, Mawheriti	NGA3	10	10	0	0	0	0	0	0	0	0
04-4119	RPL	Orwell Creek Rd	NGA3	10	10	0	0	0	0	0	0	0	0
-	RPL	Red Jacks Ngahere	NGA3	0	15	15	15	0	0	0	0	0	0
04-4120	RPL	Nelson Creek	NGA3	15	15	15	15	15	0	0	0	0	0
-	E	Upgrade 11 kV Line to Hartmount Place, Punakaiki	RAP1	0	20	0	0	0	0	0	0	0	0
04-4121	RPL	Replace 11 kV line at McCleans Pit area	RAP3	18	0	0	0	0	0	0	0	0	0
04-4122	RPL	Lower Buller Gorge	RFT1	15	0	0	0	0	0	0	0	0	0
04-4123	RPL	Upper Buller Gorge	RFT1	10	10	0	0	0	0	0	0	0	0
-	RPL	Browns Ck - O'Reagans	RFT1	0	10	10	0	0	0	0	0	0	0
04-5104	E	Upgrade 11 kV line - Reefton Ring	RFT3	25	25	0	0	0	0	0	0	0	0
-	RPL	Garveys to Craigs Flat Line Replacement	RFT3	0	15	15	0	0	0	0	0	0	0
-	RPL	Crushington-Garveys Creek Line Replacement	RFT3	0	15	15	0	0	0	0	0	0	0
-	RPL	Buller Rd Crampton Rd to Caples St	RFT3	0	15	0	0	0	0	0	0	0	0
04-4124	RPL	Upgrade 11 kV poles and conductor, Ross township	ROS3	10	10	0	0	0	0	0	0	0	0
04-5105	E	Upsize light 11 kV conductors, Greymouth	SYS	20	0	0	0	0	0	0	0	0	0
04-5106	E	Mullet Line Replacement	SYS	30	30	30	30	30	30	30	30	0	0
-	RPL	Bird Road, Whataroa, Line Replacement	WAT1	0	0	20	0	0	0	0	0	0	0
04-4125	RPL	Scally Rd Whataroa	WAT1	10	0	0	0	0	0	0	0	0	0
-	RPL	Whataroa Flat Rd (10 poles Near J Spencer)	WAT1	0	0	25	0	0	0	25	0	0	0
04-4126	RPL	Replace railway iron poles & conductor, Whataroa Flat	WAT1	20	0	0	0	0	0	0	0	0	0
			Total	1113	610	460	210	155	70	95	50	0	0

6.3.2.2 Enhancement

Project 04-5103: Upgrade Conductor, Kumara Area

After investigations, it has been discovered the conductor in the Kumara is to light to carry possible fault currents. A staged programme will see this conductor replaced by the end of the 2004-05 financial year.

Project 04-5105: Upsize light 11 kV Conductors, Greymouth Area

As with project 04-5103 above, some light conductors in the Greymouth area will require replacement. This will allow these lines to withstand possible fault current.

Project 04-5106: Replace Mullet Conductors

This is an on-going project which will see the gradual replacement of Mullet conductor with Squirrel. The replacement programme was initiated due to the unstandard nature of the flat bodied Mullet. Jointing sleeves are extremely difficult to source and the corrosive nature of the conductor deemed it an undesirable component on the network.

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.

6.3.2.3 Development

Project 04-6103: Install 11 kv Alternate Feed, Cobden Bridge - Coal Creek

Staged over two years, this project will see the reconstruction of the line between McGeadys corner at Coal creek and the Brewery Hill along with 11 kV line constuction at the Cobden bridge finished this financial year. The following year a 11 kV underground cable is to be installed and connected to existing circuits, therefore creating a link between Dobson cct 1 and Greymouth cct 8.

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 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 ccondition assessment programme will be implemented 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 04-4124: Upgrade 11 kV poles and Conductor, Ross Township.

Staged over two years, this project involves the replacement of sub standard hardwood poles, silver pine poles and conductor in the Ross township area. This year, the project will include the replacement of 6 poles and approximatley 500m of 7/.136 conductor along Moorhouse Road.

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 Westland Dairy Factory Supply (WDFS) project will provide a strong 11 kV bus near to the major loads in Hokitika, and therefore remove an effective voltage constraint that has existed for several years. This should allow major new loads in the area to be supplied with 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.

6.3.4 South Westland Area

The distribution network in South Westland is contained in pockets based around Waitaha, Harihari, Whataroa and Wahapo, as well as a long 11 kV line extending from Franz Josef Glacier south to Paringa and Fox Glaciers 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 04-4110: Replace Structures, Fox Hills

This project will see the replacement of the southern structure 17705 in the Acrobat Creek area. The northern most structure was replaced in the last financial year. The replacement of structures on both sides of the 1200m span across the Omaroa River is seen as a logistical challange, as the terrain is very harsh with the use of a helicopter being the only access to the northern structure.

Project 04-4125: Scally Road, Whataroa

This financial year will see the completetion of the Scally Road upgrade, with 7 hardwood poles and associated fittings marked for replacement.

Project 04-4126: Replace Railway Iron Poles and Conductor, Whataroa Flat

The final section of line at northern end of Whataroa Flat Road consists of steel poles and no 8 wire which must be replaced. This project has 12 poles and approximately 1200m of single phase conductor tagged for replacement.

6.3.4.2 Enhancement

Project 04-5102: Upgrade 11 kV Line La Fontaine, Harihari

This project involves the reconstuction of the deteriorated hardwood poles along La Fontaine Road, near Harihari. 6 poles and associated fittings are to be replaced at the beginning of the line.

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.

Project 04-6101: Franz Josef 11 kV Ring (incl Gibb Subdivision)

Major development of the Franz Josef township has created the opportunity to rearrange the 11 kV reticulation in the area to form a ring circuit that can feed the area from two directions. This is particularly important when cable networks are involved because of the long repair times involved.

The work will be incorporated with the new supply to the Gibb Subdivision that is currently being developed.

Project 04-6102: Fox Glacier 11 kV Ring

As for Franz Josef, much of Fox Glacier is fed from a radial 11 kV cable network, leading to a high security risk.. The opportunity to provide for an 11 kV ring feed has arisen in conjunction with a major Telecom project along with the development of the Fox Glacier 33/11 kV substation (Project 04-6402)

Liasion will continue with the local council and the laying of ducts will continue in areas being excavated for new footpaths etc.

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.

Reticulation Projects and Programmes ($'000)										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inspect, Service & Test	61	40	29	26	29	31	31	30	20	20
Faults	20	20	20	20	20	20	20	20	20	20
Repairs	17	17	17	17	17	17	17	17	17	17
Replacement	180	85	135	70	0	20	0	0	0	0
Enhancement	100	20	0	110	0	50	0	0	0	0
Development	15	15	15	15	15	15	15	15	0	0
Total	**393**	**197**	**216**	**258**	**81**	**153**	**83**	**82**	**57**	**57**

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 2003-04 financial year will see the initiation of a 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.

Reticulation Projects ($'000)													
ID	Act	Description	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
04-4201	RPL	Iveagh Bay Underground	ALD4	20	0	0	0	0	0	0	0	0	0
04-4202	RPL	Lichfield St Kaiata	DOB3	15	0	0	0	0	0	0	0	0	0
04-4203	RPL	Dobson LV Replace	DOB3	10	30	60	60	0	0	0	0	0	0
04-5201	E	Dobson Garage to Ohau Street	DOB3	20	0	0	0	0	0	0	0	0	0
-	E	Install 185mm AL NS, Sullivan Road, Fox Glacier	FRZ1	0	0	0	0	0	0	0	0	0	0
-	E	Install ducts at Condon St, Franz	FRZ3	0	0	0	0	0	0	0	0	0	0
-	RPL	Tindale Rd	GYM13	0	0	0	10	0	0	0	0	0	0
04-4205	RPL	Lord St Tarapuhi Street, Greymouth	GYM6	20	0	0	0	0	0	0	0	0	0
04-4206	RPL	Replace 400V Chapel St, Top End	GYM6	30	0	0	0	0	0	0	0	0	0
-	E	Underground Cable Upgrades (Rolleston St)	HKK12	0	0	0	80	0	50	0	0	0	0
04-5202	E	Hampden Street 400V	HKK12	50	0	0	0	0	0	0	0	0	0
-	RPL	Blackball LV Network	NGA1	0	0	20	0	0	0	0	0	0	0
04-4207	RPL	McLeans Pit Road, LV Upgrade	RAP1	10	0	0	0	0	0	0	0	0	0
04-4208	RPL	Upgrade 400V poles and conductor, Blacks Point	RFT3	20	0	0	0	0	0	0	0	0	0
04-5203	E	Upgrade of Reefton LV Network	RFT3	20	20	0	30	0	0	0	0	0	0
04-4209	RPL	Upgrade 400V poles and conductor, Ross township	ROS3	20	20	20	0	0	0	0	0	0	0
04-1201	I	Streetlight Audit	SYS	10	0	0	0	0	0	0	0	0	0
04-5204	E	Upgrade Hokitika link boxes to 3 way switching	SYS	10	0	0	0	0	0	0	0	0	0
04-4210	RPL	LV Upgrade, Okarito Township	WAH1	20	20	20	0	0	20	0	0	0	0
04-4211	RPL	Upgrade 400V poles and conductor, Whataroa	WAT1	15	15	15	0	0	0	0	0	0	0
			Total	290	105	135	180	0	70	0	0	0	0

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

Project 04-4208: Upgrade 400V Poles & Conductor, Blacks Point.

Due to the state of disrepair of LV poles in the Blacks Point area, the replacement of 8 such poles and LV conductor are scheduled for replacement in this financial year.

6.4.1.2 Enhancement

With the development of the Macraes gold 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 04-5203: Upgrade of Reefton LV Network

This project will be run in conjunction with project 04-5104 "Upgrade 11 kV Line Reefton Ring". An upgrade of the 400 V reticulation supplying Reefton will help to 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 early 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 carried out.

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

Project 04-4201: Iveagh Bay Underground

This project will run in conjunction with Project 04-4105 - "Iveagh Bay Underground". With recent land development in the Cashmere Bay/Iveagh Bay area, a substantial amount of underground cabling has already taken place. The installation of an additional 260 metres of underground cable would replace the current overhead line, built in 1968.

Project 04-4202: Lichfield St, Kaiata

This project will take a high priority in the 2003-04 financial year. It will involve the replacement of 7 LV poles and associated hardware, along with 250m of 3 phase conductor. The poles are currently in a state of disrepair and could pose a Health and Safety risk if not attended to.

Project 04-4203: Dobson LV Replace

The Dobson LV Replacement project involves the replacement of sub-standard poles and conductor within Dobson township over the next five years. The section tagged for replacement this financial year is from Maori Street east to the end of the LV.

Project 04-4205: Lord St - Tarapuhi St, Greymouth

Due to the poor condition of low voltage poles and conductor within the Lord Street-Tarapuhi Street area, this project has been initiated. The project consists of the replacement of 9 poles, 300m of three phase conductor and associated hardware.

Project 04-4206: Replace 400V Chapel St Top End

With the hardwood low voltage poles and conductor at the eastern end of Chapel Street reaching the end of their serviceable life, the "Replace 400V Chapel St Top End" project will have 6 poles, 160 metres of conductor and associated hardware replaced.

Project 04-4207: McCleans Pit Road 400V Upgrade

This will run in conjuncion with project 04-4123 'McCleans Pit Upgrade'. Four low voltage poles and associated hardware will be replaced along with 350m three phase conductor. This section of 400V could, in the near future, pose a Health and Safety risk which must be mitigated.

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.

Project 04-5201: Dobson Garage to Ohau St

This project will see the 400V conductor and associated hardware being upgraded from Ohau Street through to the Challange Garage, a distance of approximately 300 metres.

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 04-4209: Upgrade 400V poles and Conductor, Ross Township.
This project, which is to span three years, comprises of the replacement of all sub-standard low voltage poles within the Ross township. 10 of these poles along The Terrace have been identified for replacement this year, along with 400 metres of conductor.

