Westpower

Asset Management Plan 2010 - 2019

West Coast's Locally Owned Electricity Distributor

Asset Management Plan
A 10 Year Management Plan for Westpower's Electricity Network
From 1 April 2009 to 31 March 2019

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Contents

1.0 EXECUTIVE SUMMARY

1.1 Purpose of the Plan

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

Each year, a comprehensive update of the plan is completed including network changes that have taken place. Furthermore, the results of a formal, external peer review process are taken into account to ensure that this plan meets current disclosure requirements in terms of the Electricity Information Disclosure Requirements 2008 and amended requirements 2006 and is continually improved in both content and layout.

1.1.1 Period Covered

This particular plan was completed in March 2009 and covers a planning period from 1 April 2009 through to 31 March 2019. The main focus is placed on the next three years, with updates being completed annually.

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

This plan was approved by Westpower's Board of Directors on the 13 March 2009.

1.1.2 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."

1.1.3 Company Mission and Statement of Corporate Intent

Westpower's Mission is;

"A West Coast Company operating successful businesses which provide first class electrical and technology solutions, wherever our customers take us"

Westpower's Vision is;

"Recognised for excellence in all links of the electricity value chain"

Statement of Corporate Intent (SCI)

Salient statements from the Statement of Corporate Intent (SCI) that relate to management of Westpower's assets include:

- To continue to provide West Coast communities with a safe, secure, sustainable and cost effective electricity distribution network;
- To ensure obligations under the Energy Companies Act 1992, the Electricity Act 1992, the Electricity Industry reform Act 1998 and their various amendments and regulations are met;
- To continue to lobby on behalf of the West Coast consumers to ensure that a reliable transmission network is maintained into the West Coast.

1.2 Improvements to the Plan

Westpower's AMP for the ten year period 1 April 2009 through 31 March 2019 has been thoroughly reviewed and compared against other Electricity Lines Business (ELB) plans and industry comments and reports.

1.3 Westpower's Network

This AMP includes Westpower's assets that transport electricity (owned by the electricity retailers) from Transpower's seven Grid Exit Points (GXP's) to over 12,000 electricity consumers on the West Coast of New Zealand's South Island.

The Westpower network consists of 110 kV, 66 kV and 33 kV subtransmission networks supplying 110/33/11 kV substations at Reefton and Logburn Road, 66/33/11 kV substations at Dobson and Hokitika, 66/11 kV substations at Greymouth and Kumara and 33/11 kV substations at Globe, Pike River, Ngahere, Arnold, Rapahoe, Ross, Waitaha, Harihari, Whataroa, Wahapa, Franz Josef and Fox Glacier.

Transpower's seven grid exit points (GXP's) supplying Westpower's networks are Reefton and Atarau at 110 kV, Greymouth, Kumara and Hokitika at 66 kV, Dobson at 33 kV and Otira at 11 kV.

Westpower has network assets throughout the 18,017 square kilometers of the West Coast from Lyell in the North to Paringa in South Westland with a total of some 40,000 assets in 76 classifications.

The distribution system comprises 2,085 circuit kilometres of high voltage AC distribution lines, 19 zone substations and switchyards strategically located throughout the network (which in turn provide an 11 kV supply for distribution to 2,244 distribution substations), one control room, and a telecommunications network. Figure 1.1 shows a map of the Westpower network area in relation to the other South Island ELB's. Table 1.1 shows the Network Summary as at 31 March 2008.

Westpower's distribution lines consist of varying line capacities, dependent upon local demands and geographical considerations. Operating voltages include 110 kV, 66 kV, 33 kV, and 11 kV. These lines involve a large population of poles, transformers, disconnecters and other assets of varying types essential to the distribution of electricity. Figure 1.3 shows a diagram of Westpower's network

Both the management and the maintenance of the network is carried out by ElectroNet Services (based in Greymouth) as the preferred contractor and a wholly owned subsidiary of Westpower. The Asset Management Division carries out all management of the assets and represents the asset owner. The Operations Division 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. Figure 1.2 shows a photo of their head office.

1.4 Westpower's Asset Management Process

Figure 1.4 illustrates Westpower's Asset Management process;

The Asset Management Policy provides the key linkage between Westpower's strategic business plan and the asset management process. This is consistent with the Statement of Corporate Intent (SCI) and is approved by the board of directors.

Figure 1.1 - Map of Westpower's Network

Table 1.1 - Network Summary
(Year ending 31 March, 2009)

Description	Quantity
Consumer Connections	12,409
Network Maximum Demand (MW)	47.3
Network Deliveries (GWH)	286.8
Annual Load Factor (%)	30
Lines & Cables (circuit km)	2085
Zone Substations	19
Distribution Substations	2,244
Network ODRC ($m)	86.4

Figure 1.2 - Westpower's Greymouth Head Office

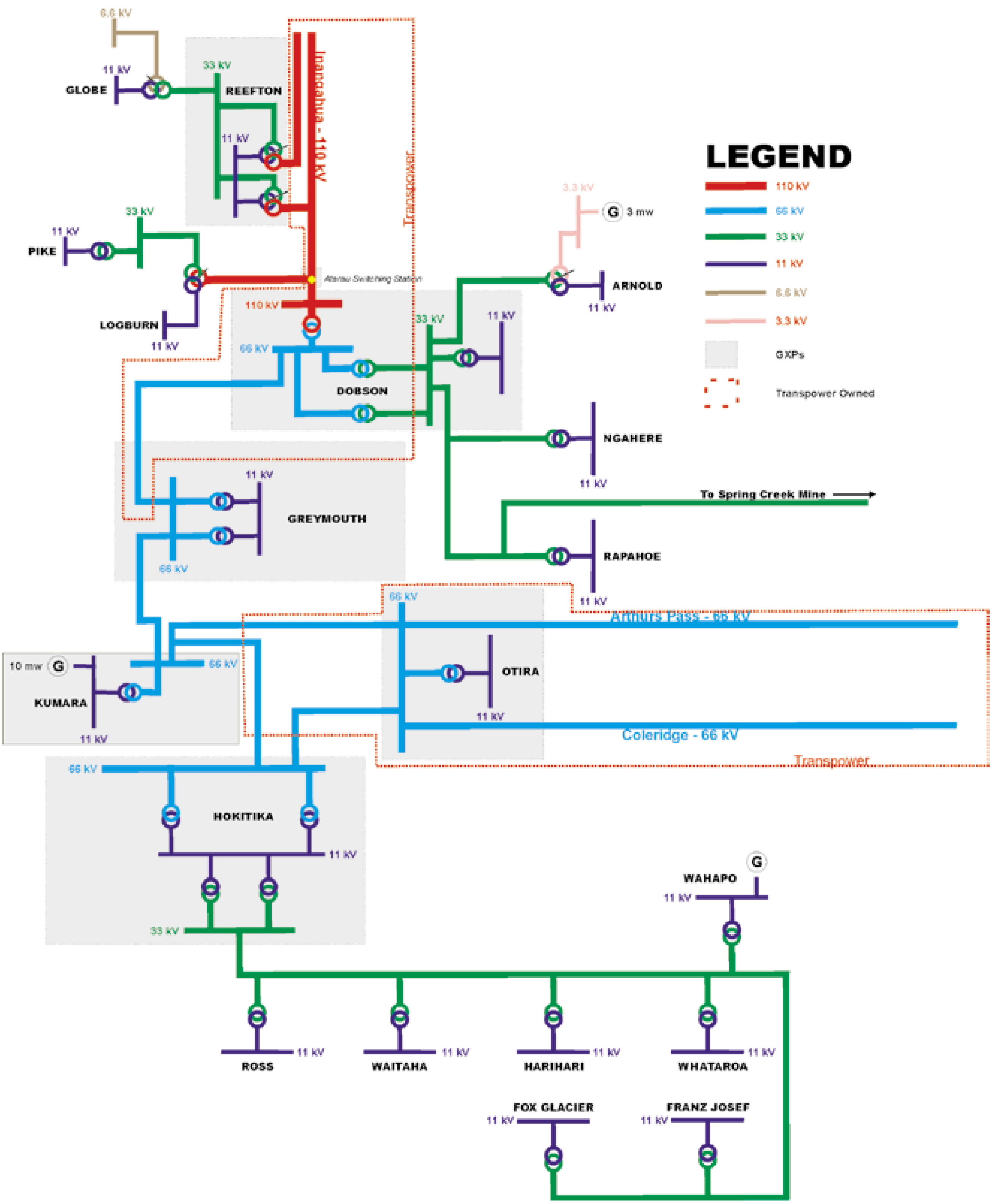


Figure 1.3 - Westpower's Network Diagram

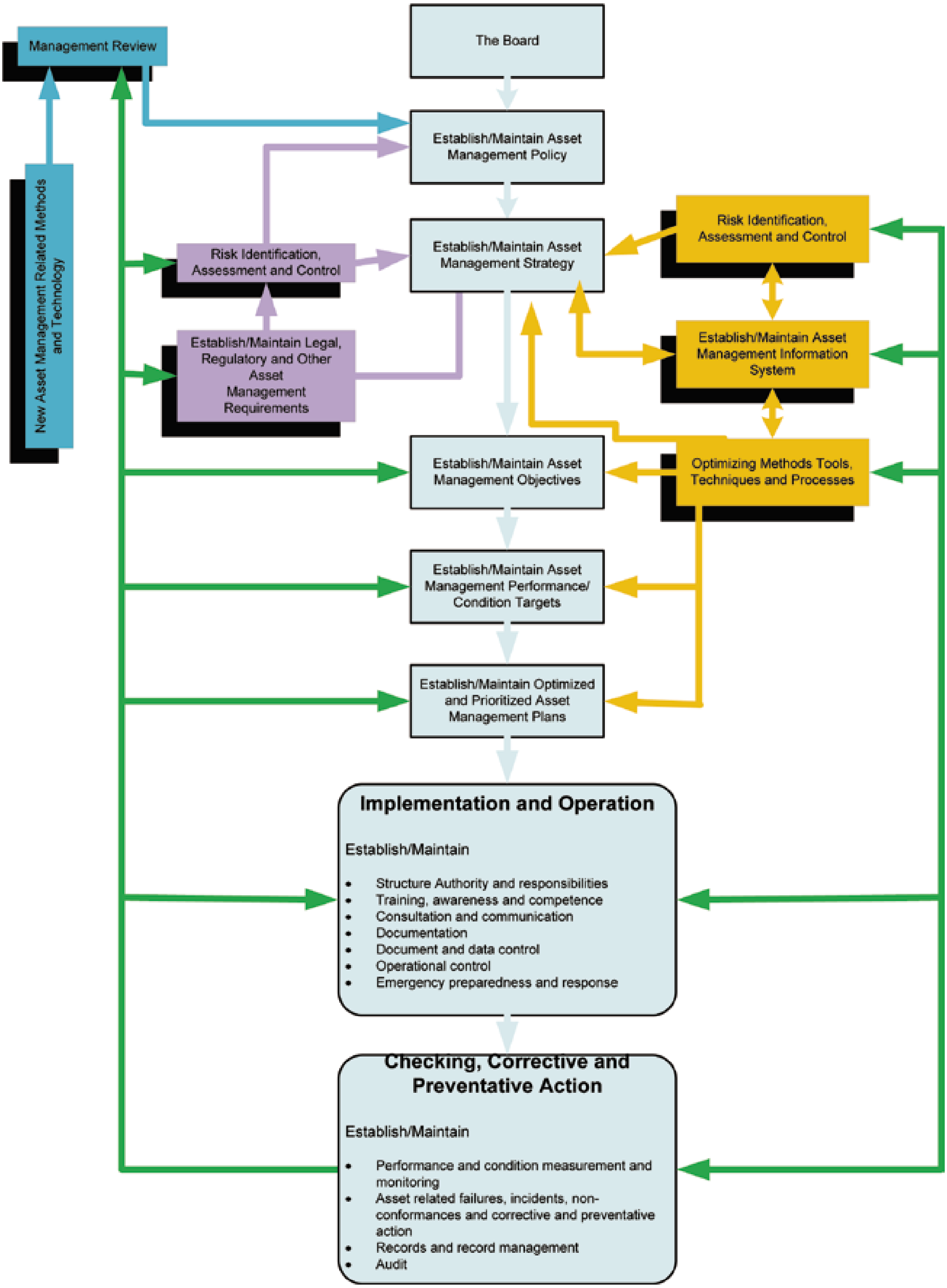


Figure 1.4 - Westpower's Asset Management Process Flow Diagram

1.5 Assets covered

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 operating 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 disconnecters used in the distribution and sub-transmission systems;
- ***SCADA, Communications and Protection Equipment –*** SCADA, Communications and Protection Equipment 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 5 kVA to 1000 kVA and generally having a primary voltage of 11 kV.
- ***Ripple Control –*** Ripple Injection Equipment.
- ***Embedded Generation –*** Generation Units connected to Westpower's network but not necessarily owned by Westpower.
- ***Capacitor Units –*** For voltage support.
- ***Mobile Substation –*** Allows improved maintenance access to existing substations and for emergency use in case of substation failure.
- ***Buildings –*** Substation buildings within the Westpower network.

Westpower owns 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.

1.6 Asset Management Policy

We are committed to maximising our shareholder's investments in a legally and environmentally compliant and sustainable manner, without compromising the health and safety of our employees, consumers, or the public. We shall achieve this by including the following elements in all asset management processes.

- *Safety - Safety is of paramount importance in everything that we do and will not be compromised for cost, time or any other reason.*
- *Quality of Supply - Quality of supply, commensurate with the load type and criticality, will be closely monitored and remedial action will be taken where the quality does not meet Westpower's stated standards.*
- *Legislative Compliance - All asset management planning and associated activities will be carried out in accordance with the relevant legislation. Where non-compliance issues are identified, these will be dealt with promptly and transparently.*
- *Cost Efficiency - All projects must compete for financial resources and prudent asset stewardship requires that careful budgeting and robust financial review processes are used to ensure that maximum cost efficiency is assured.*
- *Environmental Impact - Westpower is environmentally responsible and carefully considers the environmental impact of any of its actions. Furthermore, the company works hard to mitigate any negative affects and provide a net environmental benefit where this is practical.*
- *Reliability of Supply (SAIDI, SAIFI) - Through continued investment in relevant technology and system configuration, reliability will continue to be a key focus of all asset management planning.*
- *Security of Supply - Acceptable security of supply will be developed and maintained through prudent planning based on sound engineering processes.*
- *Energy Efficiency - Energy efficiency will be encouraged in all areas of Westpower's activities and this will be a key outcome from the design process. Where opportunities exist to enhance energy efficiency for existing assets, these will be actively pursued and implemented where technically and economically feasible.*
- *Technology - Technology is seen as a key enabler in providing improved service and value to our consumers. We will continue to keep abreast of developments in the field of new and emerging technology and apply these to Westpower's network where appropriate.*
- *Maintain Service Potential - The future of Westpower's business is wholly dependent of the ability of the network to continue to provide service for the foreseeable future. To this end, every effort will be made to maintain the ongoing service potential of the network where this is appropriate.*
- *Supporting Economic Growth - We recognise that electricity infrastructure is a key enabler of economic growth and will work with current and future developers to provide electricity with the capacity, security and quality required to support their business.*
- *Productivity - Opportunities for improved productivity through training, technology, process improvement or other means will be constantly pursued.*
- *Continual Improvement - We will never be satisfied with where we have come from and will continue to look forward at ways of improving what we do and standards we apply.*
- *Strategic and Long Term - The infrastructure business involves long term investments and we will be cognizant of the impact of our decisions on the long term health of the business and future generations of consumers.*

1.7 Levels of Service

Westpower's primary business is to provide a secure, high quality electricity supply to its consumers in a cost effective manner and to ensure stakeholder's interests are met. To achieve this objective, we are in continued consultation with consumers to ensure their requirements are considered.

We believe this consultation has resulted in a strong focus on continuity of supply, which is reflected in the comparison of international reliability measures SAIDI, SAIFI and CAIDI, with other NZ lines businesses.

Table 1.2 provides an overview of our performance in the key areas of service. A more detailed version of this table is shown in Section 4 (as Tables 4.1 and 4.2) which breaks down the SAIDI, SAIFI and CAIDI figures into the Urban, Rural and Remote Rural categories.

The targets shown in Table 1.2 were set in the previous 2008-2009 AMP and are based on raw outage data including extreme events. Accordingly, the actual results are presented on the same basis.

For this and future years, however, targets and performance will be based on "normalised" data which excludes extreme events. This approach better represents the underlying performance of the network and provides for a more meaningful comparison with other lines businesses.

As a result of this change in approach, Westpower is now projecting a modest improvement in performance over time.

Table 1.2 - Service Level Performance Summary 1-04-08 - 31-03-09

Service Criteria	Quality Group	Target Level of Service	Level of Service	Indicator	Measurement Process
Reliability	Faults/100 km of cct	5.3	13.81	Figures for Total values disclosed in accordance with the Electricity Information Disclosure Requirements 2008	Westpower network faults, logged as outages occur. *(Monthly totals for Feb & Mar have been projected)*
	TOTAL SAIDI	150	*178.81		
	TOTAL SAIFI	1.70	*3.13		
	TOTAL CAIDI	88	58		
Efficiency	Capacity Utilisation	30	30	% Utilised	Max demand/ transformer capacity

1.8 Reliability Trends

The harsh geographic nature and extreme weather conditions experienced on the West Coast can contribute to sometimes unpredictable supply outages. With this in mind, every effort has been made to mitigate these natural environmental factors by means of protection devices such as automatic reclosers on distribution lines and lightning arrestors on all distribution substations.

Historic reliability statistics indicated a relatively high

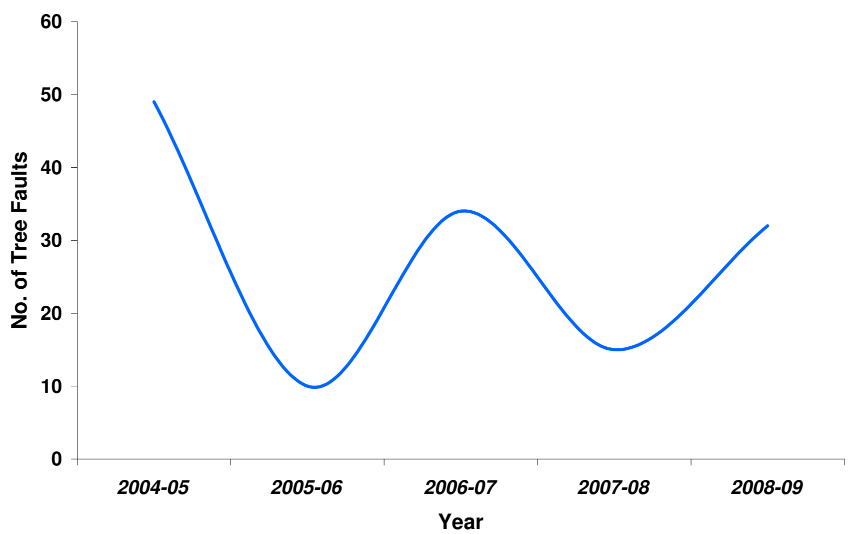


Figure 1.5 - Number of Vegetation Related Faults

number of faults were incurred due to tree strikes. This prompted a comprehensive tree trimming programme to be established to further ensure supply is not interrupted by the vegetative nature of the West Coast. Figure 1.5 shows the reliability trends based on "tree related" issues only and the impact of the programme since 2004-05.

To assist in preventing outages during planned maintenance, contractors have been encouraged to employ Live Line techniques where practicable.

Figure 1.6 below depicts Westpower's reliability trend over the last four years excluding Major Event Days (MEDs) as defined by the Commerce Commission.

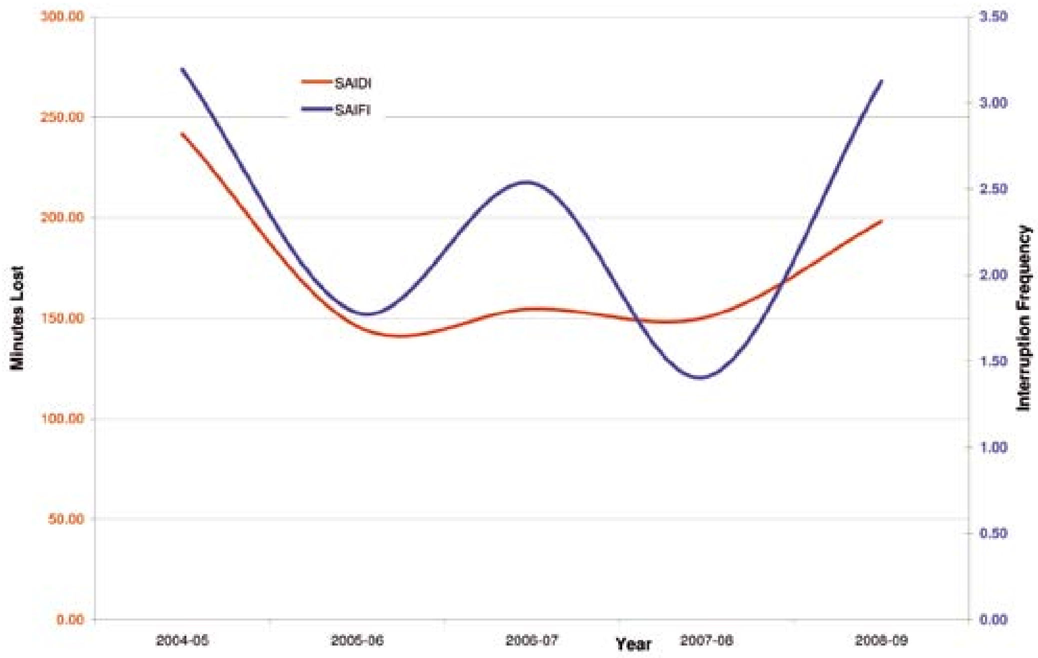


Figure 1.6 - Westpower's Four-Year Reliability Trend (Excluding MED's)

1.9 Security of Supply

In general, Westpower security levels meet accepted guidelines for loads of this size and type.

For loads of 10 MW and above, an n-1 security level is maintained, whereby supply can be maintained for any single component failure. For small loads of less than 1 MW, no backup is specifically provided except where these are conveniently available e.g. tying 11 kV feeders together.

Supply to the Central Business Districts of Hokitika and Greymouth is secure with adequate redundancy built in. Some work has been recently done to enhance the security of supply to the Greymouth CBD.

The major risk to the security of supply to the West Coast lies with the Transpower network. There are two long, exposed transmission feeds into the West Coast,

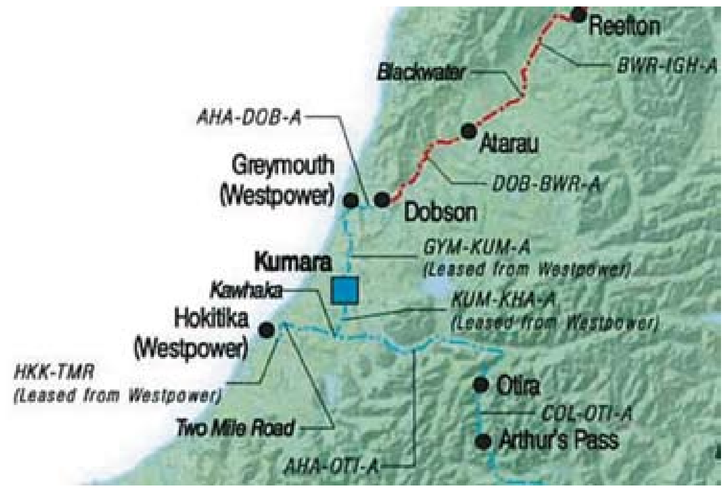


Figure 1.7 - Transpower Feeds from Reefton and Otira.

from Inangahua via Reefton and Coleridge via Otira (see Figure 1.7), supported by TrustPower generation at peak times.

Local generation has also greatly reduced the risk of major system outages when a Transpower fault occurs. Furthermore the ability to use the Westpower Mobile substation for planned outages or a major plant fault will be very beneficial.

The Transpower West Coast Grid Upgrade Project (WCGUP), which was recently approved by the Electricity Commission, provides for additional transmission security to the West Coast by constructing a second 110 kV transmission line from Reefton to Dobson and installing a 14 Mvar capacitor bank at Hokitika. Work has now begun on the design phase of the project with completion planned for 2011/12.

Once WCGUP is commissioned, security of supply to the area will be significantly improved and entirely satisfactory, given the nature of the terrain and size of loads involved.

1.10 Losses

Westpower losses, which are estimated at 5% of energy delivered, are managed through optimising conductors and transformers in accordance with good industry design principles.

1.11 Network Development

Although the key driver for development of the Westpower network is demand, system security is also a major factor. The West Coast area is currently experiencing strong economic growth, with the mining industry in particular pushing demand to unprecedented levels.

The construction of the second Inangahua – Reefton 110 kV line has eased transmission constraints and provided additional security to the region from the north. Transpowers' proposed extension of this line through to Dobson will further enhance supply to Greymouth and surrounding areas by providing full n-1 security on the Dobson 66 kV Bus.

In addition, load forecasting is carried out at the Zone Substation level and this is critical to ensure that sufficient capacity is available in Westpower's sub-transmission and zone substation infrastructure. These forecasts are developed using a zero-based approach from information and requests received directly from customers including intelligence on future load trends such as proposed dairy farm conversions. A summary of the results by major Zone Substation is shown in Figure 1.8. This shows that maximum demand before diversity (BDMD) is around 57.5 MW while also showing that maximum demand after diversity (ADMD) is 47.3 MW. Future demand by 2019 is expected to rise to over 100 MW.

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

1.12 Life Cycle Management Plan

Westpower has adopted a program to manage the lifecycle of its assets from design and planning through to disposal. The methodology used to prioritise projects is described in more detail in Section 6 of this AMP.

A typical lifecycle of any asset consists of the following stages:

- Design and planning
- Acquisition and installation
- Maintenance and operation
- Disposal

For planning purposes, Westpower has adopted a probabilistic planning technique which offers significant

benefits in terms of targeted capital expenditure. The justification for using this approach is that it instills more objective assessments into the decision making process.

All equipment acquired and installed within Westpower's network will be new, unless used equipment is accepted by Westpower on an item by item basis. Such equipment will be accepted only on conditions specified by Westpower.

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

Decommissioned equipment or materials are only disposed of when they are not required as critical spares and there is a low likelihood of them being required in the future.

The main drivers for the decision making process in implementing this program are:

- Reliability/Security and Quality of Supply - to meet customer levels of service and contractual obligations.
- Occupational Health and Safety - to establish a safe working environment and comply with OSH legislative safety requirements.
- Regulatory - to meet regulations imposed by external organisations.
- Environmental - to comply with emission regulations to air, land and water.
- Asset Performance/Condition - use of historical data to asses the performance and condition of the assets and predict potential remaining life.
- Cost Efficiency - to ensure that maximum cost efficiency is achieved in accordance with asset management policy.
- Corporate Image - to ensure that any activity carried out by asset management team and subcontractors will not damage Westpower's image.

1.13 Financial Summary

Typically 83% of current maintenance expenditure on network assets is scheduled (i.e. planned work) in

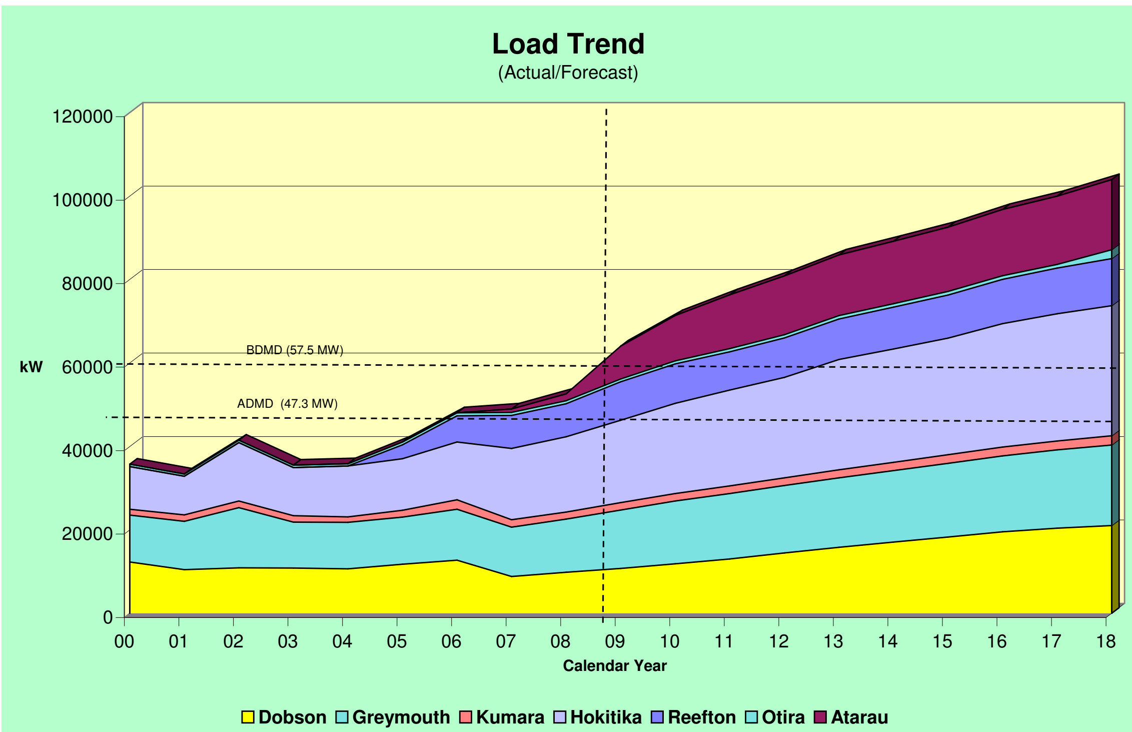


Figure 1.8 - Load Trend 2000 - 2018 Actual and Forecast (Including Local Generation).

advance. Another 5% of maintenance is not planned but is required to be done as repairs to the network assets. The remaining 12% of maintenance expenditure is for emergency work (i.e. fault repairs) to keep the network in service.

Capital Expenditure typically represents 44% of the total AMP expenditure, while maintenance expenditure represents the remaining 56%. The following table (Table 1.3) shows the summary of forecast expenditures for the period 2010 to 2019.

No provisions for inflation have been made in these figures but a transparent contingency has been allowed.

Tables 1.3 and 1.4 have also been broken down into the category sub groups of Faults, Repairs and I, S & T (Inspection, Service and Testing) for Maintenance Expenditure and Replacement, Enhancement and Development for Capital Expenditure.

Table 1.3 - Summary by Activity ($'000)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Capital Expenditure	5129	5249	5177	5329	5516	5821	6152	6516	6859	7256
Maintenance Expenditure	6625	6262	6455	6029	5875	5782	5491	4435	5549	6368
Total	**11754**	**11511**	**11632**	**11358**	**11391**	**11603**	**11643**	**10951**	**12408**	**13624**

Table 1.4 - Summary by Activity ($'000)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Inspection, Service & Testing	4322	4440	4314	4414	4552	4797	5061	5359	5637	5962
Faults	503	531	566	599	633	672	715	758	801	848
Repairs	304	278	297	316	331	352	376	399	421	446
Replacement	3201	3575	2837	2226	1368	735	527	2085	649	854
Enhancement	1103	371	504	476	433	401	1085	341	399	873
Development	2321	2316	3114	3327	4074	4646	3879	2009	4501	4641
Total	**11754**	**11511**	**11632**	**11358**	**11391**	**11603**	**11643**	**10951**	**12408**	**13624**

1.14 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, as demonstrated through the industry information disclosure regime, 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.

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.

ElectroNet Services provide Asset Management services to Westpower through the Asset Management group.

A number of systems are employed to optimize the management of Westpower assets, these include:

- Maximo MXES, proprietary asset management software to record and analyse all of Westpower assets. This provides works order and financial tracking along with asset valuation modules.
- ArcMap GIS, to spatially represent Westpower's assets with tools available to provide information such as outage data. The GIS is interfaced to the Maximo system.
- RealFlex SCADA, to allow real time data acquisition, automation and remote control of many of Westpower's outstations.
- ETAP Loadflow Software to analyse the effect of new connections and load changes on the network.

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.

1.14.1 *Asset Management Systems and Information*

1.14.1.1 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. Westpower will continue to monitor these and apply the technologies where appropriate.

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

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

A computerised "Maximo" works management system has been developed to maintain a complete history of each asset and to ensure that regular scheduled maintenance is carried out when needed. This includes 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.

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. Many maintenance tasks involving voltages from 400 V to 33,000 V 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.

1.14.1.2 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 network to improve this information.

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

1.15 Risk Management

Westpower has a separate Risk Management Plan completed as part of its overall business planning strategy. This includes 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.

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.

1.15.1 Business Continuity Plan (BCP)

The Business Continuity Plan is defined by each department and enable the re-establishment of normal processes and procedures following a major disruptive event which results in either the loss of business premises, resources or people.

1.15.2 Emergency Management Team (EMT)

The EMT Standard Operating Procedures (SOPs) prescribes the appropriate processes and assigns responsibilities for the conduct of the Emergency Management Team (EMT) in the event of a disaster of such proportions that requires coordinated command and control.

1.15.3 Health and Safety Management

Operating and maintaining an electrical network involves hazardous situations that cannot entirely be eliminated. Westpower is committed to providing a safe reliable network and a healthy work environment by taking all practical steps to see that our operations do not place our staff, community or environment at risk. Hazardous situations are controlled through training, appropriate guidelines and Westpower Standards, and operating procedures. We also require that any hazards, in particular electrical hazards, be taken into account when new network installations are being designed and constructed.

1.15.4 Environmental Management

Westpower is committed to a policy of environmental sustainability through the application of their Environmental Policy. The following topics are covered in this policy: stakeholder consultation, protection of the biosphere, sustainable use of natural resources, reduction and disposal of waste, wise use of energy, risk reduction, restoration of environment, disclosure, commitment of management resources, assessment and annual audit. Oil spill management systems have been in place for many years now and to date have successfully managed any significant spills. A SF6 monitoring programme has also been successfully in place for a number of years.

1.15.5 Impact of Natural Disasters

In 2004 Westpower commissioned a review of the West Coast Lifelines study and again in 2006 to assess the impact of a natural disaster on the Westpower network. Earthquakes, storms and Tornados are Westpower's major natural disaster risks. Overall the studies have concluded that there is a very high dependency on communications as well as a clear need to have the airports and ports available after the event. An electricity supply would be essential for almost all service authorities in the restoration period following a natural disaster. Since the original study in 2004, further detailed studies and actions have been implemented to minimise the overall risk to the network in a cost effective manner.

1.15.6 Asset Failure

All our individual key assets have been assessed based on known past performance. Modern partial discharge detection technology has been employed to manage the risk of premature failure and to plan for an end of life replacement strategy, especially 11 kV metal-clad switchgear. A regular DGA oil testing programme is carried out on Westpower's Zone Substation Transformers to monitor their condition and highlight potential issues. The two major asset classes that present the biggest risk are the 33 kV and 11 kV motorised air-break switches and DDO fuse links.

Insulators on the overhead lines are now being checked with a "corona" camera. This is a new technology that can detect excessive discharge on line insulators not normally detectable by other means. It is being used to detect faults and for general condition assessment of the insulators.

1.16 Plan Outcomes

The major outcome of this plan is a ten year capital investment forecast that is characterised by:

- A relatively constant level of investment in new connections and extensions to the network. This is based on an overall modest growth level with pockets of higher growth in specific areas.

- The additional maintenance cost of regulatory compliance with the Tree Regulations and additional requirements for tree worker safety.

- Material cost increases that are starting to impact on our construction costs because of the combined effect of raw material demand and exchange rate fluctuations.

This document is publicly available and we welcome constructive comments and suggestions.

Comments may be made in writing to:-

Rodger Griffiths
Asset Manager
Westpower Limited
P.O.Box 375
Greymouth
New Zealand
Email: rodger.griffiths@ElectroNet.co.nz

2.0 INTRODUCTION

This is the sixteenth Asset Management Plan to be produced for Westpower and it includes some significant changes from last year, including changes to bring it more into line with the Commerce Commission's requirements and to address the comments made in the Commerce Commission's review of the Westpower AMP reported in 2008. Some areas of note include changes in Section 4 to focus on only the key performance indicators whilst throughout the document, changes and additions have been made to focus on the role of the asset owner, Westpower.

The Asset Management 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.

2.1 Background

2.1.1 The Purpose of the Plan

The purpose of Westpower's Asset Management Plan is to document the asset management practices employed by Westpower to strategically manage its assets while continuing to meet the requirements of the Electricity Information Disclosure regulations 2004 and the 2006 amendments. It is also intended for general viewing, assuring Westpower's stakeholders that the Westpower network continues to be managed in a professional and cost effective manner. Figure 2.1 shows the basis for the Asset Management System used by Westpower.

This Asset Management Plan covers a period of ten years from the financial year beginning on 1 April 2009 until the year ended 31 March 2019. The main focus of analysis is the first three to five 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. These project requirements may not be defined here.

To provide a framework for asset management within the planning period, it is necessary to determine the longer-term direction in which the network 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. Further, strategic development planning must be responsive to a range of scenarios that might occur.

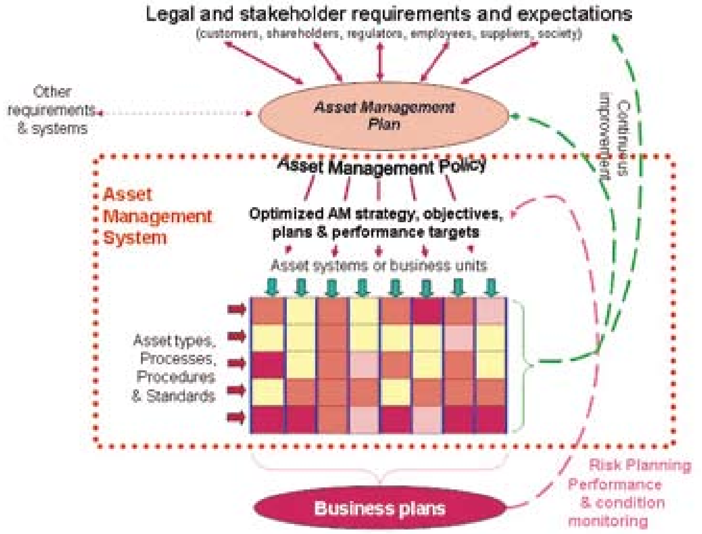


Figure 2.1 - The Westpower Asset Management System

This plan was approved by Westpower's Board of Directors on the **31st March 2009.**

2.1.2 Relationship with Other Planning Documents

It is important for stakeholders that the manner and the basis upon which this Asset Management Plan is intended to operate is 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 stakeholders in dealing with this Asset Management Plan:

- This Asset Management 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 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. This 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 stakeholders described below, starting with the release of this Asset Management Plan.

Figure 2.2 below shows the interaction of the different Westpower plans and stakeholders involved;

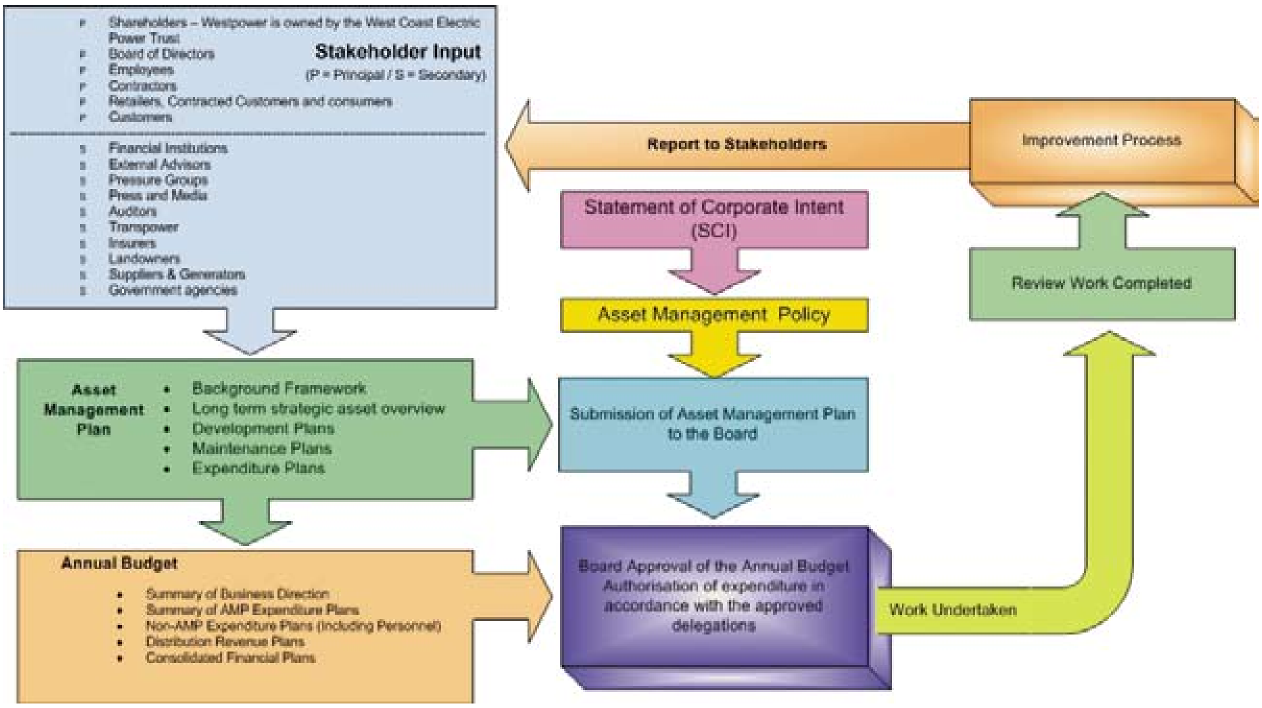


Figure 2.2 - Relationship With Other Plans and Approval Process

2.1.3 Assets Covered in this Plan

This AMP includes Westpower's assets that transport electricity (owned by the electricity retailers) from Transpower's seven Grid Exit Points (GXP's) to over 12,000 electricity consumers on the West Coast of New Zealand's South Island.

The Westpower network includes 110 kV, 66 kV and 33 kV sub-transmission networks. The 66 kV network is supplied from Transpower GXP's at Greymouth, Hokitika, Kumara and 33kV from Dobson and Hokitika. An

11 kV system is supplied from Transpower's Otira GXP whilst Reefton has a 110 kV supply from Transpower.

Westpower has network assets throughout the 18,017 square kilometers of the West Coast from the Lyell in the North to Paringa in South Westland with a total of around 40,000 assets in 76 classifications.

The distribution system comprises 2,085 circuit kilometers of AC distribution lines, 19 zone substations and switch-yards strategically located throughout the network which in turn provide an 11 kV supply for distribution to 2,244 distribution substations, one 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 110 kilovolt (kV), 66 kV, 33 kV, and 11 kV. These lines involve a large population of poles, transformers, disconnectors and other assets of varying types essential to the distribution of electricity.

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.

2.1.4 Issues Facing Westpower

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 current total load of around 47.3 MW will be over 100 MW in ten years.

This projection is dependent on proposed industry projects proceeding and in the current economic climate there is no certainty of this. For this reason this AMP is focused on maintaining (or improving) the reliability of the network and catering for incremental growth on the basis that larger industrial developments will require project specific augmentations that will only proceed once the various projects are committed and connection contracts are signed with developers.

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, refer to Section 4 - Levels of Service.
- 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, refer to Section 5 - Network Development.
- Acquiring revenue funding through a pricing structure that is also at a level acceptable to customers, refer to Section 7 - Financial Summary.

2.1.5 Westpower Organisation Structure

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 it will continue to own the infrastructure assets. The 100% owned subsidiary contracting company ElectroNet Services not only performs work on the Westpower infrastructure assets but also the asset management function under contract from Westpower. The structure of the Westpower Group is as shown in Figure 2.3;

- Mitton ElectroNet is based in Christchurch and is the result of a recent merger between Mitton Consulting and the Christchurch office of ElectroNet Services. Mitton ElectroNet Limited is 100% owned by ElectroNet Services Limited.

- Amethyst Hydro Limited is a joint Venture company with Westpower (80% ownership) and Harihari Hydro Limited (20% ownership) to build, own and operate a 6 MW hydro scheme on the Amethyst river, near Harihari.

- ElectroNet Transmission is a new venture involving the acquisition of ABB's lines division in Nelson and Greymouth on April 1st of 2008.

Apart from the board of Directors, a Chief Executive and the Westpower Asset Manager, who all work directly for Westpower, all staff are employed by Westpower's subsidiary ElectroNet Services.

The Board sets the high level business goals and strategies and the Chief Executive and Asset Manager are responsible for implementing them through ElectroNet Services.

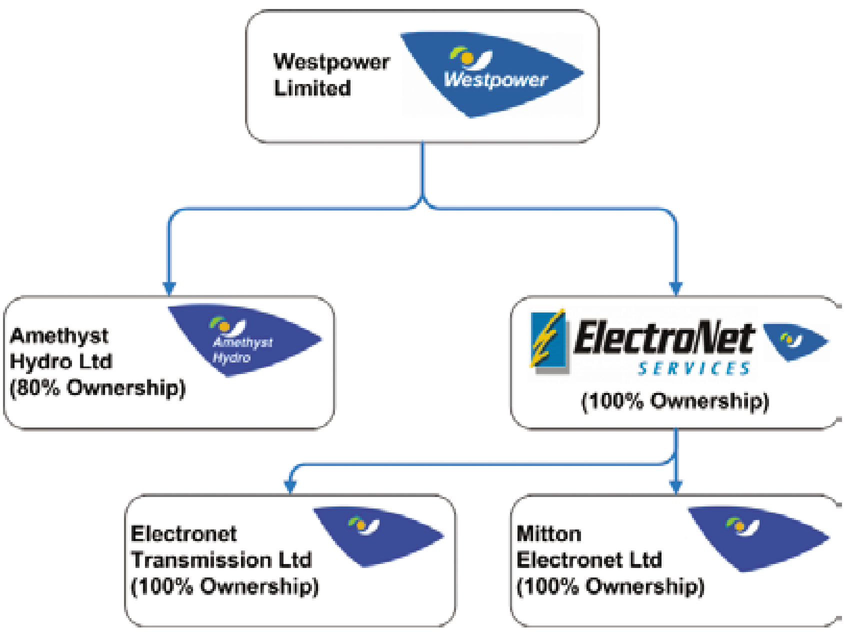


Figure 2.3 - Westpower Group Corporate Organisation Structure

2.1.5.1 Westpower's Mission and Vision

Mission

A West Coast Company operating successful businesses which provide first class electrical and technology solutions, wherever our customers take us.

Vision

Recognised for excellence in all links of the electricity value chain.

2.1.5.2 Statement of Corporate Intent

Salient statements from the Statement of Corporate Intent (SCI) that relate to management of Westpower's assets include:

- To continue to provide West Coast communities with a safe, secure, sustainable and cost effective electricity distribution network.

- To ensure obligations under the Energy Companies Act 1992, the Electricity Act1992, the Electricity Industry reform Act 1998 and their various amendments and regulations are met.

- To continue to lobby on behalf of the West Coast consumers to ensure that a reliable transmission network is maintained into the West Coast.

2.1.5.3 Asset Management Policy

The key document linking Westpower's business objectives, as outlined in the SCI, with the asset management process is the Asset Management Policy, which defines the high level policy objectives that the Board expects all asset management planning to achieve. As such, it is an overarching document that is embedded in the asset management plan.

The policy states;

We are committed to maximising our shareholder's investments in a legally and environmentally compliant and sustainable manner, without compromising the health and safety of our employees, consumers, or the public. We shall achieve this by including the following elements in all asset management processes.

- *Safety - Safety is of paramount importance in everything that we do and will not be compromised for cost, time or any other reason.*

- *Quality of supply - Quality of supply, commensurate with the load type and criticality, will be closely monitored and remedial action will be taken where the quality does not meet Westpower's stated standards.*

- *Legislative compliance - All asset management planning and associated activities will be carried out in accordance with the relevant legislation. Where non-compliance issues are identified, these will be dealt with promptly and transparently.*

- *Cost efficiency - All projects must compete for financial resources and prudent asset stewardship requires that careful budgeting and robust financial review processes are used to ensure that maximum cost efficiency is assured.*

- *Environmental impact - Westpower is environmentally responsible and carefully considers the environmental impact of any of its actions. Furthermore, the company works hard to mitigate any negative affects and provide a net environmental benefit where this is practical.*

- *Reliability of supply (SAIDI, SAIFI) - Through continued investment in relevant technology and system configuration, reliability will continue to be a key focus of all asset management planning.*

- *Security of supply - Acceptable security of supply will be developed and maintained through prudent planning based on sound engineering processes.*

- *Energy efficiency - Energy efficiency will be encouraged in all areas of Westpower's activities and this will be a key outcome from the design process. Where opportunities exist to enhance energy efficiency for existing assets, these will be actively pursued and implemented where technically and economically feasible.*

- *Technology - Technology is seen as a key enabler in providing improved service and value to our consumers. We will continue to keep abreast of developments in the field of new and emerging technology and apply these to Westpower's network where appropriate.*

- *Maintain service potential - The future of Westpower's business is wholly dependent on the ability of the network to continue to provide service for the foreseeable future. To this end, every effort will be made to maintain the ongoing service potential of the network where this is appropriate.*

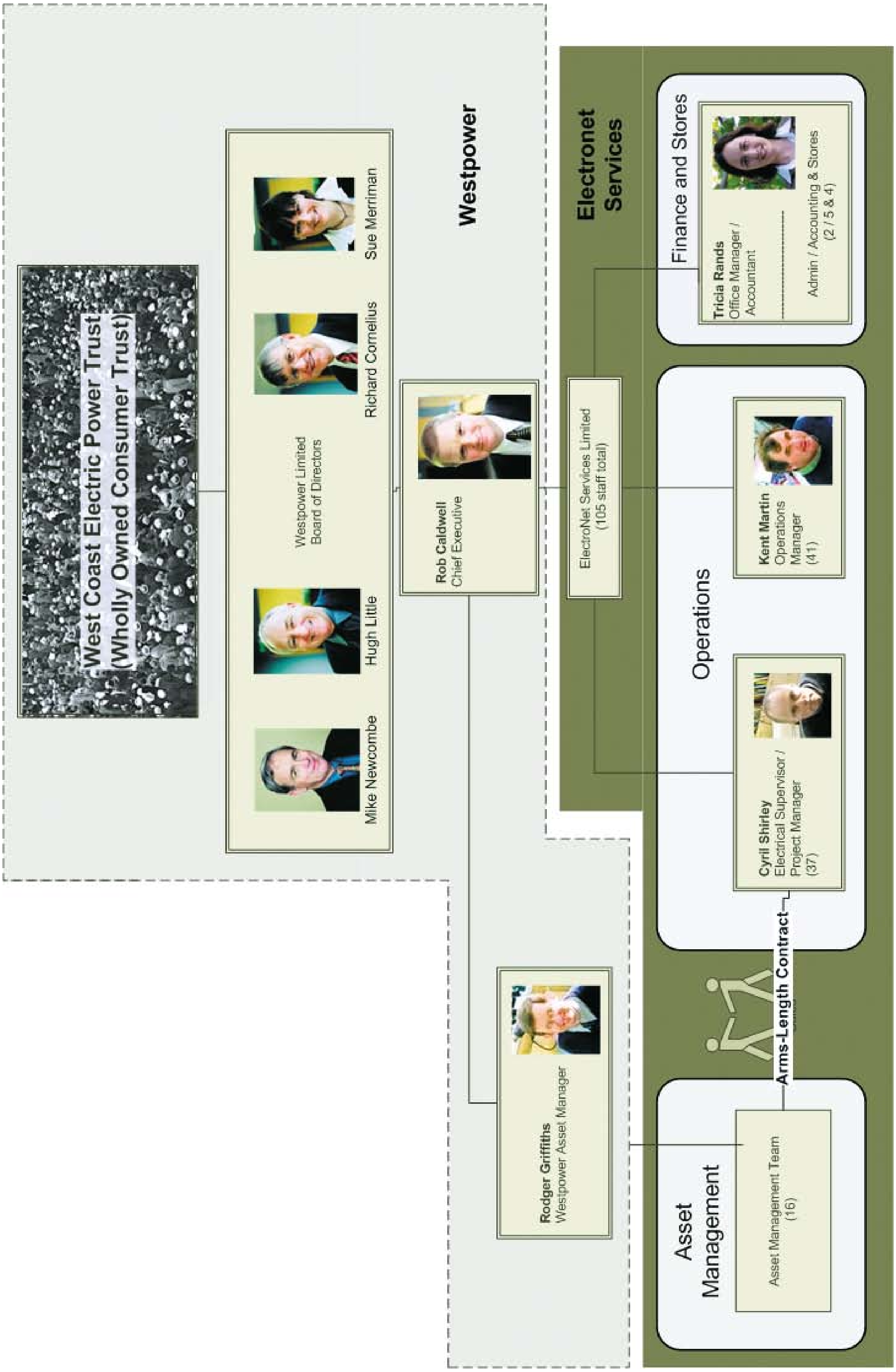


Figure 2.4 - Westpower Limited Organisation Chart

ASSET MANAGEMENT DEPARTMENT

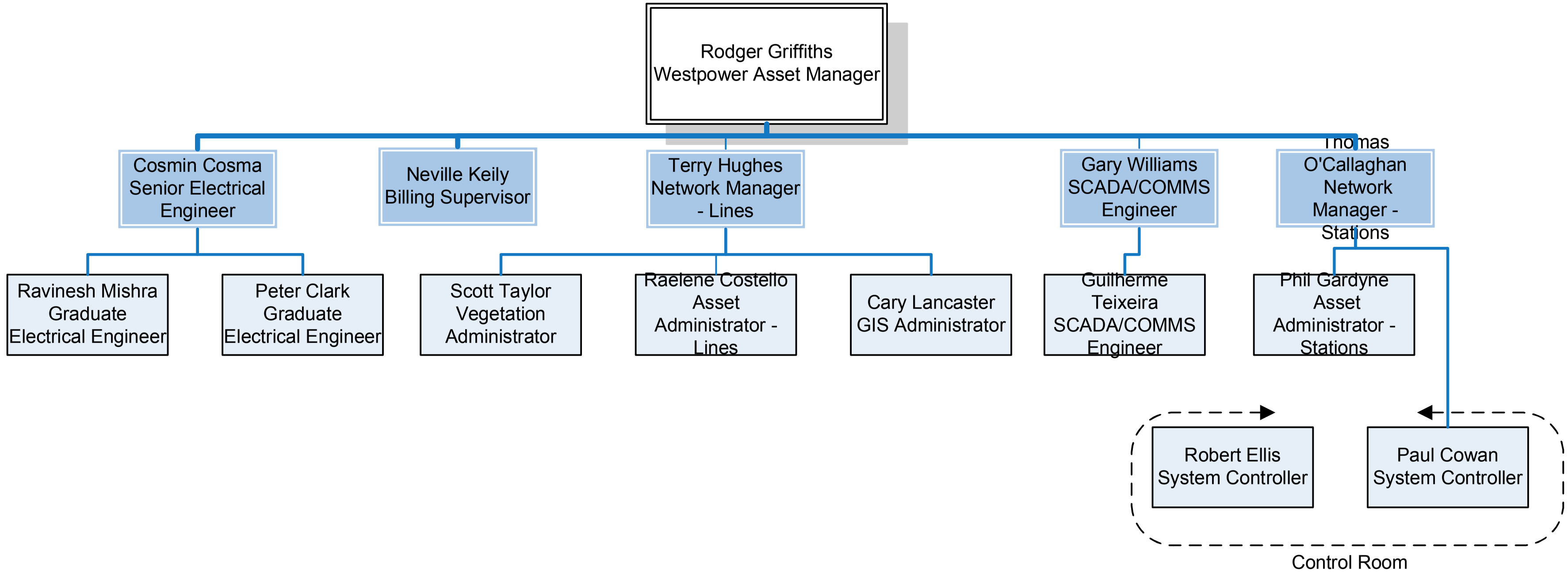


Figure 2.5 - Westpower Limited Organisation Chart

- *Supporting economic growth - We recognize that electricity infrastructure is a key enabler of economic growth and will work with current and future developers to provide electricity with the capacity, security and quality required to support their business.*

- *Productivity - Opportunities for improved productivity through training, technology, process improvement or other means will be constantly pursued.*

- *Continual improvement - We will never be satisfied with where we have come from and will continue to look forward at ways of improving what we do and standards we apply.*

- *Strategic and long term - The infrastructure business involves long term investments and we will be cognizant of the impact of our decisions on the long term health of the business and future generations of consumers.*

The asset management and planning processes discussed throughout the rest of the Asset Management Plan have been developed to directly support this policy and must adhere to it.

The Asset Management Division holds the requisite technical knowledge and is responsible for technical decisions regarding the asset. Thus the Asset Management Division is in charge of Westpower Assets and hence the requirements of equipment and safety issues remain with the Asset Manager.

The Company structure is shown in the previous Figure 2.4 and also in Figure 2.5, detailing the Asset Management Division.

2.1.5.4 Corporate Structure

The key functions of the groups are:

- ***Chief Executive Officer***

Financial performance of Westpower, management and company secretariat, attaining of revenue streams.

- ***Board of Directors***

The Board provides overall governance of the Westpower group of companies and ensures that the following four pillars of good governance are maintained (Figure 2.6 shows the process for "Sign-off" by the board)

1. Determination of Purpose – Drives the company's purpose, goals and strategy.

2. Governance Culture – Ensures operation within a high performance culture that deals effectively with the right issues in the right manner and encourages debate and candour. It maintains effective relationships with shareholders and other stakeholders.

3. Holding to account – Holds management to account through informed, astute, effective and professional oversight.

4. Compliance – Ensures the company is, and remains, solvent. Ensure the probity of financial reports and compliance with regulatory environments.

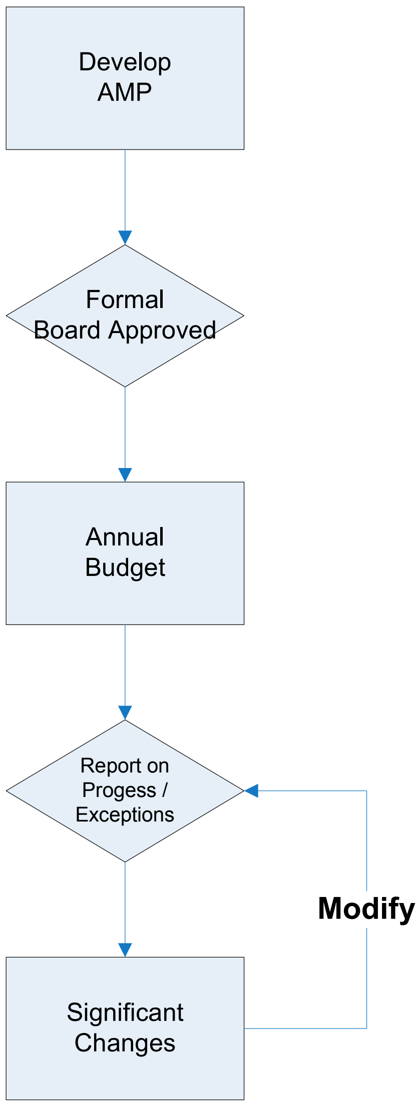


Figure 2.6 - Process for Board Sign-off

- ***Westpower Asset Manager***

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

2.1.5.5 Asset Management Roles

The Asset Management department is under the overall control of the Westpower Asset Manager.

A series of team leaders are responsible for the various activities carried out by the department and the roles of each of these team leaders are discussed below.

- Senior Electrical Engineer

The Senior Electrical Engineer is responsible for setting engineering policy as well as overseeing all engineering design. He is also responsible for reviewing non-conformances in the network and ensuring that the appropriate standards are in place.

- Billing Supervisor

The Billing Supervisor is responsible for all matters surrounding the collection of metering data and billing of retailers. This includes reconciliation activities.

- Network Manager Lines

This role involves the management of all high voltage and low voltages lines assets owned by Westpower, including control and management of the GIS system and vegetation management programmes.

- SCADA Comms Engineer

The SCADA Comms Engineer is responsible for all of Westpower's SCADA and communication assets including data communication in the network and SCADA control of substations and switching assets.

- Network Manager Stations

Network Manager Stations looks after all the Zone Substations including maintenance and development and applies the policies developed by the Senior Electrical Engineer. This role also includes responsibility for the Control Room.

2.1.5.6 Relationship Between Asset Management and Operations Divisions

The Asset Management Division assumes the role of asset owner and is responsible for managing the interests of Westpower and in particular maintaining the service delivery potential of Westpower's assets.

The operations division fulfils the role of the service provider and is responsible for carrying out all maintenance and development on the asset at the physical level.

The relationship between Asset Management and the Operations and Finance Division is based on an arms length contract between Westpower and the Operations Division of ElectroNet Services, with Asset Management effectively acting as Westpower's agent.

2.1.5.7 Operations Division Roles

Within the operations division, managers are responsible for particular areas of work and these are as follows;

- Electrical Supervisor/Project Manager

This role is responsible for the Testroom, Electricians and Electrical Fitters within Zone Substations.

- Operations Manager

The Operations Manager is responsible for all lines staff including Line Mechanics and fault staff, along with a small number of Fitters who work on Distribution Substations.

- Office Manager/Accountant

This role manages the back office functions of ElectroNet as well as stores and procurement.

2.1.5.8 Board Report

Management provides regular monthly reports to the board on asset management outcomes. These reports include:

- Asset Management Plan Expenditure

Expenditure is reported on a monthly and year-to-date basis against budget showing appropriate variances. This report also includes a comparative with the previous year and tracks projected expenditure for the rest of the reported period.

- Billing Statistics

This report shows the allocation of sales amongst the various retailers active on Westpower's network, by tariff category.

- Network Delivery Performance

This shows monthly peak demands in megawatts and consumption in megawatt hours for the current year to date and the previous two years for comparative purposes.

- SAIDI

A monthly progressive SAIDI report is provided in both tabular and graphical format, along with explanations of major events.

This report shows both the raw SAIDI statistics and the baseline SAIDI result, excluding Major Event Days (MED's) using the 2.5 beta approach developed by IEEE.

- SAIFI

This report is produced in graphical format only and provides similar information to the SAIDI report but focuses on SAIFI.

- Legislative Compliance

A review of legislative compliance is provided to the board each month and any non-compliances are noted.

2.1.6 Westpower's Stakeholders

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

- Consumers
- Shareholders - Westpower is owned by the West Coast
- Electric Power Trust, a wholly owned consumer Trust
- Board of Directors
- Employees
- Contractors
- Retailers

The secondary stakeholders that may have an interest or opinion in the affairs of Westpower are;

- Auditors
- Government agencies
- Suppliers and Generators
- Transpower
- Landowners
- Insurers
- Financial Institutions
- External Advisors
- Pressure Groups
- Press and Media

2.1.6.1 Identification of Stakeholder Interests

Retailers and Customers

Westpower has liaised closely with Energy Retailers to determine the expectations of their customers and quantify these in terms of desirable reliability indices. Westpower has conducted its own consultation with its 25 largest customers and discussed alternative combinations of price and quality that may be available to customers who commit to a commercial contract.

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

The main interests for retailers and customers have been identified as reliability in terms of continuous availability of supply, restoration of supply and adequate shutdown notification as well as receiving timely and up to date information if an outage occurs on the network so that they can plan accordingly.

Also that Westpower is cost effective in its services delivery and provides a good quality of service in terms of both maintenance and power quality.

Also to be charged a fair price, with information to justify that price.

The above interests are accommodated in the plan by:

- The SAIDI reliability target.

- The gap analysis on asset segments to ensure each customer is receiving the promised standard of service, and the targeting of expenditure accordingly.

- Re-investment in renewals.

- Strong customer consultation commitment.

- Direct customer billing including a move away from energy to demand based charges for all customers.
- Supply point and density based pricing structure.
- Customers expect good service at a fair price, as well as a continued distribution by shareholder trusts.
- Customers tend to judge the efficiency of the company from the size of the distribution.

Retailers' interests are identified through communication and direct discussion. Retailers are interested in selling energy to customers with little barriers to competition. The above interests are accommodated in the plan by Westpower's direct billing programme.

Shareholders

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).

The interests of Westpower's shareholders are identified through the Statement of Corporate Intent (SCI) process and consultation with shareholders. Shareholders are interested in:

- An acceptable return being earned from the assets.
- An acceptable cash return from the network.
- The business being sustainable in the long term.
- A reasonable standard of service being provided to customers.
- The price to customers being equivalent to that charged in other rural areas.
- Customer satisfaction.
- A network that meets acceptable industry safety standards.

It is noted that the above interests are not necessarily achievable in totality if revenues are limited to below an acceptable return.

The above interests are accommodated in the plan by:

- The requirement that any customer-driven development work produces at least its cost of capital.
- Funding development work that is expected to produce future revenue by debt, rather than reducing cash returns to existing customers.
- The SAIDI reliability target. Strong, but targeted, re-investment in renewals to provide a long term safe and sustainable network.

Westpower's ability to earn an acceptable return on assets is constrained by the need for price stability. The organisation can limit investment in new customer driven work if acceptable returns cannot be earned. Investment in existing assets is however a sunk cost.

Board of Directors

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

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

The above interests are accommodated in the plan by providing direct reporting to the Board of Directors in terms of annual budget proposals, monthly reports and the Asset Management Plan.

Employees and Contractors

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 team 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.

The interests of our employees are identified through direct discussion with them and their representatives. Our employees are interested in:

- Advanced knowledge of work requirements so that they can plan their lives.
- A safe network and safe working practices so that they are not harmed.
- Fair remuneration.
- Enjoyable work.

The above interests are accommodated in the plan by:

- The high priority given to eliminating or mitigating hazards.
- Advanced planning of work.
- The recognition that our staff have unique skills.
- Creating a positive work environment that creates a high level of self worth.

Contractors' interests are identified through direct discussion. Currently they are interested in having:

- A secure work programme known sufficiently in advance that they can plan their resource allocation.
- A safe network and safe working practices, so that their staff are not harmed.
- A profitable work stream.

The above interests are accommodated in the plan by:

- The high priority given to eliminating or mitigating hazards.
- Advanced planning of work, particularly commitment to a long-term asset renewal programme.

The secondary stakeholder interests are as follows;

Auditors

Suitability of systems and processes to meet legislation requirements.

Government Agencies (this includes District and Regional councils and Central Government).

Processes in place to meet compliance requirements and reporting systems in place to meet disclosure requirements.

District Council interests are identified through direct discussion. Currently they are interested in having sufficient infrastructure available so that growth in their local community is not hampered.

The above interest is accommodated in the plan by the requirement that any customer driven development work we undertake produces at least our cost of capital.

Regional Council interests are identified mostly by correspondence and written information. Regional Council interests include: Protecting the environment and emergency response.

Central government interests are identified mostly by correspondence, written information and legislation. Central government interests include ensuring that a reliable, fairly priced supply of electricity is available to the West Coast region and that the network is safe.

The interests are recognised through compliance and submissions.

Suppliers and Generators

Westpower provides a reliable network upon which to transport energy, so that the network has sufficient capacity to accommodate the required transfers of energy. The charges imposed in using Westpower's network are acceptable and that there is adequate access to Westpower's network.

Suppliers and Generators interests are identified through communication and direct discussion.
Currently these groups are interested in protection of its connected equipment and the electricity system from harm caused by the network and load customers who are connected to the Westpower network. Westpower is also interested in receiving revenue and being charged a fair market price for transmission services.

The above interests are recognised in the plan by the sums we have programmed for expenditure due to anticipated growth in distributed generation and load. A significant proportion of this is to ensure the protection of the grid.

Transpower

That Westpower provide adequate maintenance standards to keep the network operational. That the network is reliable and that sufficient communication is maintained between Westpower and Transpower.

Transpower's interests are identified through communication and direct discussion.
Currently Transpower is interested in protection of its grid and the electricity system from harm caused by generators and load customers who are connected to the Westpower network. Another of Transpower's interests is receiving revenue from us.

The above interests are recognised in the plan by the sums we have programmed for expenditure due to anticipated growth in distributed generation and load. A significant proportion of this is to ensure the protection of the grid.

Landowners

Issues are identified through discussion with their representatives (e.g. Federated Farmers) and the pre-access notification process. Currently they are interested in protecting areas of heritage value, protecting amenity value, having their property treated with respect, protecting property values, having an electricity supply at a competitive rate which is suitable for the activities on their land. These interests are, recognised directly; however, it is more likely that they are not specifically identified but part of the background ethos.

Insurers

That Westpower provide adequate risk management to meet the insurance requirements and minimise risks where possible. These interests are met by Westpower having adequate insurances in place for identified risks and liabilities to employees, assets and the general public.

Financial Institutions

Westpower should provide sufficient financial performance to cover borrowings and maintain their corporate identity to a consistent standard. These interests are met by Westpower through reporting regularly on financial performance and regular audits.

External Advisers

Continuity of work, contractual relationship (if applicable), safety. These interests are met by Westpower through communication with parties as necessary.

Pressure Groups

Policy, reliability, pricing and safety. These interests are met by Westpower through publicly issued reports and press and media releases.

Press & Media

News, PR, alternative Energy Sources, Environment, Information channels, crises. These interests are met by Westpower through publicly issued reports and press and media releases.

2.1.6.2 Management of Conflicting Stakeholder Interests

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

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

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

Communication is the key tool used to manage residual conflict between stakeholders. It is our experience that when stakeholders have all the facts before them, they are willing to adopt the solution that is in the best overall good. Our task is to ensure that stakeholders have the required level of information.

Examples of how conflicting interests are managed include:

1. Asset Renewal

Our shareholders require that investment returns Westpower's cost of capital. They are not willing to lower cash returns received in order to fund network upgrades. On the other hand, consumers are unwilling to meet high price increases. Both groups want a sustainable network and improvements in reliability. This conflict is met through a targeted renewals programme, which ensures that the network does not receive over investment, and a targeted reliability programme to ensure that reliability continues to improve without significant increase in network investment. Innovative practices also play a major part in aligning these interests.

2. Network Capacity Charges

Historically networks based charges on transported energy, a fixed component and perhaps, demand. The cost of transporting energy has a demand and fixed component. Westpower has changed the structure of all line charges to better reflect costs by having separate demand and dedicated asset components. In the medium term, energy passing through the meter is being used to estimate demand using a complex algorithm. Long term it is proposed that demand meters shall be used on all installations.

3. Safety Improvements

Experience has shown that all stakeholders want a safe network. Determining what is safe or unsafe is not black and white. The definition of what is safe and unsafe is constantly evolving as time goes on. As events occur, and expectations advance, safety codes are repeatedly re-written and re-drafted. This means that equipment which, when installed was considered safe, is over time, eclipsed by changed and improved equipment. When growth occurs in a network, equipment is constantly replaced and updated. In the Westpower network, much of the old legacy equipment has not been replaced as part of the natural growth cycle. This leads to conflict between funding safety improvement work and other renewal and CAPEX work along with the call on the definition of safe and unsafe. Fortunately much of the renewal associated with safety also improves security, reliability and general network capacity. Available resources tend to dominate the conflict as to how much can be done at once. The conflict between safe and unsafe is based on:

- Observations of obvious problems.
- Industry accident reports.
- The various Acts, Regulations and Codes that control the industry.
- The application of ongoing principles to how equipment operates and the risks that come about when things go wrong.
- Experience from investigating and being involved with various industry incidents.

4. Conflict between Customer Interests as Customers and Shareholders

As shareholders, customers get a return. Some customers would prefer lower upfront charges or to see the money reinvested in the network. We believe that this is the responsibility of the Trustees who are elected by our customers, to resolve this conflict by consultation and advise the company through the SCI process.

2.2 Objective of the Plan

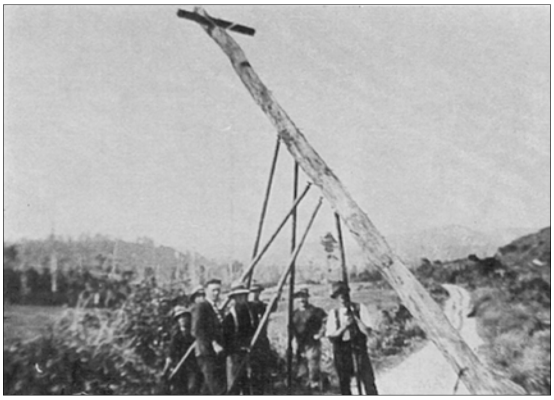
The defined objective of this Westpower Asset Management Plan is:

"To provide a systematic and coordinated approach to the optimum management of Westpower's physical assets and their associated performance, risks and expenditures over their lifecycle for the purpose of achieving the organisational strategic plan and to satisfy stakeholders requirements."

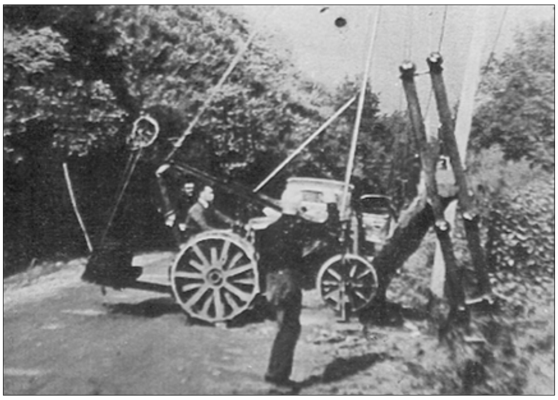
2.3 Asset Ownership Justification

2.3.1 Westpower Yesterday

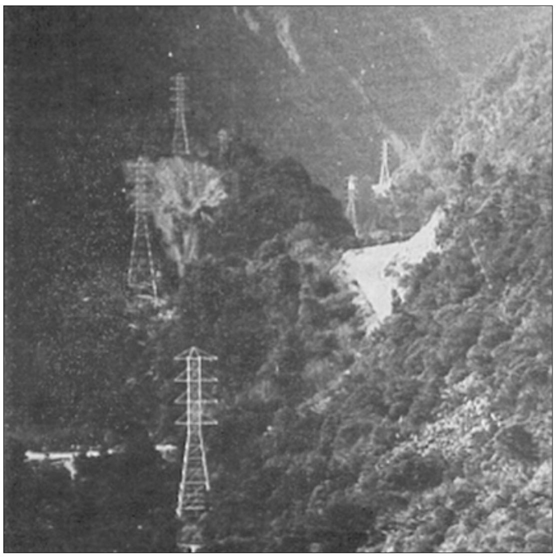
In the late 1800's - early 1900's private power generating schemes were being built throughout the West Coast region to supply mainly gold claims. Reefton was the first public supply connected in the Southern Hemisphere in December 1887. Other supplies were at Dillmanstown and Kaniere in the Hokitika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



In the early 1900's poles were transported by horse and cart and erected by hand.