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 04-5202: Hampden Street 400V
This project will see approximately 600m overhead line replaced with underground reticulation. The overhead line is, at present, in a state of disrepair and as the vast majority of Hokitika reticulation is underground it has been decided this is the best replacement option for this area.

Project 04-5204: 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 a 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 utilized. 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 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, 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 04-4210: LV Upgrade, Okarito Township

The overhead reticulation system in Okarito is in an extremley poor condition. In accordance with local authority by-laws the existing overhead low voltage line will be replaced with underground cables. This year will see the removal of 6 hardwood poles and 270 metres of conductor along The Strand from Palmerston Street to Wharf Street.

Project 04-4211: Upgrade 400V Poles and Conductor, Whataroa

This project, spanning the next three years, will see the replacement of sub-standard low voltage poles in the Whataroa township. The first stage, to be completed this year, will be the replacement of 4 low voltage poles, conductor and associated hardware along Roberts Street.

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.

6.5.0 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.

Service Projects ($'000)

		Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
D	New Service Connections	SYS	15	15	15	15	15	15	15	15	15	15
I	Service Pole Replacement	SYS	30	30	30	30	30	30	30	30	30	30
		Total	45	45	45	45	45	45	45	45	45	45

There are several exceptions to this general rule however including

- replacement of blown service fuses due to faults
- repair of sub-standard 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 sub-standard
- 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 to be initiated this year is to include 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.

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 individual stations.

Zone Substation Projects and Programmes ($'000)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inspect, Service & Test	178	144	94	94	94	94	97	97	97	96
Faults	12	12	12	12	12	12	12	12	12	12
Repairs	19	19	19	19	19	19	19	19	19	19
Replacement	67	0	0	0	0	0	350	0	0	0
Enhancement	1342	155	180	250	240	120	120	0	0	0
Development	2925	0	0	0	500	0	0	0	3550	0
Total	**4542**	**329**	**304**	**374**	**864**	**244**	**598**	**128**	**3678**	**127**

Zone Substation Projects ($'000)

ID	Act	Description	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
04-5401	E	Upgrade Multilin with 351-S at Arnold sub	ALD	15	0	0	0	0	0	0	0	0	0
04-6401	D	Install Ripple Plant Dobson	DOB	10	0	0	0	0	0	0	0	0	0
04-5402	E	Install tie switch between 11 kV feeders Dobson	DOB	30	0	0	0	0	0	0	0	0	0
04-6402	D	Constuct 33/11 kV sub at Fox Glacier	FOX	400	0	0	0	0	0	0	0	0	0
04-5403	E	Install 1 extra Tx to Franz Sub	FRZ	800	0	0	0	0	0	0	0	0	0
-	E	Fit pumps to T2 Greymouth sub	GYM	0	0	0	0	10	0	0	0	0	0
04-5404	E	Replace GYM T1 & T2 Protection	GYM	70	0	0	0	0	0	0	0	0	0
-	E	Grey Sub 11 kV feeder protection replacement	GYM	0	0	140	0	0	0	0	0	0	0
04-1401	I	Overhaul all 66 kV CB's at Grey Sub	GYM	50	50	0	0	0	0	0	0	0	0
-	RPL	Replace 5 x Minimum OCB, Greymouth Sub	GYM	0	0	0	0	0	0	350	0	0	0
04-4401	RPL	Replace ODJB's, Greymouth Substation	GYM	10	0	0	0	0	0	0	0	0	0
-	D	SWGR Zone Sub Upgrade - Harihari Sub	HHI	0	0	0	0	0	0	0	0	2000	0
-	D	SWGR Zone Sub Upgrade - Hokitika Sub	HKK	0	0	0	0	0	0	0	0	300	0
-	D	SWGR Zone Sub Upgrade - Waitaha Sub	HKK	0	0	0	0	0	0	0	0	250	0
-	D	Build New 33/11kV Zone Substation Ikamatua	IKA	0	0	0	0	500	0	0	0	0	0
-	E	Kumara protection upgrade	KUM	0	0	0	0	60	0	0	0	0	0
04-5405	E	Replace CB 912 with Alstom GL309	KUM	52	0	0	0	0	0	0	0	0	0
04-5406	E	Upgrade Kumara protection to 3ph + EF	KUM	10	0	0	0	0	0	0	0	0	0
-	E	Upgrade Ngahere Substation	NGH	0	0	0	0	0	0	0	0	0	0
-	E	Upgrade Rapahoe protection to 3ph + EF	RAP	0	0	0	0	0	0	0	0	0	0
-	E	11 kV Feeder Isolation	RAP	0	0	10	0	0	0	0	0	0	0
04-6403	D	WCGR 110/33 kV Reefton Substation	RFT	2515	0	0	0	0	0	0	0	0	0
-	D	SWGR Zone Sub Upgrade - Ross Sub	RSS	0	0	0	0	0	0	0	0	1000	0
-	E	Install 33 kV Bypass Switches (NGH-WAT)	SYS	0	20	20	0	0	0	0	0	0	0
04-5407	E	South Westland Transformer Referbishment	SYS	50	50	0	250	50	0	0	0	0	0
04-1402	I	Perform Oil tests at Zone Subs	SYS	20	20	20	20	20	20	20	20	20	20
04-1403	I	Service OLTC's KUM, GYM, RAP, NGH	SYS	20	0	0	0	0	0	0	0	0	0
04-1404	I	Earthing Review of Zone Subs	SYS	10	0	0	0	0	0	0	0	0	0
04-5408	E	Install New Ripple Control Static Convertors	SYS	120	0	0	0	120	120	120	0	0	0
04-5409	E	Retrofit Porcelain Lightning Arresters	SYS	10	10	10	0	0	0	0	0	0	0
04-5410	E	Fit New RTU units	SYS	75	75	0	0	0	0	0	0	0	0
04-1405	I	Zone Sub Landscaping and Beautification	SYS	5	5	5	5	5	5	5	5	5	5
04-1406	I	Zone Substation Building Maintenance	SYS	10	10	10	10	10	10	10	10	10	10
04-1407	I	Zone Sub Building Climate Control	SYS	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
04-4402	RPL	Replace 11 kV Station Class Surge Arrestors	SYS	21	0	0	0	0	0	0	0	0	0
04-4403	RPL	Replace 33 kV Station Class Surge Arrestors	SYS	36	0	0	0	0	0	0	0	0	0
04-5411	E	Replace Tx at Wahapo	WAH	100	0	0	0	0	0	0	0	0	0
04-5412	E	Install 1 MVA regulator at Waitaha Sub	WTH	10	0	0	0	0	0	0	0	0	0
			Total	4454	241	216	286	776	156	506	36	3586	35

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 three 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 maintained 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 cause of power transformer failures is 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

(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 five 66 kV minimum oil circuit breakers, and a maintenance strategy is being formulated that will ensure a minimum of 30 years life is obtained.

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, getting 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 under-rated.

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.

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 04-6403 New 110 kV Substation at Reefton

Macraes Mining is investigating a major gold mining project for Globe Hill at Reefton. The expected load from the project is estimated to be about 5 MW, which will exceed the capacity of Westpower's Reefton Substation.

Additionally, an increase in load of just 2 MW at Reefton could not be handled by the West Coast Transmission System as a whole under certain operating conditions and this would mean that the Dobson-Inangahua Transmission Line would have to be upgraded to 110kV first.

A new 110/33kV substation would need to be built on the site of Westpower's Reefton Zone Substation, to supply the mining load as well as maintaining a supply to the local area. For economic reasons, this would best be built by Westpower to its own standards. A Conceptual Design Report has been completed to look at the advantages of this course of action, including sketch layouts and site surveys, but future progress will depend on the mining company's decision to proceed.

A new 12km 33kV feeder will need to be constructed from the substation site to the proposed mine site. The full cost of this feeder will need to be borne by the customer.

Zone Substation Projects 2003-04

Various Substations

Project 04-5407: South Westland Transformer Refurbishment

To be performed over several years, major servicing of the older 6MVA transformers at Wahapo and Franz Josef will extend the life of this equipment and add to security of the South Westland network.

Project 04-1402: Perform Oil Tests at Zone Subs

An enhanced baseline analysis of transformer oil conductivity and dissolved gases will be continued in the 2004 year to gain a better understanding of the condition of the asset.

Project 04-1403: Service OLTC's KUM,GYM,RAP,NGH

The tapchangers at these sites have had a high number of operations since their last maintenance and a special project has been instigated to address this issue.

Project 04-1404: Earthing Review of Zone Substations

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 minimized 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 04-5414: 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 program planned involves replacing one critical plant at Greymouth Substation with a modern, high capacity unit in the 2004 year and using the plant that as been released from service as spare parts to maintain the other plants. This will extend the life of the remaining units until 2008 at which time an annual replacement programme over three years will be instituted to upgrade the remaining injection plants.

Project 04-5409: Retrofit Porcelain Lightning Arrestors.

Lightning arrestors can deteriorate over time as they survive the continual stresses of absorbing lightning surges. In addition, porcelain lightning arrestors can create a safety hazard if they explode while staff are working in the vicinity. Moreover, many of the older porcelain arrestors were rated at 9 kV, which is somewhat lower than the 12 kV rating currently used throughout Westpower's network. (A 12 kV rating must be used when the supply to an area is fed with a Neutral Earthing Resistor). For this reason, a replacement program has been instituted that will result in new 12 kV rated polymer arrestors being fitted throughout all Zone Substations over the next three years.

Project 04-5410: Fit New RTU Units

Westpower's C68 Dataterm Remote Terminal Units have reached the end of their economic lives with spare parts and repair services no longer being available. These units cannot use modern communications protocols and this limits Westpower's overall SCADA capabilities.

While some spares have been released from service as a result of other development projects, this will only cover projected failures and an enhancement project sees all of these RTUs replaced over the next two years..

Project 04-1405: 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 Westpowers zone substation sites.

Project 04-1406: Zone Sub Building Maintenance

This too is an ongoing project which involves building maintenance such as cladding repairs, spouting repairs etc on all of Westpower's zone substation buildings.

Project 04-1407: Zone Sub Building Climate Control

This project has been initiated to ensure that equipment, especially of the electronic kind, enclosed in Westpower's zone substation buildings is kept at the correct temperature and humidity levels. This project will see an initial cost with ongoing maintenance costs.

Project 04-4402: Replace 11 kV Station Class Arrestors

Some of the older station class arrestors used on transformers in Zone Substations do not meet Westpower's current standards and will be replaced in the 2004 year.

Project 04-4403: Replace 33 kV Station Class Arrestors

As for Project 04-4402 above, except this covers the 33 kV arrestors used on the HV terminals of transformers.

Reefton Substation

Project 04-6407: WCGR 110/33 kV Reefton Substation

As part of the WCGR project, discussed in Section 6.1.4, a new 110/33/11 kV substation will be established at Reefton. Although this is primarily required to supply the 33 kV load at the new GRD Macraes mine at Reefton, it will also benefit the local area through provision of alternative 33 kV and 11 kV supplies, resulting in enhanced security.
The substation will be constructed on the old Transpower site at Waitahu near Reefton and will interface to the existing Westpower 5 MVA 33/11 kV Substation on the same site.

Arnold Substation

Project 5401: Upgrade Multilin with 351-S at Arnold Substation.

The existing Multilin Recloser Controller at Arnold Substation has reliability issues and does not match the Westpower standard used at most other sites, leaving it as somewhat of an orphan.. This unit is to be replaced with the more reliable SEL 351-S unit currently used elsewhere by Westpower .

Dobson Substation

Project 6401: Install Ripple Plant, Dobson

Ripple Signal coverage in the Dobson/Grey Valley area is currently marginal, and additional coverage can be provided by installing the existing spare Ripple Plant Unit at Dobson. As discussed in Project 04-5408 above, another spare will be created as a result of replacing the existing Greymouth unit.

Project 5402: Install Tie Switch between 11 kV Feeders, Dobson

This project is to be initiated to further enhance network security via the Dobson Substation. It entails the reconfiguration of the 11 kV cables exiting the substation allowing Dobson ctt 1 to feed off Dobson cct 3 and visa versa.

Greymouth Substation

Project 5404: Replace GYM T1 and T2 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 recently at Hokitika.