During the 1920's with the advent of the motor vehicle, line construction became a little easier.



One of the great achievements of line construction teams was the state hydro department's transmission line through the Otira Gorge, built in 1939.

More recently, with the use of helicopters, reticulation is possible to the more rugged areas of the West Coast.

2.3.2 Westpower Today

Westpower is a combination of a number of the 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.

2.3.3 Westpower Tomorrow

Asset Management Plans must address growth. Projections for the West Coast are continually reviewed by Westpower to ensure that the sub-transmission and distribution network is adequate for the demand. This plan projects that the total load will be over 100 MW in ten years time.

2.4 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.

2.5 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 for this plan are as follows (these are covered in more detail in Section 4 - Levels of Service);

- Safety
- Customer Service
- Capacity (i.e. Adequacy of Service)
- Reliability (i.e. Continuity of Service)
- Economic Efficiency
- Environmental Responsibility
- Corporate Profile
- Legislation and Compliance

2.6 Asset Management Linkage with Westpower Performance

Figure 2.7 shows the relationship between asset management and Westpower's performance.

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

Ultimately Westpower's performance is judged externally and the drivers outlined in section 2.5 above are the parameters by which this performance is measured.

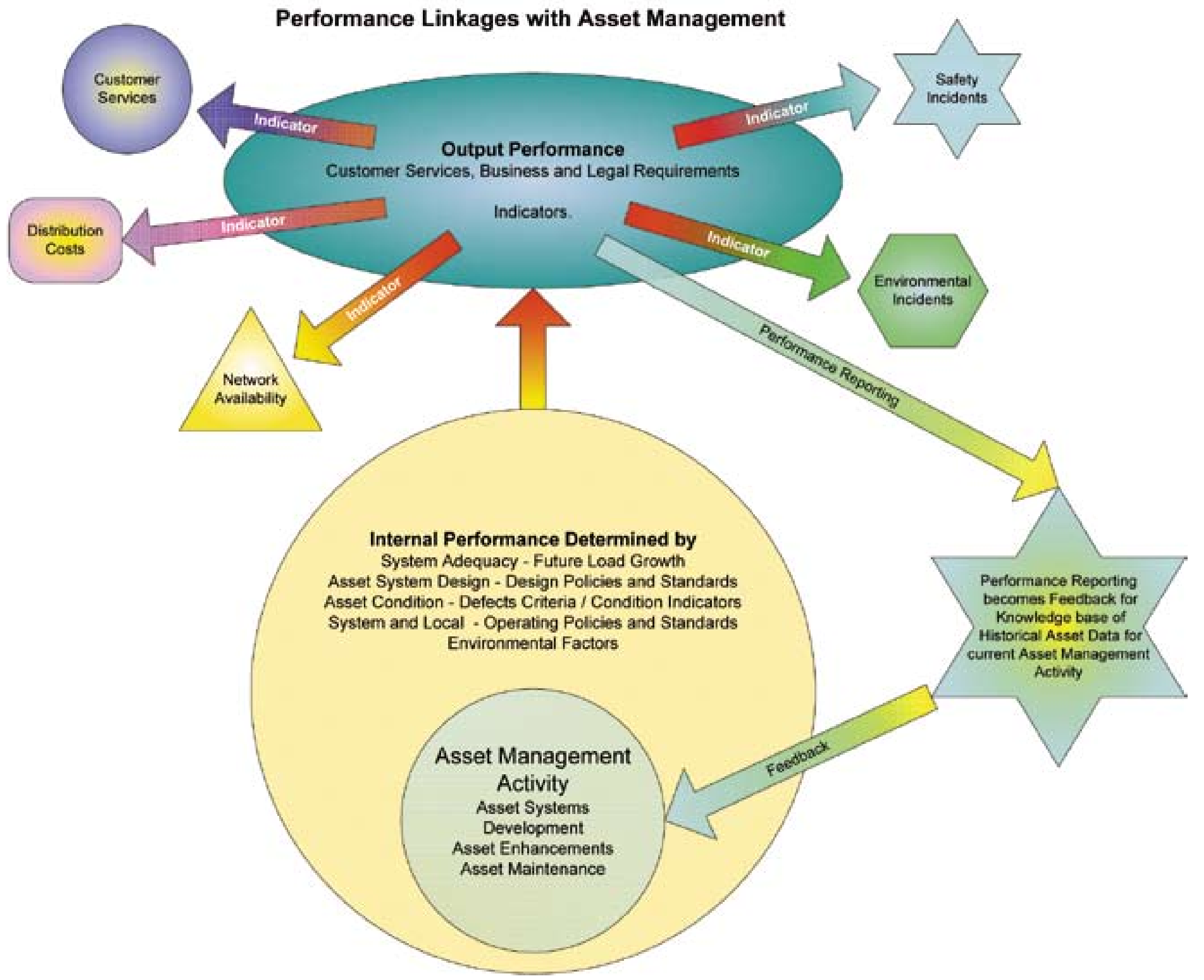


Figure 2.7 - Performance Linkages

Different asset management and operational responses can be used to 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.

2.7 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 are 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". 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, 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.

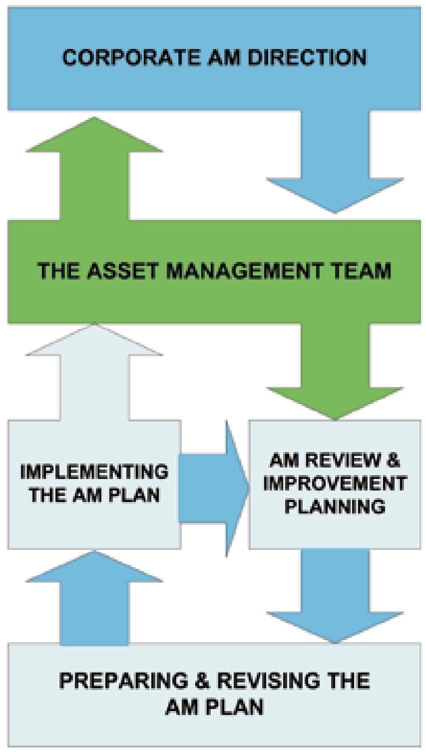


Figure 2.8 - Flowchart for Development of Asset Management Plan

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 connectors 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.

2.8 Core and Advanced Asset Management

2.8.1 Outline of Core to Advanced Approach

The core approach can be typified as 'top down' with decisions made at a systems level using simple analysis processes.

Asset management will evolve in a continuous cycle of review and improvement so that quality of outputs matches the changing business needs of an organisation. Figure 2.8 shows the typical flowchart for this approach.

Enhancements may seek to strengthen asset management outputs by using a 'Bottom Up' approach for gathering asset information for individual assets to support the optimisation of activities and programmes to meet agreed service standards (Advanced Approach).

The Westpower Asset Management Plan is a hybrid of these approaches as will be demonstrated in the following sections.

2.8.2 Limitations of this Asset Management Plan

This Asset Management Plan (AMP) is for internal working and regulatory purposes only and it is not intended that any external parties should place specific reliance on any particular aspect.

This AMP does not cover;

- Details of Westpower's network pricing derivation and application (these are available on our website).
- Vehicles, non-network related land, buildings, furniture or general office computer equipment.
- The overhead costs of operating the network control centre and other indirect overhead costs.

2.9 Asset Management Systems and Processes

There are several systems and processes used in Westpower's asset management to facilitate routine maintenance and inspections, planning for network development and measuring network performance.

Network data collection and reporting and is performed and represented by both GIS (spatially) and Maximo (Asset Infrastructure Framework). Although independent, GIS and Maximo share location and asset data via a series of synchronisations and system views. This data is used to evaluate risk, inform managers and provides the framework for preventative maintenance which all strengthens the Westpower network.

These systems and the accurate and timely information they provide support the cost/benefit effect of maintenance. This results in better maintenance optimisation and predictions of long-term effects.

This section outlines the following systems and process;

- New Connections
- PM's (Preventative Maintenance)
- Asset Maintenance and Inspections (Condition Assessment Programme)
- Network Development
- Network Performance

2.9.1 New Connections

Workflow is an integral part of Westpower's Asset Works Management system and enforces Westpower business processes. The following diagram describes the workflow used for new connections. The key elements of the workflow include notification to the customer and electrician so they are informed, and the acknowledgement from the retailer ensuring that all customers have a retailer contract before they are livened.

All new connection requests are maintained on the asset management system and supporting documentation showing connection points, connection agreements, and livening sheets are attached.

Figure 2.9 shows the process for new connections.

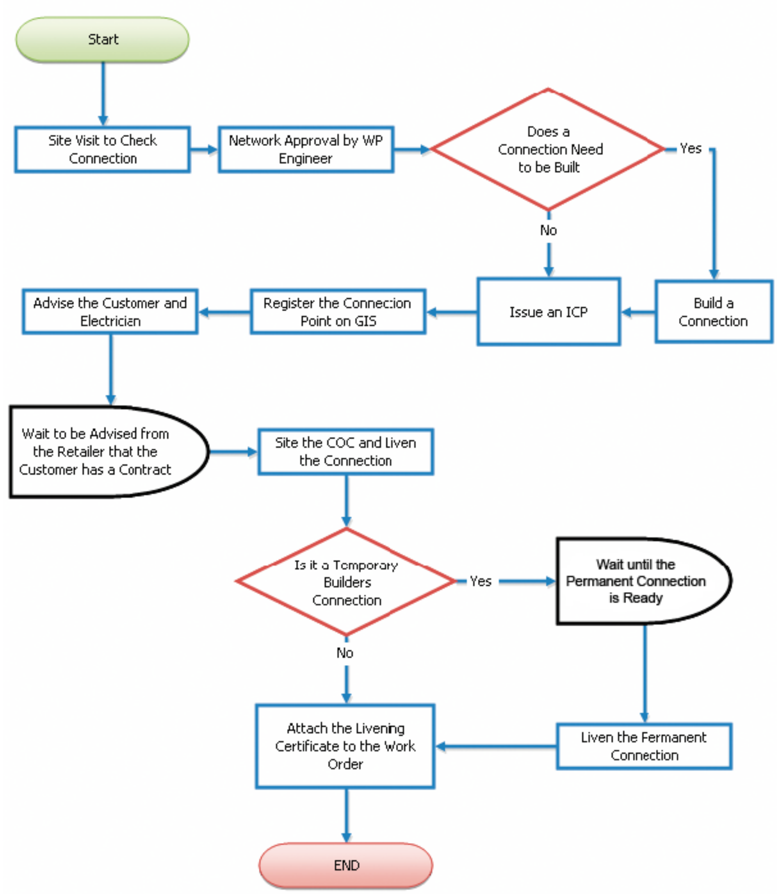


Fig 2.9 - Process for New Connections

2.9.2 Preventative Maintenance

Westpower has employed preventative maintenance (PM) plans which are preformed regularly based on elapsed time or meter readings. PMs are being developed for each asset / location which is active in the network and where condition assessment does not apply.

Time lapsed PMs are based on manufacturer's specifications / recommendations or engineering assessments subject to the nature of the equipment, its importance to the network and the environmental conditions it may be exposed to.

As these PMs are developed, Job Plans (JP) are being attached which dictate the nature of maintenance required by task. Where relevant, the task sequence is also determined on the job plan. Any photos or manufacturer's manuals of the equipment or location are also attached to the PM.

Where appropriate, Routes are applied to PMs which organises work packages into a logical and efficient order.

In addition to elapsed time or meter reading based PM initiation, Westpower is optimising Outages and co-ordinating maintenance during these periods.

2.9.3 Condition Assessment Programme

Field data collection initiatives, in conjunction with work audit processes will ensure accurate data is collected in a timely fashion which in turn will instill confidence in reporting of historical asset data.

The first stage of the data collection programme was the upgrade of the Condition Assessment programme, which will provide direct integration of the ArcPad field data collection system with the ArcSDE database. This information is then passed to Maximo on a nightly schedule. As assets are inspected on at least five yearly intervals, and changes recorded on completion of any work carried out. The spatial and aspatial data collected will provide an accurate reflection of the network at any one time.

Audits carried out at work completion which will assist with the closing off of the process.

The processes outlined above have been activated and are proving to be very successful.

Processes have been initiated to ensure all assets are recorded. This financial year will see the collection of both spatial and aspatial data pertaining to LV pillar and links boxes. It is envisaged that all assets, including low voltage line and cables will be recorded within two years. This will enable a more accurate tracking of work history and align with the Maximo hierarchy.

2.9.3.1 Westpower Condition Assessment Specification

To enable Westpower to accurately assess the condition of it's network, a Condition Assessment programme has been initiated. This programme involves the collection of relevant data on primarily lines and associated equipment. This data is then used, via GIS, to forecast required maintenance and capital works and also identify areas which may pose Health and Safety risks.

Collection is performed using HP Ipaq hand held computers, complete with ESRI's ArcPad software which eliminates the need for manual data entry into GIS.

20 per cent of each line (feeder) is assessed in a year, allowing the total network to be completed in a five year cycle.

Network components to be assessed will be divided into categories. These being

- Pole
- Pillarboxes
- Linkboxes
- Crossarms

- Fittings (bracebars, insulators, shackles, polesteps, LV fuses etc)
- Stays
- Disconnectors
- Transformers
- Dropout Fuses and Lightning Arrestors.
- Earthing System
- Conductors LV
- Conductors HV
- Cables LV
- Cables HV
- Other (recloser, sectionaliser, capacitor, etc)
- Vegetation

All catagories are assessed using the same terminology, these being

Excellent	Component is near new, less than two years old, still in excellent condition.
Good	Component still has greater than a ten year life expectancy and is generally in good condition.
Fair	Component has a less than ten year life expectancy, but will last longer than five years.
Poor	Component could last up to five years, however is generally in poor condition.
Needs Replacing	Component is considered condemned however will last up to two years.
Red Tagged	Component is in urgent need of replacement. Poses a health and safety risk.

2.9.3.2 Methodology

The process for each component will be completed as follows:

Pillar boxes
All pillar boxes shall be thoroughly inspected and earth resistance tests carried out.
Condition of fuses, cables and box shall also be recorded.

Pole
All wooden poles shall be thoroughly inspected below ground (to 600mm). A standard probe test shall be carried out, along with a hammer test. Any knot-holes or splits above ground shall be probed and assessed accordingly.

All poles shall have a detailed visual inspection performed. This includes the recording of any spalling or cracking found on concrete poles.

Crossarms
All crossarms shall have a detailed visual inspection performed. Any suspect LV or service crossarms shall be probed and assessed accordingly. Any suspect HV or sub-transmission crossarms shall be noted for future inspection.

Fittings
Fittings such as bracebars, insulators, shackles, polesteps, LV fuses, bolts etc are to be assessed collectively using a detailed visual inspection. The worst case condition of fittings shall be recorded. If any fitting is assessed as ‘poor’ or ‘needs replacing’, notes describing relevant details of the fitting shall be recorded.

Stays
The condition of stays and their associated fittings are to be assessed collectively using a detailed visual inspection. This will include condition of stay wire, stay insulators, stay deadend, hose, eyebolts etc. The worst case condition of stays and their fittings shall be recorded.

Transformers
Transformers shall have a detailed visual inspection performed, including checks on oil level, cracked bushings, deterioration of gaskets and any signs of oil discharge.

Dropout Fuses and Lightning Arrestors
Dropout fuses and lightning arrestors shall have a detailed inspection performed, with condition to be assessed collectively. The worst case condition of dropout fuses and lightning arrestors shall be recorded.

Earthing System
The earthing system for transformers, disconnectors etc. shall be assessed by means of a detailed visual inspection. Only exposed components of the earthing system need be inspected with the worst case condition of the earthing system be recorded.

Conductors LV, Conductors HV
General condition of overhead conductors shall be recorded. Conductors shall be assessed by voltage. The worst case condition of the conductors shall be recorded in the case of multiple conductors of the same voltage.

Cables LV, Cables HV
General condition of underground cables shall be recorded. Only exposed components of underground cables need be inspected with the worst case condition of the cables be recorded in the case of multiple cables of the same voltage.

Vegetation
While assessing the condition of Westpower's network, the assessor shall note any vegetation that may be encroaching the line, or access to equipment that may be hindered by excessive vegetation.

General Comments
The assessor will be required to note any general comments which could provide information to assist the overall security of Westpower's network.

Work Required
Any maintenance work identified should be recorded in the Work Required text box. Photo's must be taken where work is required and the number recorded in the Photo ID box. All Work Required descriptions should be as detailed as possible with a description of the defect and recommended actions. An electronic copy of all photos must be supplied to Asset Management in Greymouth on completion of the Assessment.

Field Data is then uploaded into the SDE Database. All condition codes are updated instantly as this data is uploaded, changing the Status of the Asset's last condition and date of assessment. All work required is then separated and analysed using ArcGIS and work orders raised where needed.

This data can now be audited for analysis and further assessment when needed. Figure 2.10 shows the condition assessment process.

2.9.3.3 Condition Assessment Retrieved Data

All asset data collected in the field is uploaded to GIS from the handheld device updating certain fields and tables in the database. The condition assessment date is also updated so these assets can be assessed again within five years.

Work Required Table

The work required table uploaded from the handheld is split into two categories.

Urgent work is grouped into areas. A work order is then generated for this area including any assets marked as needs replacement or red tagged in the condition attribute of the asset data. Any asset that requires instant action will have a separate work order raised in order to rectify this issue as soon as possible.

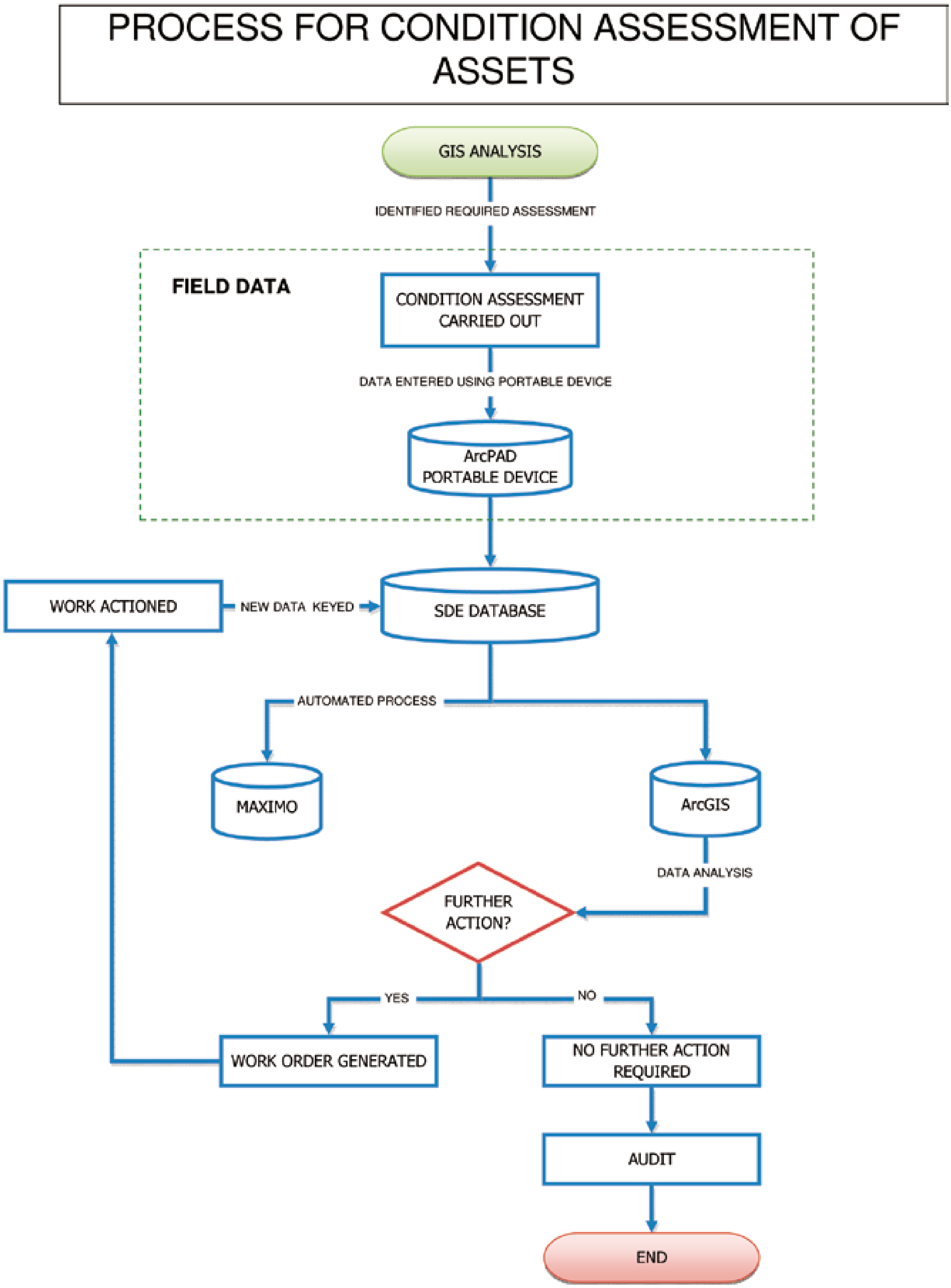


Figure 2.10 - Condition Assessment Process

Non urgent work is also grouped into areas and is set aside for action during planned outages or when time allows.

The data retained in this table also enables the Asset team to design efficient maintenance programs by being able to identify specific asset types and their location.

Condition Codes

All asset data is returned with an updated condition code and these are separated and analysed for action where required

Excellent Condition	No further action is required on these assets before the next scheduled assessment.
Good Condition	These assets have more than ten year's life expectancy and will be assessed again within this term.
Fair	These assets have less than ten years life expectancy but will last longer than five years and will be assessed again within this term.
Poor	This asset could last up to five years, however as it is in poor condition future assessment will be required during this term.
Needs Replacing	Any assets with this condition code are grouped into areas along with any other urgent work required and a work order is raised for the asset(s) to be replaced as soon as possible.
Red Tagged	All red tagged assets are urgently in need of replacement and work orders are raised individually for these assets for prompt action.

Using the Network Analysis Toolbar in GIS the asset team is able to flag a disconnector which is planned for future outage and identify any of the work required in the affected area.

Work orders are then raised for this work to be done during the planned outage.

2.9.4 Network Development

The Network Development Plan is required to maintain, enhance and develop the operating capability of the Westpower network. The following activities are the key drivers to prepare such a Network Development Plan:

a. Develop and update a ten years period load forecast following the recording of the summer or winter maximum demands and future developments information. These load growth projections are used as a basis for determining the likely timing for those projects.

b. Evaluate network limitations and select the best development/configuration to alleviate each system limitation.

c. The identification of the necessary major project shall be completed on the basis of repeatedly evaluating the network limitations and selecting the best developments for each year of the forecast period, assuming completion of the projects in the design and construction phase and the projects identified in earlier years of the forecast period.

d. Collect any relevant data relating the network performance or capability. This includes data on switchgear condition, transformer condition, worse performing feeders, operational limitations, etc.

e. Identify areas where future substation sites and/or future circuits may be required.

f. Revision may be required in the period between the annual reviews if new projects are identified in that area or existing projects are significantly changed.

There are two different planning types considered by Westpower when developing the Network Development Plan:

- High Voltage planning
- Low Voltage planning

The High Voltage planning also known as the Strategic Network Plan incorporates a list of Zone Substations and associated sub-transmission feeders, a list of strategies for network development, recommendation for the acquisition of future substation sites and high voltage circuit easements grouped by area to ensure that sufficient capacity is available in Westpower sub-transmission and zone substation infrastructure.

The Low Voltage planning is developed to ensure that adequate voltage levels are maintained for all customers along a LV distribution at all times throughout the life of the LV network. In order to achieve this, accurate voltage drop calculations are carried out at the design stage.

Figure 2.11 shows the process to determine development options.

2.9.5 Asset Data Collection

Historically, asset data was collected through as-build drawings and recorded on hardcopy files. The inception of the GIS allowed this data to be electronically recorded, however much of data was still captured on paper and manually transferred to electronic format. Advances in technology has seen electronic data collected in the field and automatically transferred to the GIS, creating a more accurate and efficient data collection system than that in the past. This data is now utilised for a number of tasks including asset condition monitoring, asset valuation, work scoping, outage planning and a number of regulatory tasks. Confidence in the integrity of the data has grown with the current data collection methods used and high levels of accuracy are now being achieved.

As mentioned, much of the data relating to Westpower's assets has been collected. However in some cases data is missing or incomplete. Programmes such as condition assessment and pillar box inspections have been initiated to ensure all field data is included in the GIS and subsequently Maximo via the sychronisation process. The following lists various asset types and plans in place to ensure data accuracy.

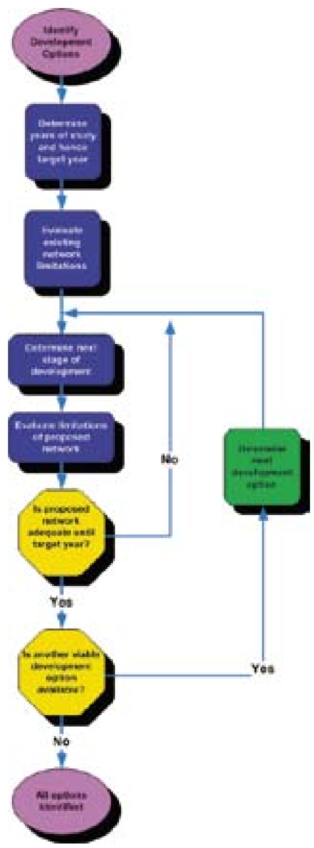


Fig 2.11 - Process to determine development options

2.9.5.1 Poles and Spans

New or replacement poles and spans are recorded during the design phase of each job and transferred from design software to GIS with a status of 'Not Ready'. On completion of line construction the status is changed to 'Active' and all relevant attribution is populated.

Any pole or span replacements not requiring design are updated on the GIS by either electronic means or the manual pole data form.

Pockets of poles and spans on the network are yet to be recorded, however these assets are rapidly being identified and corrected primarily via the condition assessment programme. It is estimated that all outstanding poles and spans will be accurately recorded by mid 2010.

2.9.5.2 Underground Cables

Although many underground cables have been electronically recorded, there is still a large number to yet be completed. Programmes such as the pillar box identification and inspection will assist to identify those cables not currently included in GIS.

A programme will be initiated mid 2009 to record missing cables and relevant data shall be included. This should be completed by the last quarter of 2010.

As with spans, the spatial recording of underground cables is integral to utilizing GIS functions such as network tracing (connectivity), which asset management staff are becoming increasingly dependent on for a number of tasks.

2.9.5.3 Pillar Boxes

An identification and inspection programme was initiated in 2008 to electronically record all pillar boxes on the Westpower network. Both spatial and aspatial data is recorded along with a series of tests. Any defects found are recorded at the time of inspection and are automatically uploaded to the GIS with the core inspection data to be actioned. This programme should be complete by the final quarter 2009. Any new pillar box additions to the network are spatially recorded either via locality plans or GPS. Similar to pole data collection, attribution data can be gathered electronically or by completing the manual pillar box data form.

2.9.5.4 Transformers and Switchgear

There are a number of methods for collecting data for transformers and switchgear. As these components generally consist of a ‘location’ (earths, fuses etc.) and an asset (transformer, disconnector etc.) data is independently recorded. The transformer or switchgear is recorded only in Maximo, with the ‘location data being recorded in GIS and available to Maximo upon nightly synchronization. Although stored in a different database, the asset data is viewable on GIS when querying a ‘location’.

Asset history recorded in Maximo includes information such as asset moves, servicing history (via work order) and asset specifications, whereas the location data is recorded in the field either by hand held electronic device or manual data entry forms. A very high level of confidence is awarded to the transformer and switchgear data, with records periodically audited.

2.9.5.5 Summary

Processes previously unavailable are now in place to ensure any network additions, deletions or asset moves are recorded in appropriate repositories. Maximo workflows and auditing processes allow asset management staff to audit each work order and check that all documentation and data entry is completed before closing off the job. With this in mind, integrity of the data can be assured and can be utilized with a high degree of confidence.

2.9.6 Measuring Network Performance

The following section outlines the process by which Westpower records its outage data to comply with disclosure requirements.

All interruptions to Westpower’s network are recorded including those on the Transpower Grid. For disclosure purposes, all relevant outage data is reported on and grouped by Class (e.g Class A, B, C and D - Class B and C related to Westpower, Class A and D relate to Transpower).

2.9.6.1 Data Collection

At the time of an outage, there are two categories of notification that may occur, Alarm/Operator and Informant/Customer. These notifications trigger the recording part of the process

Alarm/Operator	If a circuit-breaker opens, an alarm will trigger on the SCADA system and the operator (if on duty) will notify the retailer. If the operator is not on duty then the alarm will trigger a pager and the on-call operator will be called in.
Informant/Customer	If a circuit-breaker has not opened and the cause of the outage is localised to a distribution transformer (for example) this will not cause an alarm on the SCADA system.

The fault will generally be forwarded to the retailer from the effected consumer.

The outage will then be passed on from the retailer to Call-Care, who will then notify ElectroNet Services who will initiate any work required to fix the fault. A Control Room operator will collect the following data whenever a network interruption is experienced;

- Date and time (Time power went off, and time last customer was restored)
- Location
- Description of event
- Type of outage (e.g. Planned or unplanned)
- Feeder
- Notification
- Component effected
- Cause
- Voltage effected
- Protection unit information
- Network (e.g. Westpower, Transpower)

This outage information is currently stored in a Geodatabase via Westpower's GIS system. The GIS is used to select transformers effected by an outage and along with all related information is recorded as a entry in the Geodatabase.

Customer information such as ICP numbers, retailer number and site numbers are automatically updated every night and stored as a CSV file. This file is uploaded to the geodatabase and used in calculations to find the number of customers effected by outages. The customers are linked to their respective transformer numbers, so when transformers are selected from GIS, an accurate number of customers can be found.

2.9.6.2 Data Processing

SAIDI (System Average Interruption Duration Index), SAIFI (System Average Interruption Frequency Index) and CAIDI (Customer Average Interruption Duration Index) are the most widely accepted KPI's for electricity networks.

Westpower collects the data required from several different internal systems including the GIS and Maximo to perform the following calculations;

SAIDI *(Total System Minutes Lost x Number of Customers Effected)* / Total Number of Customers

SAIFI Number of Customers interruptions / Total Number of Customers

CAIDI Can be derived by dividing SAIDI by SAIFI

There are power outage events where not every customer has their power restored at the same time. Because of this, it is unrealistic to use the start and end time of an outage to calculate SAIDI/SAIFI.

1. Each switching operation is recorded including number of customers effected and time power went off and the time power was restored.
2. A SAIDI/SAIFI figure is calculated for this operation.
3. To calculate the total for the outage, the SAIDI/SAIFI for each operation is summed

Figure 2.12 shows the data process.

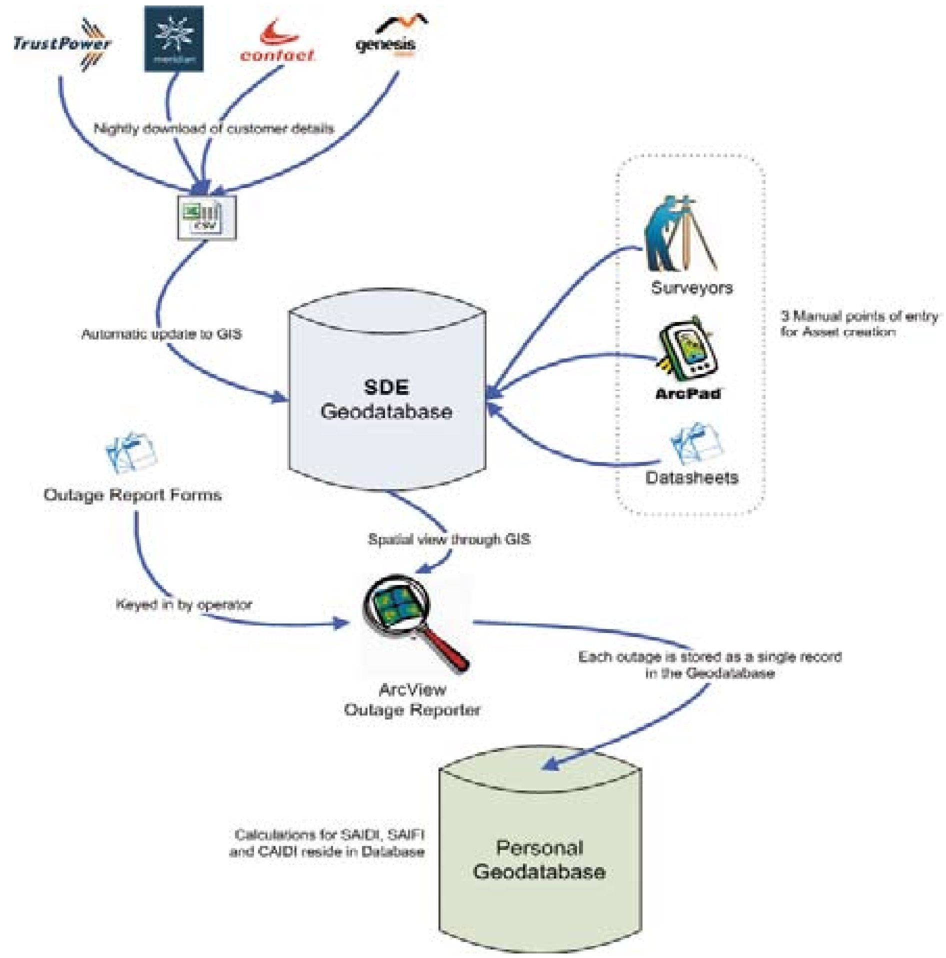


Figure 2.12 - Data Model for Reliability Data

3.0 ASSETS COVERED

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 operating 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 Equipment 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 5 kVA to 1000 kVA and generally having a primary voltage of 11 kV.
- ***Ripple Control -*** Ripple Injection Equipment.
- ***Embedded Generation -*** Generation Units connected to Westpower's network but not necessarily owned by Westpower.
- ***Capacitor Units -*** For Voltage support.
- ***Mobile Substation -*** Allows improved maintenance access to existing substations and for emergency use in case of substation failure.
- ***Buildings -*** Substation buildings within the Westpower network.

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 (refer to Figure 3.1).

An overview of Westpower's Network Diagram can be seen in Figure 3.3.

3.1 Asset Condition

The present condition of the above asset types is also described in this section, based on information from routine inspections.

The reader unfamiliar with the geographical layout of the system is referred to the maps throughout this Section.

This assessment of the present condition of the assets and their implications is the basis for the proposed maintenance programmes and Network Development described in Section 5. The primary asset management drivers are:

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

The majority of these network assets are shown as a percentage of ODRC in the pie chart of Figure 3.2.

Figure 3.1 - Westpower's Operational Area in Relation to Other South Island Electricity Lines Businesses.

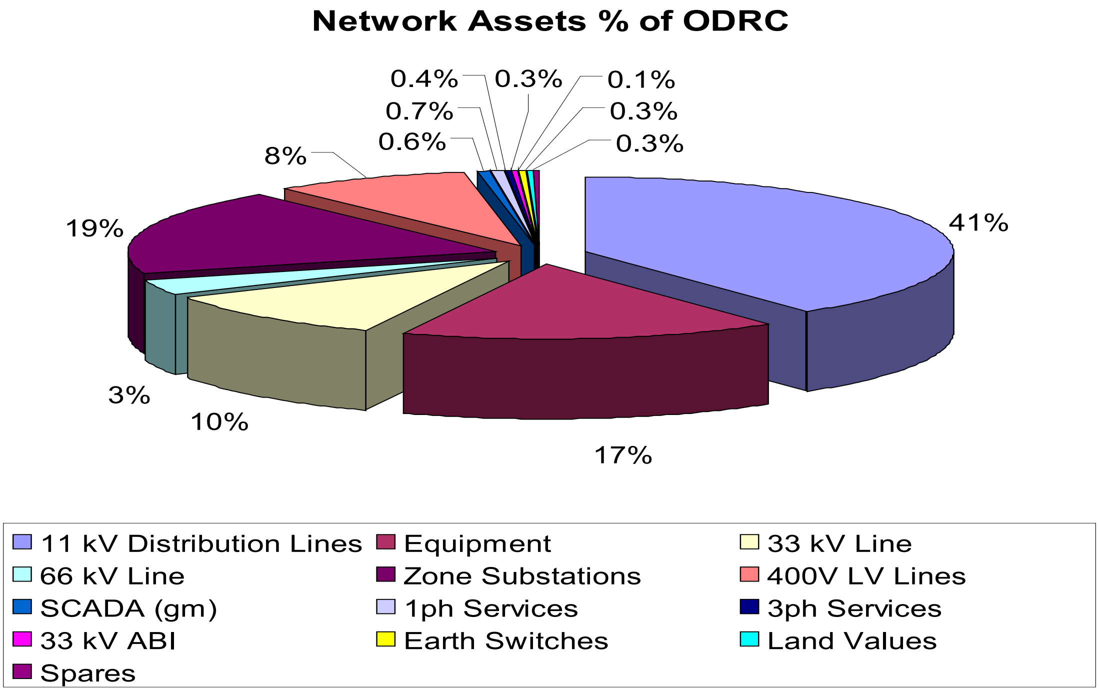


Figure 3.2 - ODRC - Optimised Depreciated Replacement Cost as a Percentage of Total Network Asset ODRC.

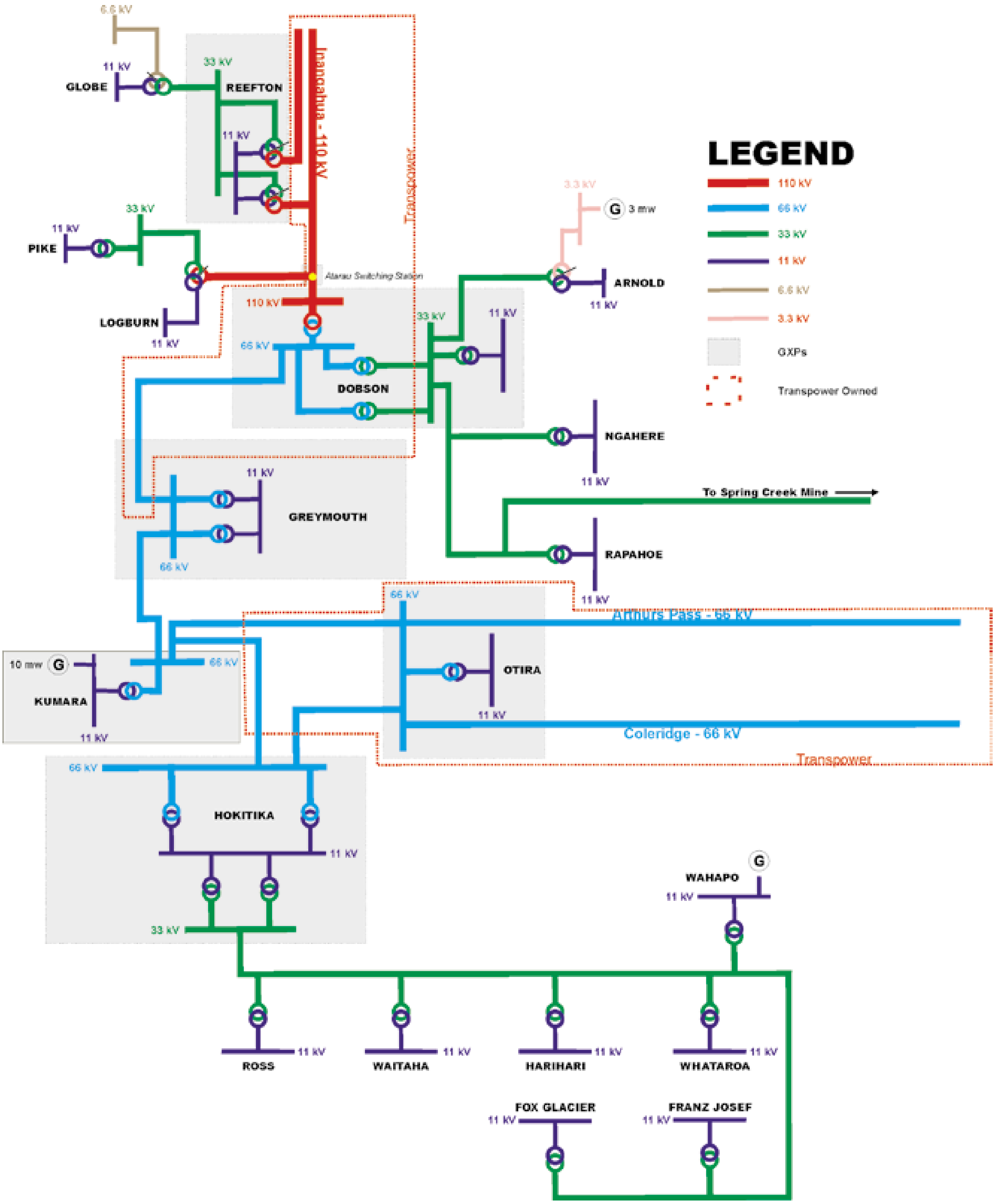


Figure 3.3 - Diagram of Westpower's Network

3.2 Transpower Grid Exit Points (GXP)

Atarau switching station, situated on Transpower's Dobson-Reefton-Inangahua circuit, was commissioned by Transpower in 2007 to feed the new Pike River Coal Mine. Westpower takes supply at 110 kV from this GXP, but there is insufficient capacity in the Transpower network to supply this load from the south in the event of a fault on the 110 kV circuit from the north. The load is therefore interruptible until the network can be strengthened as discussed below.

The Electricity Commission's approval of the West Coast Grid Upgrade Plan (WCGUP) in 2008 has paved the way for an additional 110 kV circuit to be constructed from Dobson to Reefton and this will result in two geographically diverse and relatively strong feeds from Inangahua to Dobson, securing supply into the West Coast from the North. As Westpower was already well advanced with securing property rights for this route, which extends some 72 km through farmland and DOC reserves, and had built up a good rapport with local landowners, an agreement was reached between Transpower and Westpower for Westpower to construct the new line and then sell it to Transpower on commissioning.

The new line, termed DOB-TEE A, is expected to be commissioned in late 2011 and this will provide n-1 security to the Atarau GXP.

When commissioned, this project along with a related 14 Mvar switched capacitor bank to be installed at Hokitika will restore security levels to a Good Electricity Industry Practice (GEIP) standard for loads of the size and type supplied by Westpower. In the meantime, in the event of a fault on the sole existing 110 kV line between Inangahua and Dobson, load curtailment may be required from time to time as a post contingency action to maintain supply to the area.

Westpower takes supply from seven Transpower GXP's at 110 kV, 66 kV, 33 kV and 11 kV as shown in Table 3.1.

Table 3.1 - GXP Capacity and Load Profile

Grid Exit Point	Asset Owner	Voltage (kV)	Transformer Capacity (MVA)	Present Maximum Demand. (MW)
Greymouth	Westpower	66	2 X 10/15	12.738
Hokitika	Westpower	66	2 x 15/20	18.038
Kumara	Westpower	66	1 x 10	9.386
Dobson	Transpower	33	2 x 10/20	9.830
Otira	Transpower	11	1 x 5	0.696
Reefton	Westpower	110	2 x 20/30	7.938
Atarau (Switching Station)	Transpower	110	N/A	1.642

Maintenance of the metering equipment at these GXP's is Transpower's responsibility.

The southern part of the Westpower network is fed from double circuit 66 kV line from Coleridge, which is supported by a limited capacity 66 kV connection between Dobson and Kumara (see Figure 3.4). This provides an acceptable level of supply security, although some load curtailment may be necessary should a common mode fault affect both circuits of the incoming double circuit line at the same time. The probability of such a fault occurring is relatively low.

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. 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.

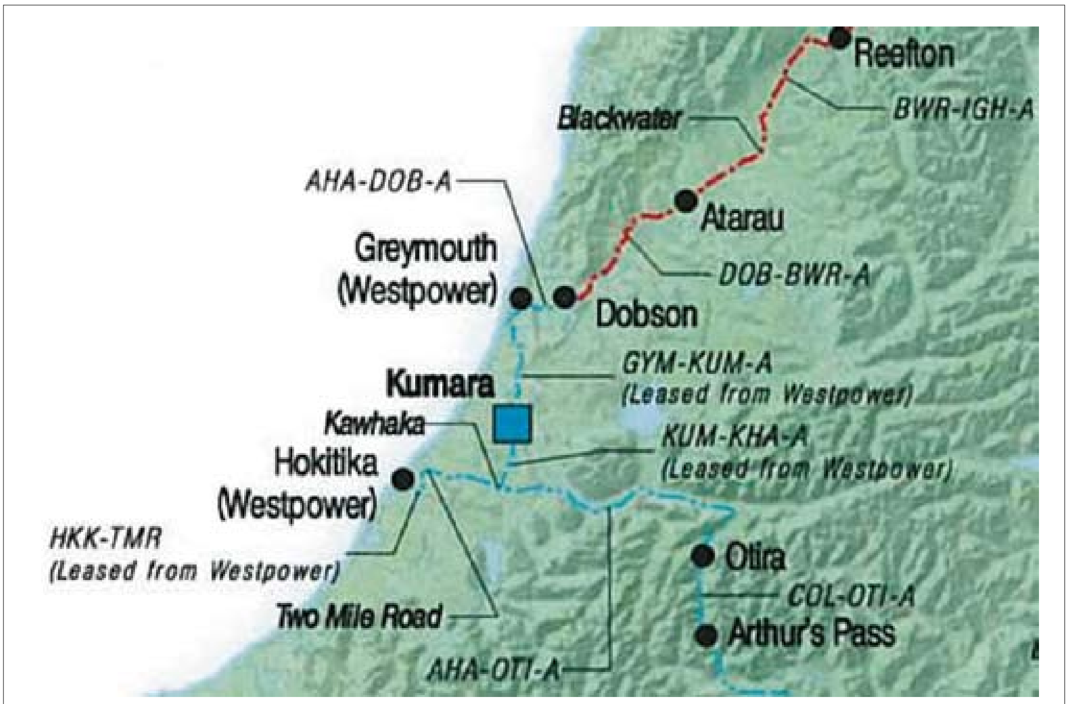


Figure 3.4 - Map of Transpower Lines to Westpower Network

3.3 Sub-transmission Assets

Westpower owns three distinct classes of sub-transmission assets, running at 110 kV, 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. The entire line is under Transpower operational control however.

The 110 kV assets owned by Westpower include the Reefton Substation, where the interface points between Westpower and Transpower assets are the incoming disconnectors on the line side of the 110 kV circuit breaker.

Westpower also owns an 8 km stretch of 110 kV line from Transpower's Atarau switching station to an associated 20/30 MVA 110/33/11 kV substation at Logburn. This was commissioned by Westpower in 2007 as part of the reticulation to the new Pike River Coal Mine.

3.3.1 Asset Justification

Sub-transmission assets, either at 110 kV, 66 kV or 33 kV, are required to transmit high levels of electrical energy over significant distances, prior to stepping 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.

3.3.2 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 3.5 shows the age profile of sub-transmission lines, by route kilometre.

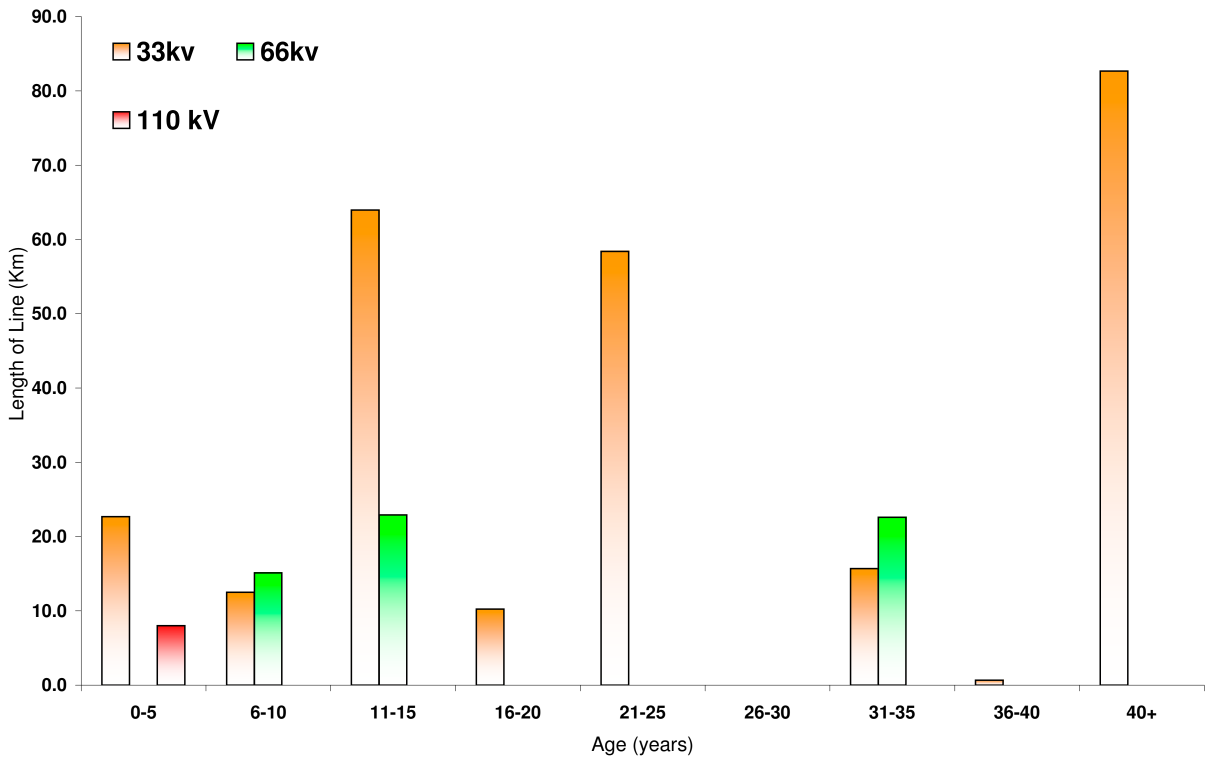


Figure 3.5 - Sub-transmission Line Age Profile

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

Westpower sub-transmission lines fall into four broad groups: 110 kV pole lines, 66 kV wood pole lines, 33 kV pole lines and 33 kV fully insulated lines as 33 kV Hendrix Spacer Cable.

3.3.3 110 kV Lines

Westpower owns one 110 kV line from Atarau to Logburn Road. This line is 8 km of concrete poles strung with Neon AAAC Conductor.

Table 3.2 summarises the quantity of the 110 kV line by circuit length.

Table 3.2 - 110 kV Lines Summary

Type	Circuit Length (km)
Light Overhead	0
Medium Overhead	0
Heavy Overhead	8

3.3.4 66 kV Lines

[1]DRC - $ 2,074,730
ODRC - $ 2,074,730

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

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-stressed concrete poles have been used to support the 7.8 km of Iodine AAAC conductor.

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

Table 3.3 summarises the quantity of 66 kV overhead Line by Circuit Length.

Table 3.3 - 66 kV Lines Summary

Type	Circuit Length (km)
Light Overhead	0
Medium Overhead	60
Heavy Overhead	0

3.3.4.1 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.

[1] *All DRC and ODRC values are taken directly from the 2004 ODV revaluation excercise*

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.

3.3.5 33 kV Lines

DRC - $6,566,784
ODRC - $6,566,784

There are two general areas served by Westpower's 33 kV sub-transmission network, one based around the Dobson and Grey Valley areas and the other serving South Westland. These two areas are connected between Greymouth and Hokitika via Kumara through the 66 kV network.

Figure 3.6 shows the geographical spread of these two asset areas.

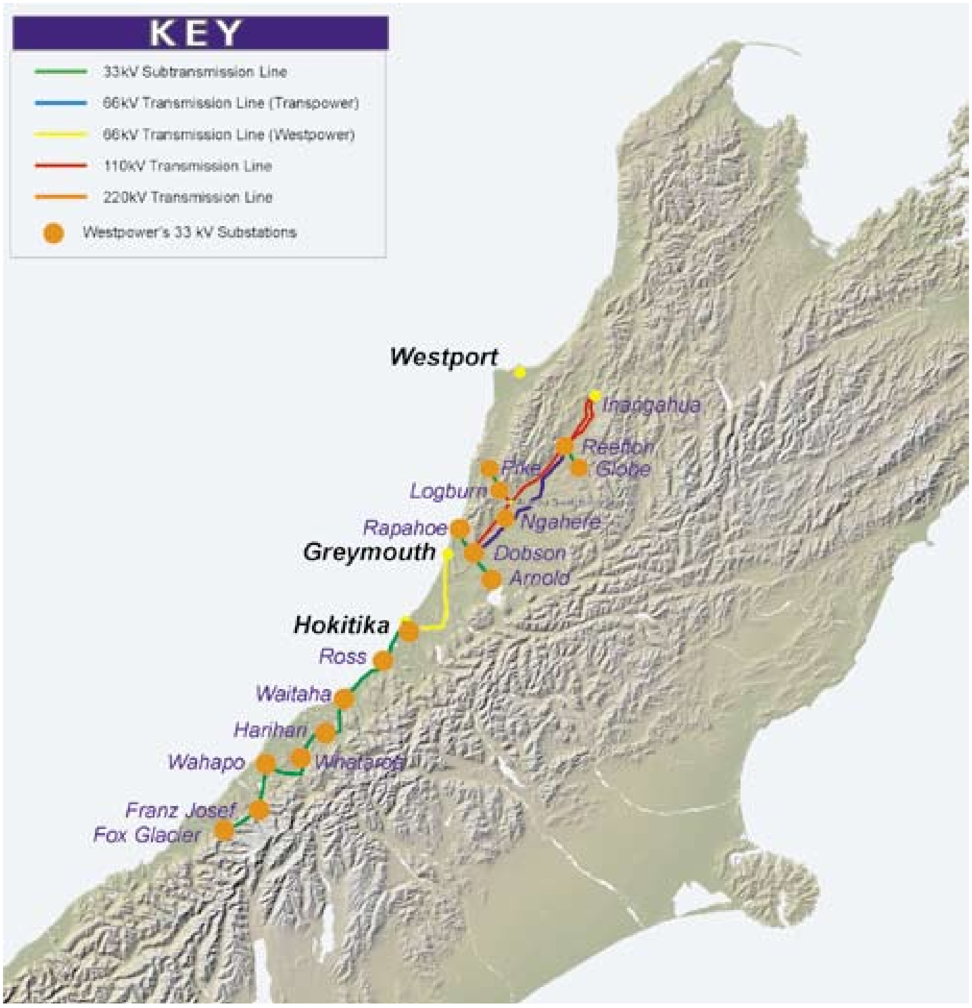


Figure 3.6 - Westpower 33 kV North and South Networks

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

Except for a short length of Mink ACSR line over Mt Hercules and some fully insulated 33 kV overhead line in South Westland, the rest of the sub-transmission lines are strung with either Dog ACSR or Iodine AAAC conductor.

The 33 kV sub-transmission line from Hokitika to Harihari, originally constructed in 1966, was purchased from Transpower. The large majority of the remaining 33 kV assets have been constructed since 1983 and are mainly of concrete pole construction.

Table 3.4 summarises the quantity of 33 kV overhead line by circuit length.

Table 3.4 - 33 kV Lines Summary	
Type	Circuit Length (km)
Light Overhead	286
Medium Overhead	0
Heavy Overhead	0

3.3.5.1 33 kV Pole Lines

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

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

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

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

The Dobson-Arnold Line purchased from Transpower in 1994 is over fifty years old and several of the wooden 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 60 years.

3.3.5.2 33 kV Overhead Line Reliability

Most of Westpower's reticulation consists of overhead lines.

Over the past 15 years, all of the major 33 kV and 11 kV feeders have been replaced or refurbished and are in very good condition overall.

While overhead lines are subject to more faults than underground cables, due to such things as lightning and bird strikes, it is relatively easy and quick to get them back into service.

The maximum repair time of about four hours is required when a complex pole structure is damaged due to say, a vehicle running into it.

Distribution automation equipment installed over recent years has allowed Westpower to quickly diagnose and locate rural faults, and then restore supply remotely to adjacent areas without having to get staff on site.

Spares of all types of conductor and poles are kept in stock to cover most eventualities. Access to other network company's stocks is likely in the event of a major disaster.

3.3.6 33 kV Cables

In Westpower's case, the highest voltage underground cables it operates are at a voltage of 33 kV. These are of standard Paper-Lead construction (PILCSWA) over a very short distance of less than 100m with backup, as feeder cables at its Dobson Substation.

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, repair times are critical. Underground cables are the major constraint in this area.

3.3.6.1 Hendrix 33 kV Spacer Cable

In South Westland, there are two sections of fully insulated 33 kV overhead conductor, both constructed using the Hendrix Spacer Cable System.

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 this cable also runs close to Lake Wahapo (this uses three separate, fully insulated conductors, held apart by insulated spacers).

The Hendrix system has a 40 year track record in the United States and has proven to be very reliable.

Spacer cable was installed for a 6 km stretch of line around Lake Mapourika in 2000, and this replaced the existing Aerial Bundled Cable (ABC) system that had proved to be unreliable.

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 ten metres, and supported by a separate, high strength catenary wire (Figure 3.7).

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 quickly because there is no need to apply stress control measures when jointing.

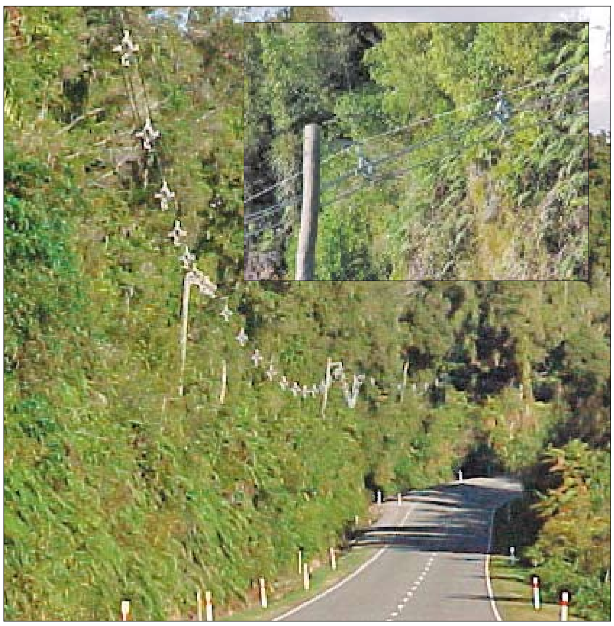


Figure 3.7 - Hendrix 33kV Spacer Cable

3.3.7 Condition of Specific Line Components

3.3.7.1 Wood Poles

The Greymouth-Kumara 66 kV line was constructed in 1977 using untreated hardwood poles and these are now beginning to shows signs of deterioration. However, approximately 50% of the line had ground line preservation work done on it in the early 1990's, which should extend the life of the poles involved. Over the next few years, condition assessment of the line will be stepped up and it is likely that a pole replacement programme will be initiated toward the end of the planning period.

The 33 kV line south of Hokitika to Harihari was

constructed in the mid 1960's and a large proportion of the untreated hardwood poles have now reached replacement criteria. A pole replacement programme was initiated in 2008 and this is expected to continue through until 2012.

3.3.7.2 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 ten 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 60 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.

3.3.7.3 Insulators and Insulator Fittings

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

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

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

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

3.3.8 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, its existence owes much to the line's heritage as a Transpower asset. The road is in excellent condition for the purpose intended.

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

No specific access roads have been constructed to gain access to the Greymouth-Kumara or Mt Hercules lines.

A contingency sum is included in the annual budget to provide maintenance on already formed access roads.

3.4 Distribution Assets

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

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

Figures 3.8 and 3.9 show the extent of Westpower distribution line assets spread throughout the length of the West Coast.

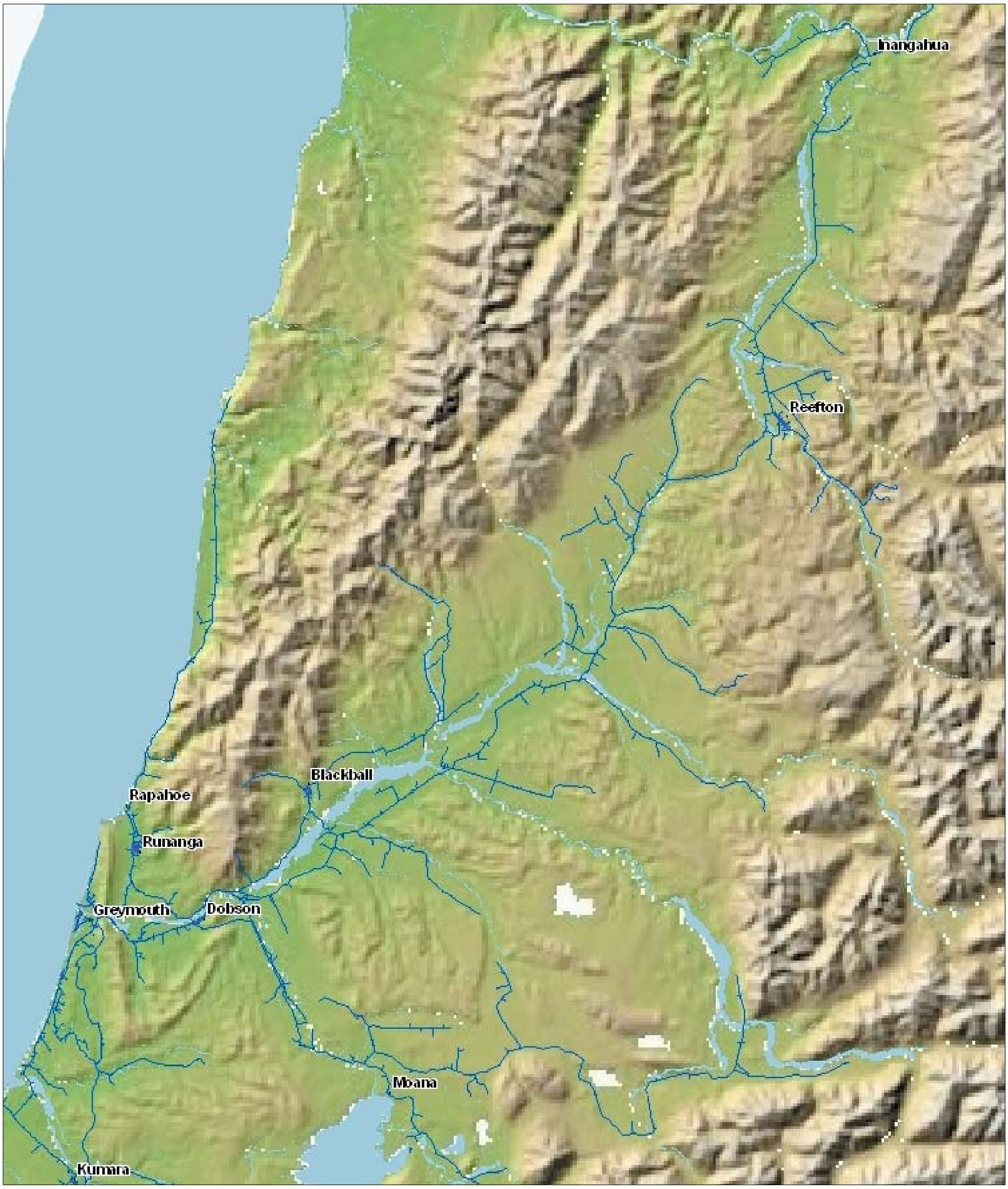


Figure 3.8 - Northern Section of Westpower's Distribution 11kV Line Assets

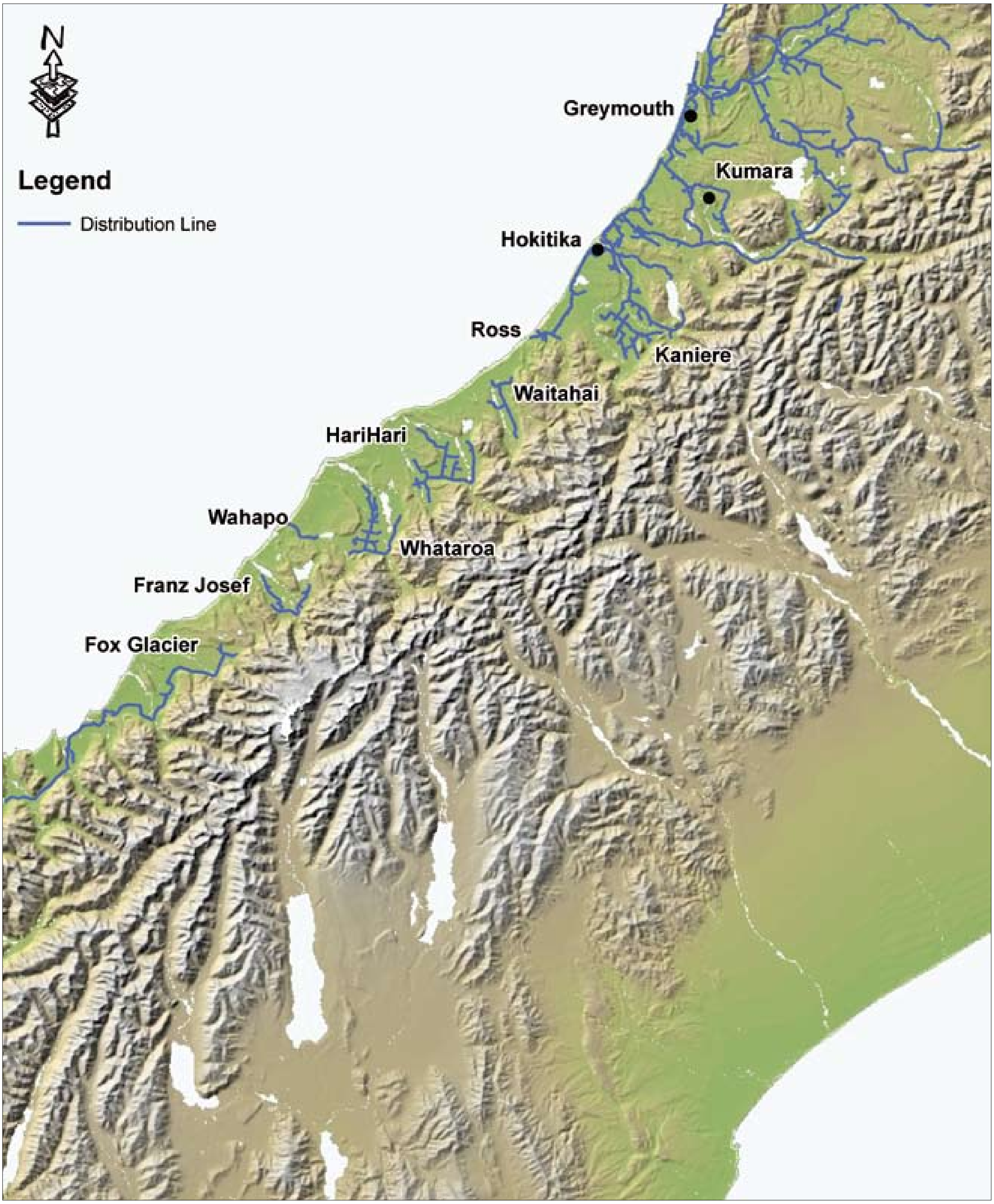


Figure 3.9 - Southern Section of Westpower's Distribution Line Assets

3.4.1 Asset Justification

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

3.4.2 11 kV Overhead Lines

Table 3.5 below lists the total overhead distribution line assets owned by Westpower.

Table 3.5 - 11 kV Lines Summary	
Type	Circuit Length (km)
Light Overhead	1060
Medium Overhead	373
Heavy Overhead	7

Westpower owns a large variety of distribution lines and cables that cover a wide age profile. Overhead lines cover three broad groups including

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

Since 1972, most of the major lines have been reconstructed with concrete poles and AAAC or ACSR aluminium conductors and this has resulted in a few remaining pockets of earlier hardwood lines in the Greymouth and Reefton areas. 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.

Softwood or concrete poles are used for all replacement or new construction work and these types make up over 60% of the pole population. An example of a modern construction is shown in Figure 3.10.

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.

Figure 3.10 - Modern Line Construction

3.4.2.1 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 20 years.

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 three broad groups.
Figure 3.11 shows the age profile of distribution lines, by circuit kilometre.

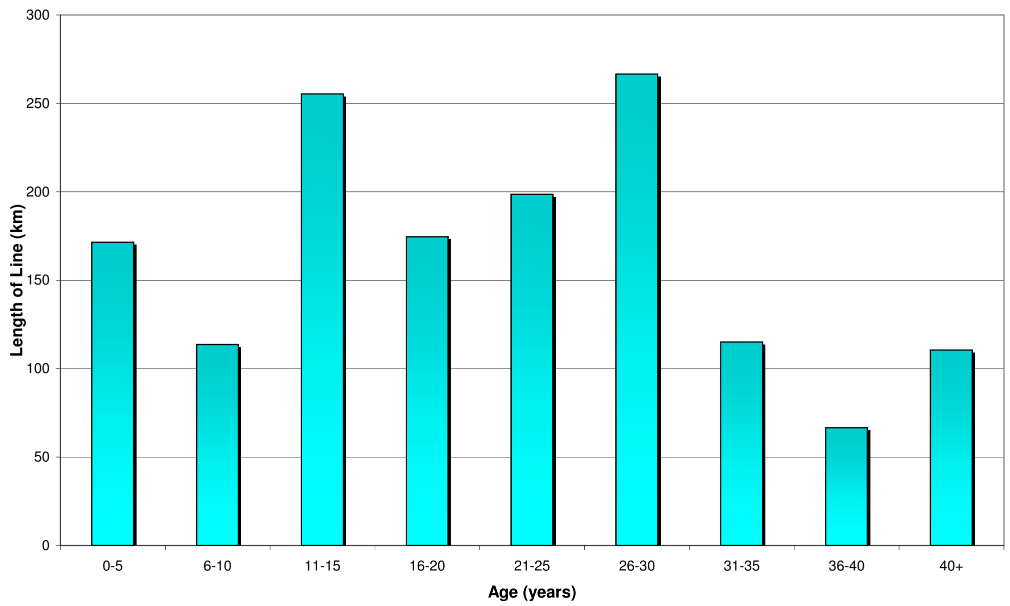


Figure 3.11 - Distribution Line Age Profile

3.4.2.2 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.

3.4.2.3 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.

3.4.2.4 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.

3.4.3 11 kV Distribution Line Components

Table 3.6 summarises the present numbers of specific distribution line components.

Table 3.6 - Summary of Distribution Line Components			
Components		**No.**	**%**
Structures (11 kV)			
Poles-Wood	Hardwood	2663	20%
	Silver Pine	29	0.23%
	Softwood	1046	8.05%
	Treated	70	.54%
	Larch	6	.05%
Poles-Concrete	Hokitika	2981	22.95%
	Stresscrete	6092	46.9%
	Spuncrete	17	.13%
	Buller	26	0.2%
	Other	60	.46%
Total Structures		**12,991**	**100.0%**
Crossarms			
	11 kV	22277	70%
	400 V	7906	25%
	Service	1502	5%
Total Crossarms		**31685**	**100.0%**
Conductors and Accessories			
	11 kV Conductor (km)		1465
	400 V Conductor (km)		131
Insulators	11 kV	98237	61%
	400 V	47287	30%
	Service	14390	9%
Total Insulators		**159914**	**100.0%**

3.4.3.1 Wood Poles

There are approximately 3800 distribution wood poles in service. An estimated 338 poles (2%) are assessed to be currently at replacement criteria, or to reach it within five years. Approximately another 506 (3%) are estimated as needing to be replaced between 2009 and 2014.

3.4.3.2 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 ten years to determine what, if any, replacement programme should be undertaken.

3.4.3.3 Insulators and Insulator Fittings

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

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

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

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

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

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

3.4.4 11 kV Cables

The majority of Westpower's underground HV cable network consists of 11 kV cable of both Paper-Lead and XLPE construction. Both of these are dry-type constructions that allow for joints to be readily made within four hours after the fault has been located and the trench dug.

In the Greymouth area, the reticulation in the Central Business District (CBD) consists of a double-redundant ring of 11 kV cables. At least two separate HV cables would have to fail to cause an outage of a distribution transformer. Even if this was to happen, the LV networks are highly interconnected and would continue to supply most of the load.

All of Westpower's cables are operating well within their thermal ratings, even taking account of the possibility of poor thermal resistivity backfill.

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

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

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

Table 3.7 shows the distribution of 11kV underground cables in the Westpower network.

Table 3.7 - 11 kV Undergound Cable Summary

Type	Circuit Length (km)
Heavy Underground	0
Medium Underground	16
Light Underground	43

3.5 Reticulation Assets

DRC - $5,306,762
ODRC - $5,306,762

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

3.5.1 Asset Justification

Once the electricity is 'stepped-down' from 11,000 volts to 415 volts at distribution substations, the 415 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.

3.5.2 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 20 years with underground cable.

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

Westpower currently owns 169 circuit 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.

Many of the factors described in Section 3.4 – "***Distribution Assets"*** – applies equally to their low voltage counterparts.

In general, the age distribution of this asset shows an average age of around 20 years. Figure 3.12 shows the age distribution profile for these assets.

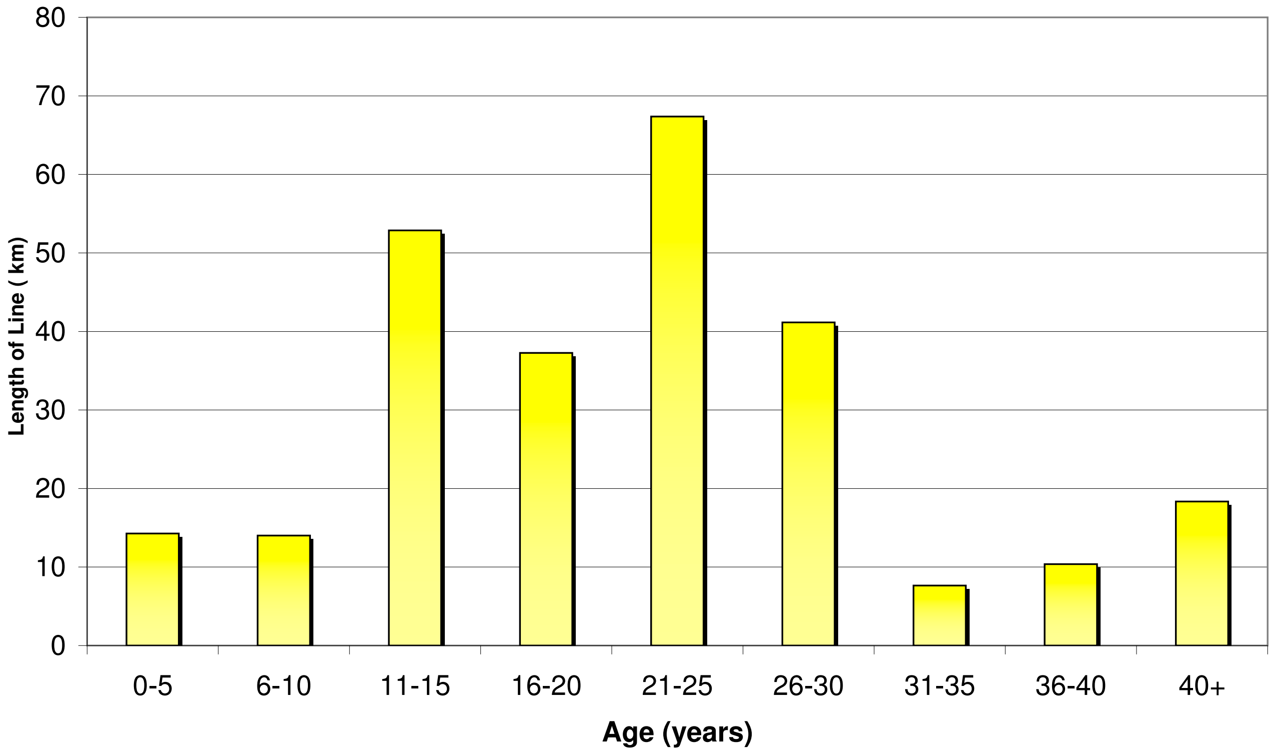


Figure 3.12 - 400V Reticulation Line Age Profile

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.