Project 1401: Overhaul All 66 kV CB's at Grey Sub

The existing 66 kV minimum oil circuit breakers at Greymouth Substation need enhanced maintenance as they move into the final part of their lifecycle. Amaintenance project is planned to ensure that all units receive a major overhaul in the 2004 year.

Project 4401: Replace ODJB's Greymouth Substation

The steel outdoor junction boxes (ODJB's) in the Greymouth substation have reached the end of thier serviceable life due to corrosion. The new boxes will be fabricated from aluminium.

Kumara Substation

Project 5405: Replace CB 912 with Alstom GL309

As discussed in Project 1401 above, the existing minimum oil circuit berakers (4 at Greymouth and 1 at Kumara) require enhanced maintenance to reduce the risk of catastrophic failure. It is planned to install a new SF6 66 kV circuit breaker at Kumara in the 2004 year to release the existing minimum oil unit there as a source of spare parts.

Project 5406: Upgrade Kumara Protection to 3ph + EF

The present feeder protection at Kumara does not meet current Westpower standards with overcurrent protection on 2 phases only. While this is a common solution used in the past, it has been decided to bring this protection into line with the modern Westpower standard of three phase overcurrent protection

Waitaha Substation

Project 5412: Install 1 MVA Regulator at Waitaha Sub

Waitaha is fed from a fixed tap transformer with no regulator. This results in poor voltage regulation when there are significant swings in the 33 kV bus voltage at Waitaha due to load changes in South Westland. As the South Westland load grows, these fluctuations will become more pronounced, and an existing regulator will be installed in the 2004 year to overcome this problem and improve power quality in the area.

Wahapo Substation

Project 5411: Replace Tx at Wahapo

The Wahapo transformer requires significant maintenance, along with its sister unit at Franz Josef. One option is to replace the existing unit with a smaller second-hand unit and then maintain the old unit for later fitting at Franz Josef. This project is contingent to some extent upon Project 5403 discussed below.

Franz Substation

Project 5403: Install 1 Extra Transformer to Franz Sub

The existing zone substation at Franz Josef comprises a single 6 MVA 33/11 kV transformer that requires significant maintenance including work to upgrade its tapchanger. Recent oil diagnostic tests have raised some further concerns which require more analysis and investigation.

As the township of Franz Josef continues its rapid growth, the level of security expected by the local tourism industry is rising commensurately. At the same time, Westpower is facing a security risk related to the one transformer installed because of the need to cover for

1. Unexpected failure of the current unit.
2. The need to have extended maintenance outages to service the single unit installed there.

A number of options have been considered to reduce this risk including a series of enhancement options for the Franz Substation that would provide for two transformers to be permanently installed. These range from simply having a spare transformer sitting on an adjacent pad that could be bought into service within a few hours, through to rebuilding the whole substation to provide for two units being permanently in service with a full 11kV and 33 kV bus.

While preparing this plan, a further option has come to light that would involve the use of a fully transportable substation being constructed that could be taken to site at short notice to provide for both of the scenarios listed above. In addition to answering many of the concerns for Franz Josef, it could also provide a valuable spare for all of Westpower's other 33/11 zone substations, all of which consist of a single transformer.

A separate report is currently being prepared for consideration by the Westpower board that will investigate these options in detail and make a recommendation on the best overall solution.

Fox Substation

Project 6402: Construct 33/11 kV Sub at Fox Glacier

The Fox Glacier area is feed by a single 11 kV feeder from Franz Josef, some 25 kms away. This line was constructed to a 33 kV insulation level at the time, bit has never yet run at this voltage.

Load growth in the Fox Glacier area has led to the installation of 11 kV regulators some years ago, and more recently to the installation of voltage support capacitors, leaving little headroom for further expansion. It has now reached the stage where increasing the supply voltage to 33 kV and installing a 33/11 kV zone substation at Fox Glacier has become necessary.

Load flow studies have demonstrated that this project will not only improve capacity and voltage regulation in the Fox Glacier area, but also improve supply to all of the South Westland area through reduced losses and improved voltage support. This positive effect is compounded when combined with the installation of additional capacitors in the area.

As all of South Westland is currently a concern in terms of voltage regulation, this project has been accelerated into the 2004 year. In turn, this will allow a major 66 kV project, the South Westland Grid Reinforcement or SWGR project, to be deferred for several years, or until additional load growth requires it.

Westpower has already purchased a site at Fox Glacier and now plans to proceed immediately with the substation construction and upgrade of the operating voltage of the line feeding it to 33 kV.

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.

Distribution Substation Projects and Programmes ($'000)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inspect, Service & Test	209	209	209	209	209	209	209	209	209	209
Faults	23	23	23	23	23	23	23	23	23	23
Repairs	53	53	53	33	33	33	33	33	33	33
Replacement	120	30	55	30	30	30	30	30	30	30
Enhancement	135	80	0	0	0	0	0	0	0	0
Development	60	60	100	100	100	100	100	100	100	0
Total	**600**	**455**	**440**	**395**	**395**	**395**	**395**	**395**	**395**	**295**

Distribution Substation Projects ($'000)

ID	Act	Description	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
5501	E	Replace 200 kVA Tx at Felix Campbell St with 300kVA	GYM11	5	0	0	0	0	0	0	0	0	0
-	E	Replace Badger Lane Substation	GYM6	0	40	0	0	0	0	0	0	0	0
5502	E	Replace Chapel St Sub	GYM6	40	0	0	0	0	0	0	0	0	0
-	RPL	Rebuild Gresson Street Sub	GYM6	0	0	25	0	0	0	0	0	0	0
4501	RPL	Rebuild Wilson Lane Sub	GYM6	80	0	0	0	0	0	0	0	0	0
4502	RPL	Changeout 300 kVA Tx at S649, Stafford St	HKK	10	0	0	0	0	0	0	0	0	0
-	E	Upgrade Sub, Hartmount Place, Punakaiki	RAP1	0	40	0	0	0	0	0	0	0	0
3501	RPR	Replacement of Tinned Live Line Taps	SYS	20	20	20	0	0	0	0	0	0	0
5503	E	Fitting Lightning Arrestors	SYS	80	0	0	0	0	0	0	0	0	0
1501	I	Sub (site) Upgrades	SYS	80	80	80	80	80	80	80	80	80	80
6501	D	New Transformer Sites	SYS	60	60	100	100	100	100	100	100	100	0
4503	RPL	Distribution Sub Replacements	SYS	30	30	30	30	30	30	30	30	30	3
5504	E	Upgrade main isolators on 500 kVA transformers	SYS	10	0	0	0	0	0	0	0	0	0
			Total	**415**	**270**	**255**	**210**	**210**	**210**	**210**	**210**	**210**	**110**

Project 04-1501 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 an ongoing project, with all earth test results and upgrade notes recorded in the Electrical Network System.

6.7.2 Fault Repairs

Lightning damage or ingress of water causes most transformer faults.

Westpower has had a programme over the last six 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 will be 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.

Generally it is necessary to refurbish a transformer's oil initially after a 25 year period then approximately every 10 years which, with Westpower's in-service power transformer population means oil refurbishment will be required on two units throughout the planning period. With an estimated life of 60 years, this means each transformer will have its oil refurbished at least 3 times in its life.

It is expected that in the future, because of the exacting high quality requirements for the insulating oil in transformers now being purchased, the initial and following periods to oil refurbishment will be less than the aforementioned 25 and 10 years.

Project 3501: Replacement of Tinned Live Line Taps

Previous years have seen the fitting of live taps become the standard for connecting distribution substations less than 200 kVA to the network. After recent evidence that the live line taps have a tendency to seize at the thread and/or damage the conductor it is attached to, this practise ceased. The taps were no longer a reliable long term connection, therefore a project has commenced to see these replaced with the more robust amp joint. Live line taps will still be used for temporary connections and contractors are encouraged to register the locations of these to enable changeout by a live line crew.

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.

Westpower is at present assessing its stock of spare transformers and its ability to cover potential failures. At present a contingency allowance is made to cover this work. When the planned replacement policy is finalised, the results from this will replace the contingency sum.

Pending further analysis, current levels of transformer replacements are planned. Typical prices for new units range from $3,000 for small single-phase units to $20,000 for urban pad-mount transformers.

Project 4501: Rebuild Wilson Lane Sub

After a detailed investigation, it was determined that the equipment and building associated with the Wilson Lane substation has reached the end of it's operational life. A project will take place this year to replace all switchgear, transformers and associated equipment with more compact and advanced components. The new equipment will be housed it in one of the two existing buildings. This will mean one building will be demolished, while the other will be refurbished.

Project 4502: Changeout 300 kVA Tx at S649, Stafford St

The tap changer on the transformer at S649, Stafford St, Hokitika, is incapable of managing a high 11 kV secondary potential. Therefore the changout of this transformer has been included in this years budget.

After routine inspection it was discovered that there were unacceptable levels of corrosion at the point of contact between tinned live line taps and aluminium conductors within coastal areas. Therefore a replacement programme has been scheduled to alleviate this problem and prevent possible outages.

6.7.5 Enhancement

Project 5501: Replace 200 kVA Tx at Felix Campbell Street with a 300 kVA.

The transformer at S1139, Felix Campbell Street, is showing signs of severe corrosion and is currently operating at it's maximum capacity. A project has been adopted to replace this transformer with a 500 kVA unit in the 2003-04 financial year.

Project 5502: Replace Chapel Street Sub

This project will see the replacement of the building substation S1 in Chapel Street, Greymouth. The building is to be demolished with the switchgear and transformer to be replaced with more compact and advanced equipment.

Project 5503: Fitting Lightning Arrestors

With the development of the Hokitika substation, it was discovered equipment containing an impedence 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.

Project 5504: Upgrade Main Isolators on 500 kVA Transformers.

As a result of increased load on six 500 kVA transformers on the network, a project will take place to see the main isolators on these transformers uprated from 630 amps to 1000 amps. This will help to achieve improved system security within the effected areas.

6.7.6 Development

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.

MV Switchgear Projects and Programmes ($'000)										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inspect, Service & Test	60	35	35	35	35	35	35	35	35	35
Faults	11	11	11	11	11	11	11	11	11	11
Repairs	21	21	21	21	21	21	21	21	21	21
Replace	160	160	160	30	30	30	30	30	30	0
Enhancement	185	55	55	45	0	0	0	0	0	0
Development	177	87	72	12	12	12	12	12	12	0
Total	**614**	**369**	**354**	**154**	**109**	**109**	**109**	**109**	**109**	**67**

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 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 is being 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.

MV Switchgear Projects ($'000)													
			Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
04-1601	I	Relocate 11 kV Regulator, Fox Glacier	FRZ1	15	0	0	0	0	0	0	0	0	0
04-5601	E	Relocate RW17T, Trickies Road	GYM11	10	0	0	0	0	0	0	0	0	0
04-4601	RPL	Replace RMU (unspecified)	GYM13	70	70	70	0	0	0	0	0	0	0
04-1602	I	Shift recloser L51 to William Stewart Bridge	KUM1	10	0	0	0	0	0	0	0	0	0
04-5602	E	Install KFME Recloser - Roa mine	NGA1	35	0	0	0	0	0	0	0	0	0
04-5603	E	Disconnector Automation General	SYS	30	30	30	30	0	0	0	0	0	0
04-6601	D	Installation of Fault Indicators	SYS	15	15	0	0	0	0	0	0	0	0
04-6602	D	New Disconnectors	SYS	12	12	12	12	12	12	12	12	12	0
04-4602	RPL	Disconnector Replacements	SYS	90	90	90	30	30	30	30	30	30	0
04-5604	E	Upgrade Sectionalising Disconnectors (4 units)	SYS	90	0	0	0	0	0	0	0	0	0
04-5605	E	Disconnector Load Break	SYS	15	15	15	15	0	0	0	0	0	0
04-5606	E	Fit Earth Fault Indicators to RMU's	SYS	5	10	10	0	0	0	0	0	0	0
04-6603	D	Install Capacitors at Various locations (WAH, FOX)	SYS	150	60	60	0	0	0	0	0	0	0
			Total	547	302	287	87	42	42	42	42	42	0

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 04-1601 Relocate 11 kV Regulator, Fox Glacier

The 11 kV regulator at Fox Glacier is to be relocated to the new Fox Glacier 33 kV substation and will become an integral part of it.