Table 3.8 lists a summary of 400V overhead lines in the Westpower network.

Table 3.8 - 400 V Lines Summary	
Type	**Circuit Length (km)**
Light	107
Medium	62
Heavy	0

3.5.2.1 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.

3.5.2.2 Greymouth

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

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

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

3.5.2.4 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.

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.

Table 3.9 shows the distribution of 400 V Underground Cable.

Table 3.9 - 400 V Underground Cable Summary

Type	Circuit Length (km)
Light	87
Medium	0
Heavy	0

3.5.3 Condition of Specific LV Line Components

3.5.3.1 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.

3.5.3.2 Conductors and Conductor Accessories

All of the overhead lines constructed over the last 20 years consist mainly of PVC covered All Aluminium Conductor (AAC) and are in generally good condition.

For a further period of about 20 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 40 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.

3.6 Services

DRC - $637,381
ODRC - $637,381

This asset consists of the equipment used to connect approximately 12,000 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 11 kV circuit breaker and in this situation the connection asset would be an 11 kV disconnector.

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

3.6.1 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.

3.6.2 Service Line Condition

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.

3.7 Zone Substations

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

Zone Substations are used to transform power from transmission and sub-transmission voltages of 33 kV 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 40 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. (Please refer to appendix C "Network Reliability by Zone Substation and Feeder" for further information).

Figure 3.13 shows the location and size of Westpower's 19 Zone Substations.

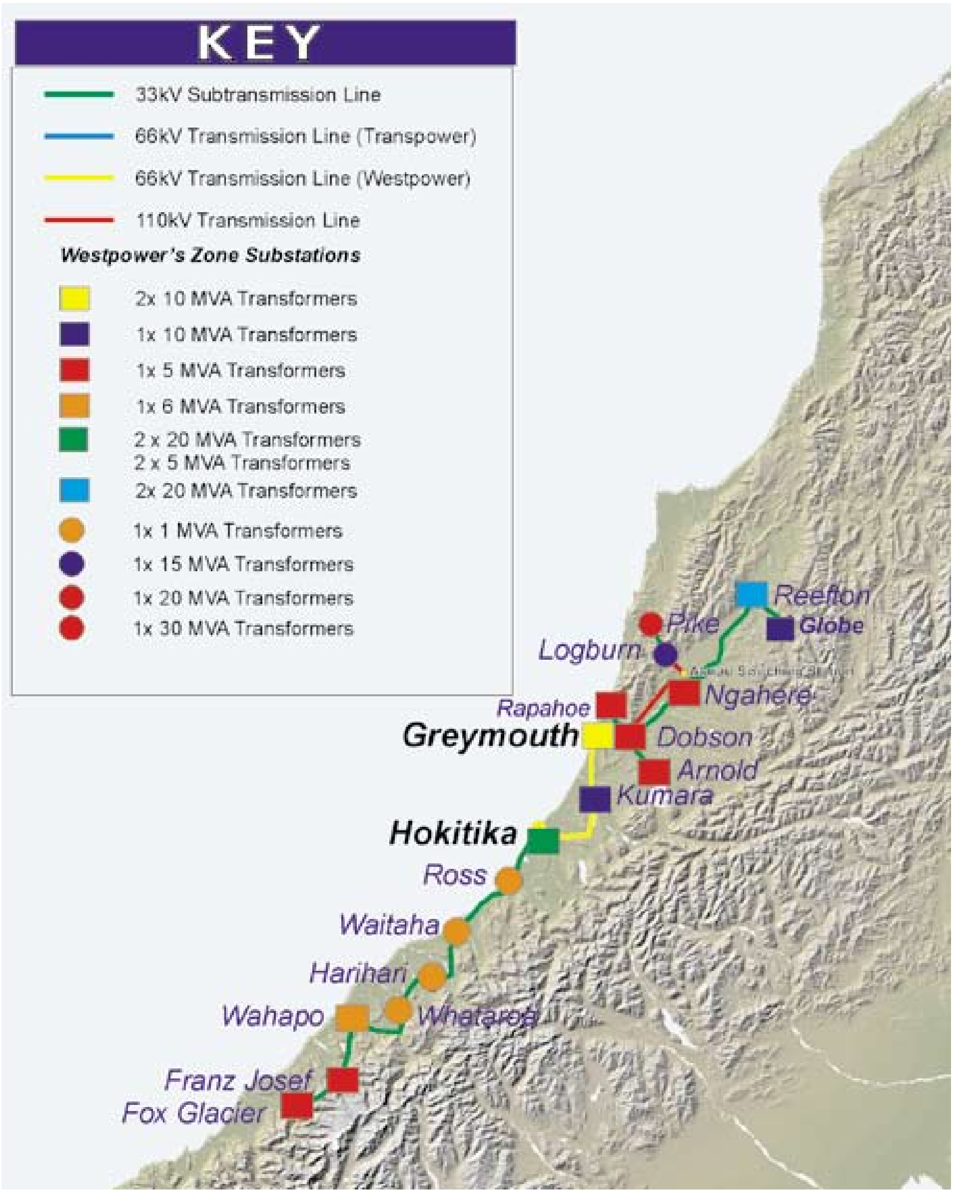


Figure 3.13 - Westpower's Zone Substations

Table 3.10 shows the zone substation capacity, asset owner and current maximum demand seen in 2008/9.

Table 3.10 - Zone Substaion Capacity and Maximum Demand				
Substation	Asset Owner	Voltage (kV)	Present Maximum Demand. (MW)	Transformer Capacity (MVA)
Greymouth	Westpower	66	12.73	2 x 10/15
Hokitika	Westpower	66	18.03	2 x 15/20
Kumara	Westpower	66	79.38	10
Dobson	Transpower	33	9.83	2 x 10/20
Otira	Transpower	11	0.69	1 x 5
Reefton	Westpower	110	7.9	2 x 20/30
Ngahere	Westpower	33	3.42	1 x 5
Arnold	Westpower	33	2.74	1 x 5/6.25
Rapahoe	Westpower	33	3.18	1 x 5/6.25
Ross	Westpower	33	0.43	1 x 1
Waitaha	Westpower	33	0.25	1 x 1
Harihari	Westpower	33	0.74	1 x 1
Whataroa	Westpower	33	0.80	1 x 1
Wahapo	Westpower	33	2.92	1 x 6
Franz Josef	Westpower	33	1.89	1 x 6
Fox Glacier	Westpower	33	1.1	1 x 5
Globe	Westpower	33	5.045	1 x 8/10
Logburn	Westpower	110	1.69	1 x 20/30
Pike	Westpower	33	1.69	1 x 15/20

Figure 3.14 shows 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 Figure 3.15.

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

Figure 3.14 - Greymouth Zone Substation

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

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

Westpower also owns a number of nominal 5 MVA substations, which are similar to the Arnold construction shown in Figure 3.16.

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

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

Figure 3.15 - Whataroa Zone Substation

Figure 3.16 - Arnold Zone Substation

3.7.1 Asset Justification

Zone Substations are required to break down sub-transmission voltages (110,000 volts, 66,000 volts and 33,000 volts) to the local distribution voltage of 11,000 volts. These assets form an integral part of the supply chain and are strategically spread throughout Westpower's area.

3.7.2 Power Transformers

Westpower has 27 power and earthing transformers installed at its Zone Substations, (as opposed to distribution transformers, which are used in Distribution Substations). Of these, 15 are fitted with on-load tapchangers.

Table 3.11 gives the general details of the power transformer population.

Table 3.11 - Summary of Power Transformers

Type	110 kV	66 kV	33 kV	11 kV	Total Units
Power Transformers					
Supply 3 phase	3	5	17	0	25
Subtotal	3	5	17	0	25
Other Transformers					
Earthing	0	0	2	1	3
Voltage Regulating	0	0	0	9	9
Subtotal	0	0	2	10	12
Total Transformers	**3**	**5**	**19**	**10**	**37**

Most of the larger (above 1 MVA) power transformers are three phase units fitted with on-load tapchangers.

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

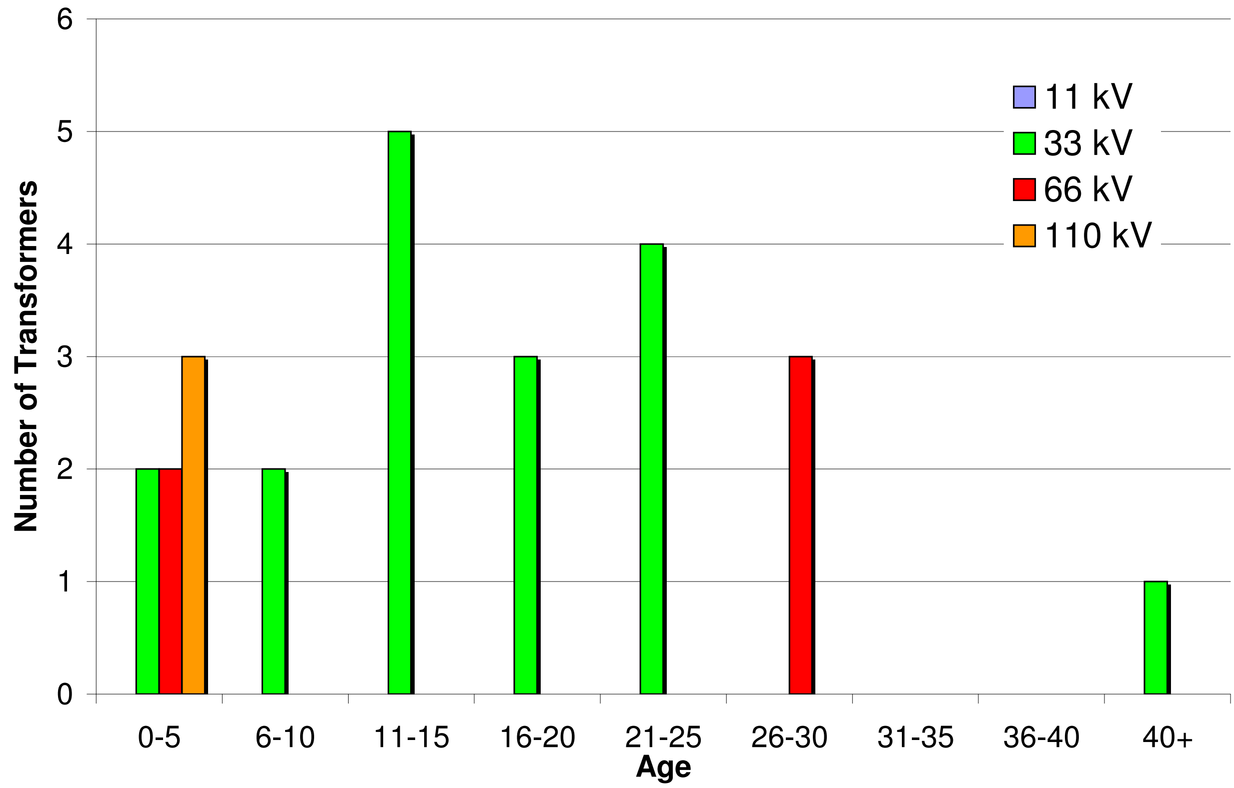


Figure 3.17 - Power Transformers Age Profile

3.7.3 Switchgear

Table 3.12 summarises the present asset mix for this equipment used in Zone Substations.

Table 3.12 - Circuit Breakers					
Type	**110 kV**	**66 kV**	**33 kV**	**11 kV**	**Total Units**
Outdoor					
SF_6	3	10	6	0	**19**
Minimum Oil	0	2	0	0	**2**
Oil Recloser	0	0	0	0	**0**
Vacuum Recloser	0	0	20	16	**36**
Total Outdoor	**3**	**12**	**26**	**16**	**57**
Indoor					
SF_6	0	0	0	4	**4**
Vacuum	0	0	1	52	**53**
Metalclad Panels (Bulk Oil)	0	0	0	3	**3**
Total Indoor	**0**	**0**	**1**	**60**	**60**
Total Circuit Breakers	**3**	**12**	**27**	**76**	**117**

3.7.4 Oil Containment

Oil containment facilities have been installed at major substations constructed since 1993, including Dobson, Globe, Logburn Road, Pike, Fox Glacier, Reefton, Arnold and Hokitika substations. These facilities have also been retrofitted at the Greymouth, Kumara, Wahapo, Rapahoe, Ngahere and Franz Josef Substations.

3.7.5 General Condition

All of Westpower's Zone Substations are less than 30 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 following is a list of recently built Zone Substations;

- A new 110/33/11 kV Zone Substation was built at Reefton in 2005.
- A new 110/33/11 kV Zone Substation was built at Logburn Road in 2007.
- A new 33/11/6.6 kV Zone Substation was built at Globe in 2006
- A new 33/11 kV Zone Substation was built at Pike in 2007.

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

3.7.5.1 Transformers

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

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

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

In September 2000, a 1984 Tolley 5 MVA 33/11 kV transformer failed catastrophically after a series of heavy line faults. While the unit was successfully repaired, a failure mode analysis revealed a design fault whereby the windings were insufficiently braced to withstand strong short-circuit forces. This particularly affected the tertiary winding. As a result of this, both the faulted unit and a sister unit purchased at the same time were fully refurbished. Both units are now expected to give good service for at least another 30 years.

3.7.5.2 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 20 years.

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

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

3.7.5.3 Minimum Oil Switchgear

66 kV Minimum Oil Circuit Breakers were supplied during the late 1970's. They are physically smaller than Bulk Oil Circuit Breakers, containing a much lower volume of oil, which leads to high electrical stresses and

their performance is more susceptible to maintenance standards. Rigorous maintenance schedules need to be strictly adhered to, to prevent failures from occurring.

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

Notwithstanding the above, experience from Transpower suggests that these units are reaching the end of their useful life and are to be replaced. Two of these units (66 kV) remain in the Westpower network at Greymouth substation and will be replaced during this financial year.

3.7.5.4 Outdoor Switchgear

This population has an age profile as shown in Figure 3.18.

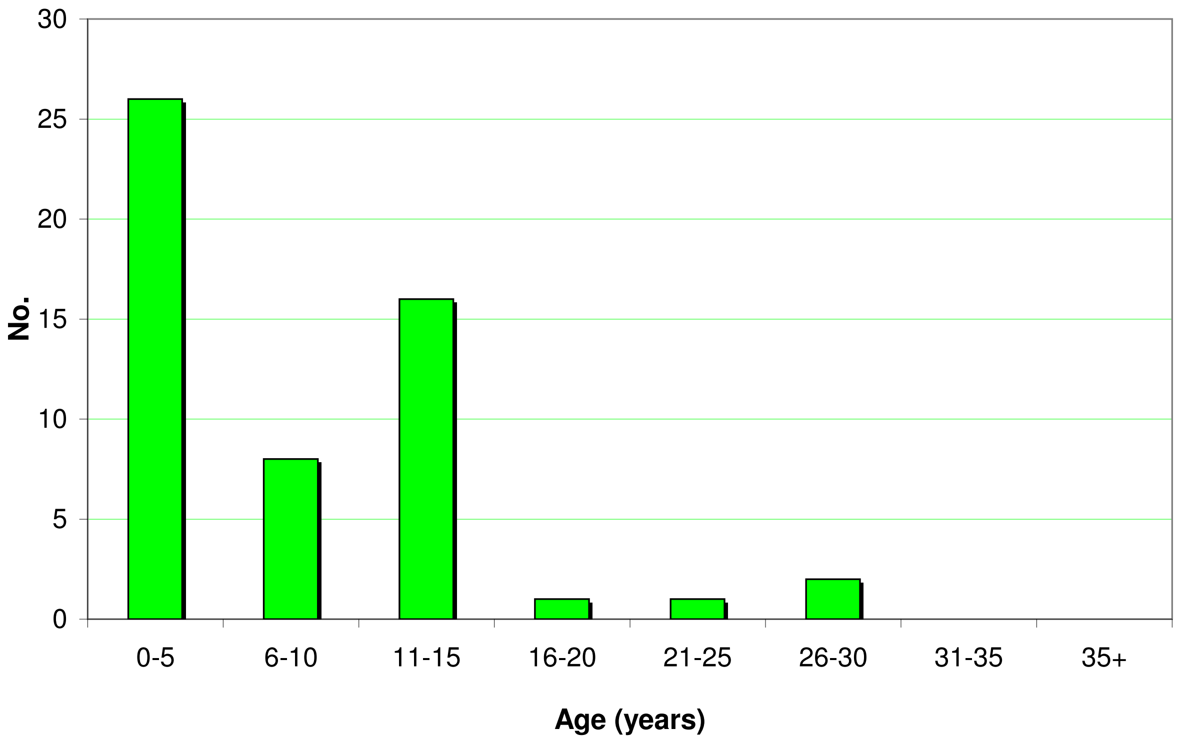


Figure 3.18 - Outdoor switchgear ages - Age Distribution of Westpower Outdoor Switchgear (Zone Substations)

CIGRE studies indicate typical replacement ages of 40-45 years for circuit breakers rated at 80 kV and below.

3.7.5.5 Indoor Switchgear

Westpower indoor switchgear installations comprise 61 switch units in seven locations. These comprise the following types:

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

In early 1999, Westpower's oldest 11 kV indoor switchgear at Kumara was upgraded with the retrofitting of SF6 circuit breaker trucks. A life expectancy of 30 years is now expected from this equipment.

A potential reliability problem was identified with the indoor bulk oil switchgear at Greymouth after a series of catastrophic failures elsewhere in New Zealand. Prior to this the SO-HI type equipment used has had a

chequered history, suffering from low internal clearances, resin insulation breakdown and poor immunity to water ingress. Furthermore, these indoor circuit breakers, while being relatively young at an average age of 22 years, had been subjected to a heavy-duty cycle throughout their lives. Accordingly this switchboard was replaced with new vacuum circuit breakers during 2003.

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

Figure 3.19 shows the age profile of Westpower's Indoor switchgear.

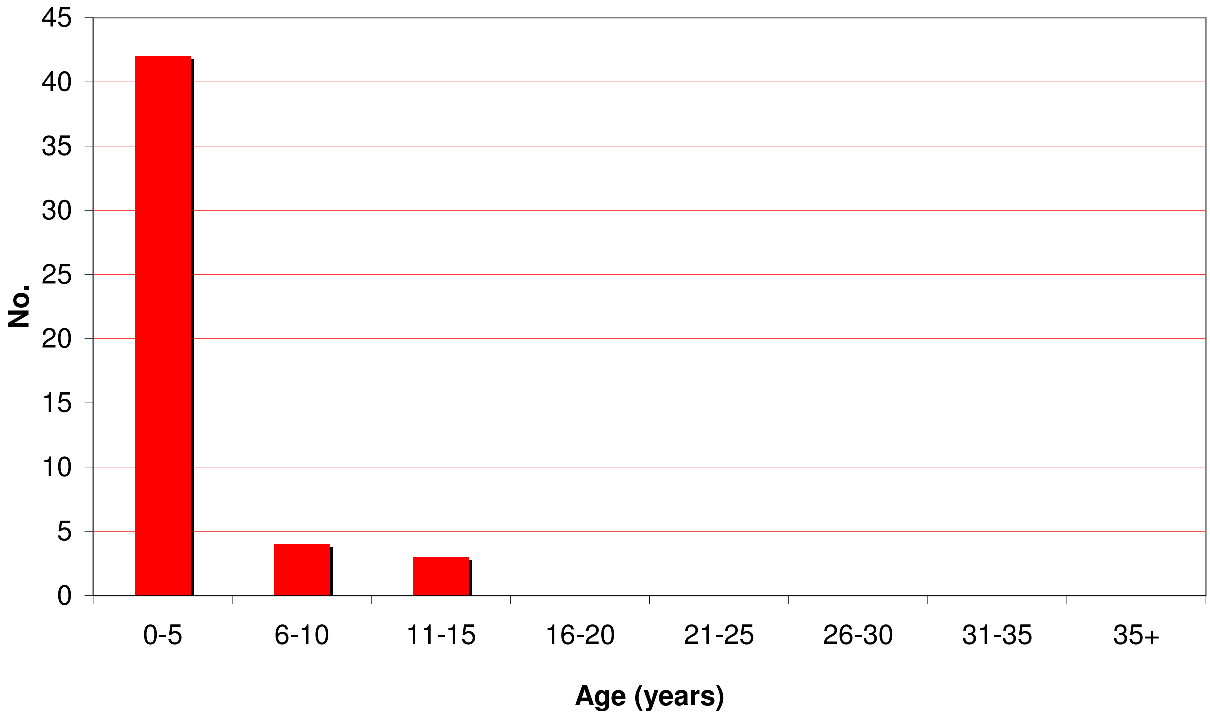


Figure 3.19 - Age Distribution of Indoor Switchgear

3.7.5.6 Disconnectors

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

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

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

Some of the older Canterbury Engineering type DA2 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.

3.7.5.7 Buswork

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

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

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

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

3.7.5.8 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 110 kV. It is estimated that the average age is over 15 years and only a small percentage is in excess of 30 years of age.

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

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

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

3.7.5.9 Oil Containment

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

3.7.5.10 Earthing Systems

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

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

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

3.7.5.11 SCADA Remote Terminal Units

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

3.7.5.12 Protection Relays

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

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

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

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

3.7.5.13 Other Station Equipment

Battery banks at stations were originally fitted with automotive lead-acid type cells, which typically give a life of about ten 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.

Safety permit rope and stands are also part of the station inventories.

3.8 Distribution Substations

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

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

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

Figure 3.20 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.

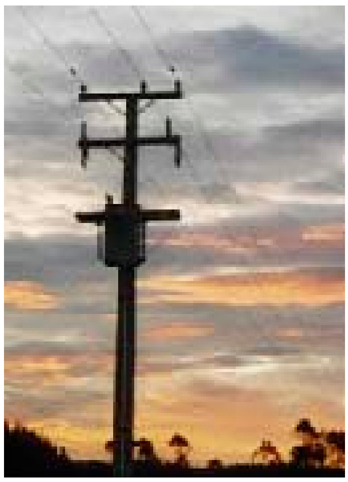


Figure 3.20 - Typical Distribution Substation

In addition to these items, larger substations rated at 100 kVA and above, such as that shown in Figure 3.21 will often have the following additional components:

- Galvanised Steel Platform
- Maximum Demand Indicator

Figure 3.21 - Distribution Substation >100 kVA < 200 kVA

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 as shown in Figure 3.22.

Extra assets required for these substations are;

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

Table 3.13 lists the overall range and transformer capacities of the Distribution Substation sites, sub-totalled by number and total capacity.

All substation data including servicing records are stored in the Maximo system. In addition, all substations are logically linked to individual Installation Control Points (ICPs) for the purposes of outage notifications and network reliability analysis.

3.8.1 Asset Justification

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

3.8.2 Distribution Substation Condition

Within Westpower's network there are around 2200 distribution substations comprising single and three phase units ranging from 5 kVA to 1.5 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.

Figure 3.22 - Pad Mount Substation

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

3.8.3 Distribution Transformers

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

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

A so-called stainless-steel tank was also trialed for a short period, but the poor quality tank material exhibited low corrosion resistance and the unit was no longer accepted.
All units used in Westpower's network must now have galvanised or coreten tanks and use stainless steel bolts to maintain resistance from corrosion.

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

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

Two three-phase 33 kV/400 V units were purchased specifically to supply the remote South Westland broadcasting site at Mt Hercules, one unit maintained in service and the other kept as a spare.
Single-phase 33 kV/400 V units supply customers in the South Westland area remote from Westpower's distribution network, but close to the Hokitika-Harihari 33 kV line. The customers accept that no spare will be provided for these units.

Table 3.13 summarises the Distribution Transformers by type and size.

Table 3.13 - Distribution Substation Transformers Number and Capacity						
KVA	INSIDE		PAD		POLE	
	1	3	1	3	1	3
5					19	1
7.5					29	
10					253	16
15				1	559	64
16.5						1
20					33	27
22.5					1	
25					2	21
30		4	1	3	50	536
35						1
40					1	
50				4	1	159
75				4		74
100	4	1	1	25	1	67
125		2		1		11
150		1		1		28
175						1
200		1		75		30
250		1		2		4
300		4		41		7
325		1				1
500		8		30		8
750		1		8		
1000		7		5		
1500		1				
SUBTOTAL	**4**	**32**	**2**	**200**	**949**	**1057**
TOTAL						**2244**

Figures 3.23 and 3.24 shows the age profile and KVA profile of the Distribution Transformers respectively.

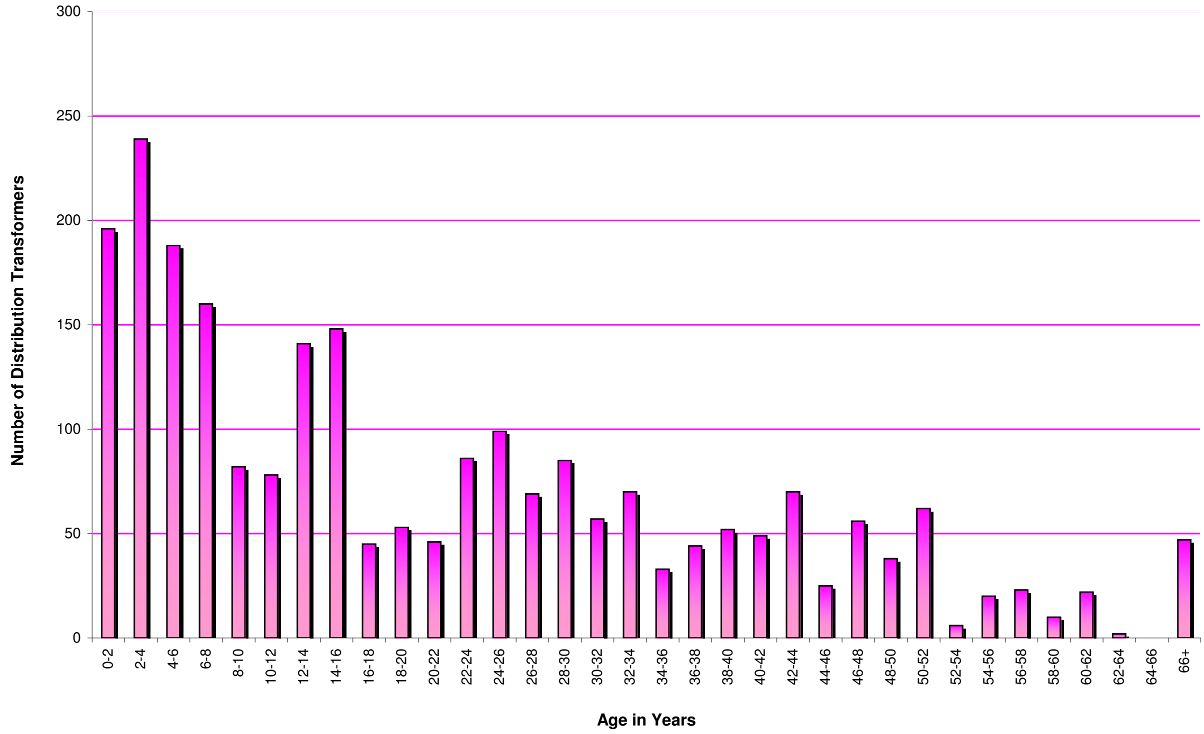


Figure 3.23 - Age Distribution of Transformers

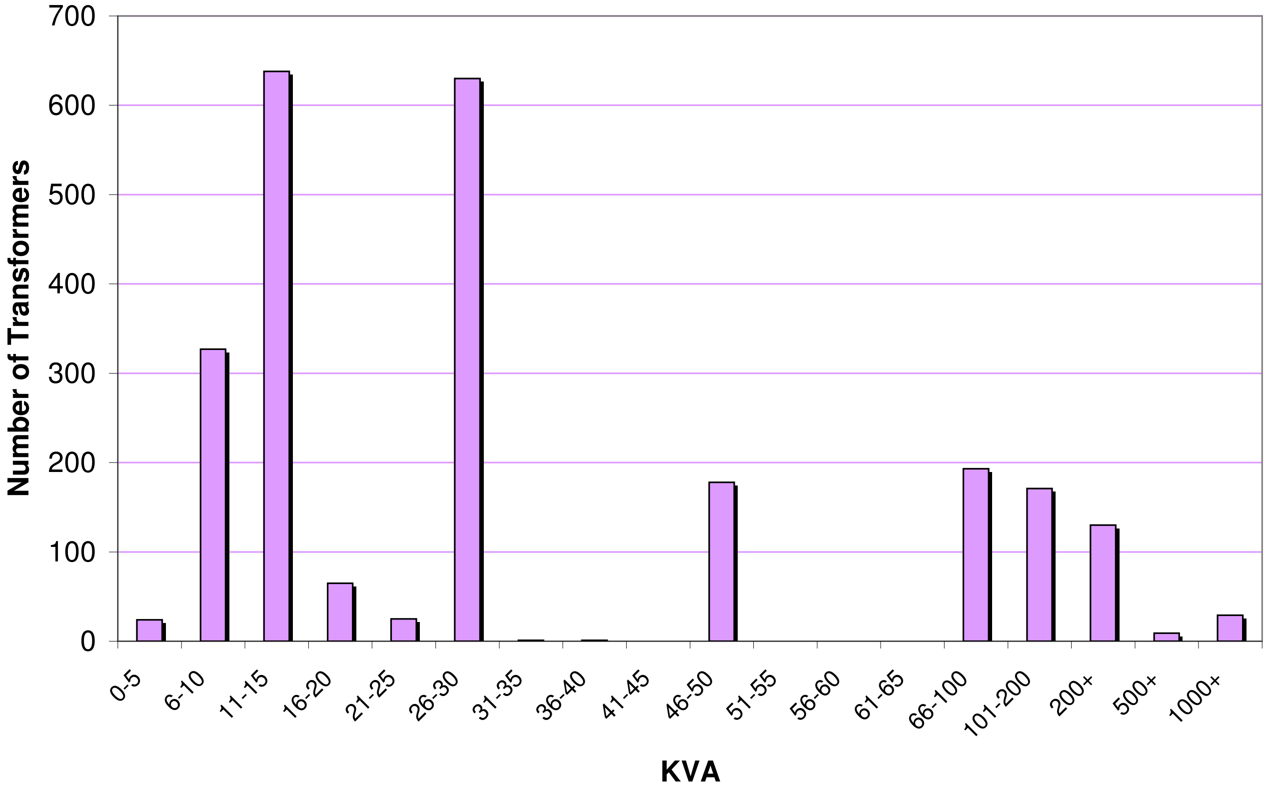


Figure 3.24 - KVA Profile of Distribution Transformers

Table 3.14 summarises the population of distribution transformers.

Table 3.14 - Summary of Distribution Transformers				
	Primary Voltage			
Type	**66 kV**	**33 kV**	**11kV**	**Total Units**
Power Transformers				
Distribution 1 phase	0	4	953	957
Distribution 3 phase	0	5	1282	1287
Total Transformers	**0**	**9**	**2235**	**2244**

3.8.3.1 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 Table 3.14.

3.8.3.2 Distribution Transformer Condition

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 six to ten 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.

3.8.4 Dominion Drop Out (DDO) Fuses

As a standard design policy, a DDO fuse unit fuses all the distribution transformers, which are fed directly from an overhead high voltage line.

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

3.8.5 Earthing Systems

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

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

Based on experience, it is expected that during the testing phase, several substandard earthing installations will be identified that are capable of being practically upgraded. A programme of upgrading these earth systems using driven rods and extra copper conductor will follow on directly from the earth testing exercise.

3.9 Medium Voltage Switchgear

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

This class of equipment includes:

- Regulators
- Disconnectors
- 11 kV circuit breakers
- Reclosers
- Sectionalisers
- Ring main units
- 11 kV 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 11 kV lines with significant loads near the end. Westpower has such installations at Longford Corner (near Kokatahi), Cronadun (north of Reefton), the Haupiri area and a 33 kV regulator at Harihari.

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

Westpower has used a range of reclose equipment over the last fifty years, but has now standardised on the use of G & W VIPER-ST vacuum reclosers and enter load break switches for all future installations.

A typical recloser can be seen in Figure 3.25.

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

The Ring Main Units are mainly Reyrolle or ABB “Safelink” type, SF6 insulator or ABB “SD” oil insulator and are all less then 25 years old.

There is one remaining Andelect Ring Main Unit.

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.

Fig 3.25 - Typical Recloser

Table 3.15 summarises the present population of MV Switchgear.

Table 3.15 - MV Switchgear			
Type	**33 kV**	**11kV**	**Total Units**
Disconnectors	3	511	514
Load Break Disconnectors	0	22	22
Motorised Disconnectors	7	20	27
Vacuum Recloser	1	30	31
Ring Main Unit	0	40	40
Dry Switch Unit	0	2	2
Total Units	**11**	**625**	**636**

3.9.1 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.

3.9.2 Medium Voltage Switchgear Condition

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 most of these units being replaced over the last five years using new SF6 units. Westpower no longer use Series I Anderlect 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 3.9.6.

3.9.3 Regulators

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

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

With the increasing load at Fox, present peak at about 50 A, the 100 A regulators capacity was limited. These regulators were replaced with 200A units in 2008.

The line regulator at Cronadun, is an old tap-changing unit purchased second-hand from Transpower. This unit is reaching the end of its economic life and requires constant maintenance. Spare parts are hard to source and the unit is costly to maintain. This regulator is to be replaced with refurbished (ex Fox) 100A units this year.

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

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

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

3.9.4 Circuit Breakers

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

3.9.5 Pole Mounted Reclosers

There are 26 pole mounted 11kV reclosers at various locations throughout the network. 24 of the reclosers are remote controlled from SCADA. These reclosers are a combination of Cooper type KFME, KFE and KF reclosers.

This year all KF type reclosers are to be replaced will be replaced. Over the next four years all Cooper type reclosers are to be replaced with G & W Viper ST reclosers with SEL651R protection relays.

3.9.6 Disconnectors

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

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

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.

3.10 SCADA, Communications and Protection

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

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

3.10.1 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.

3.10.2 *Supervisory Control and Data Acquisition System (SCADA)*

Westpower's Master SCADA Station is based upon the RealFlex 6 product supplied by DATAC operating on IBM Server hardware running a QNX Neutrino operating system.

In 2004, a major upgrade of the Human Machine Interface took place which involved windows based clients running on standard desktop networked pc's. Additionally, storage of historical data was moved from the proprietary QNX file structure to the more open MySQL DBMS. Both of these changes led to significant improvements in both the flexibility and reliability of the system. With the main SCADA engine being upgraded to RealFlex 6 in 2006, Westpower has extended the life of its current SCADA platform significantly.

Figure 3.26 SCADA Master Station

The Human Machine Interface (HMI) data and control is now accessed via Flexview PC software, which is run in the control room on a standard Windows XP PC fitted with dual 19 inch LCD. This gives the operator the ability to not only view SCADA data but also simultaneously use any other PC software. The ability of Flexview to run on PC's allows the SCADA information to be viewed from almost anywhere within Westpower's computer network. Figure 3.26 shows the SCADA Master station layout.

The information viewed within Flexview is captured by RealFlex which runs on a pair of dedicated HP ProLiant DL140 Intel XEON Servers located in the secure server room, one being the online server while the other acts as a hot standby in case of hardware failure. These servers were upgraded this year to the latest version of RealFlex and run on an operating system called QNX Neutrino RTOS which is similar to UNIX, and provides a network operating system (NOS) designed for real-time application such as SCADA.

All vital SCADA equipment is powered via the Uninterruptible Power Supply (UPS) which provides an eight-hour backup in case of a major power outage. Furthermore, a 3-phase generator has been installed to provide power to all equipment including the UPS, further extending this back-up period if required. Figure 3.27 shows the 3-phase generator used.

Figure 3.27 - 3-Phase Generator

3.10.3 *Remote Terminal Units (RTUs)*

RealFlex has the ability to communicate with many different types of RTU's and field equipment such as protection relays and PLC's via most of today's standard communication protocols.

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

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

A feature of these units is the pre-emptive communications protocol, which allows the RTU to be polled very infrequently, while at the same time providing the 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. Figure 3.28 shows a typical Abbey TopCat installation.

3.10.4 Communication System

Westpower Communications Network provides vital SCADA, Telephony and Tele-protection services for the Westpower Distribution Network, Transpower Transmission Network, TrustPower and Pike River Coal. The Communication Network is a mix of Fibre, VHF Radio, UHF Radio and Digital Radio.


Figure 3.28 - Abbey TopCat

3.10.5 Communication Cables

A fibre optic cable runs from the server room in the Tainui St building to the Greymouth Substation. This fibre link is used for speech, SCADA and surveillance monitoring of Greymouth Substation.

A second fibre cable runs from the server room to Chapel St. This fibre link is used for SCADA and offsite computer backups.

3.10.6 VHF Network

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

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

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

3.10.7 UHF Network

The UHF network is used exclusively to provide communication paths for the aging Dataterms currently installed at the Whataroa and Wahapo substations.

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

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

Mains power is reticulated to all of these sites.

3.10.8 Digital Network

The digital radio network consists of a mixture of Radio technologies. Mostly consisting of Licensed point to point radio frequencies. Digital radio links provide IP and where required serial and voice channels to all Westpower major substations. Current sites covered by Digital network are Greymouth, Dobson, Hokitika, Reefton, Ngahere, Arnold, Rapahoe, Kumara, Globe, Logburn and Pike Substations.

3.10.9 Protection

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

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

Due to the high maintenance costs and spare parts unavailability for these reclosers, Westpower has decided to develop a program to replace them by 2013/2014. The new recloser approved by Westpower is a G & W Viper-ST controlled by SEL651R protection relay.

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

All other protection systems are included in the Section 3.7, Zone Substations.

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

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

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

3.10.10 Communication System Condition

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 existing UHF analogue system in South Westland will be maintained for several years.

3.11 Ripple Injection Plants

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

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

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

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

Hokitika and Greymouth have Enermet SFU-K303 series 120 kVA injection plant installed while Dobson and Reefton have Enermet SFU-K 203 series 80 kVA plants. All plants have associated injection transformers, coupling cells and high voltage circuit breakers. In all cases, the injection plant and major coupling cell components are housed inside a building.

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

All plants are controlled remotely by SCADA Load Management System and locally via Abbey Powerlink Injection controllers.

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

Later this year we will be installing a stand alone ripple plant at Wahapo zone substation. This will be installed in the existing shed and will be used on occasion to provide ripple control to South Westland area when Wahapo generation is running islanded from the remainder of Westpower's network.

This plant will consist of the best available parts from the de-commissioned Plessey TR series 75 kVA plants at Reefton, Greymouth and Hokitika.

3.11.1 Asset Justification

Ripple injection plants are a key part of Westpower's demand side management strategy and are used to send ripple signals to receivers in customer's premises that allow interruptible loads such as water heating to be

switched on or off. This is critical to maximise use of existing assets and avoid unnecessary asset expenditure to cover unnecessarily high peak demands.

3.11.2 Ripple Control Condition

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.

All ripple injection plants are either new or in good order, as would be expected from their age profile.

3.12 Optimised Assets

Other than the following Asset optimisation there has been no other over-design or over investment in the Westpower network. Table 3.16 summarises the Optimised Assets.

In the case of the Hokitika-Harihari 66 kV line, this was purchased from Transpower in 2001 and has only been running at 33 kV since 1993, when a physical optimisation took place. The new generation scheme for South Westland (Harihari and Waitaha) planned for 2011/2012 and 2014/2015 respectively will involve re-commissioning the 66 kV voltage level and upgrading the existing conductor and the connected substations from 33 kV to 66 kV.

Table - 3.16 Optimised Assets

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

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

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

3.13 Generation

Westpower currently owns no generation plant, but is planning to re-enter this market segment through a joint venture with other partners to construct 6 MW and 20 MW hydro schemes near Harihari and Waitaha respectively.

Customer embedded generation onto the Westpower network (greater than 1MW) is as shown in Table 3.17.

Table 3.17 - Trustpower Embedded Generation

Site	Owner	Year in Service	KW Generated	Connection Point	Connection Voltage
Arnold Power Station	TrustPower	1932	3,000	Arnold	11 kV
Dillmans Power Station	TrustPower	1928	3,500	Dillmans	11 kV
Kumara Power Station	TrustPower	1928	6,500	Kumara	11 kV
McKays Creek	TrustPower	1931	1,100	McKays Creek	11kV
Wahapo	Trustpower	1991	3,000	Hokitika	11 kV

TrustPower owns all of this generation plant and are connected to the 11 kV Westpower Network.

3.14 Load and Customer Characteristics by GXP

As discussed in Section 3.1, Westpower is supplied by six GXP's spread throughout its area. The following discusses the load characteristics and large consumers in each of the areas supplied by these GXP's.

Reefton (RFN110)

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

The load is characterised mainly by dairy farming and domestic load, although there is some small commercial load in the town of Reefton along with some mining.

Table 3.18 shows the bulk customers supplied from this GXP.

Table 3.18 - Bulk Customers from Reefton GXP

Bulk Load	Load Type	Load Size
Solid Energy - Terrace Mine	Underground Coal Mine	700 kW
Oceana Gold Limited - Reefton Gold Project	Open Cast Gold Mine	5000 kW

Dobson (DOB033)

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

This GXP covers a wide area with a mix of farming, industrial, residential and holiday home load, but relatively little commercial load. It was originally constructed to supply the town of Greymouth and the coal mining load in the lower Grey Valley and Runanga areas, but was situated too far from Greymouth township to supply the growing load there, and a separate GXP was constructed in Greymouth in the late 1970's.

Table 3.19 shows the bulk customers supplied from this GXP.

Table 3.19 - Bulk Customers from Dobson GXP		
Bulk Load	**Load Type**	**Load Size**
Solid Energy - Spring Creek Mine - Dunollie	Underground Coal Mine	6200 kW
Roa Coal Mine - Roa (near Blackball)	Underground Coal Mine	1000 kW
Stillwater Lumber - Stillwater Sawmill	Timber Mill	800 kW
CMP - Phoenix Meat Works, Kokiri	Abattoir	1200 kW

Greymouth (GYM066)

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

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

Table 3.20 shows the bulk customers supplied from this GXP.

Table 3.20 - Bulk Customers from Greymouth GXP		
Bulk Load	**Load Type**	**Load Size**
Kingsgate - Kingsgate Hotel - Greymouth	Hotel	300 kW
Westfleet - Westfleet Fish Processing - Greymouth	Fish Processing Plant	300 kW
Fresh Choice - Greymouth	Supermarket	250 kW
Monteiths Brewery - Greymouth	Brewery	200 kW
New World - Greymouth	Supermarket	310 kW
The Warehouse - Greymouth	Retail Store	180 kW
Coast Health - Greymouth Hospital - Greymouth	Hospital	410 kW
IPL - Plywood - Gladstone	Timber Processor	550 kW

Kumara (KUM066)

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

Apart from the significant generation, the load type is mainly farming and rural residential, although there is one significant industrial load connected to this GXP as shown below in Table 3.21.

Table 3.21 - Bulk Customers from Kumara GXP		
Bulk Load	**Load Type**	**Load Size**
IPL - Plywood Mill - Gladstone	Timber Processor	800 kW

Otira (OTI011)

The load at Otira is totally isolated from other GXP's, and apart from a small hotel and a few houses and baches, the majority of the load consists of the fan motors for the Otira tunnel. This is detailed in Table 3.22 below.

Table 3.22 - Bulk Customers from Otira GXP		
Bulk Load	**Load Type**	**Load Size**
Tranz Rail - Otira	Fan Load	750 kW

Hokitika (HKK066)

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

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

Table 3.23 shows the bulk customers supplied from this GXP.

Table 3.23 - Bulk Customers from Hokitika GXP		
Bulk Load	**Load Type**	**Load Size**
Westland Dairy - Hokitika Dairy Factory - Hokitika	Milk Processing Factory	7500 kW
Westco Lagan - Ruatapu Sawmill - Ruatapu	Timber Mill	850 kW
Mair Venison - Hokitika Venison Factory - Hokitika	Venison Abattoir	250 kW
New World - Hokitika	Supermarket	250 kW
Westland Motor Inn - Franz Josef	Hotel	400 kW

3.14.1 Voltage Support Systems

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

Table 3.24 shows the schedule of voltage regulators installed in Westpower's network.

Table 3.24 - Voltage Regulators		
Regulator Site	**Voltage**	**Size**
Cronadun (north of Reefton)	11 kV	2250 kVA
Longford Corner (east of Hokitika)	11 kV	2000 kVA
Haupiri (east of Dobson)	11 kV	2000 kVA
Harihari	33 kV	10000 kVA

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

In addition to voltage regulators, a number of high voltage capacitors have been strategically installed throughout the 11 kV distribution network. This improves the apparent power factor of the loads seen from Transpower's GXPs, resulting in improved voltage regulation throughout the West Coast. It also improves the voltage profiles in individual 11 kV feeders leading to improved capacity and reduced losses.

Capacitors have been installed at various locations throughout the 11 kV network. There are a total of 17 capacitor sites, varying in size from 0.3 MVAR to 1.2 MVAR, with a total of 11.8 MVAR. All of these capacitor locations are less than eight years old and are a combination of pad mount and pole mounted. All of the above are under Westpower operational control.

All of the capacitors installed in the network are fixed, as opposed to switched, capacitors although switched banks do exist inside Greymouth, Hokitika and Franz Josef Zone Substations. The Franz Josef switched capacitors bank is low voltage.

Table 3.25 details the 11 kV distribution capacitors installed on Westpower's network and the Zone Substation that they are connected to.

Table 3.25 - Capacitors

Location	Zone Substation	Voltage	Capacity
South Highway 6 - Hokitika	Hokitika	11 kV	1000 kVAr
Kaniere Tram	Hokitika	11 kV	1000 kVAr
Strongman	Rapahoe	11 kV	1000 kVAr
Fox Glacier	Fox Glacier	11 kV	500 kVAr
Reefton Saddle	Reefton	11 kV	500 kVAr
Kokiri	Arnold	11 kV	1200 kVAr
Wahapo	Wahapo	11 kV	500 kVAr
Solid Energy Bath House	Rapahoe	11 kV	1000 kVAr
Punakaiki	Rapahoe	11 kV	500 kVAr
Rotomanu	Arnold	11 kV	500 kVAr
Kokatahi	Hokitika	11 kV	1000 kVAr
Kotuku	Arnold	11 kV	500 kVAr
Haupiri	Arnold	11 kV	300 kVAr
Gladstone	Greymouth	11 kV	1000 kVAr
Gladstone	Kumara	0.4 kV	500 kVAr
Roa Mine (Switched)	Ngahere	0.4 kV	500 kVAr
Ikamatua (Switched) (Temporary)	Ngahere	0.4 kV	500 kVAr
Chesterfield	Hokitika	11 kV	500 kVAr
Kapitea	Hokitika	11 kV	500 kVAr
Franz Josef (Switched)	Franz	0.4 kV	500 kVAr
Waiuta	Reefton	11 kV	300 kVAr

In addition, a 7 MVAR capacitor bank at Greymouth substation and a 5 MVAR bank at Hokitika substation are under Transpower operational control.

3.15 Westpower Mobile Substation

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

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

This substation can be used to

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

This is one of only two such substations that Westpower is aware of and the only one in the South Island, but has improved security and reliability in Westpower's network. It has so far been used on five occasions saving loss of supply or extra cost from temporary hire of generators.

Figure 3.29 shows the completed substation.

A number of substations have been modified to accommodate the mobile substation and this modification programme will continue throughout this planning period. The Zone Substation sites prepared for WMS connection so far are Arnold, Dobson, Ngahere, Rapahoe and Franz Josef.

Figure 3.29 Westpower's Mobile Substation

Zone substation sites to be prepared for WMS connection this financial year are to be completed in the following order:

- Wahapo
- Whataroa
- Waitaha
- Harihari

The following WMS connections will be required for maintenance this financial year:

- Wahapo – 11kV bus extension, T1, T1 OLTC overhaul and general zone substation maintenance.
- Whataroa – T1 & R1 regulator maintenance.

3.16 Substation Buildings

Westpower have a number of building of different types located around their network some house substations and some house control equipment. Table 3.26 lists the buildings within the Westpower network, their location, purpose and type of construction.

Table 3.26 - Summary of Substation Buildings

Building Location	Purpose	Materials of Construction
Arnold Substation	Storage and office	Light timber Framed
Badger Lane Substation	Swichgear	Permanent
Dobson Substation	Control equipment	Transportable sandwich panels
Fox Substation	Control equipment	Transportable sandwich panels
Franz Josef Substation	Control equipment	Light timber Framed
Greymouth Substation	Switchgear & control gear	Permanent
Hari Hari Substation	Control equipment	Transportable sandwich panels
Hokitika Substation	Switchgear & control gear	Permanent
Mawhera Quay Substation	Switchgear & control gear	Permanent
Rapahoe Substation	Switchgear & control gear	Light timber Framed
Ross Substation	Control equipment	Transportable sandwich panels
Wahapo Substation	Control equipment	Light timber Framed
Waitaha Substation	Control equipment	Transportable sandwich panels
Whataroa Substation	Control equipment	Light timber Framed
Wilson Lane Substation	Switchgear & control gear	Permanent
Dobson Substation	Switchgear & control gear	Light timber Framed
Reefton Substation	Switchgear & control gear	Permanent
Logburn Substation	Switchgear & control gear	Permanent
Ngahere Substation	Control equipment	Light timber Framed
Hari Hari Regulator	Control equipment	Transportable sandwich panels
Globe Substation	Switchgear & control gear	Transportable sandwich panels
Pike Substation	Switchgear & control gear	Transportable sandwich panels

Building maintenance is an important part of maintaining the condition of assets within. The condition of the buildings was assessed in the 2004 Lifelines survey report for Westpower and a number of issues were highlighted. These included checking for the presence of reinforcing steel in the early permanent buildings and ensuring that the sandwich panel buildings were restrained sufficiently to mitigate the effects of earthquake loads.

4.0 LEVELS OF SERVICE

4.1 Introduction

In order to properly manage the delivery of service to Westpower's consumers, it is critical that appropriate Key Performance Indicators (KPI's) are developed to objectively measure the performance of the network and ensure that these can be applied consistently across the network and over time. Furthermore, the KPI's must be relevant to the service being delivered and readily understandable by interested stakeholders.

Once the KPI's are created and reporting mechanisms put in place to routinely monitor them on an ongoing basis, performance targets are developed to set clear benchmarks against which the service delivery performance of the business can be assessed. This has a twofold benefit of providing:-

- A means of monitoring trends over time and measuring just how well the business is delivering service to its consumers.
- Creating realistic goals for the future that provide a clear basis for the provision of well targeted reliability maintenance or enhancement programmes.

The targets created through this process need to be consistent with Westpower's business strategies and asset management objectives, which in turn are derived from the Asset Management Policy that forms the key linkage between the corporate direction of the business and the asset management function.

Over time, the KPI's and targets will continue to be refined based on historical performance and stakeholder requirements. In addition, the targets must reflect what is realistically achievable given the current condition of the network and the financial expenditure capability of the business.

Furthermore, by adopting this approach of setting targets and then measuring performance against the targets, it is possible to objectively assess the success of programmes designed to enhance the service delivery performance of the asset and then make adjustments to provide optimum long-term outcomes.

The target levels of service may generally be subdivided into the following two main areas:-

- Consumer Oriented Performance Targets.
- Other Targets Relating to Asset Performance, Asset Efficiency and Effectiveness, and the Efficiency of the Line Business Activity.

This section explains the target levels of service that have been chosen based on the KPI's developed. Historical performance against these target levels is provided along with commentary on the reasons for any underlying trends or significant perturbations. Finally, a justification is provided for current and future target levels of service based on consumer, legislative, regulatory, stakeholder and other considerations. Included in this justification is a discussion of how stakeholder needs were ascertained and translated into service target levels.

4.2 Customer Orientated Performance Targets

The Key Performance Indices commonly used throughout the electricity industry to assess customer oriented performance are:

- SAIDI - System Average Interruption Duration Index; and
- SAIFI - System Average Interruption Frequency Index

(as defined in IEEE Std 1366:2003)

These are the same indices as required by the Commerce Act (Electricity Distribution Thresholds) Notice

2005 which currently determines the information disclosure requirements for all electricity distribution businesses. By adopting an approach consistent with this regulatory requirement, benchmarking of Westpower's performance against other EDB's is supported.

This section provides historical performance of the network according to these indices and compares them with related targets currently mandated by the targeted control regime under the control of the Commerce Commission.

Going forward, Westpower is no longer constrained by this regime and so has developed more meaningful targets that are specific to particular customer groups and types of outages as discussed in the following sections. These have been derived from historical performance as well as expectations of the impact of particular improvement initiatives that Westpower has undertaken over recent years.

4.2.1 Extreme Events

As Westpower's area is subjected to extreme weather events from time to time, it is important to disaggregate the above KPI's into baseline values, that reflect the underlying performance of the business, and extreme event values that result from environmental externalities that are beyond the reasonable control of Westpower. The baseline values (i.e. excluding major events) are the key indicators used consistently throughout this plan and the reader needs to exercise caution in comparing these normalized statistics with information published under the information disclosure regime, which includes all events.

The method of achieving the normalisation of the measured values is based on IEEE Std 1366:2003, where a Major Event Day (MED) is defined and then used as a threshold to exclude statistics that relate to a major event.

This process used to identify MEDs is termed the "Beta Method". Its purpose is to allow major events to be studied separately from daily operation, and in the process, to better reveal trends in daily operation that would be hidden by the large statistical effect of major events.

A major event day (MED) is a day in which the daily system SAIDI exceeds a threshold value, TMED. The SAIDI index is used as the basis of this definition since it leads to consistent results regardless of utility size and because SAIDI is a good indicator of operational and design stress. Even though SAIDI is used to determine the MED's, all indices should be calculated based on removal of the identified days.

In calculating daily system SAIDI, any interruption that spans multiple days is accrued to the day on which the interruption begins.

The major event day identification threshold value, T_{MED}, is calculated at the end of each reporting period (typically one year) for use during the next reporting period as follows:

a) Collect values of daily SAIDI for five sequential years ending on the last day of the last complete reporting period. If fewer than five years of historical data are available, use all available historical data until five years of historical data are available.

b) Only those days that have a SAIDI/Day value will be used to calculate the T_{MED} (do not include days that did not have any interruptions).

c) Take the natural logarithm (ln) of each daily SAIDI value in the data set.

d) Find α (Alpha), the average of the logarithms (also known as the log-average) of the data set.

e) Find β(Beta), the standard deviation of the logarithms (also known as the log-standard deviation) of the data set.

f) Compute the major event day threshold, T_{MED}, using the following equation

$$T_{MED} = e^{(\alpha + 2.5 \beta)}$$

g) Any day with daily SAIDI greater than the threshold value T_{MED} that occurs during the subsequent reporting period is classified as a major event day.

Activities that occur on days classified as major event days are excluded from the measured statistics.

Westpower has calculated a T_{MED} based on all outages recorded during a five year outage period covering April 2003 through March 2008 and this has yielded a SAIDI figure of 18.14 system minutes. Accordingly, the reported statistics have been normalized by excluding all events that had a SAIDI value in excess of this figure.[1]

Historical performance has been based on using the same number for T_{MED} in all years, as opposed to using a rolling five year data set, as there is some question around the accuracy of data collected prior to 2003.

4.2.2 Breakdown by Location

To further disaggregate the performance data and create more meaningful targets against which performance can be assessed, the data is broken down by the following locations:-

- Urban – Including major towns and isolated areas with urban characteristics (e.g. underground distribution)
- Rural – Generally farming areas outside of major towns
- Remote Rural – Areas of South Westland south of Hokitika but excluding local feeders of Ross, Waitaha, Harihari and Whataroa

The definition used for Remote Rural is slightly different than that used by the Commerce Commission (i.e. more than 75 km from the nearest base), as all of South Westland extending up to around 150 km south of Hokitika is fed by a single 33 kV feeder and analysis is greatly simplified by grouping this area together for 33 kV faults only as a mixture of areas are affected. Local faults are treated as rural as discussed above.

Figure 4.1 overleaf shows the defined areas.

4.2.3 Planned vs Unplanned Performance

In addition to the foregoing analysis of the data, namely exclusion of Major Event Days and disaggregating the reliability data by location, a further refinement has been applied by splitting the service levels into planned and unplanned (of fault) categories.The rationale behind this approach is that there are different drivers for each type of service level.

Planned outages result from scheduled maintenance activities that are often part of a proactive maintenance approach to improve the overall performance of the network over the long term. In addition, consumers are notified well in advance of a planned outage and are often able to take steps to minimize their exposure to the effects of the outage. In view of this, planned outages are less disruptive than unplanned outages. In addition, they are more acceptable to consumers in view of the perceived longer term benefits.

On the other hand, unplanned outages can cause significant economic damage to industrial and commercial consumers, while residential consumers are often significantly inconvenienced. Accordingly, consumers are less tolerant of this type of outage and separate targets need to be developed that recognize the disparity between the customer damage functions from each of these of outages.

The data included in this section of the AMP allows for this disaggregation wherever possible, including the comparison of historical performance against historical targets.

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[1]Note that this is slightly different from the Commerce Commission approach where the statistic for the MED is capped to a maximum value rather than excluded. The purpose of this service level performance exercise is best served by excluding the values so that the statistical effects of major events on daily operations are completely removed.

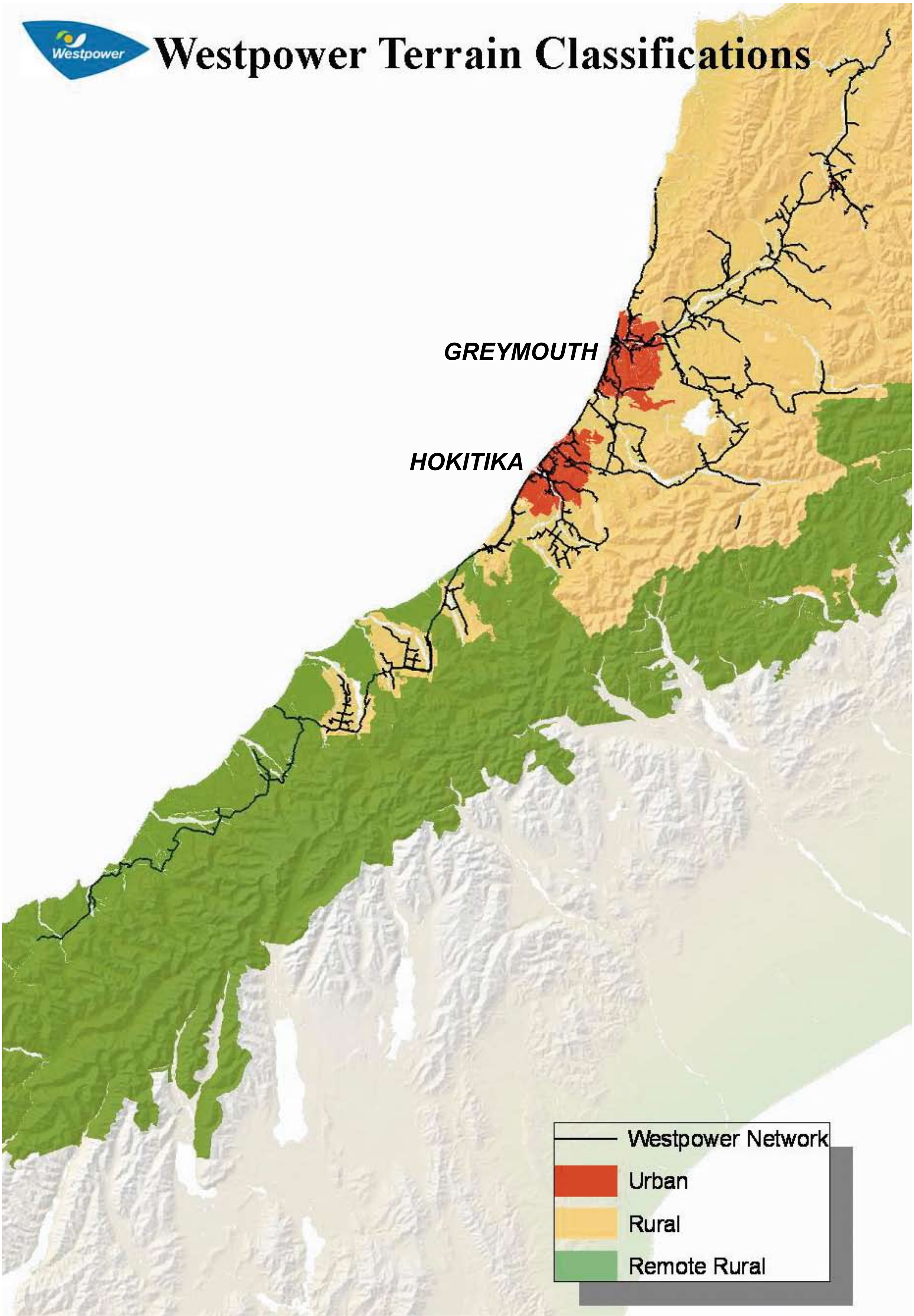


Figure 4.1 - Areas defined within Westpower's Network

4.2.4 Historical Performance

Table 4.1 - Planned and Unplanned SAIDI (Urban, Rural & Remote Rural)

		2004-05	2005-06	2006-07	2007-08	2008-09
URBAN	Planned	22.91	46.35	19.11	8.05	19.56
	Unplanned	50.69	17.87	26.34	33.12	36.21
	Total	73.60	64.22	45.45	41.17	55.78
RURAL	Planned	35.52	20.45	30.54	30.32	21.42
	Unplanned	91.05	43.44	48.70	52.08	54.91
	Total	126.57	63.89	79.24	82.40	76.33
REMOTE RURAL	Planned	12.88	9.57	6.00	6.09	2.74
	Unplanned	28.62	8.17	23.95	20.86	43.96
	Total	41.50	17.74	29.95	26.95	46.70
	Grand Total	**241.67**	**145.85**	**154.64**	**150.52**	**178.81**
	Planned Actuals	71.31	76.37	55.65	44.46	43.72
	Planned Targets	40.00	40.00	40.00	55.00	55.00
	Unplanned Actuals	170.36	69.48	98.99	106.06	154.42
	Planned Targets	70.00	70.00	70.00	95.00	95.00

Table 4.2 - Planned and Unplanned SAIFI (Urban, Rural & Remote Rural)

		2004-05	2005-06	2006-07	2007-08	2008-09
URBAN	Planned	0.12	0.15	0.10	0.03	0.08
	Unplanned	0.76	0.51	0.44	0.40	1.14
	Total	0.88	0.66	0.54	0.42	1.22
RURAL	Planned	0.16	0.08	0.20	0.10	0.12
	Unplanned	1.78	0.69	1.43	0.66	1.11
	Total	1.94	0.77	1.63	0.76	1.23
REMOTE RURAL	Planned	0.05	0.05	0.02	0.10	0.02
	Unplanned	0.33	0.29	0.35	0.12	0.65
	Total	0.38	0.35	0.37	0.23	0.67
	Grand Total	**3.19**	**1.78**	**2.54**	**1.41**	**3.13**
	Planned Actuals	0.32	0.28	0.31	0.23	0.22
	Planned Targets	0.25	0.25	0.25	0.34	0.32
	Unplanned Actuals	2.87	1.50	2.22	1.18	2.90
	Planned Targets	1.00	1.00	1.00	1.36	1.27

The above historical figures for SAIDI and SAIFI have been normalised by the removal of Major Event Days (MED's).

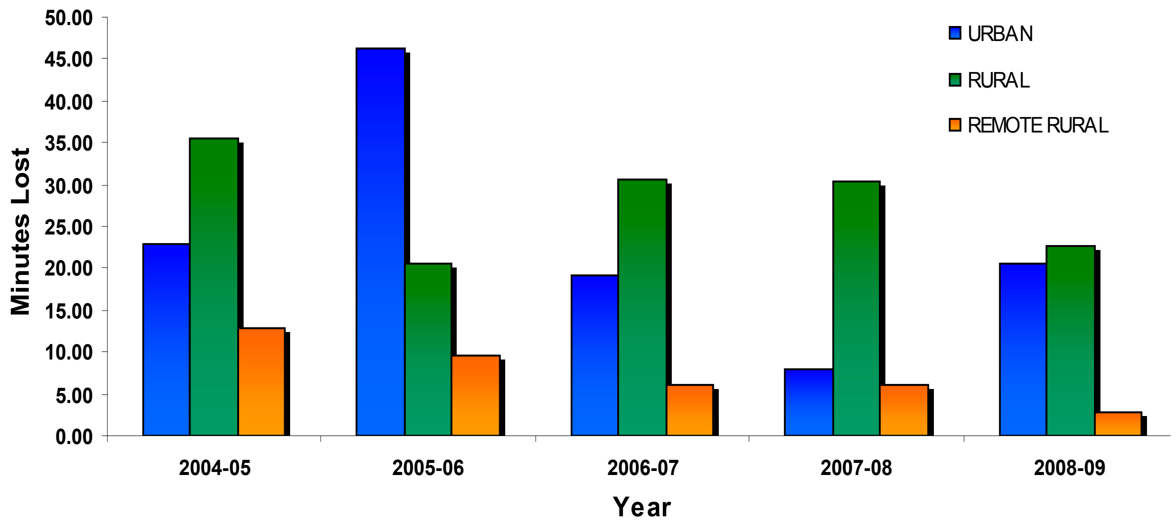


Figure 4.2 - PLANNED SAIDI Profile for Last 5 Years.

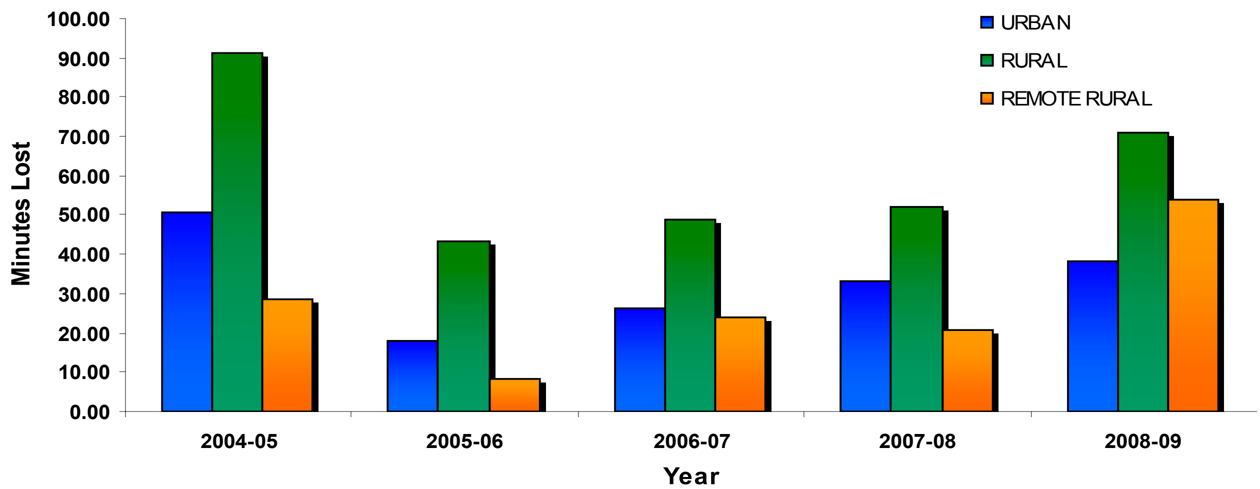


Figure 4.3 - UNPLANNED SAIDI Profile for Last 5 Years.

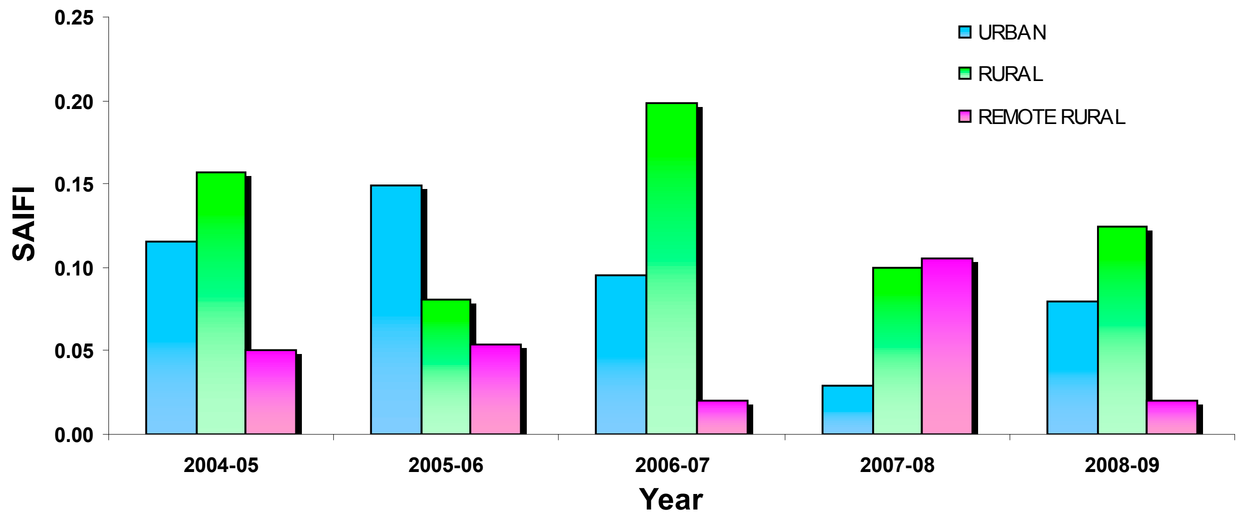


Figure 4.4 - PLANNED SAIFI Profile for Last 5 Years.

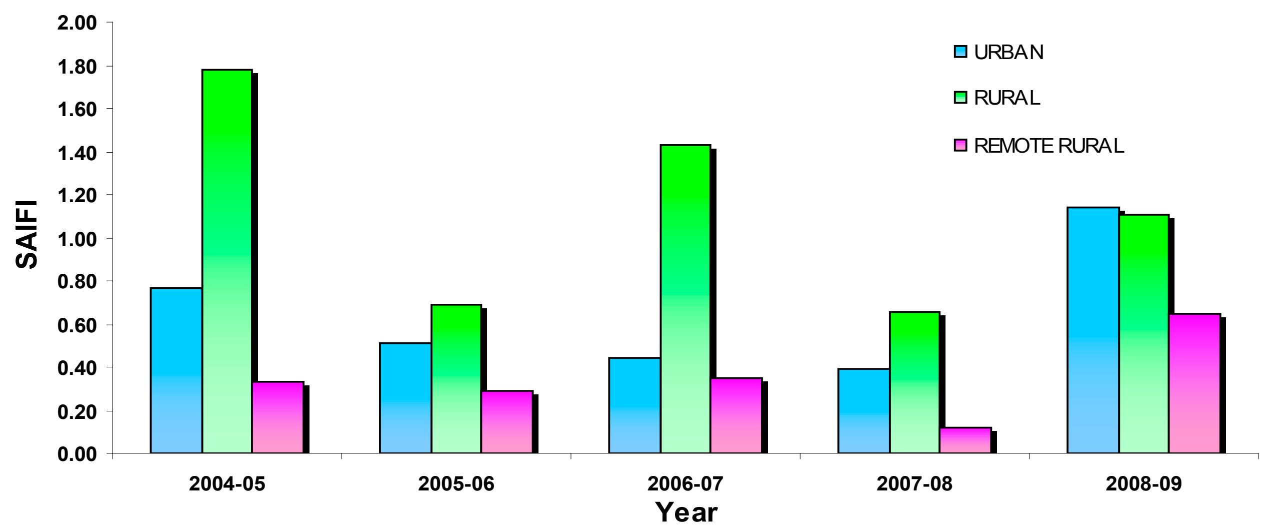


Figure 4.5 - PLANNED SAIFI Profile for Last 5 Years.

4.2.5 Performance Targets

The Table below shows the specific performance targets set by Westpower for the planning period in question.

The rationale for setting the specific target levels is discussed in Section 4.4.

Table 4.3 - SAIDI Targets Projected 10 Years

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Planned Targets	50	45	40	39	38	37	36	35	34	33
Unplanned Targets	90	85	80	79	78	77	76	75	74	73
Totals	**140**	**130**	**120**	**118**	**116**	**114**	**112**	**110**	**108**	**106**

Table 4.4 - SAIFI Targets Projected 10 Years

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Planned Targets	1.18	1.09	1.07	1.06	1.04	1.02	1.00	0.98	0.96	0.95
Unplanned Targets	0.29	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24
Totals	**1.47**	**1.36**	**1.34**	**1.32**	**1.30**	**1.27**	**1.25**	**1.23**	**1.20**	**1.19**

As these specific performance targets have only been created for the first time as part of this year's AMP, future AMP's will disclose detailed performance against each of the targets and report on any significant variances. This will provide a strong basis for the development of improvement plans that are intended to ensure long term compliance with the published targets.

In addition to the generic targets discussed above, additional targets have been developed around

1. the maximum length of outage; and

2. the number of extended faults that consumers will be exposed to in each type of area.

Table 4.5 - Other Customer Service Targets		
Service Area	**Customers Affected**	**Performance Target**
Restoration of Supply	Urban Areas	95% of faults restored within 3 hours of notification
	Rural Areas	95% of faults restored within 8 hours of notification
	Remote Rural Areas (South of Hokitika excluding local 11 kV Feeders of Ross, Whataroa, Waitaha, and Harihari)	95% of faults restored within 12 hours of notification
Customer Outage Impact	Urban Customers	No more than 2 planned outages per annum No more than 2 unplanned outages per annum (for 90 % of customers)
	Rural Customers	No more than 2 planned outages per annum No more than 4 unplanned outages per annum (for 90 % of customers)
	Remote Rural Customers	No more than 2 planned outages per annum No more than 8 unplanned outages per annum (for 90 % of customers)

These targets are constant throughout the planning period and performance against each of them will be disclosed in future AMP's.