Project 04-5601 Relocate RW17T, Trickies Road

A rearrangement of the two 11 kV feeders into the area to provide for dual 11 kV supply to the IPL plywood factory at Gladstone requires that the automated tie switch in the area be relocated to allow for both feeders to be available at IPL.

Project 04-4601 Replace RMU (unspecified)

Several older Andelect Series 1 RMU's are at the end of their lives and require regular maintenance. A replacement program is in place to gradually remove these units from the system.

Project 04-1601 Shift Recloser L51 to William Stewart Bridge

To provide additional security to areas fed from the Kumara 11 kV bus, the existing recloser at Taramakau Settlement will be shifted closer to Kumara and installed at the William Stuart bridge on the Taramakau River.

Project 04-5602 Install KFME Recloser - Roa Mine

A new 11 kV supply is being taken at the Roa Coal Mine and a KFME 11 kV recloser is to be installed to provide the required level of protection.

Project 04-5603 Disconnector Automation General

This project is a continuation of Westpower's program to automate critical disconnectors and reclosers throughout the area.

Project 04-6601 Installation of Fault Indicators

Fault Indicators are to be installed on certain spur lines to assist in fault-finding and to improve restoration times.

Project 04-6602 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. It will also assist locating faults.

Project 04-4602 Disconnector Replacements

Many of the older two-insulator disconnectors in the area have reached the end of their lives and will be gradually replaced with modern units.

Project 04-5604 Upgrade Sectionalising Disconnectors (4 units)

Sectionalising disconnectors are the modern replacement for old oil-filled sectionalisers and incorporate a fault indicator feeding an intelligent controller capable of opening the disconnector during recloser dead-times. For such units are planned to be installed during the 2004 year to improve system reliability and cut down the extent of fault outages.

Project 04-5605 Install Disconnector Load Break

Some disconnectors within Westpower's network are required to break significant load currents during normal switching operations.

During certain conditions, which include factors such as loading , wind strength and direction, there is a potential for flashover to occur while opening the disconnector. This creates a significant safety hazard for the operators as well as a risk of permanent damage to the equipment.

A project to fit five sets of load break heads per year has been initiated to help alleviate this problem. This project will be active for the next five years, with an additional five load break heads fitted in 2007. This project will run in conjunction with general disconnector maintenance.

Project 04-5606 Fit Earth Fault Indicators to RMU's

As with project 04-6601, earth fault indicators fitted to critical ring main units assist in fault finding and improve restoration time.

Project 04-6603 Install Capacitors at Various Locations

With several areas on West Coast requiring support for its potential, capacitors are to be installed in the most adversly effectedareas being Rotomanu, Punakaiki and Kokiri.

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.

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.

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.

SCADA, Comms and Protection Projects and Programmes ($'000)										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inpect, Service & Test	62	37	37	37	37	37	37	37	37	37
Faults	19	19	19	19	19	19	19	19	19	19
Repairs	13	13	13	13	13	13	13	13	13	13
Replace	35	350	0	0	0	10	0	0	0	0
Enhancement	125	50	50	50	50	50	50	50	50	0
Development	230	250	200	0	0	0	0	0	0	0
Total	**484**	**719**	**319**	**119**	**119**	**129**	**119**	**119**	**119**	**69**

Antennae are to be checked annually with a "Bird" RF wattmeter.

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 re-affirm 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.

SCADA, Comms Protection Projects ($'000)

			Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
04-5701	E	Upgrade UPS , Tainui St Depot	SYS	0	0	0	0	0	0	0	0	0	0
04-5702	E	Protection upgrades	SYS	50	50	50	50	50	50	50	50	50	0
04-6701	D	Digital UHF HKK-KUM-PAP	SYS	50	0	0	0	0	0	0	0	0	0
-	D	VHF Digital Radio, South Westland	SYS	0	0	200	0	0	0	0	0	0	0
04-6702	D	UHF Digital Radio, Grey Valley	SYS	150	250	0	0	0	0	0	0	0	0
04-4701	RPL	SCADA Master Station Replacement	SYS	25	350	0	0	0	0	0	0	0	0
04-6703	D	New Repeater, Mt Kakawau	SYS	30	0	0	0	0	0	0	0	0	0
04-5703	E	SCADA for protection upgrade	SYS	25	0	0	0	0	0	0	0	0	0
04-4702	RPL	Install new batteries, Mt Kakawa	SYS	10	0	0	0	0	10	0	0	0	0
04-5704	E	Front end comms processor	SYS	50	0	0	0	0	0	0	0	0	0
04-1701	I	Change South Westland relays to allow extra channel	SYS	10	0	0	0	0	0	0	0	0	0
04-1702	I	Replace UHF/VHF aerial assembly Tainui Street	SYS	15	0	0	0	0	0	0	0	0	0
			Total	**415**	**650**	**250**	**50**	**50**	**60**	**50**	**50**	**50**	**0**

Contract maintenance technicians are expected to respond to approximately 12 faults per annum.

6.9.2.2 Protection

The condition of protection assets was described in section 10.2.9. The expenditure planned over the review period is mainly in the following areas

- replacement of outdoor junction boxes
- replacement of aged feeder protection and controls

Distribution Transfomers Projects ($'000)

ID	Act	Description	Area	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
04-6801	D	Purchase of new transformers	SYS	400	200	150	150	100	100	100	100	100	100
04-3801	RPR	Referbish ETEL, ABB & Tolley Transformers	SYS	50	20	0	0	0	0	0	0	0	0
04-4801	RPL	Transformer Replacements	SYS	50	50	50	50	50	50	50	50	50	0
04-5801	E	General Transformer Servicing	SYS	90	90	90	90	90	90	125	125	125	0
			Total	**590**	**360**	**290**	**290**	**240**	**240**	**275**	**275**	**275**	**100**

- replacement of lead acid batteries with sealed cells
- seismic strengthening of protection panels
- seismic restraints for batteries
- installation of DC monitoring and distribution panels

6.9.3 Replacement Programmes

6.9.3.1 Communications

Communications equipment has in general a shorter life expectancy than heavy electrical equipment. Typi-

cally electronic equipment reaches technical obsolescence in 5-10 years although generally the equipment can be supported in service for 10-15 years. Westpower has 1 power line carrier (PLC) system that is 16 years old, however, this is likely to be retired from service when the new digital UHF radio network between Greymouth and Kumara is comissioned in 2002.

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.

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 Defined Projects

Project 7.2: Upgrade Antenna Tower at Kakawau VHF Repeater Site.

The existing radio antenna tower at Kakawau behind Greymouth is becoming crowded and will require replacement if any further increase in the number of channels on the site takes place.

6.9.5.2 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.

6.9.6 Development

Project 7.3 Digital UHF Radio System

Development of SCADA, Comms and Protection assets normally take place in conjunction with a major substation development. At present there is one defined project however, which is in conjunction with Hokitika Substation development.
The construction of a major new substation at Hokitika and the pending construction of a similar substation at Reefton caused Westpower to review the communications infrastructure supporting these new assets.

A number of changes in technology over recent years means that most equipment manufacturers are adopting standard interfaces such as Ethernet IP (Internet Protocol) for their equipment. This is a standard platform allowing multiple equipment types to coexist on the same communications backbone and provide for enhanced diagnostic and monitoring functions required. In addition, protection relay signaling over communications channels, which Westpower is now required to use for the first time for these new substations, requires high integrity digital data links.

The existing analogue UHF system is not capable of handling the additional scope and type of data traffic required.

As much of the existing UHF radio equipment is now over fifteen years old and reaching the end of it's economic life, a descision was made to embark on a replacement program that will see the existing equipment totally replaced with Exicomm 64K Digital UHF radio links.

Stage 1 of the project covering the repeater at Paparoa and bases at Greymouth, Hokitika, Kumara and Dobson will be completed by the end of third quater of 2003.

SCADA, Comms, Protection Projects

Project 04-5701 Upgrade UPS, Tainui Street Depot

The existing Uninterruptible Power Supply (UPS) at Tainui St Depot has reached the end of its economic life and is approaching full capacity. Spare parts are difficult to source and a growing number of faults are beginning to appear.

This unit is critical to the operational performance of the Control Room, especially during times such as Civil Defence emergencies, when a viable operational center must be maintained.

A new UPS including batteries and Charger/Inverter will be installed this year.

Project 04-5702 Protection Upgrades

Some of Westpower's older protection relays have either reached the end of their economic life, or do not have the necessary functionality to provide for the requirements of a modern, secure protection scheme. This can directly impact on the reliability of supply to consumers when proper discrimination is not achieved, and a number of cases of this have occurred recently..

It is planned to replace a number of these relays with modern numerical relays in the 2004 year.

Project 04-6701 Digital UHF HKK-KUM-PAP

An amount of funds has been allocated for the completetion of this project which was performed primarily in the 2002-03 financial year. This project is comparable with project 04-6702 described below.

Project 04-6702 Digital UHF, Grey Valley

This project is an extension of the earlier digital UHF radio project completed in the 2003 year, and will extend coverage to zone substations in the Grey Valley area including Arnold, Ngahere and Reefton substations. This will replace the existing aged equipment and also provide for enhanced communications capabilities in that will be required by the West Coast Grid Reinforcement (WCGR) project protection scheme.

At the end of the project, most of Westpower's Zone Substations (with the exception of South Westland) will be covered by a modern digital communications backbone.

Project 04-4701 SCADA Master Station Replacement

A major SCADA replacement project is planned for 2004-05 and a modest sum has been allowed to carry out initial scoping and investigation studies in the 2004 year.

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. There are several options available for upgrading the Master Station including a further life extension of the existing system and this will be fully investigated.

Project 04-6703 New Repeater, Mt Kakawau

For several years, Westpower has been using its 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 (RTUS'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.

A new VHF repeater will be installed at Mt Kakawau in the 2004 year.

Project 04-5703 SCADA for Protection Upgrade

With the planned replacement of the T1 and T2 protection at Greymouth Substation, an opportunity is being taken to replace the existing aged RTU at the site. This would have to be replaced within the next two years anyway as part of the RTU replacement programme.

The new RTU will consist of a PLC in line with Westpower's current SCADA methodology.

Project 04-4702 Install New Batteries, Mt Kakawau

The batteries at Mt Kakawau have reached the end of their projected life and need to be replaced. As this is a solar-powered site, there is severe duty on the batteries as they are required to charge and discharge daily, and regular replacement is the best strategy for maintaining the operational integrity of this important communications site.

Project 04-5704 Front End Comms Processor

A number of new SCADA RTU's have been installed over the last year in association with major projects such as the Westland Dairy Factory Supply (WDFS) and this has severely increase the communications processing load of the SCADA Master Station, leading to declining response times. In addition, a number of new communications protocols are now required to connect to the plethora of intelligent devices that are now becoming common in the industry, and these are not always available for Westpower's existing RealFlexä Master Station

The solution chosen, and one commonly employed in many new SCADA schemes, is to use a separate communications processor to handle RTU communications, and then serve this information up to the SCADA Master Station using an industry standard protocol called OPC.

This project provides for the installation of an IOServerä communications server and the interface of this unit to the existing SCADA Master Station.

Project 04-1701 Change South Westland Relays to Allow Extra Channel

All ripple relays in the South Westland area use the same channel, which means that all controllable load has to be switched off or on together.

By creating a new channel and changing the programming on some of the existing relays to this new channel, it will be possible to break up the size of the channels and allow for more efficient use of the existing power supply capacity in the area.

This project will require further negotiation with TrustPower, the owner of the ripple relays in each installation

Project 04-1702 Replace UHF/VHF Aerial Assembly, Tainui Street.

The existing UH/VHF Aerial Assembly at Tainui St is difficult to maintain because of restricted access. It is not possible to climb the existing antenna mast and long reach buckets 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 of other antenna masts at the Tainui Street depot

6.10 Distribution Transformers

The population of distribution transformers covers a diverse range of sizes, types and ages. As such, it is 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 resulted 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. This indicates loading trends to be monitored and that allows 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 this 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 semi-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.