4.3 Other Targets Relating to Asset Performance, Asset Efficiency and Effectiveness, and the Efficiency of the Line Business Activity

A small number of key asset performance and efficiency targets have been chosen that provide the reader with a clear understanding of the way the business is performing. It is felt that this is a better approach than to include a large number of less significant and often conflicting performance targets that would create unnecessary confusion.

Relevant standard performance and efficiency targets, as defined in the Electricity (Information Disclosure) Requirements 2008 have been chosen for inclusion in this AMP. These are:-

- Operational Expenditure Ratio (Operational Expenditure/System Assets Replacement Cost).
- Capital Expenditure Ratio (Capital Expenditure/System Assets Replacement Cost).
- Renewal Ratio (Asset Renewal-Refurbishment Opex and Capex/Depreciation).
- Distribution Transformer Capacity Utilisation.
- Faults per 100 circuit km (disaggregated by voltage and conductor type (overhead/underground).

These indicators will be measured in a manner that is consistent with the definitions in the Electricity Distribution (Information Disclosure) Requirements 2008.

Table 4.6 below shows the historical performance of these indices and, where appropriate, the target that existed.

Table 4.6 - Historical Performance						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**
Distribution Transformer Capacity Utilization	**31%**	**31%**	**31%**	**31%**	**31%**	**30%**
Targets	30%	30%	30%	30%	30%	30%
Faults per 100km Circuit Length	**11**	**12.9**	**4.8**	**12.3**	**16.9**	**12.4**
Targets	5.3	5.3	5.3	5.3	5.3	11.7

Based on the historical performance disclosed in Table 4.6, and targets for the financial ratios already defined in Westpower's Statement of Corporate Intent, the following targets are provided for the planning period in Table 4.7.

Table 4.7 - Future Performance of Efficency Targets Stated in Section 4.3										
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Operational Expenditure Ratio	6.4%	6.4%	6.1%	6.2%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%
Capital Expenditure Ratio	6.5%	5.7%	5.7%	5.2%	4.4%	4.4%	4.4%	4.4%	4.4%	4.4%
Renewal Ratio	127%	146%	112%	89%	63%	63%	63%	63%	63%	63%
Distribution Transformer Capacity Utilization	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Faults per 100km Circuit Length	11.3	11.0	10.7	10.4	10.0	9.7	9.5	9.2	8.9	8.6

A key performance indicator in terms of asset performance is the Faults per 100 km index and this is predicted to slowly improve over the planning period as initiatives such as better segregation of the network (more reclosers) and an improved focus on vegetation management begin to take effect.

4.4 Justification for Targets

In general, the targets reflect historic performance and consumer engagement indicates a high level of satisfaction with existing service levels. In addition, consumers have indicated an unwillingness to pay the additional costs necessary if service levels were to be significantly improved.

4.5 Stakeholder Needs

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

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

Customer Damage Function reports recently carried out on behalf of the Electricity Commission in support of Transpower's application for the West Coast Grid Upgrade Plan showed that even short outages can result in several hours of production downtime for major process-based consumers. Accordingly, solutions that provide for continuous connection to the network, rather than "change-over" schemes are preferred.

Part of Westpower's role is to maintain an efficient and reliable electricity distribution network on the West Coast. In this context, "efficiency" and "reliability" are relative terms that are subject to personal perceptions. In turn, these perceptions must be viewed from the customer's viewpoint, which must be actively sought. Westpower intends to liaise closely with the Energy Retailers to determine the expectations of their customers, and quantify these in terms of desirable reliability indices.

5.0 NETWORK DEVELOPMENT

5.1 Introduction

This section outlines the Network Development plan required to maintain, enhance and develop the operating capability of the system. The primary drivers for Network Development are described in Section 6 - Asset Lifecycle Management. Essentially they can be summarised as follows:

- Reliability/Security and Quality of Supply - to meet customer levels of service and contractual obligations.
- Occupational Health and Safety - to establish a safe working environment and comply with OSH legislative safety requirements.
- Regulatory - to meet regulations imposed by external organisations.
- Environmental - to comply with emission regulations to air, land and water.
- Asset Performance/Condition - use of historical data to asses the performance and condition of the assets and predict potential remaining life.
- Cost Efficiency - to ensure that maximum cost efficiency is achieved in accordance with asset management policy.
- Corporate Image - to ensure that any activity carried out by the Asset Management Team and subcontractors will not damage Westpower's image.

The main focus of this Network Development section is the use of condition based maintenance and risk management techniques (as described in Section 9) to programme the projects required to meet the reliability targets and remain within the budgetary limitations imposed for this planning period and to appropriately schedule network development programmes for future periods.

The Network Development programmes are outlined by asset type and, within this, according to area and then by maintenance activity as follows:

- **Maintenance**
  - » servicing, inspections and testing
  - » fault repairs
  - » planned refurbishment and renewal (including replacement at the component level)
- **Replacement**
  - » planned replacement and renewal programmes (at the asset level)
- **Enhancement**
  - » projects which will add value or capability to the network
- **Development**
  - » new projects which will expand the network

5.2 Load Forecasting

5.2.1 Introduction

A further factor in considering network development plans is the projected load growth. The projected load growth for Westpower is shown in Figure 5.1. It is anticipated that the current maximum demand of around 47.3 MW will rise to about 100 MW in ten years time.

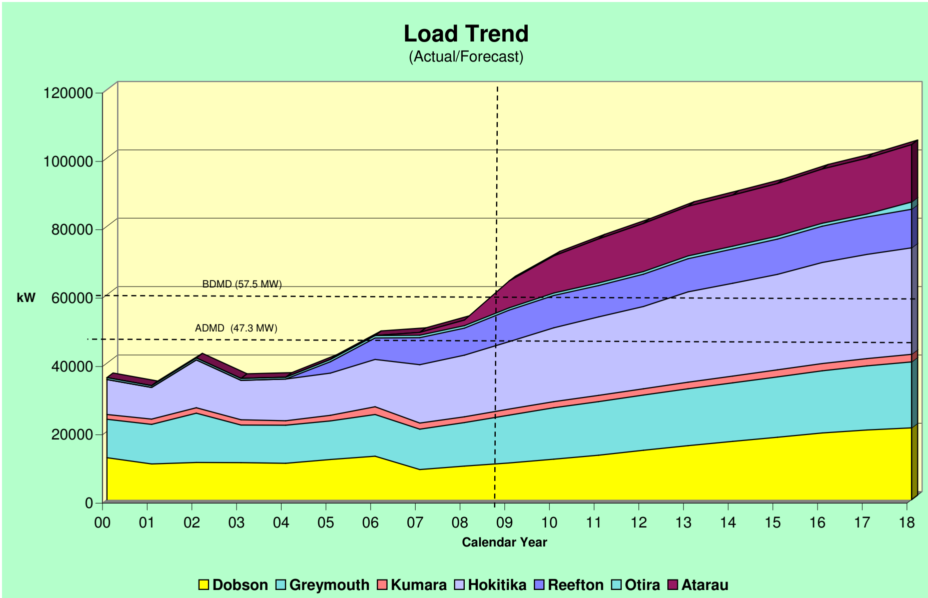


Figure 5.1 - Load Trends

Typical customer requests relate to issues of capacity, quality and or security of supply and can lead to plans for asset enhancement or development. These are outlined in Section 4 - levels of service with particular reference to Table 4.3, 4.4 and 4.5, Customer Service Targets.

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

Alternatively, network analysis including load projections at points of supply, power flows, network and point of supply performance leads to options for consideration by customers and Westpower management. Table 5.1 shows a typical example of a load trend table.

5.2.1.1 Historical Factors

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

Some of the factors that affect future load include:

- Climatic conditions
- Economic activity
- Commodity prices
- Foreign exchange rates
- Major step load increases/decreases

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

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

With the relatively small overall demand of 47.3 MW, major step load changes have a great impact on system demand. Unfortunately these are also the most difficult to predict or quantify as they depend on investment decisions from major industries. Historically, final commitments on these projects have been deferred to a very late stage, often involving significant last minute load revisions, leaving Westpower in a difficult situation from a planning perspective.

	PERCENT INCREASE OR DECREASE																		
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/2013	2013/2014	2014/15	2015/16	2016/17	2017/18	2018/19
Reefton	----------	----------	----------	----------	----------	100.00%	90.00%	25.93%	0.53%	15.69%	2.95%	-3.10%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Atarau	----------	----------	----------	----------	----------	----------	----------	100.00%	101.23%	378.84%	38.17%	18.41%	9.48%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Dobson	2.00%	-15.05%	4.48%	-0.62%	-1.82%	10.38%	8.38%	-30.66%	11.21%	9.62%	10.20%	9.75%	10.94%	9.45%	7.88%	7.16%	6.88%	4.41%	3.00%
Greymouth	2.00%	3.15%	24.06%	-23.43%	1.13%	1.58%	2.00%	2.00%	7.71%	9.71%	7.69%	4.21%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Kumara	3.00%	11.88%	5.77%	-6.57%	-11.80%	20.30%	40.63%	3.00%	-2.99%	4.59%	1.61%	1.22%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
Hokitika	3.00%	-9.33%	50.67%	-17.67%	5.52%	1.73%	11.96%	23.56%	5.41%	9.48%	9.21%	6.56%	4.65%	9.84%	2.76%	3.00%	5.72%	3.00%	2.37%
Otira	0.00%	-2.70%	-63.22%	6.83%	-11.11%	33.33%	5.97%	-1.88%	-4.92%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	132.14%
Total Load ex TPNZ	**2.00%**	**-6.56%**	**24.23%**	**-14.42%**	**0.90%**	**14.63%**	**17.08%**	**1.87%**	**7.37%**	**21.80%**	**11.43%**	**6.95%**	**5.95%**	**6.19%**	**3.82%**	**3.80%**	**4.59%**	**3.28%**	**3.98%**

	Actual kW 2000/01	Actual kW 2001/02	Actual kW 2002/03	Actual kW 2003/04	Actual kW 2004/05	Actual kW 2005/06	Actual kW 2006/07	Actual kW 2007/08	Actual kW 2008/09	Forecast kW 2009/10	Forecast kW 2010/11	Forecast kW 2011/12	Forecast kW 2012/2013	Forecast kW 2013/2014	Forecast kW 2014/15	Forecast kW 2015/16	Forecast kW 2016/17	Forecast kW 2017/18	Forecast kW 2018/19
Reefton	0	0	0	0	0	3300	6270	7896	7938	9184	9454	9162	9437	9720	10011	10312	10621	10940	11268
Atarau	0	0	0	0	0	0	0	816	1642	7863	10864	12864	14084	14507	14942	15390	15852	16327	16817
Dobson	12306	10454	10922	10854	10656	11762	12748	8839	9830	10776	11875	13033	14459	15826	17072	18295	19554	20416	21028
Greymouth	11240	11594	14384	11014	11138	11314	12197	11826	12738	13975	15050	15684	16155	16639	17138	17652	18182	18728	19289
Kumara	1364	1526	1614	1508	1330	1600	2250	1738	1686	1763	1792	1814	1868	1924	1982	2041	2103	2166	2231
Hokitika	10246	9290	13997	11524	12160	12370	13849	17112	18038	19749	21568	22982	24051	26418	27146	27961	29561	30448	31169
Otira	570	520	556	594	528	704	746	732	696	717	738	761	783	807	831	856	882	908	2108
Total Load ex TP	**35726**	**33384**	**41473**	**35494**	**35812**	**41050**	**48060**	**48959**	**52568**	**64026**	**71341**	**76299**	**80836**	**85840**	**89123**	**92507**	**96754**	**99931**	**103910**

Table 5.1 - Load Trends and Forcasts to 2018/19

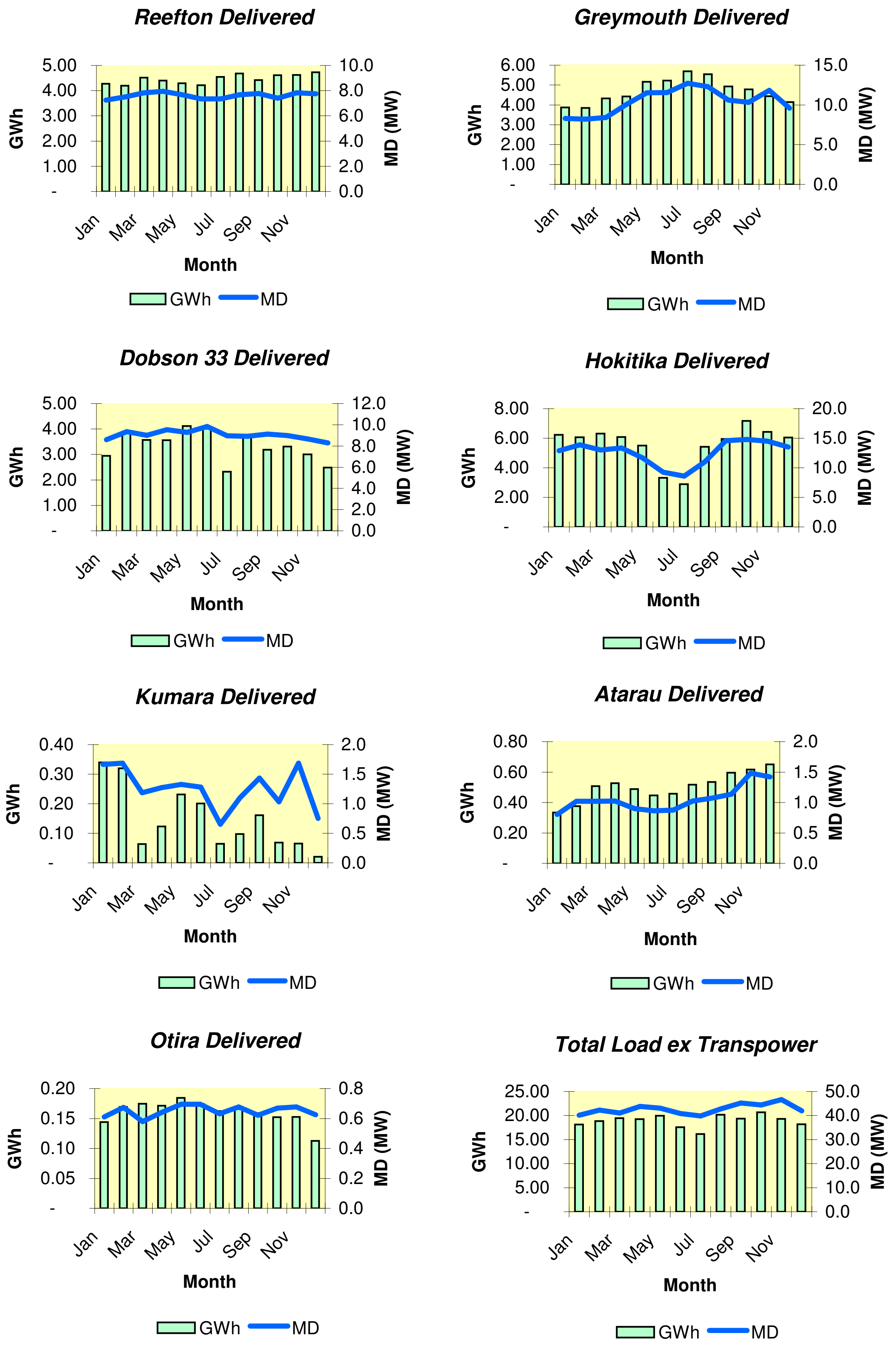


Figure 5.2 - GXP Energy and Demand Statistics - 2008

A careful and rigorous approach has been taken to developing future load projections based on historical trends, available information and estimates on future changes. These projections don't take into account any of the embedded generation on Westpower's network because the total energy delivered is not effected by them.

Firstly, load trends at each Grid Exit Point over the previous seven 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.

Figure 5.2 (previous page) shows the GXP Demand for the calender Year 2008.

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.

5.2.2 Future GXP Load Projections

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

The data collected from the customers is analysed and adjusted with a weight coefficient based on the likelihood of occurrence and the result is included into zone substation load forecast. The likelihood weight coefficients are:

- Load is **Confirmed** = 100%
- Load is **Likely** to occur = 70%
- Load is **Possible** to occur = 30%
- Load is **Speculative** = 10%

Table 5.2 below shows the current maximum demand, capacity and % utilisation.

Table 5.2 - GXP Maximum Demand and Current Capacity Utilisation

GXP Feeder	Maximum Demand (MW) 2008	**Maximum Demand (MVA) 2008	Capacity (MVA)	Utilisation %
DOB0331	9.830	10.347	20	51.74%
GYM0661	12.738	13.408	15	89.39%
KUM0661	6.677	7.028	10	70.28%
HKK0661	18.038	18.987	20	94.94%
OTI0111	0.696	0.733	10	7.33%
RFN110	7.938	8.356	30	27.85%
*ATU110 (LGN110)	1.642	1.728	20	8.64%

Strong economic growth on the West Coast coupled to the dairy, gold and coal mining industries, is underpinning a vibrant general economy. Over the next three years this effect is still expected to continue even though the recession has started spreading to the usually "recession-resistant" coal industry.

Unfortunately, severe constraints currently exist in the transmission network feeding the West Coast meaning that much of the new load must be treated as interruptible as there is insufficient *n*-1 transmission capacity available.

**The ATU switching station supplies LGN substation and therefore the utilised factor is applicable for LGN*
***The Maximum Demand (MVA) is calculated based on the assumption that the power factor is 0.95*

Clearly, the consumers involved are very concerned about the potential impact on their business and therefore they are supporting the Grid Upgrade Project submitted by Transpower to the Electricity Commission in June 2008. The development plan describes the following scope of works:

- Install a second 110 kV circuit between Reefton and Dobson.
- Install a second 110/66 kV transformer at Dobson substation.
- Install a new 14 MVAr fast switching capacitor bank at Hokitika substation.

As noted in the Grid Upgrade Project, these individual projects are required as soon as possible and hence the projects are planned to start in 2009 and finalised in early 2011. The project is not included in the Westpower AMP because it will be fully funded by Transpower.

The basis for the installation of the new 14 MVAr switching capacitor bank at Hokitika is to provide fast switching reactive support to help prevent voltage collapse in the West Coast area following a contingency.

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

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

Four of the larger industrial customers have indicated they will be increasing load over the next five years as presented below:

1. Following a resurgence in gold prices, Birchfield Minerals gold dredge, which was shut down in 2004, is now confirmed to restart in mid 2009. Estimated load is 1.3 MW at Ngahere substation.

2. Oceana Gold Limited is planning to increase its load with 1MVA at the Globe Substation, and this is likely to happen by 2009/2010.

   In addition to this, it is also investigating additional mining load in the Waiuta area with a possibility to add a further 2 MW to this figure, although this is far from committed after a false start in 2005 when the original shaft was found to be damaged beyond repair.

3. The Pike River Coal Company has begun production of coal from the new underground coal mine in the Paparoa Ranges near Atarau in the Grey Valley. All of the major construction has been finalised and the coal loading facility at Ikamatua is expected to be developed by 2010/2011 (about 0.5-1 MW). A new substation at Blackwater (BWR) is required to supply this load and will be commissioned in mid 2009.

4. Solid Energy New Zealand Limited is expecting to commission a new 8 MW drive at Spring Creek and open a new coal mine at Strongman (about 4 MW), which is likely to happen by 2011/2012. Also, they are planning to increase their load at Spring Creek mine with an additional 2 MW in 2009/2010.

   Additional to the above mentioned load, 30 new dairy farms are expected to be developed in the Fox Glacier area on the Landcorp Farming Ltd property over the next five years.

As can be readily noted, the projected *additional* demand over the next three years could potentially reach as high as 30 MW. Considering that the total system demand is around 47.3 MW with around 24 MW of this currently supplied by Transpower, the current capacity of the transmission network will effectively need to triple for the demand to be met. This issue is going to be resolved when the grid upgrade project is finalised.

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

The future zone substation load projections, as presented in the next paragraph, demonstrate that most of

Westpower's Zone Substations have sufficient capacity to deal with expected load growth throughout the planning period. Although some substations may require capacity upgrades in three to five years. Of course, as these load forecasts are subject to change, and there is considerable uncertainty as to what the load will actually be at the time the upgrade is projected, no further action is planned for the Zone Substations at this stage. A close watch on customer's load expectations and maximum demand meter readings is still required.

5.2.3 Future Zone Substation Load Projections

In addition, load forecasting is carried out at the Zone Substation level and this is critical to ensure that sufficient capacity is available in Westpower sub-transmission and zone substation infrastructure. These forecasts are developed using a zero-based approach and load demand management from information and requests received directly from customers including intelligence on future load trends such as proposed dairy farm conversions. This is termed a Load-watch.

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

A summary of the results by major Zone Substation is shown in Table 5.3.

Table 5.3 - Zone Substation Forecast Demand

	Zone Substation	Firm Cap (MVA)	Peak	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
			2008											
Block	**Arnold**	5	2.746	2.75	3.19	3.97	4.76	4.96	5.06	5.26	5.42	5.58	5.75	5.92
3% Base Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16	0.17	0.17	0.18
Loadwatch Growth				0.44	0.78	0.79	0.20	0.10	0.20	0.00	0.00	0.00	0.00	0.00
Predicted Load				**3.19**	**3.97**	**4.76**	**4.96**	**5.06**	**5.26**	**5.42**	**5.58**	**5.75**	**5.92**	**6.09**
Block	**Blackwater**	5	0.00	0.00	1.65	1.70	1.75	1.80	2.40	2.48	2.55	2.63	2.70	2.79
3% Base Growth				0.00	0.05	0.05	0.05	0.00	0.07	0.07	0.08	0.08	0.08	0.08
Loadwatch Growth				1.65	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**1.65**	**1.70**	**1.75**	**1.80**	**2.40**	**2.48**	**2.55**	**2.63**	**2.70**	**2.79**	**2.87**
Block	**Dobson**	5	3.893	3.89	4.21	4.52	4.83	5.33	5.83	6.03	6.23	6.48	6.68	6.88
3% Base Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.20	0.21
Loadwatch Growth				0.31	0.31	0.31	0.50	0.50	0.20	0.20	0.25	0.00	0.00	0.00
Predicted Load				**4.21**	**4.52**	**4.83**	**5.33**	**5.83**	**6.03**	**6.23**	**6.48**	**6.68**	**6.88**	**7.08**

	Zone Substation	Firm Cap (MVA)	Peak	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Block	**Fox Glacier**	5	0.242	0.24	0.37	0.50	0.60	0.69	0.71	0.73	0.76	0.78	0.80	0.83
3% Base Growth				0.01	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Loadwatch Growth				0.12	0.12	0.10	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**0.37**	**0.50**	**0.60**	**0.69**	**0.71**	**0.73**	**0.76**	**0.78**	**0.80**	**0.83**	**0.85**
Block	**Franz Josef**	5	1.890	1.89	2.83	4.00	5.07	6.04	6.35	6.45	6.64	6.84	7.04	7.25
3% Base Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.20	0.21	0.21	0.22
Loadwatch Growth				0.94	1.17	1.07	0.98	0.30	0.10	0.00	0.00	0.00	0.00	0.00
Predicted Load				**2.83**	**4.00**	**5.07**	**6.04**	**6.35**	**6.45**	**6.64**	**6.84**	**7.04**	**7.25**	**7.47**
Block	**Globe**	15	5.045	5.05	5.55	5.80	6.05	6.23	6.41	6.61	6.80	7.01	7.22	7.43
3% Base Growth				0.00	0.00	0.00	0.18	0.19	0.19	0.20	0.20	0.21	0.22	0.22
Loadwatch Growth				0.50	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**5.55**	**5.80**	**6.05**	**6.23**	**6.41**	**6.61**	**6.80**	**7.01**	**7.22**	**7.43**	**7.66**
Block	**Greymouth**	20	12.738	12.74	13.98	15.05	15.68	16.15	16.64	17.14	17.65	18.18	18.73	19.29
3% Base Growth				0.00	0.00	0.00	0.47	0.48	0.50	0.51	0.53	0.55	0.56	0.58
Loadwatch Growth				1.24	1.08	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**13.98**	**15.05**	**15.68**	**16.15**	**16.64**	**17.14**	**17.65**	**18.18**	**18.73**	**19.29**	**19.87**
Block	**Harihari**	1	0.740	0.74	0.88	0.89	0.92	0.94	0.97	1.00	1.03	1.06	1.09	1.13
3% Base Growth				0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Loadwatch Growth				0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**0.88**	**0.89**	**0.92**	**0.94**	**0.97**	**1.00**	**1.03**	**1.06**	**1.09**	**1.13**	**1.16**

Table 5.3 - Zone Substation Forecast Demand Continued...														
	Zone Substation	**Firm Cap (MVA)**	**Peak**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**	**18/19**	**19/20**
Block	**Hokitika**	20	18.038	18.04	18.89	19.89	20.55	20.80	23.61	24.32	25.05	26.87	27.67	28.23
3% Base Growth				0.00	0.00	0.00	0.00	0.00	0.71	0.73	0.00	0.81	0.00	0.85
Loadwatch Growth				0.85	1.01	0.65	0.25	2.81	0.00	0.00	1.82	0.00	0.56	0.00
Predicted Load				**18.89**	**19.89**	**20.55**	**20.80**	**23.61**	**24.32**	**25.05**	**26.87**	**27.67**	**28.23**	**29.08**
Block	**Kumara**	10	6.677	6.68	6.98	7.10	7.18	7.40	7.62	7.85	8.08	8.33	8.58	8.83
3% Base Growth				0.00	0.00	0.00	0.22	0.22	0.23	0.24	0.24	0.25	0.26	0.27
Loadwatch Growth				0.31	0.11	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**6.98**	**7.10**	**7.18**	**7.40**	**7.62**	**7.85**	**8.08**	**8.33**	**8.58**	**8.83**	**9.10**
Block	**Logburn**	30	1.642	1.64	7.86	10.86	12.86	14.08	14.51	14.94	15.39	15.85	16.33	16.82
3% Base Growth				0.00	0.00	0.00	0.00	0.42	0.44	0.45	0.46	0.48	0.49	0.50
Loadwatch Growth				6.22	3.00	2.00	1.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**7.86**	**10.86**	**12.86**	**14.08**	**14.51**	**14.94**	**15.39**	**15.85**	**16.33**	**16.82**	**17.32**
Block	**Ngahere**	5	3.428	3.43	5.01	5.17	4.96	5.11	5.26	5.42	5.58	5.75	5.92	6.10
3% Base Growth				0.00	0.00	0.00	0.15	0.15	0.16	0.16	0.17	0.17	0.18	0.18
Loadwatch Growth				1.58	0.15	-0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**5.01**	**5.17**	**4.96**	**5.11**	**5.26**	**5.42**	**5.58**	**5.75**	**5.92**	**6.10**	**6.28**
Block	**Otira**	10	0.696	0.70	0.72	0.74	0.76	0.78	0.81	0.83	0.86	0.88	0.91	2.11
3% Base Growth				0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.00	0.06
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00
Predicted Load				**0.72**	**0.74**	**0.76**	**0.78**	**0.81**	**0.83**	**0.86**	**0.88**	**0.91**	**2.11**	**2.17**

Table 5.3 - Zone Substation Forecast Demand Continued...

	Zone Substation	Firm Cap (MVA)	Peak	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Block	**Rapahoe**	6.25	3.182	3.18	3.47	3.66	4.05	4.17	4.29	4.42	4.55	4.69	4.83	4.97
3% Base Growth				0.00	0.00	0.00	0.12	0.12	0.13	0.13	0.14	0.14	0.14	0.15
Loadwatch Growth				0.28	0.20	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**3.47**	**3.66**	**4.05**	**4.17**	**4.29**	**4.42**	**4.55**	**4.69**	**4.83**	**4.97**	**5.12**
Block	**Reefton**	30	7.938	7.94	8.43	8.58	7.94	8.18	8.42	8.68	8.94	9.20	9.48	9.76
3% Base Growth				0.00	0.00	0.00	0.24	0.25	0.25	0.26	0.27	0.28	0.28	0.29
Loadwatch Growth				0.49	0.16	-0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**8.43**	**8.58**	**7.94**	**8.18**	**8.42**	**8.68**	**8.94**	**9.20**	**9.48**	**9.76**	**10.06**
Block	**Ross**	1	0.430	0.43	0.46	0.51	0.51	0.53	0.55	0.56	0.58	0.60	0.61	0.63
3% Base Growth				0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Loadwatch Growth				0.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**0.46**	**0.51**	**0.51**	**0.53**	**0.55**	**0.56**	**0.58**	**0.60**	**0.61**	**0.63**	**0.65**
Block	**Spring Creek**	9	6.179	6.18	6.68	7.18	7.58	9.08	10.58	12.08	13.58	15.08	15.98	16.46
3% Base Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.49
Loadwatch Growth				0.50	0.50	0.40	1.50	1.50	1.50	1.50	1.50	0.90	0.00	0.00
Predicted Load				**6.68**	**7.18**	**7.58**	**9.08**	**10.58**	**12.08**	**13.58**	**15.08**	**15.98**	**16.46**	**16.95**
Block	**Wahapo**	6.25	2.923	2.92	3.01	3.10	3.19	3.29	3.39	3.49	3.59	3.70	3.81	3.93
3% Base Growth				0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.12
Loadwatch Growth				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**3.01**	**3.10**	**3.19**	**3.29**	**3.39**	**3.49**	**3.59**	**3.70**	**3.81**	**3.93**	**4.05**

Table 5.3 - Zone Substation Forecast Demand Continued...

	Zone Substation	Firm Cap (MVA)	Peak	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20
Block	**Waitaha**	1	0.251	0.25	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38	0.39
3% Base Growth				0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Loadwatch Growth				0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**0.30**	**0.31**	**0.32**	**0.33**	**0.34**	**0.35**	**0.36**	**0.37**	**0.38**	**0.39**	**0.40**
Block	**Whataroa**	1	0.802	0.80	0.98	1.08	1.10	1.13	1.17	1.20	1.24	1.28	1.31	1.35
3% Base Growth				0.00	0.00	0.00	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
Loadwatch Growth				0.17	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Predicted Load				**0.98**	**1.08**	**1.10**	**1.13**	**1.17**	**1.20**	**1.24**	**1.28**	**1.31**	**1.35**	**1.39**

5.3 Strategic Plans by Area

5.3.1 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. This served the base demand for several years until a major new load developed in the form of the Globe Gold Project, which is currently operated by Oceana Gold Limited.

Development of this project, involving a load of 4 MW, required significant strengthening of the supply into the Reefton area. After considerable investigation, the solution chosen was for Westpower to construct a new 2 x 20 MVA 110/33/11 kV Zone Substation at Reefton fed by two 110 kV lines from Inangahua. One of these lines was the existing Transpower DOB-IGH 66 kV circuit, which was upgraded to 110 kV in 2005. At the same time a new 110 kV spur from Inangahua to Reefton was constructed by Westpower and then sold to Transpower.

In July 2008, the Electricity Commission approved the proposal to upgrade reliability and security of electricity supply into the West Coast through extension of the 110 kV transmission line from Reefton to Dobson (second circuit). It is expected that construction will commence in 2009 and be completed by 2011.

This work was designed to be compatible with Transpower's own transmission development in the area to ensure that the greatest shared benefit accrues to consumers in the area in terms of both capacity and security. This means that the Reefton area is now supplied by a strong transmission network with *n-1* security and so further development will be limited to the distribution system.

Due to voltage constraints on the 11 kV circuits at Ikamatua, a new 33/11 kV 5 MVA Zone Substation is required at Blackwater to provide an additional 2000 kW of demand should the Waiuta Gold Mine ever be developed, (this is currently considered a possibility) and the 0.5 MW coal loading facility at Ikamatua confirmed to be developed by mid 2009. The construction of this substation has already started and will be commissioned by mid 2009.

5.3.2 Greymouth Network

Several significant coal-mining projects are in the development stage including the Pike River Coal Company development in the Paparoa Ranges and further development of the Solid Energy Spring Creek Mine near Rapahoe. The estimated loads for these projects are 14 MW for Pike River Coal and an additional 14 MW for

Spring Creek in the next five years. In addition, base load growth, and continuing expansion in the exotic timber milling and tourism industries will require significant capacity increases in the short term.

A new 110 kV GXP switching station has been developed by Transpower at Atarau as a bus on the DOB-RFN-IGH circuit to supply the Pike River Coal mine load and associated with this project, Westpower has constructed 110 kV and 33 kV lines and substations to connect this load to the new GXP.

The existing Westpower 33 kV sub-transmission network can support expected load growth, however, the same does not also hold true for the existing transmission network into the West Coast, which is severely constrained. The recent upgrading of the DOB-RFN-IGH line to 110 kV has certainly strengthened the supply from Inangahua in the north, but this has not significantly improved firm capacity into the area as the 66 kV circuits from Coleridge are still constrained if the DOB-RFN-IGH circuit is out for any reason.

Accordingly, the West Coast Grid Reinforcement Project (WCGR) has been launched, in co-operation with Transpower, to provide significant additional and secure transmission capacity into the area. This involves the construction of a new single circuit 110 kV line from Reefton to Dobson that will be operated as part of Transpower's national grid. Contemporaneously, Transpower will install a new 110/66 kV interconnecting transformer bank at Dobson. Once complete, this will result in significantly improved transmission capacity and security into the central West Coast region with two strong, route-diverse 110 kV transmission lines. The new 110 kV transmission line will be commissioned by 2011

If TrustPower proceeds with its project to upgrade Arnold Power Station, a new 11 kV substation at Kokiri is required. The new substation may be required by 2014/2015.

To support the more demanding communication requirements of the transmission development projects, a new digital radio backbone has been installed. This has replaced aging analogue UHF radios that have become technically obsolete.

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

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

5.3.3 Hokitika Network

The completion of the Westland Dairy Factory Supply, comprising a new Westpower 2 x 15/20 MVA 66/33/11 kV substation in Hokitika, has vastly improved both the capacity and security of supply to the town of Hokitika and surrounding districts including all of South Westland. This will also provide for continuing expansion at the Westland Dairy Products factory, along with downstream growth in the dairy industry in general, for at least the next ten years.

The Westland Dairy Factory is likely to continue with plans for major step load increases throughout the planning period and this will require some re-configuration and possible augmentation of the 11 kV feeder cables into the plant, along with changes to the network within the plant itself.

The new generation scheme in South Westland (Harihari and Waitaha, planned for 2011/2012 and 2014/2015 respectively) will involve an extension of the 66 kV bus and provision of an additional 66 kV bay in Hokitika substation and re-commissioning of the 66 kV line from Hokitika to Harihari.

This will affect the substations at Ross and Waitaha, which will need to be upgraded to 66 kV.

As part of the West Coast Grid Reinforcement Project, Westpower will supply and install a 14 MVar switched capacitor bank connected to an 11 kV circuit at Hokitika substation. This will provide reactive support in order to maintain and stabilize the voltage of Transpower's 66 kV transmission system on the West Coast. The project is fully funded by Transpower which will take over the ownership of these capacitors after commissioning date.

5.3.4 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 30 years to bring the reticulation system up to an acceptable standard.

Notwithstanding the above, significant load growth due to expansion in the tourism industry is currently being experienced and the network is approaching voltage constraint limits under certain operating scenarios. In view of this, system planning studies have identified the need for additional voltage support in the short term, and this will be provided by a mixture of fixed, switched and variable capacitor banks at both 11 kV and 400 V.

In addition, a new 33 kV regulator has been commissioned at Harihari, and this will provide for significant additional capacity into areas south of that point including the glacier region. Also, three new single-phase regulators have replaced the existing units at Fox to increase security of supply for that area and the capacity (from 1.9 MVA to 3.8 MVA).

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

It is possible that the South Westland Grid Reinforcement Project (SWGR) may be implemented toward the end of 2011 and this will involve upgrading the Hokitika - Harihari line to 66 kV along with conversion of the Waitaha and Harihari Substations to 66 kV operation. A possible variation to this plan involves the option of supplying the relatively small Waitaha load at a lower voltage from nearby Ross. As part of this project, Westpower has already started to upgrade the pole structure and configuration between Ross and Waitaha and is planning to upgrade Hokitika - Ross circuit by 2009/2010 and Waitaha - Harihari circuit by 2010/2011.

Security of supply is always going to be a major concern in this area as it is fed by a very long single circuit line and the benefit of alternative supply from local generation, particularly from TrustPower's Wahapo Power Station, is fast becoming eclipsed by load growth. The proposed 6 MW Amethyst and 20 MW Waitaha Power Schemes being developed by Westpower, as a joint venture with our partners, will play a large role in improving security of supply to South Westland when it is commissioned in 2012 and 2015 respectively.

5.3.5 Westpower Substations

Westpower intends to install its first Ground Fault Neutraliser in Greymouth substation as a trial in 2009/2010.

Called a Ground Fault Neutraliser, the technology greatly reduces earth fault currents at the point a fault occurs on the network. This reduces the level of threat to human life and risk of fire. It also allows the Westpower control centre to maintain power supply to homes and businesses while field staff are dispatched to fix the fault.

Transient or momentary faults can be neutralised as well, eliminating most cases of flickering lights and short term interruptions to power supply.

5.3.5.1 Circuit Breakers

In the next five years, Westpower has decided to replace all KFE and KFME circuit breakers with new vacuum interrupter circuit breakers to improve its network reliability. At the same time the old protection systems will be upgraded with new digital relays to improve sensitivity and selectivity.