Westpower is currently working with bushing suppliers and gasket manufacturers to provide a suitable bushing, and this is not expected to be difficult as the coating technology sought is already used on 22 kV and higher voltage bushings.

Once a suitable bushing is found, this will be specified for all future transformer supplies and a long term replacement programme will be 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

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 in-service ripple injection plants are all of the same make and model (Plessey TR series) making lifecycle management easier to implement.

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

Other Projects and Programmes ($'000)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
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	15	15	15	15	15	15	15	15	15	15
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	500	500	500	0
Total	**35**	**35**	**35**	**35**	**35**	**35**	**535**	**535**	**535**	**35**

of the

- converters
- coupling transformers
- coupling cells
- GPS time base receivers

Every three years independent experts to determine injection levels, current balance, optimum tuning and load sharing with other units carry out 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 rare.

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

No replacements are foreseen within the planning period.

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	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Inspection, Service & Testing	1653	1538	1437	1439	1277	1309	1282	1311	1271	1311
Faults	293	293	293	293	293	293	294	294	294	294
Repairs	368	338	318	298	298	298	298	298	298	298
Replace	1325	1145	850	360	215	180	525	130	110	30
Enhancement	2072	595	533	711	458	368	333	213	183	0
Development	6622	4887	552	292	742	242	742	742	4277	115
Total	12333	8796	3983	3393	3283	2690	3474	2988	6433	2048

Summary by Asset Type	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Subtransmission	2101	1598	1448	1178	1123	1038	1063	1018	968	978
Distribution	600	455	440	395	395	395	395	395	395	295
Reticulation	627	397	327	327	277	277	312	312	312	137
Services	614	369	354	154	109	109	109	109	109	67
Zone Substations	35	35	35	35	35	35	535	535	535	35
Distribution Substations	393	197	216	258	81	153	83	82	57	57
MV Switchgear	484	719	319	119	119	129	119	119	119	69
SCADA, Comms, Protection	99	99	99	99	99	99	99	99	99	99
Distribution Transformers	2839	4599	442	455	182	212	162	192	162	184
Other	4542	329	304	374	864	244	598	128	3678	127
Total	12333	8796	3983	3393	3283	2690	3474	2988	6433	2048

Figure 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 educated guesses due to a large number of unpredictable factors. Furthermore, in developing these figures, Westpower has had several years of experience in budgeting and controlling this expenditure and there is a high degree of certainty 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.

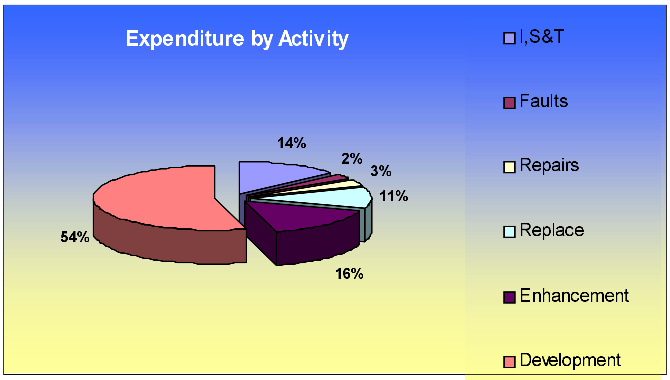


Figure 7.1b

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%.

The higher levels for Development and Enhancement are due to the major projects such as the West Coast Grid Reinforcement project and the installation of Capacitor Banks. Previously Westpower has had a large proportion of older lines that were rapidly approaching failure, and a replacement programme of the last seven years has substantially overcome this issue. The I,S&T expenditure has been kept to the same level of expenditure as the previous year to continue the enhanced monitoring of the condition of older components such as hardwood poles so that the future maintenance may be targeted toward life extension of ageing assets.

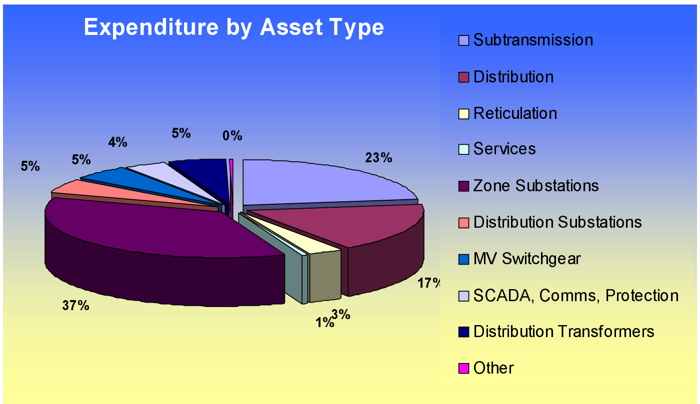


Figure 7.1c

The enhancement expenditure also 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 shows the expenditure by asset type. As would be expected, the bulk of the expenditure involves the development of new sub-transmission assets.

Following this, is expenditure on distribution assets at 17%. This is due to the maintenance costs involved with Westpower's long distribution network.

Most of the other 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

The major unknown, causing the greatest amount of uncertainty at the time of writing, is the threat of price control under the new regulatory regime as signalled in the Commerce (Goods and Services) Amendment Bill.

Other factors that will impact on network expenditure include

- Weather (which affects fault expenditure)
- Load Growth / Decline
- Price Control (either through regulation or the countervailing monopsony power of retailers and generators)

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.

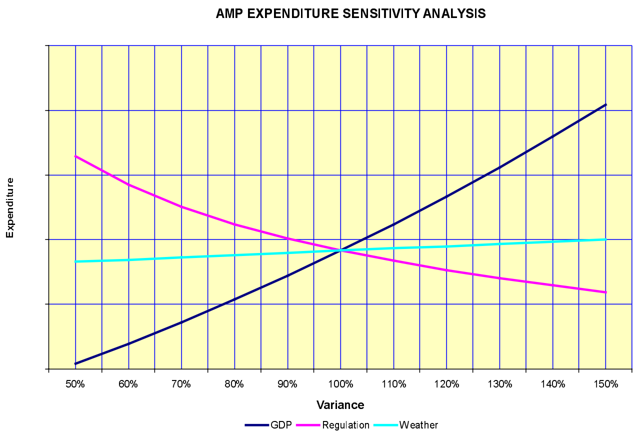


Figure 7.2a – AMP Expenditure Sensitivity Analysis

The exact effects of regulation (either through direct price control or the countervailing power of retailers and generators) are unknown, but it is likely that this will affect prices that can be charged. As a result, costs will 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.

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.

8.0 ASSET MANAGEMENT PRACTICES

8.1 Introduction

The electricity distribution system is comprised of assets with long lives. The management of these assets (comprising 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 co-ordination 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 on-going 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 widespread audit is carried out which reviews Westpower's achievement with respect to this plan.

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 following 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

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.

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 Westpower'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 and form the basis of the monthly reporting to management.

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 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. This database is being expanded to accommodate information on pole and span data, and has been updated to incude a GPS co-ordinate.

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 MoC 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

Many industry analysts have long held that there are far too many lines businesses operating for the size of the New Zealand market and a wave of rationalisation has been predicted. While there is no direct imperative for mergers and acquisitions intrinsic in the current legislation, market forces are likely to take over as inefficient operators with high fixed costs relative to their asset base are forced out of the business.

The Minimum Efficient Scale (MES) for retailing activities has been suggested to be a customer base of around 300,000 which implies a final number of around five retailers for the whole of the country. Although lines businesses operate under a different market structure, it is entirely conceivable that the current number of companies could fall to less than half over the next five years.

The companies that will come under most pressure to exit the business will be small companies like Westpower who cannot spread their overheads over a sufficiently great number of end-use customers. The medium term forecast is for trading conditions to become more difficult as the forced transition to a new environment begins to bed in.

If Westpower is to remain viable 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.

Historically, Westpower has performed poorly in these comparative analysis because of its relatively high cost structure. In part, this has been due to low population density, remoteness and extreme weather conditions.

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 Ministry of Economic Development 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

In December 2002 the Commerce Commission released its Draft Decision on the 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
3. Profitability.

At present, the proposed price path involves an annual adjustment of Consumer Price Index (CPI) – 5% per annum, effectively resulting in a 5% revenue drop in real terms over each year of a five year period beginning in 2003.

If this price path is adopted in the final decision, the resulting reduction in revenue will require 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 to 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). This countervailing influence will reduce Westpower's ability to set tariffs with strong profit margins as the supplier and retailer will effectively be acting in unison during negotiations.

To use an illustration put forward by some commentators, the lines businesses will 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.

What the overall effect of these changes will be is difficult to forecast. It can be said with some certainty

however that the lines businesses will be operating in a highly regulated market including both price and profit 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.

Prioritv	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.

Westpower is currently developing capital project evaluation procedures to provide a reliable benchmark for determining the worth of smaller capital projects, and details on this will be included in future Asset Management Plans.

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 are 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 Hokitika where system redundancy is limited by a voltage constraint.

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 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 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.

In Hokitika, the cable network consists of a single 11 kV ring, although a voltage constraint in the overall supply to Hokitika limits the ability to back feed from the other end. This issue is currently being addressed with the construction of the new Hokitika Substation.

All of Westpower's cables are operating well within their thermal ratings, even taking account of the possiblity 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 re-routed 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 on 2000 around the State Highway, which has increased the reliability of this section of line.

Alternative risk management scenarios involving standby diesel generator 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 three 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 14 Zone Substations at Reefton, Ngahere, Rapahoe, Dobson, Arnold, Greymouth, Kumara, Hokitika, Ross, Waitaha, Harihari, Whataroa, Wahapo and Franz Josef. These substation 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 Substation, 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.

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.

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 May 1997 and since that time, the old Transpower Arahura-Dobson Line has been decommissioned) and Arahura Substation 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.

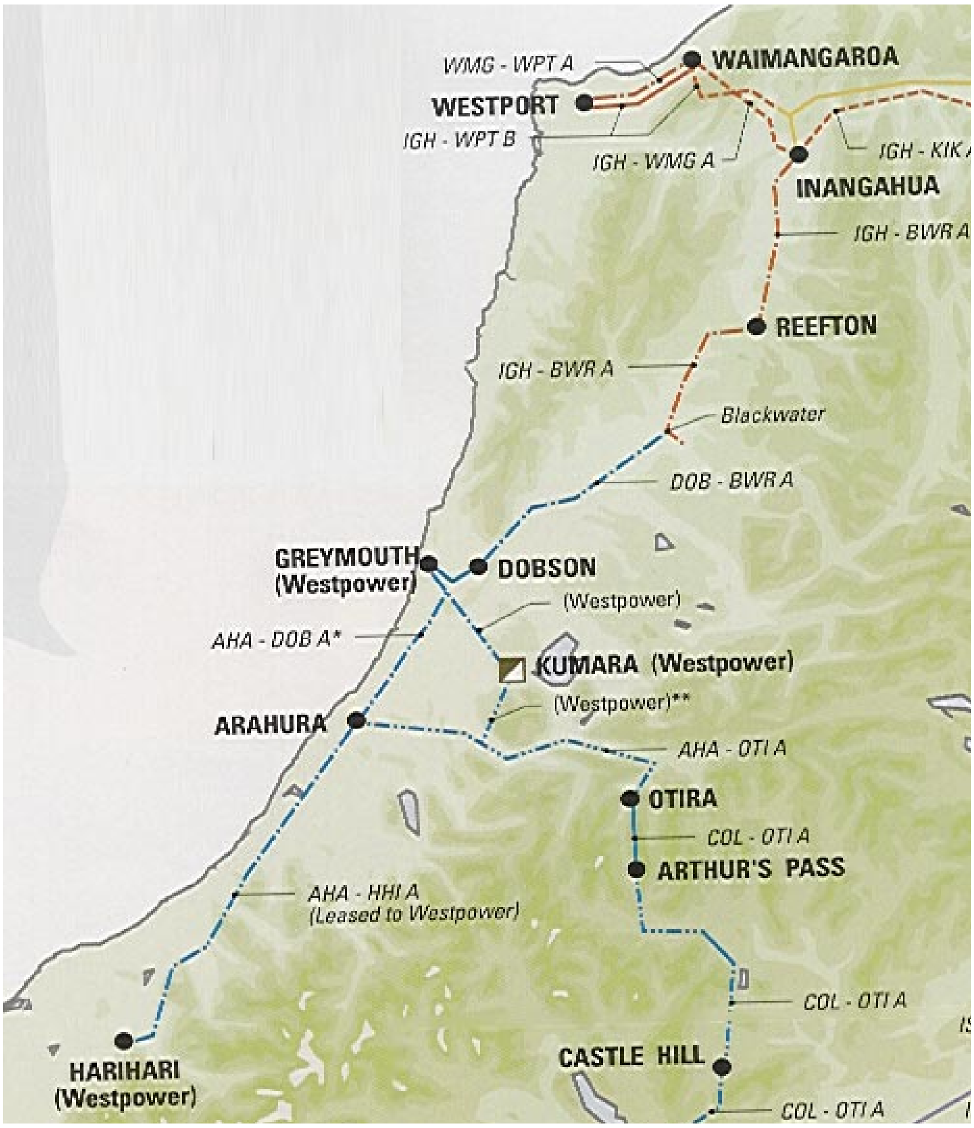


Figure 9.3a – 33kV Lines

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

Substation	Load (MW)	# HV Feeds	Feeders	Backup	Comments
Reefton	2.5	1	CB1 CB3	CB3 at Sub CB1 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 Trans Power 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, Arahura, 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	CB6 CB7 CB8 CB11 CB12 CB13	CB12 No backup CB11 DOB CB3 CB8 CB13 KUM CB1 CB6 CB13 CB11 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. A further reinforcement is planned by tying CB8 into CB6 at Chapel Street Substation to provide a backup for the main cable feed out of Greymouth Substation
Kumara	1.1	3	CB1 CB4	GYM CB11 ALD CB4 AHA CB4	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	CB1 CB2	CB2 CB3 CB1 CB3	This substation feeds Hokitika and all of South Westland down to Paringa.

Arahura	11.0	2	CB1 CB2 CB3 CB4 CB5	CB2 CB3 CB1 CB3 CB4 CB1 CB2 KUM CB4 WAH 1512	This substation feeds Hokitika and all of South Westland down to Paringa. Transpower owns the substation, which is fed by two transformers. While the 11 kV feeders are closely interconnected, the network is severely voltage constrained and this limits Westpower's ability to provide effective fault backup. CB3 relies on Trustpower generation at McKays and Kaniere Forks for voltage support. Investigations are under way to reinforce and enhance supply to the area, however this is driven to a large extent by the Westland Diary Company which accounts for 30% of the load on the substation. Future expansion plans for the Dairy Company are currently under consideration and are likely to be a major catalyst for any changes.
Ross	0.8	2	CB1 CB3	No Backup AHA CB3 Partial	CB1 is a dedicated feeder for the Birchfield Minerals mine site. Domestic load on CB3 can be fed from AHA CB3 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 is very remote and at the end of a long 33 kV sub-transmission feeder from Arahura. It feeds Franz Josef, Fox Glacier and South to Paringa. 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.

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.

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.

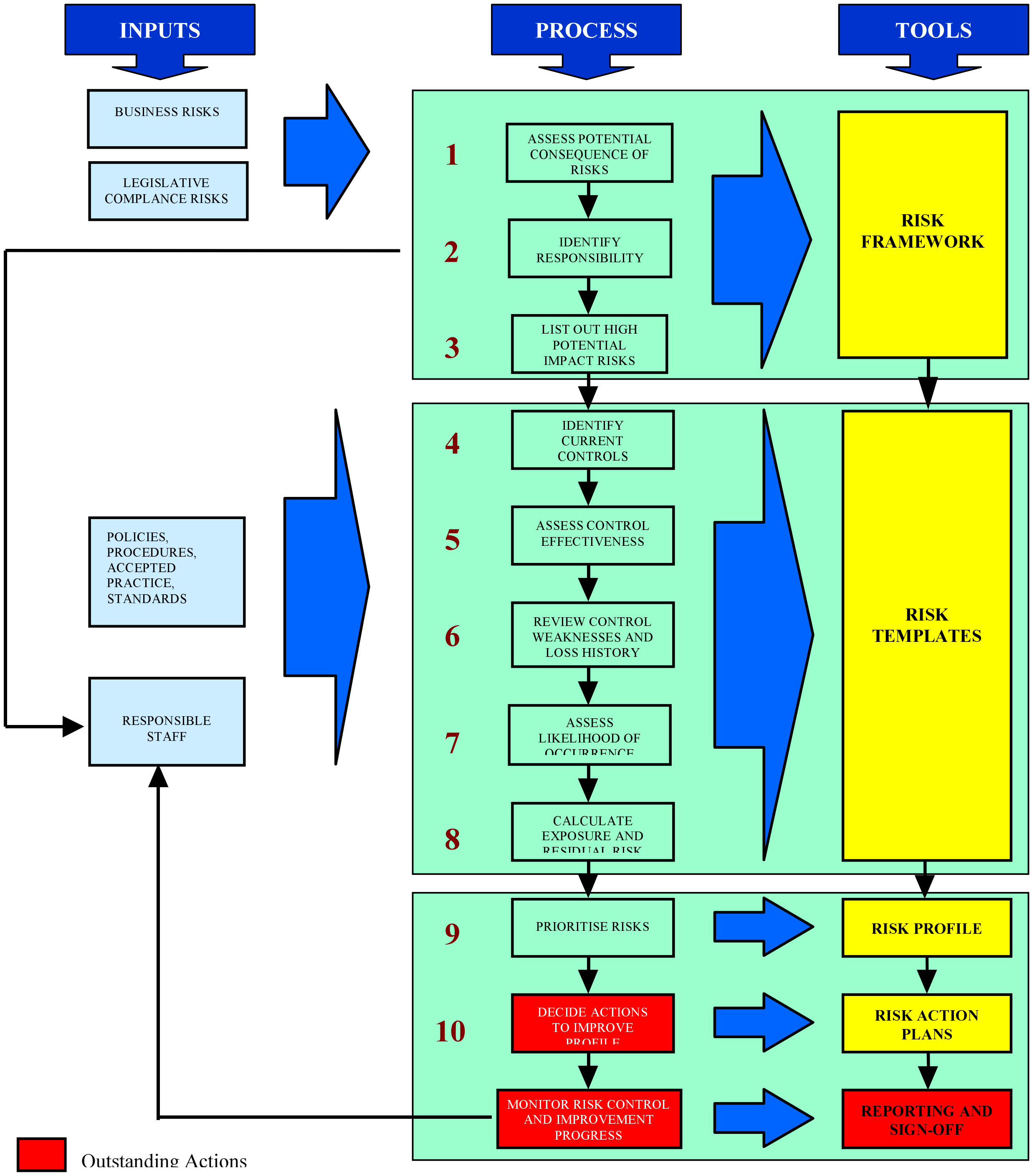
The methodology adopted was consistent with the joint Australian and New Zealand Standard AS/NZ 4360:1995. It is a simple and effective method but remains subjective. The validity of the risk control assessments may require further investigation and analysis by Westpower, particularly where the risk is critical to the business. An example of the one of the outputs is shown below.

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 Joseph 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.

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.

The Risk Framework contained in Appendix B contains a list of responsible people for each risk.

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 the Risk Templates contained in Appendix C.

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
Financial Management	88	1
Illegal or Unacceptable Behaviour	88	1=
Government Regulation	83	2
Inventory Management and Purchasing	83	2=
Project Management	79	3
Staff Planning	70	4
Succession Planning	63	5
Revenue Protection	60	6
Business Continuity Planning	55	7

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 9 risks above this figure and these are shown in the Top 9 Risks graph in Section 3.

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.

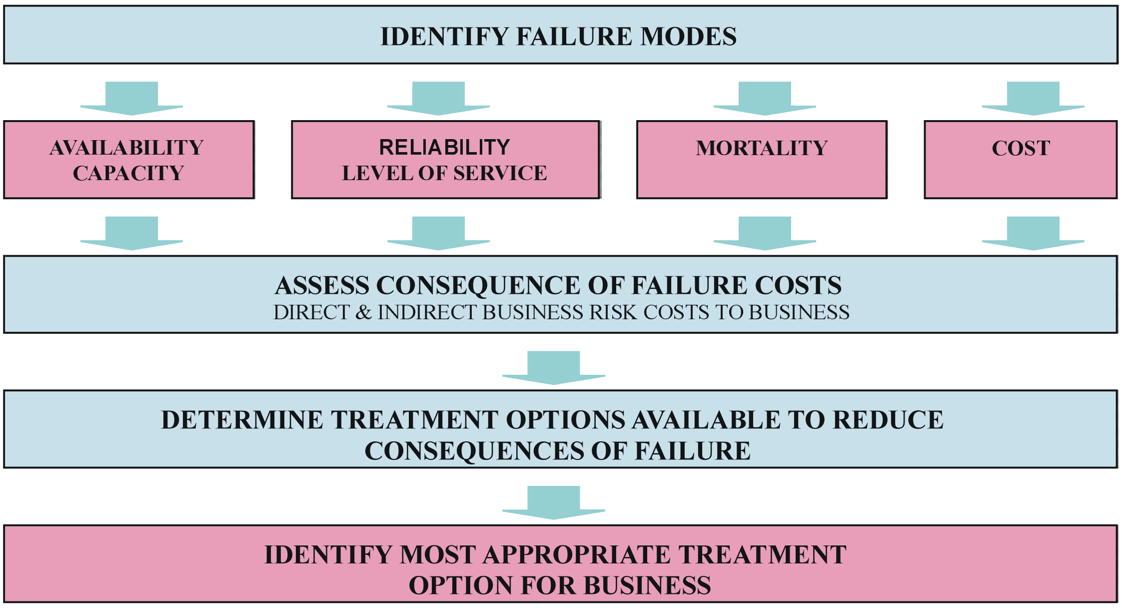


Figure 10.3a - Failure Modes Analysis Process

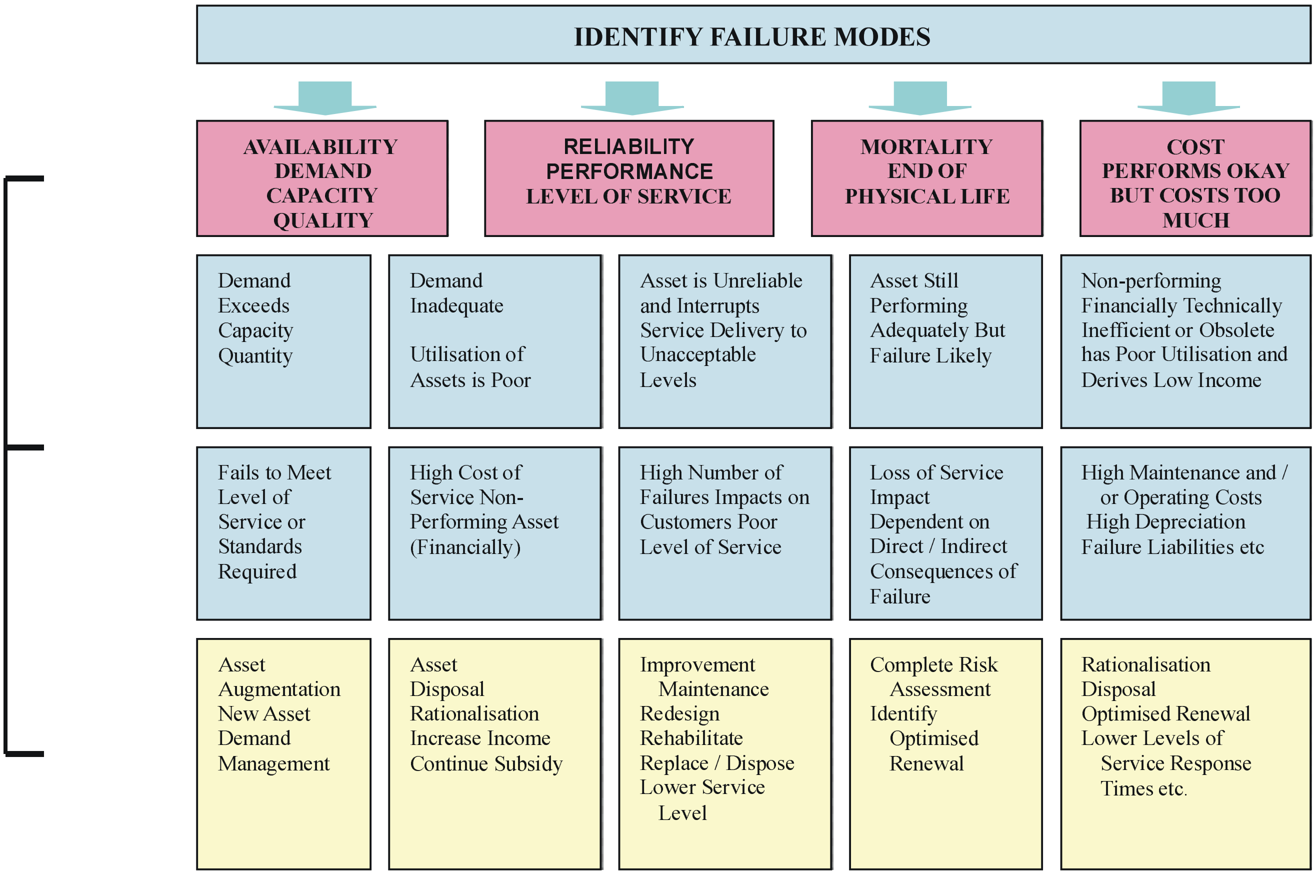


Figure 10.3b - Typical Failure Modes, Effects and Treatments

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 Complensation 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 two remaining Zone Substation sites that fit this criterion are expected to be upgraded in the 2003/04 year.

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 minimize 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 will be prepared for all 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) Arresters 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 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.

To further improve the redundancy and coverage available, a new 33 kV ripple injection plant is to be commissioned at Dobson in 2003/04.

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: -

   - Regional Emergency Load Shedding Plan
   - Electrical Industry Emeregency Contact List
   - Zone Subtations - Emergency Opererating 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 resort to external support.
- A seismic restraint study is to be carried out on Zone Substations during the current financial year.
- All sites having vessels holding in excess of 1500 litres of oil will be fully bunded by the end of the 2003/04 year.
- Development of a fully portable 33/11 kV substation is in the planning stages to provide coverage for single transformer Zone Substations. This could also be extended to provide coverage for 66/11 kV substation. Sufficient spare power transformers are available to cover faults.
- Spare circuit breakers and controllers have been purchases to cover expected failure rates.
- A new 33kV ripple plant will be installed in the 2003/04 year

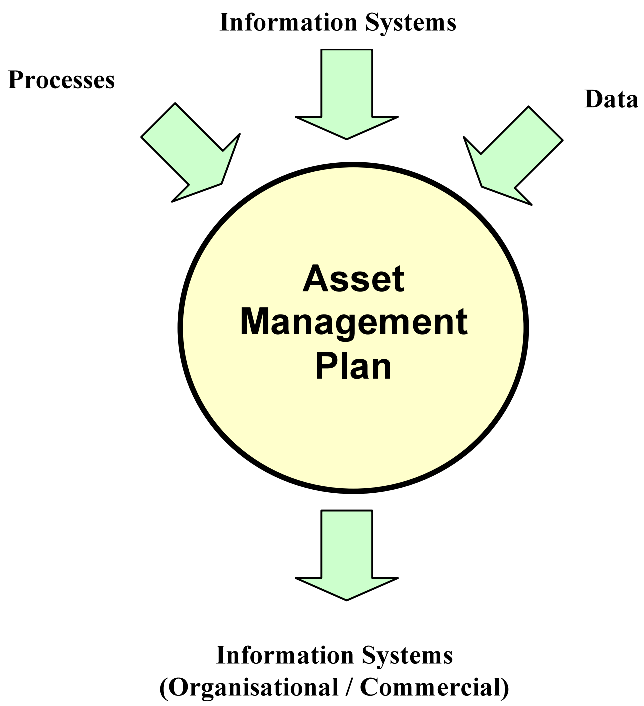
11 IMPROVEMENT PLAN

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:

11.1.1 Processes

11.1.1.1 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

This assesses the past historical trends in demand and the depth of knowledge the organisation holds.

- Element Break-up

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

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

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

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

This assesses the three priority levels of data namely:

1. Basic (primary) physical attributes;
2. Detailed information on the construction of the assets, their manufacture and condition;
3. Tertiary level information including risk, maintenance plans, detailed condition assessment and per

formance etc.

These quality elements vary for individual asset types and Westpower assesses these elements in terms of the type of asset being considered.

- Condition

The way in which the organisation assesses the condition of individual assets and their components and the process used for recording this data.

- Performance

The way in which the organisation assesses the performance of individual assets and their components and records the same.

- Utilisation

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

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

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

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

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

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

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;
- Reliability or levels of service type failures;
- Mortality or physical asset failure;
- 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).

- Risk Assessment

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

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

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

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

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

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

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

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

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

The way in which projects are taken through the budget rationalisation process to actual decisions to create or dispose.

- Project Management

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

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.

- Construction Standards and Quality Control

The construction standards and processes used in building the assets. It also looks at the way in which the organisation ensures that they are getting the quality specified or required for the assets concerned and the way in which this construction quality or acquisition quality is assessed.

- Contract Administration

The processes used from a contract administration perspective.

- Asset Hand Over

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

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

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

The quality of the operating procedures used with the individual assets including automated processes and the type of support systems provided.

- SCADA Systems

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

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

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

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

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

The way in which maintenance plans are developed and the logic contained in that development following reliability centred maintenance (RCM) type approaches.

- Scheduling

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

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

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

The quality of the processes used to develop maintenance manuals and their availability to maintenance staff throughout the organisation.

- Review / Analysis

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

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

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

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

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

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

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

The available process diagrams and flowcharts that are available to assist staff in this life cycle asset management process.

- Asset Management Quality Manual

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

The way in which the asset data has been accumulated and the usefulness of that data from an asset management perspective.

- Hierarchical Level

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

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

The quality of the data available in the basic physical parameters or Priority 1 type asset data (Primary data).

- Full Detailed Data

The secondary and tertiary priority data on the assets including manufacturing details or other relevant data.

- Condition Data

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

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

The data available in terms of job management activities including prioritisation and workforce details etc.

- Risk Assessment

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

The cost histories that are available against assets in terms of maintenance, operations, renewal and the original creation cost.

- Intervention Options and Costs

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)

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

The way in which financial costs can be assessed, aggregated and disaggregated in terms of asset management.

- Customer Records and Complaint System

The ability of the organisation to identify customers served by their assets and to link customer complaints with either system, facility or individual assets under their control. The assessment takes into account the ability of the organisation to monitor the asset performance from a customer perspective.

- Asset Register

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

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 andlor electronic type diagrams and drawings to individual assets, facilities or systems.

- Geographic Information Systems (GIS)

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

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

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 assessibility to staff. It also reviews the overall quality of the key elements necessary for the appropriate operations plans and emer-

gency response plans.

- Job Resource Management System

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

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

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

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

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

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

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

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

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 (RCMIFMECA)

The organisation's applications that assist in maintenance management planning and analysis using reliability centred 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

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

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

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

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

The quality of the contracts or service agreements that will exist for both core and non core activities (management functions).

- Information and Data Available

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)

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

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

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

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

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.

- Asset Management Steering Committee

The key elements of asset management coordination throughout the organisation including:

- The role of the coordinating group and its responsibilities and direct authorisation;

- The make-up of the steering committee
- The way in which the steering committee is performing.
- Business Asset Management Teams

The way in which individual business units have structured their asset management activity and the way in which these individual teams operate from a specific asset or asset service delivery programme perspective. eg. Faults, restoration of electricity supply etc. It also assesses the way in which these teams make use of the corporate services available.

- Overall Commitment

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

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.

- Attitude and Culture

The general demeanour, and attitude of staff throughout the organisation and the way in which they work as a team to ensure the most appropriate outputs in the asset management area. It assesses any work that has been done in this area in terms of monitoring or surveying staff attitudes and the activities undertaken to try and improve general attitudes throughout the organisation.

- Training Programs

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

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

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

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

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

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

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

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

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)

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:

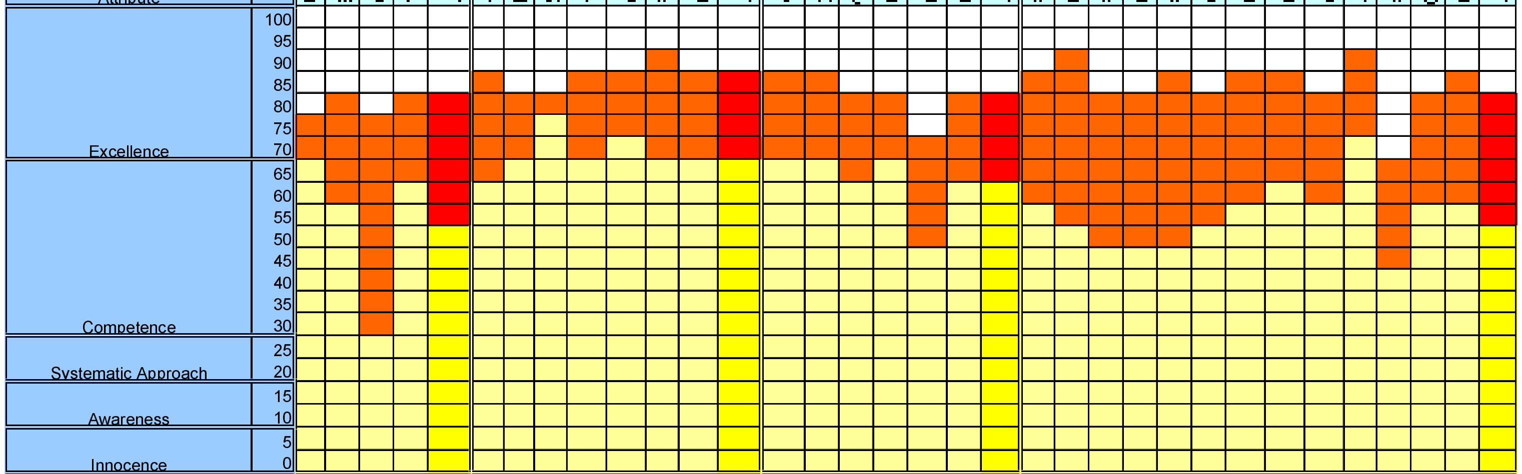
- Operations;
- Maintenance;
- Renewal expenditure
- Capital expenditure

- Improvement Planning

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.

Westpower Limited: Gap Analysis

Processes



Attribute scale (Score): Excellence (100–70), Competence (65–30), Systematic Approach (25–20), Awareness (15–10), Innocence (5–0)

Processes – Demand Analysis

Attribute	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Appropriate Practice Score	75	80	75	80	**80**
Current Score	65	55	25	60	**52**
Gap	10	25	50	20	**27**
Criticality	5	5	5	5	**5**
Weighted Gap (Criticality x Gap)	50	125	250	100	**132**
Priority Ranking					**1**

Processes – Knowledge of Assets

Attribute	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Appropriate Practice Score	85	80	80	85	85	90	85	**85**
Current Score	60	65	75	65	70	65	65	**65**
Gap	25	15	5	20	15	25	20	**19**
Criticality	5	5	5	5	5	5	5	**5**
Weighted Gap (Criticality x Gap)	125	75	25	100	75	125	100	**91**
Priority Ranking								**1**

Processes – Asset Accounting & Costing

Attribute	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Appropriate Practice Score	85	85	80	80	70	80	**80**
Current Score	65	65	60	65	45	60	**59**
Gap	20	20	20	15	25	20	**21**
Criticality	4	4	4	4	4	4	**4**
Weighted Gap (Criticality x Gap)	80	80	80	60	100	80	**78**
Priority Ranking							**7**

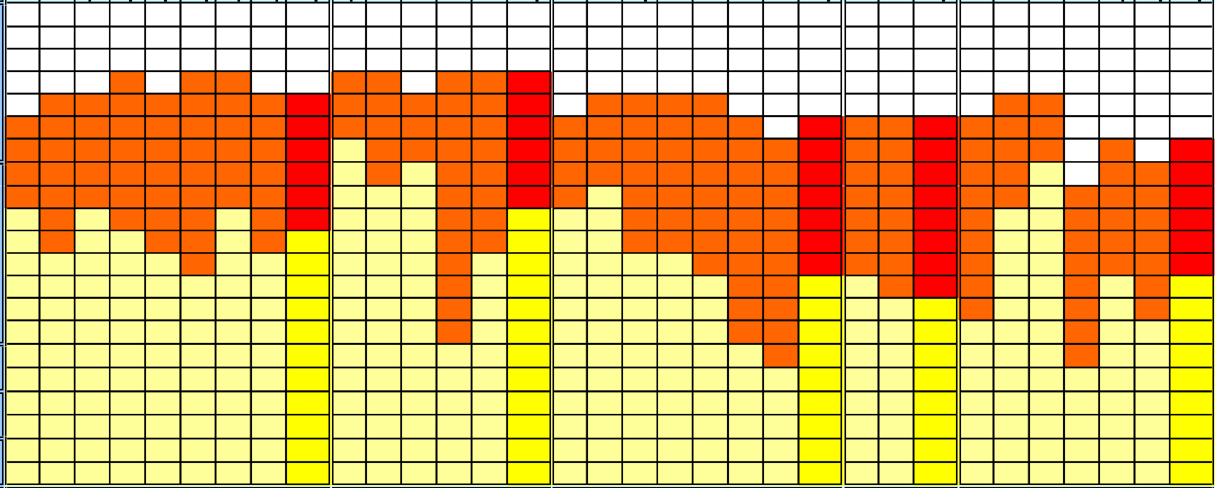
Processes – Strategic Planning

Attribute	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Appropriate Practice Score	85	90	80	80	85	80	85	85	80	90	65	80	85	**80**
Current Score	55	50	45	45	45	50	55	60	55	70	40	55	55	**52**
Gap	30	40	35	35	40	30	30	25	25	20	25	25	30	**28**
Criticality	4	4	4	4	4	4	4	4	4	4	4	4	4	**4**
Weighted Gap (Criticality x Gap)	120	160	140	140	160	120	120	100	100	80	100	100	120	**122**
Priority Ranking														**8**

Westpower Limited: Gap Analysis

Processes Continued

Attribute	Score
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



	Processes (Cont'd)																																
	Asset Creation/Disposal									Asset Utilisation (Ops.)						Asset Utilisation (Maint.)								Res. Mgt.			Review and Audit						
	Project Initiation	Project Management	Value Engineering	Contract Administration	Contract Supervision	Asset Handover	Asset Rationalisation	Asset Disposal	Overall Rating	Operating Procedures	SCADA Systems	Operators Manuals	Emergency Response Plans	Monitoring and Control	Overall Rating	Policy/Strategy	Planning	Scheduling	Job Estimation and Control (Feedback)	Maintenance Testing	Maintenance Manuals	Record Keeping	Overall Rating	Resource Planning	Inventory Control	Overall Rating	Implementation / Improvement Programme	Gap Reduction Opportunities identified	Independent AM Practice Review	Internal QA Processes	AM Process Diagrams	AM Quality Manuals	Overall Rating
Appropriate Practice Score	75	80	80	85	80	85	85	80	**80**	85	85	80	85	85	**85**	75	80	80	80	80	75	70	**75**	75	75	**75**	75	80	80	60	70	65	**70**
Current Score	55	45	55	50	45	40	55	45	**51**	70	60	65	25	45	**55**	55	60	45	45	40	25	20	**40**	45	35	**40**	30	55	65	20	40	30	**40**
Gap	20	3	25	35	35	45	30	35	**30**	15	25	15	60	40	**30**	20	20	35	35	40	50	50	**35**	30	40	**35**	45	25	15	40	30	35	**30**
Criticality	3	3	3	3	3	3	3	3	**3**	4	4	4	4	4	**4**	4	4	4	4	4	4	4	**4**	2	2	**2**	3	3	3	3	3	3	**3**
Weighted Gap (Criticality x Gap)	60	9	75	105	105	135	90	105	**86.5**	60	100	60	240	160	**125**	80	80	140	140	160	200	200	**145**	60	80	**70**	135	75	45	120	90	105	**95**
Priority Ranking									**10**						**3**								**5**			**12**							**11**

Westpower Limited: Gap Analysis

Information Systems

Attribute	Score
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

Information Systems – Primary Applications

Attribute	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Appropriate Practice Score	80	80	75	60	80	75	70	80	**75**
Current Score	60	30	45	40	65	30	45	50	**45**
Gap	20	50	30	20	15	45	25	30	**30**
Criticality	4	4	4	4	4	4	4	4	**4**
Weighted Gap (Criticality x Gap)	80	200	120	80	60	180	100	120	**120**
Priority Ranking									**6**

Information Systems – Sec. Apps

Attribute	[illegible]	[illegible]	[illegible]	[illegible]
Appropriate Practice Score	70	75	70	**70**
Current Score	30	20	40	**30**
Gap	40	55	30	**40**
Criticality	3	3	3	**3**
Weighted Gap (Criticality x Gap)	120	165	90	**125**
Priority Ranking				**9**

Information Systems – Tertiary (Life Cycle) Apps

Attribute	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Appropriate Practice Score	70	75	80	75	75	**75**
Current Score	35	45	50	55	30	**45**
Gap	35	30	30	20	45	**30**
Criticality	3	3	3	3	3	**3**
Weighted Gap (Criticality x Gap)	105	90	90	60	135	**95**
Priority Ranking						**11**

Information Systems – General

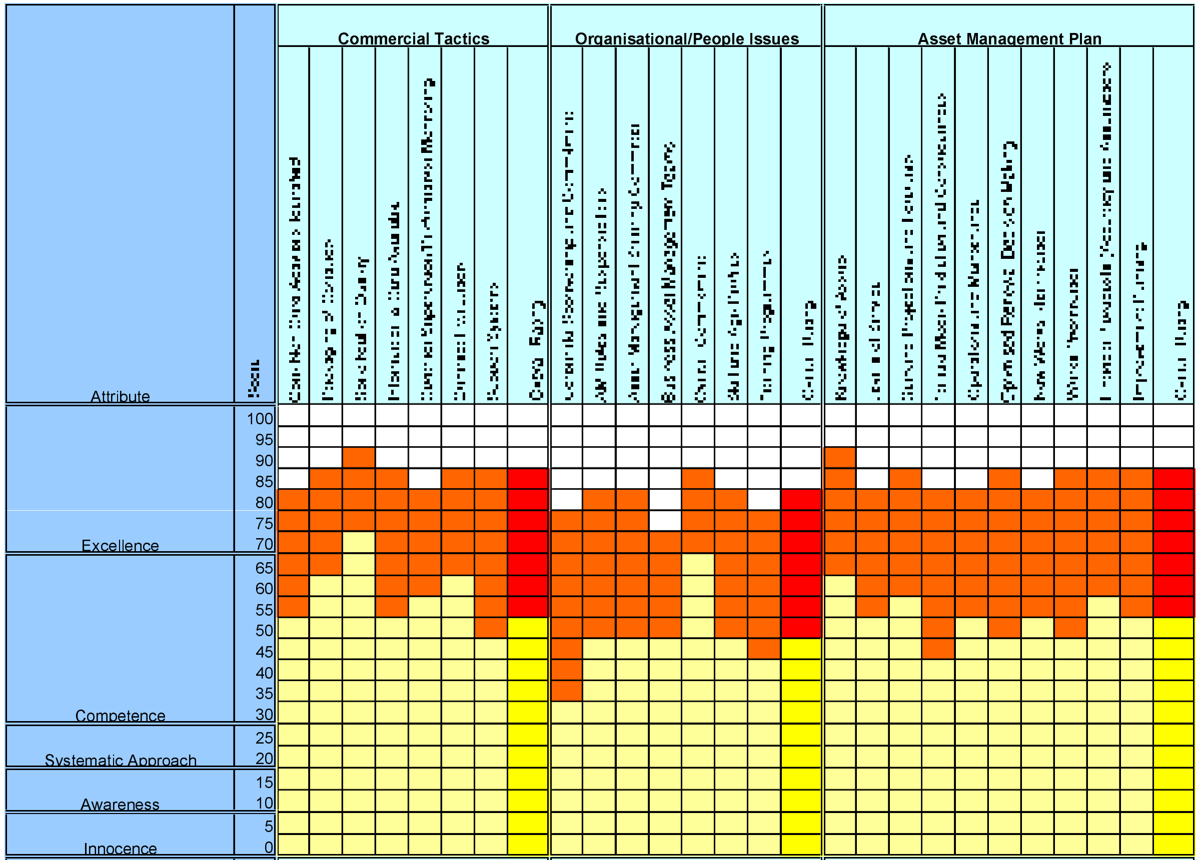
Attribute	[illegible]	[illegible]	[illegible]
Appropriate Practice Score	75	85	**80**
Current Score	40	40	**40**
Gap	35	45	**40**
Criticality	3	3	**3**
Weighted Gap (Criticality x Gap)	105	135	**120**
Priority Ranking			**7**

Data and Information

Attribute	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Appropriate Practice Score	90	95	85	85	75	85	80	85	85	80	80	85	**85**
Current Score	65	70	65	70	60	35	55	40	45	45	35	40	**50**
Gap	25	25	20	15	15	50	25	45	40	35	45	45	**34**
Criticality	4	4	4	4	4	4	4	4	4	4	4	4	**4**
Weighted Gap (Criticality x Gap)	100	100	80	60	60	200	100	180	160	140	180	180	**128**
Priority Ranking													**4**

Westpower Limited: Gap Analysis

Comm. Tactics **Org Isuues** **AMP**



Commercial Tactics	[illegible]	Packaging of Services	[illegible]	Information & Data Available	Contract Supervision/Performance Monitoring	Contract Evaluation	Support Systems	Overall Rating
Appropriate Practice Score	80	85	90	85	80	85	85	**85**
Current Score	50	60	70	5	55	60	45	**50**
Gap	30	25	20	80	25	25	40	**34**
Criticality	4	4	4	4	4	4	4	**4**
Weighted Gap (Criticality x Gap)	120	100	80	320	100	100	160	**142**
Priority Ranking								**5**

Organisational/People Issues	Leadership Sponsorship and Commitment	AM Roles and Responsibilities	Asset Management Steering Committee	Business Asset Management Teams	Change Commitment	Skills and Age Profiles	Training Programmes	Overall Rating
Appropriate Practice Score	75	80	80	70	85	80	75	**80**
Current Score	30	45	45	45	65	45	40	**45**
Gap	45	35	35	25	20	35	35	**35**
Criticality	4	4	4	4	4	4	4	**4**
Weighted Gap (Criticality x Gap)	180	140	140	100	80	140	140	**130**
Priority Ranking								**8**

Asset Management Plan	Knowledge of Assets	Levels of Service	Demand Projections and Forecasts	Failure Mode Prediction and Consequences	Operations and Maintenance	Optimised Renewal Decision Making	New Works Identification	Works Prioritisation	Financial Forecasts (Accuracy and Assumptions)	Improvement Planning	Overall Rating
Appropriate Practice Score	90	80	85	80	80	85	80	85	85	85	**85**
Current Score	60	50	55	45	50	45	50	45	55	50	**52**
Gap	30	30	30	35	30	40	30	40	30	35	**33**
Criticality	5	5	5	5	5	5	5	5	5	5	**5**
Weighted Gap (Criticality x Gap)	150	150	150	175	150	200	150	200	150	175	**167**
Priority Ranking											**2**

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

Revenue Protection

This is a programme of inspection of all customer meter systems to ensure accuracy and integrity. This is an energy-related function, but is included in the plan because of future uncertainty over meter ownership.

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.