5.4 Overall Work Plan

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

- More than 50% of a line section reaching replacement criteria within the following five year period.

- Technical obsolescence.
- Health and Safety Concerns (e.g. Series I Andelect Oil Filled Ring Main Units).
- Difficulty in obtaining spare parts.
- Inability to meet current needs.

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

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

5.4.1 Maintenance Triggers

Maintenance work is largely based on the condition of the assets, as described in Section 6.

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

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

The base-line planned maintenance expenditure projections assume, for consistency within this plan, that development projects take place as projected in this section. It will be necessary to monitor closely the likelihood of each project proceeding and additional remedial work will need to be programmed if certain projects do not proceed or are significantly delayed. Table 5.4 summarises the planned Maintenance projects and programmes by category for the planning period.

Table 5.4 - Maintenance Projects and Programmes ($'000)

Activity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inspect, Service and Test	4322	4440	4314	4414	4552	4797	5061	5359	5637	5962
Faults	503	531	566	599	633	672	715	758	801	848
Repairs	304	278	297	316	331	352	376	399	421	446
	5129	**5249**	**5177**	**5329**	**5516**	**5821**	**6152**	**6516**	**6859**	**7256**

(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.

5.4.2 Replacement Triggers

Table 5.5 - Replacement Projects and Programmes ($'000)

Activity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Replacement	3201	3575	2837	2226	1368	735	527	2085	649	854

(i) Major Refurbishments

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 mm^2, 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 five years to avoid an unnecessary risk of line drop or fault outages. These insulators have been proven to deteriorate rapidly after ten years, therefore a pro active approach is required to manage the risk of failure.

The replacement of such insulators is 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.

5.4.3 Enhancement

Table 5.6 summarises the planned enhancement works for the planning period.

Table 5.6 - Enhancement Projects and Programmes ($'000)

Activity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Enhancement	1103	371	504	476	433	401	1085	341	399	873

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.

5.4.4 Development

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).

Table 5.7 summarises the planned Development works for the planning period.

Table 5.7 - Development Projects and Programmes ($'000)										
Activity	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Development	2321	2316	3114	3327	4074	4646	3879	2009	4501	4641

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.

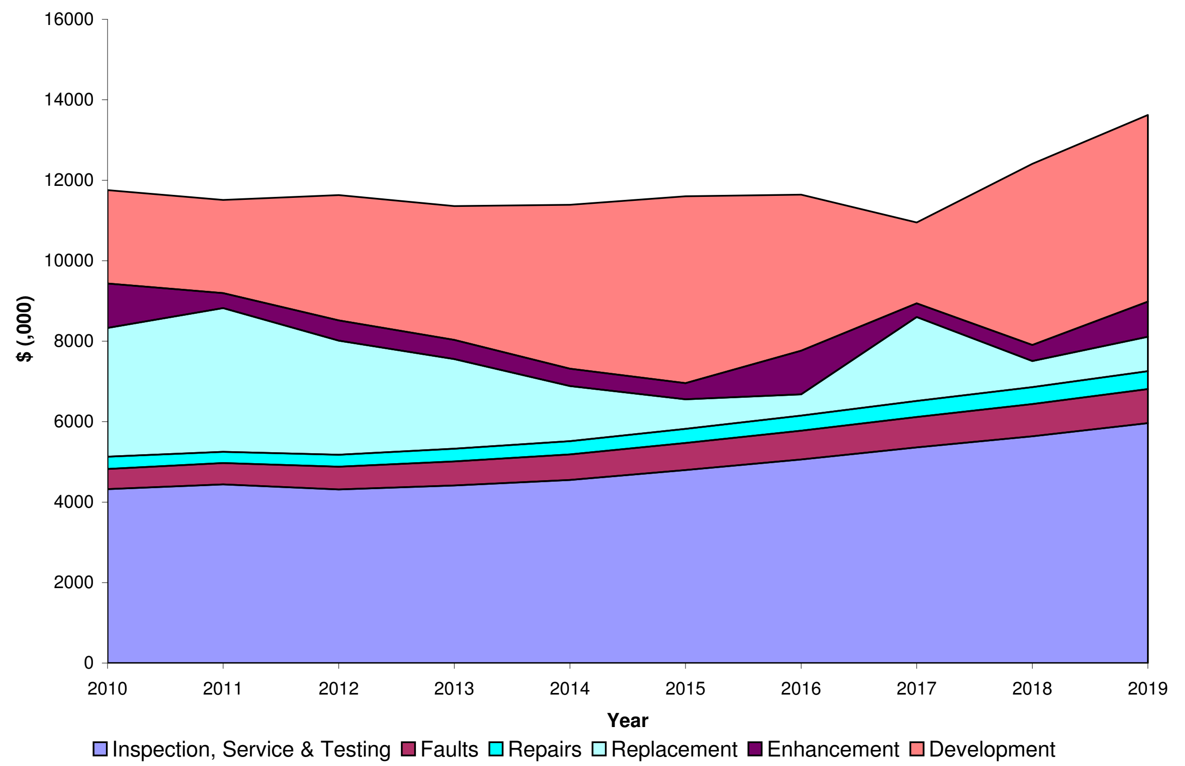


Figure 5.3 - Expenditure by Activity (Incorporating Data From Table 5.4.1 to 5.4.4).

Figure 5.3 shows the planned works in graphical form using data from Tables 5.4 through to 5.7.
Three of the larger industrial customers have indicated they will be increasing load over the next five years including:

1. Following a resurgence in gold prices, Birchfield Minerals gold dredge, which was shut down in 2004, is now confirmed to restart in mid 2009. Estimated load is 1.3 MW at Ngahere substation.

2. Oceana Gold Limited is planning to increase its load with 1MVA at the Globe Substation, and this is likely to happen by 2009/2010.

   In addition to this, it is also investigating additional mining load in the Waiuta area with a possibility to add a further 2 MW to this figure, although this is far from committed after a false start in 2005 when the original shaft was found to be damaged beyond repair.

3. The Pike River Coal Company has begun production of coal from the new underground coal mine in the Paparoa Ranges near Atarau in the Grey Valley. All of the major construction has been finalised and the coal loading facility at Ikamatua is expected to be developed by 2010/2011 (about 0.5-1 MW). A new substation at Blackwater (BWR) is required to supply this load and will be commissioned in mid 2009.

4. Solid Energy New Zealand Limited is expecting to commission a new 8 MW drive at Spring Creek and open a new coal mine at Strongman (about 4 MW), which is likely to happen by 2011/2012. Also, they are planning to increase their load at Spring Creek mine with an additional 2 MW in 2009/2010.

   Additional to the above mentioned load, 30 new dairy farms are expected to be developed in the Fox Glacier area on the Landcorp Farming Ltd property over the next five years.

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

Table 5.8 outlines the activity and the asset type numbers used for developing the project numbers which are presented in the following format: Year/Activity/Asset Type/0 Project Number.

Table 5.8 - Format of Project Numbers			
Activity		**Asset Type**	
1	IS&T	**0**	Sub-transmission
2	Faults	**1**	Distribution
3	Repairs	**2**	Reticulation
4	Replacement	**3**	Services
5	Enhancement	**4**	Zone Substations
6	Development	**5**	Distribution Substations
		6	MV Switchgear
		7	SCADA/Comms/Prot
		8	Distribution Transformers
		9	Other

5.5 Sub-Transmission Assets

As discussed in Section 3, 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.

Tables 5.9 and 5.10 (page 128) expand on the I, S & T project expenditure planned in terms of Condition Assessment programmes and Tree Trimming programmes.

Table 5.9 - Sub-Transmission - Condition Assessment ($'000)

Activity		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Dobson Arnold 33 kV Line Condition Assessment	DOB1382	7	7	8	8	9	9	10	11	11	12
Dobson Rapahoe 33 kV Line Condition Assessment	DOB1322	1	1	1	1	1	1	1	2	2	2
Dobson Reefton 33 kVLine Condition Assessment	DOB1362	3	3	3	4	4	4	4	5	5	5
Franz - Fox 33 kV Line Condition Assessment	FRZ1654	10	11	11	12	13	13	14	15	16	17
Greymouth Kumara 66kV Line Condition Assessment	GYM102	11	12	12	13	14	15	16	17	18	19
Harihari Franz 33 kVLine Condition Assessment	HHI1326	5	5	6	6	6	7	7	8	8	8
Hokitika Harihari 66kV Line Condition Assessment	HKK1012	35	37	39	42	44	47	50	53	56	59
Kumara Kawaka 66 kV Line Condition Assessment	KUM232	5	5	6	6	6	7	7	8	8	8
Reefton - Globe 33 kV Line Condition Assesssment	RFN3016	3	3	3	4	4	4	4	5	5	5
Two Mile Hokitika 66kV Line Condition Assessment	HKK266	3	3	3	4	4	4	4	5	5	5
		83	**87**	**92**	**100**	**105**	**111**	**117**	**129**	**134**	**140**

Table 5.10 - Sub-Transmission - Tree Trimming ($'000)

Activity		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Atarau - Logburn Road 110 kV Tree Timming	ATU-LGN	5	5	6	6	6	7	7	8	8	8
Dobson Arnold 33 kV Line Tree Trimming	DOB-ALD	5	5	6	6	6	7	7	8	8	8
Dobson Rapahoe 33 kV Line Tree Trimming	DOB-RAP	2	2	2	2	3	3	3	3	3	3
Dobson Reefton 33 kV Line Tree Trimming	DOB-RFN	5	5	6	6	6	7	7	8	8	8
Franz - Fox 33 kV Line Tree Trimming	FRZ-FOX	11	12	12	13	14	15	16	17	18	19
Greymouth Kumara 66kV Line Tree Trimming	GYM-KUM	106	112	119	126	134	142	150	159	169	179
Harihari - Whataroa 33 kV Line Tree Trimming	HHI-WAT	5	5	6	6	6	7	7	8	8	8
Hokitika Harihari 33kV Line Tree Trimming	HKK-HHI	32	34	36	38	40	43	45	48	51	54
Kumara Kawhaka 66 kV Tree Trimming	KUM-KAH	5	5	6	6	6	7	7	8	8	8
Logburn Road - Pike River 33 kV Tree Trimming	LGN-PIK	11	12	12	13	14	15	16	17	18	19
Reefton - Globe Hill 33 kV Tree Trimming	RFN-GLB	5	5	6	6	6	7	7	8	8	8
Two Mile Road Hokitika 66kV Tree Trimming	TMR-HKK	5	5	6	6	6	7	7	8	8	8
Wahapo - Franz 33 kV Line Tree Trimming	WAH-FRZ	106	112	119	126	134	142	150	159	169	179
Whataroa - Wahapo Tree Trimming	WAH-WAT	5	5	6	6	6	7	7	8	8	8
		308	**324**	**348**	**366**	**387**	**416**	**436**	**467**	**492**	**517**

5.5.1 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.

5.5.1.1 Maintenance

(i) Routine Patrols and Inspections

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

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

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

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

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

Project 09-10008: GYM-KUM 66 kV Line General Maintenance

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

(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 Maximo Asset Works Management System now used by the Asset Management Division.

(iii) Repairs and Refurbishment

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

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

5.5.1.2 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.

5.5.2 Kumara-Kawhaka 66 kV Line

5.5.2.1 Maintenance

(i) Routine Patrols and Inspections

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

This line, although only seven years old, will be included in the condition assessment programme, with 20 percent of the line thoroughly inspected annually. This will be in addition to a full ground and aerial patrol annually.

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

(ii) Faults

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

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

(iii) Repairs and Refurbishment

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

5.5.2.2 Enhancement

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

5.5.3 North Westland 33 kV Network

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

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

5.5.3.1 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 five-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.

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

(ii) Faults

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

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

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

(iii) Repairs and Refurbishment

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

With the above exceptions, no repair or refurbishment work is required on the concrete pole lines because of the low average age.

The Arnold-Dobson line will require individual pole replacement as well as re-conductoring and re-insulation within the next ten years unless a planned enhancement project proceeds.

(iv) Replacement

If the level of refurbishment on the Arnold-Dobson line becomes greater than 50% of the asset, complete line replacement may be more cost effective. This will be reviewed toward the end of the planning period.

No replacement is foreseeable on the concrete pole lines.

5.5.3.2 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 pole replacement.

5.5.4 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, has been refurbished over the last four years due to the deterioration of poles and conductor. This line provides an essential link to South Westland, therefore demanding priority within maintenance programmes.

With the addition of the Fox Glacier 33/11 kV substation on the network in 2003, the 11 kV line from Franz Josef to Fox Glacier was uprated to 33 kV. This line had major refurbishment work carried out at this time and should not need any further major maintenance work for some years.

5.5.4.1 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 five-year basis, covering 20% of the route length per year. During the inspection every aspect of the line is checked. The aim is to identify and document all components that do not meet Westpower standards.

All pole hardware will be included in the inspections.

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

Project 09-10005: Franz Josef - Fox Glacier 33 kV Line Maintenance

The Fox-Franz 33 kV line was given a large refurbishment in the 2003/04 year. The criteria was to replace any component that did not have five years life in it, unless a pole or component could be replaced live at a later date. Little maintenance should be required on the line itself for five years. In the mean time $4,000 per year shall be allowed for minor works or the occasional live line pole replacement.

Project 09-10009: HHI-HKK - Maintenance and Replacement of Towers

There are four towers on the HHI-HKK circuit. A complete design to replace the towers 70419 - 70420 (Evans Creek) with hardwood poles has been developed in 2006/07 and the work will be carried out in this 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

Project 09-40005: HKK-HHI Line Upgrade

A gradual project has been carried out to replace the original poles on the HHI-HKK line, from the 1960's era. This project, carried out over several years, needs to be complete before the line is reconfigured for 66 kV operation.

Project 09-40002: Mapourika, Replace Substandard Poles

The section of Hendrix line traversing Lake Mapourika has several poles that are reaching replacement criteria. These poles were pre-used and some were of a substandard nature when installed. A sum has been allocated to identify and subsequently replace these poles.

5.5.4.2 Enhancement

As the load in South Westland rises, it will be necessary to provide more capacity between Harihari and Whataroa to meet the substantially increased load being supplied south of Whataroa substation. The maximum acceptable load on this circuit without incurring excessive volt drop is 2.0 MVA. This gives little margin when supplying the present tourist season peak load of 1.6 MVA. Additional reactive support has been installed along with the installation of 33 kV regulators at Harihari in 2004 to overcome unacceptable voltage regulation, particularly when Wahapo Power Station is not running. As the load continues to grow in South Westland, a decision will need to be made on when to increase the sub-transmission voltage from 33 kV to 66 kV. The line from Arahura to Harihari was originally built as a 66 kV line by the New Zealand Electricity Department in the mid-1960's, and was then leased to Westpower for operation at 33 kV in 1993 before finally being sold to Westpower in 2001. It is therefore relatively easy to re-liven the line at 66 kV in the future.

Of course, this will also mean that Zone Substations at Ross and Waitaha need to be upgraded to run at 66 kV and a new 66/33 kV substation must be established at Harihari.

5.5.4.3 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.

5.5.5 Other 33 kV Network Projects

Project 09-10011: River Protection Works for Sub-transmission Lines

In recent times it has been necessary to install river protection works for sub-transmission lines, particularly near major rivers. Erosion around structures has been an ongoing problem therefore a contingency sum will be allocated in the AMP for such protection works.

Project 09-10003: Carry out Thermovision Inspections of Sub-transmission Lines

To identify high resistant joints present on sub-transmission lines, a thermovision inspection programme is to be carried out. Strategic lines shall be inspected on a rotational basis, with each line being reviewed every three years.

Project 09-10012: Weed Spray Access Tracks and Various Line Routes

To avoid brush and scrub regrowth along access tracks and under sections of sub-transmission lines, a weed spraying programme shall be initiated. Annual sub-transmission line patrols shall identify areas requiring such work.

Project 09-10006: General Maintenance of Sub-transmission Lines

The condition assessment programme has highlighted the need for general minor maintenance to be carried out annually on Westpower's sub-transmission circuits. Such maintenance may include earth repairs, pole step replacement and stay repairs.

Project 09-10004: Corona Discharge Testing at Various Sub-transmission Lines

To identify any failing insulation on sub-transmission lines, a corona discharge inspection programme is to be carried out. Strategic lines shall be inspected on a rotational basis, with each line being reviewed every three years.

Project 09-10001: Access Road Maintenance

To assist in the swift restoration of faults in the area it is imperative access to lines are kept open and clear. Westpower administers many access roads, particularly roads adjacent to sub-transmission lines.

Project 09-4003: Remove 11 kV Conjoint cct from IGN-RFN 110 cct

Transpower's purchase of the IGH-RFN 110 kV line from Westpower prompted a change in design to ensure Transpower's standards are not compromised. This change in design includes removing any 11 kV occupying 110 kV structures and reconstructing on an alternate route.

Project 09-40004: Replace all 33 kV EPDM Strain Insulators

The rapid deterioration of the EPDM type strain insulators has forced the replacement of this type of insulator system wide. Glass strain type insulator strings shall be used as replacement discs. This is an ongoing project until all 33 kV EPDM strain insulators are replaced.

Table 5.11 Summarizes the Sub-transmission Projects for this planning period.

Table 5.11 - Sub-Transmission - Projects ($'000)

Activity		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Arnold Dobson 33 kV Line Pole Replacement	DOB1382	0	100	100	100	0	0	0	0	0	0
GYM-KUM 66 kV Line General Maintenance	GYM-KUM	53	56	60	63	67	71	75	80	85	90
GYM-KUM 66 kV cct Pole Replacement	GYM-KUM	0	112	117	90	95	101	30	32	34	36
GYM - KUM 66 kV cct Reconductor	GYM-KUM	0	0	100	80	80	80	80	80	100	0
Franz Josef - Fox Glacier 33 kV Line Maintenance	HKK1012	21	22	24	25	27	28	30	32	34	36
HHI-HKK - Maintenance and Replacement of Towers	HKK1012	42	0	0	0	0	0	0	0	0	0
Mount Hercules 33 kV Line Pole Replacement	HKK1012	0	80	0	0	0	0	0	0	0	0
HKK-HHI Line Upgrade	HKK1012	750	750	750	750	0	0	0	0	0	0
WCGR 110 kV Line Dobson-Reefton	IGH	0	0	0	0	0	0	0	0	0	0
Remove 11 kV Conjoint cct From IGH-RFN 110 cct	RFN4	150	0	0	0	0	0	0	0	0	0
SWGR Build New 33 kV Line Butlers - Kokatahi	RSS	0	0	0	0	0	0	0	0	0	0
Access Road Maintenance	SYS	37	39	42	44	47	50	53	56	59	63
Carry out Thermovision Inspections of Subtransmission Lines	SYS	12	12	13	14	15	16	17	18	19	20
Corona Discharge Testing at Various Subtransmission Lines	SYS	12	12	13	14	15	16	17	18	19	20
General Maintenance of Subtransmission Lines	SYS	17	19	20	21	22	23	25	26	28	30
River Protection Works for Subtransmission Lines	SYS	22	23	25	26	28	29	31	33	35	37
Weed Spray Access Tracks and Various Line Routes	SYS	30	17	17	19	20	21	22	23	25	27
Replace All 33 kV EPDM Strain Insulators	SYS	0	28	0	0	0	0	0	0	0	0
Stillwater - Jacksons 66 kV cct	SYS	0	0	0	0	0	0	0	0	0	0
Install 33 kV Underground Cable, Lake Mapourika	WAH1526	0	0	0	0	0	0	0	0	0	0
Mapourika, Replace Substandard Poles	WAH1526	60	60	0	0	0	0	0	0	0	0
Replace Waitangitaroa River Crossing	WAT1426	0	40	0	0	0	0	0	0	0	0
		1206	1370	1281	1246	416	435	380	398	438	359

5.6 Distribution Assets

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

Table 5.12 summarizes the Distribution Projects and Programmes for this planning period by category.

Table 5.12 - Distribution Projects and Programmes ($'000)										
Activity	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Inspect, Service and Test	1400	1415	1475	1553	1643	1735	1831	1965	2058	2156
Faults	305	324	343	363	385	409	434	459	486	515
Repairs	80	84	89	95	100	106	113	120	127	135
Replacement	940	1162	798	495	598	180	0	0	0	0
Enhancement	125	100	100	100	100	60	0	0	0	0
Development	78	113	28	29	15	38	17	18	19	0
	2928	**3198**	**2833**	**2635**	**2841**	**2528**	**2395**	**2562**	**2690**	**2806**

5.6.1 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.

5.6.1.1 Maintenance

(i) Routine Patrols and Inspections

The 2008-09 financial year will see the continuation of the condition assessment programme. Each line (feeder) is to be inspected on a rolling five-year basis, covering 20% of the route length per year. During the inspection every aspect of the line is checked.

Table 5.13 details the Condition assessment programmes planned for this AMP period.

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.

Table 5.13 - Distribution - Condition Assessment ($'000)											
Activity	**Area**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Arnold Feeder 3 Condition Assessment	ALD3	1	1	1	1	1	1	1	2	2	2
Arnold Feeder 4 Condition Assessment	ALD4	6	6	7	7	8	8	9	9	10	10
Dillmans Feeder 4 Condition Assessment	DIL4	2	2	2	2	3	3	3	3	3	3
Dobson Feeder 1 Condition Assessment	DOB1	1	1	1	1	1	1	1	2	2	2
Dobson Feeder 3 Condition Assessment	DOB3	1	1	1	1	1	1	1	2	2	2
Fox Feeder 1 Condition Assessment	FOX1	5	5	6	6	6	7	7	8	8	8
Franz Feeder 1 Condition Assessment	FRZ1	1	1	1	1	1	1	1	2	2	2
Franz Feeder 3 Condition Assessment	FRZ3	1	1	1	1	1	1	1	2	2	2
Greymouth Feeder 11 Condition Assessment	GYM11	1	1	1	1	1	1	1	2	2	2

Table 5.13 - Distribution - Condition Assessment continued... ($'000)											
Activity	**Area**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Greymouth Feeder 12 Condition Assessment	GYM12	1	1	1	1	1	1	1	2	2	2
Greymouth Feeder 13 Condition Assessment	GYM13	1	1	1	1	1	1	1	2	2	2
Greymouth Feeder 6 Condition Assessment	GYM6	2	2	2	2	3	3	3	3	3	3
Harihari Feeder 1 Condition Assessment	HHI1	1	1	1	1	1	1	1	2	2	2
Harihari Feeder 3 Condition Assessment	HHI3	2	2	2	2	3	3	3	3	3	3
Hokitika Feeder 10 Condition Assessment	HKK10	7	7	8	8	9	9	10	11	11	12
Hokitika Feeder 12 Condition Assessment	HKK12	1	1	1	1	1	1	1	2	2	2
Hokitika Feeder 4 Condition Assessment	HKK4	1	1	1	1	1	1	1	2	2	2
Kumara Feeder 1 Condition Assessment	KUM1	3	3	3	4	4	4	4	5	5	5
Logburn feeder 1 Condition Assessment	LGN1	1	1	1	1	1	1	1	2	2	2
Ngahere Feeder 1 Condition Assessment	NGH1	3	3	3	4	4	4	4	5	5	5
Ngahere Feeder 3 Condition Assessment	NGH3	5	5	6	6	6	7	7	8	8	8
Otira Feeder 1062 Condition Assessment	OTI1062	1	1	1	1	1	1	1	2	2	2
Rapahoe Feeder 1 Condition Assessment	RAP1	2	2	2	2	3	3	3	3	3	3
Rapahoe Feeder 3 Condition Assessment	RAP3	1	1	1	1	1	1	1	2	2	2
Reefton Feeder 4 Condition Assessment	RFN4	3	3	3	4	4	4	4	5	5	5
Reefton Feeder 5 Condition Assessment	RFN5	5	5	6	6	6	7	7	8	8	8
Ross Feeder 1 Condition Assessment	RSS1	1	1	1	1	1	1	1	2	2	2
Ross Feeder 3 Condition Assessment	RSS3	1	1	1	1	1	1	1	2	2	2
Wahapo Feeder 1 Condition Assessment	WAH1	1	1	1	1	1	1	1	2	2	2
Whataroa Feeder 1 Condition Assessment	WAT1	3	3	3	4	4	4	4	5	5	5
Waitaha Feeder 1 Condition Assessment	WTH1	1	1	1	1	1	1	1	2	2	2
		66	**66**	**71**	**75**	**81**	**84**	**86**	**112**	**113**	**114**

A fault base will be maintained in the Reefton area contracted to ElectroNet Services for the foreseeable future to minimise the repair times that are involved during outage.

(ii) Repairs and Refurbishment

The condition assessment project discussed previously is likely to highlight several components requiring replacement on those lines. This will be handled by a live-line refurbishment programme including individual pole, crossarm, insulator and conductor replacement where required.

Table 5.14 details the tree Trimming activity planned for this AMP period.

Table 5.14 - Distribution Tree Trimming ($'000)											
Activity	**Area**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Arnold Feeder 3 Tree Trimming	ALD3	11	12	12	13	14	15	16	17	18	19
Arnold Feeder 4 Tree Trimming	ALD4	80	80	80	80	80	80	80	80	80	80
Dillmans Feeder 4 Tree Trimming	DIL4	21	22	24	25	27	28	30	32	33	35
Dobson Feeder 1 Tree trimming	DOB1	20	21	22	24	25	27	28	30	32	34
Dobson Feeder 3 Tree Trimming	DOB3	6	6	7	7	8	8	9	9	10	10
Fox Glacier Feeder 1 Tree Trimming	FOX1	5	5	6	6	6	7	7	8	8	8
Franz Feeder 3 Tree Trimming	FRZ3	7	7	8	8	9	9	10	11	11	12
Greymouth Feeder 11 Tree Trimming	GYM11	1	1	1	1	1	1	1	2	2	2
Greymouth Feeder 12 Tree Trimming	GYM12	1	1	1	1	1	1	1	2	2	2
Greymouth Feeder 13 Tree Trimming	GYM13	5	5	6	6	6	7	7	8	8	8
Greymouth Feeder 6 Tree Trimming	GYM6	27	29	30	32	34	36	38	41	43	46
Harihari Feeder 1 Tree Trimming	HHI1	4	4	4	5	5	5	6	6	6	7
Harihari Feeder 3 Tree Trimming	HHI3	4	4	4	5	5	5	6	6	6	7
Hokitika Feeder 10 Tree Trimming	HKK10	53	56	60	63	67	71	75	80	80	80
Hokitika Feeder 12 Tree Trimming	HKK12	1	1	1	1	1	1	1	2	2	2
Hokitika Feeder 4 Tree Trimming	HKK4	7	7	8	8	9	9	10	11	11	12
Kumara Feeder 1 Tree Trimming	KUM1	5	5	6	6	6	7	7	8	8	8
Logburn feeder 1 Tree Trimming	LGN1	5	5	6	6	6	7	7	8	8	8
Ngahere Feeder 1 Tree Trimming	NGH1	32	34	36	38	40	43	45	48	51	54
Ngahere Feeder 3 Tree Trimming	NGH3	20	20	20	20	20	20	20	20	20	20
Otira Feeder 1062 Tree Trimming	OTI1062	5	5	6	6	6	7	7	8	8	8
Rapahoe Feeder 1 Tree Trimming	RAP1	5	5	6	6	6	7	7	8	8	8
Rapahoe Feeder 3 Tree Trimming	RAP3	16	17	18	19	20	21	23	24	26	27
Reefton Feeder 4 Tree Trimming	RFN4	42	45	47	50	53	56	60	63	67	71
Reefton Feeder 5 Tree Trimming	RFN5	21	22	24	25	27	28	30	32	33	35
Ross Feeder 1 Tree Trimming	RSS1	1	1	1	1	1	1	1	2	2	2
Ross Feeder 3 Tree Trimming	RSS3	32	34	36	38	40	43	45	48	51	54
Tree Register Administration	SYS	5	5	6	6	6	7	7	8	8	8
Wahapo Feeder 1 Tree Trimming	WAH1	2	2	2	2	3	3	3	3	3	3
Whataroa Feeder 1 Tree Trimming	WAT1	7	7	8	8	9	9	10	11	11	12
Waitaha Feeder 1 Tree Trimming	WTH1	2	2	2	2	3	3	3	3	3	3
		453	**470**	**498**	**518**	**544**	**572**	**600**	**639**	**659**	**685**

(iii) Replacement

The following replacement projects are planned for the coming year;

Project 09-41008: Crushington-Garveys Creek, 11 kV Line Replacement

The 11 kV line from disconnector WR15 to the Garvey's Creek spur is now 44 years old and reached the end of it's serviceable life. Many of the hardwood poles are showing signs of rot and general deterioration. An alternate route has been investigated, which will see the line cross to the south side of the Inangahua River near WR15, traversing the river and crossing back to the northern bank near the Garvey's Creek takeoff.

Project 09-41004: Boatmans Road - Replace 11 kV Line

Condition Assessment on the Boatmans Road 11 kV line has identified several sections which are deemed to be condemned. To be carried out over several years, this pole replacement project will eventually see the entire line bought up to standard.

Project 09-41021: Reefton to Blacks Point - Replace 11 kV Line

The twelve hardwood poles and associated fittings from Reefton to the Inangahua River Crossing at Blacks Point are nearing the end of their serviceable life and are in need of replacement. Poles from 09346 through to the Globe Hill 33 kV intersection will be replaced. The existing 1250 meters of 7/.092 conductor will be replaced with Iodine AAAC.

Project 09-41034: Garveys to Craigs Flat Line Replacement

A recent assessment of poles in the Craigs Flat area has determined that a number of poles are in need of urgent replacement while several others will need to be replaced within the next three years.

5.6.1.2 Enhancement

Project 09-51002: Reefton Ring, Upgrade 11 kV Line, Crampton Road

An ongoing project, this financial year will see the final stage of the 'Reefton Ring' upgrade completed. This will include the upgrade of the 11 kV line from Don St to Terrace Mine.

5.6.2 Greymouth Area

This is the largest area within Westpower's district and also involves the greatest diversity of line types and condition.

5.6.2.1 Maintenance

(i) Routine Patrols and Inspections

The 2007-08 financial year will see the continuation of the condition assessment programme. Each line (feeder) is to be inspected on a rolling five-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.

(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 only see the poles being replaced.

Project 09-41009: Dobson Straight, 11 kV Line Replacement

Recent years have seen the 11 kV line from Greymouth to Dobson progressively upgraded. The 08-09 financial year will see this project continue with the remaining substandard hardwood poles replaced over two years. Pole placement can become difficult in this area, with the need to use culverts in the drain adjacent to the line increasing costs. Poles shall be no less than 12 m in length. Iodine conductor shall be strung after each section of pole replacement.

Project 09-41006: Cobden Bridge - Kaiata 11 kV Line Replacement

The hardwood poles between the Cobden Bridge and Kaiata have been identified as in urgent need of replacement. In all, 35 poles and 2700m of conductor will be included in this project, which will see the double circuit line be replaced with a single circuit. The first section to the River View motels has been completed, and the remaining poles and conductor are to be replaced this financial year.

Project 09-41016: Kumara Junction to Kumara, 11 kV Line Replacement

Carried out over three years, the replacement of the hardwood poles between Kumara Junction and Kumara will require re-routing the line. The most optimum route has yet to be determined.

Project 09-41030: Welshmans Road, Reconductor 11 kV Line

The conductor on the section of line from Pine Tree Hill to S6, Fairhalls at Welshmans has deteriorated to the point where replacement is required. Previous years have seen some of this substandard conductor replaced, and this year will see the continuation from S1025 to a disc off point nearest the takeoff to S352.

Project 09-41002: Blackball - Atarau Rd, 11 kV Pole Replacement

In previous AMP periods several sections of substandard 11 kV line have been identified. This year will see a continuation of this project with substandard poles progressively being replaced.

Project 09-41023: Slatey Creek, 11 kV Line Replacement

With the first section built in 1966, the 11 kV line at Slatey Creek has reached the end of it's serviceable life. This year will see work carried out at the Logburn Substation end of the circuit. The replacement of 20 hardwood poles will allow the conductor to be upgraded to Iodine within 4 km of the Logburn Road substation.

Project 09-41017: Lawsons Creek - 11 kV Line to S1414, Line Replacement

Condition assessment has determined that the three pole 11 kV line to S1414 at Lawsons Creek requires replacement.

Project 09-41024: Nelson Creek, Sleepy Hollow - Replace 11 kV and LV Line

Recent work in the Sleepy Hollow area, near Nelson Creek, has identified the need to have the line upgraded. The seven substandard hardwood poles require replacement and the Mullet conductor shall be replaced with Squirrel.

Project 09-41035: Nelson Creek Road, Replace 11 kV Line

An ongoing project, the Nelson Creek Road line replacement will see poles and conductor east of L61 replaced.

Project 09-41032: Ten Mile Valley, Upgrade 11 kV Line to Service Mines

Funds have been allocated to reinstate the 11 kV line to the Ten Mile Valley if required. Indications that a mine may be redeveloped in the valley have prompted this allocation and will only proceed if this development comes to fruition.

Project 09-11002: Replace Maitahi River Crossing

A recent washout at the Maitahi River crossing and a temporary repair has necessitated a permanent fix. There are a number of options available and a contingency sum has been allocated.

5.6.2.2 Enhancement

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.

5.6.2.3 Development

To significantly increase the capacity of the power system in the Greymouth Area, a major upgrade of the Transpower Dobson-Inangahua transmission circuit will be required to provide the necessary upstream transmission capacity.

Project 09-61003: Construct 11 kV Line to Freyberg Terrace

To assist in off loading S119, Frickleton St, and S1886, Murray St consideration shall be given to construct an 11 kV line to a transformer, built in a position in Freyberg Terrace, yet to be determined.

5.6.3 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.

5.6.3.1 Maintenance

(i) Routine Patrols and Inspections

A condition assessment programme will be continued to identify substandard components or construction methods.

Similar to the Reefton area, it is expected that this will form the basis of a repair programme involving individual component replacements throughout the planning period.

After the initial inspection, the line is to be inspected on a rolling five-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

An ongoing programme to replace very old service poles will continue as required.

(iv) Replacement

Project 09-41011: Hokitika, Golf Links Road - Replace 11 kV Line

Recent new connections on the section of 11 KV line traversing Golf Links Road at Hokitika has prompted an assessment of the line. This assessment has determined that many of the poles require replacement to ensure security of supply to the area. The benefits of reconstructing to it's existing double circuit design will need to be determined.

Project 09-41037: Awatuna Rail Crossing, Replace 11 kV Poles

The four poles crossing the rail line and the State Highway at Awatuna have been found to be in need of replacement. Due to the close proximity to both road and rail they will be replaced with some urgency.

Project 09-41031: Hokitika to Ruatapu, 11 kV Line Replacement

Carried out over two years, this project will see the final 35 poles between Ruatapu and Southside replaced. This will include the stringing of approximately 3.5km of Iodine AAAC.

5.6.3.2 Enhancement

Apart from the specific projects discussed, there is no general enhancement programme planned for Hokitika.

5.6.3.3 Development

The 66/11 kV Hokitika substation provides a strong 11 kV bus near to the major loads in Hokitika, and therefore removes an effective voltage constraint that has existed for several years. This allows major new loads in the area to be supplied without significant development of distribution line infrastructure.

Of course, any major loads either some distance from Hokitika or some distance from the associated distribution lines, will require new line development.

5.6.4 South Westland Area

The distribution network in South Westland is contained in pockets based around Waitaha, Harihari, Whataroa Wahapo, Franz Josef Glacier and Fox Glacier south to Paringa and is generally in good condition.

5.6.4.1 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 five-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 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 and contracted to ElectroNet Services.

(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 09-41020: North of Franz Sub to Molloy's - Replace 11 kV Conductor

Due to the growth in the Franz Josef area, the existing Squirrel ACSR 11 kV conductor north of the Franz substation to Molloy's subdivision will be insufficient to manage expectant loads. This project may not be initiated for two to five years. The 2.6 km length of underbuilt conductor is to be replaced with Mink ACSR from the substation to pole 17470 on the State Highway near S1144.

5.6.4.2 Enhancement

As many of the distribution lines in the South Westland area have recently been rebuilt or upgraded, there is unlikely to be a requirement for capacity enhancement. There is a possibility that some small areas may require this work, however, as a result of in-fill development.

5.6.4.3 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 piecemeal fashion over several years.

5.6.5 System Wide Distribution Projects

Project 09-11004: Replace Condemned Distribution Poles

The Condition Assessment programme frequently identifies the need to replace individual poles within a section of line to ensure the security of that line. A sum has been allocated in the maintenance budget to replace such poles.

Project 09-11005: River Protection Works for Distribution Lines

In recent times it has been necessary to install river protection works for distribution lines, particularly near major rivers. Erosion around structures has been an ongoing problem therefore a contingency sum will be allocated in the AMP for such protection works.

Project 09-11003: Purchase of Aerial Photography

With the increasing use of the GIS for mapping purposes and asset identification, the purchase of aerial photographs in built up areas, particularly Greymouth, Hokitika and Reefton, has become necessary.

Project 09-11001: Fit Pole Caps to Softwood Poles

In earlier times some softwood poles were installed without aluminium pole caps fitted. To prolong the life of any of these poles found, caps are to be fitted.

Project 09-51001: Light Conductor Replacement

This is an ongoing project which will see the gradual replacement of Mullet conductor with Squirrel. This replacement program was initiated due to the substandard 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.

Project 09-61005: Purchase of PDA's for Condition Assessment

With the condition assessment programme nearing five years since it's inception, the PDA's on which contractors have been carrying out field data collection are becoming obsolete. Units are now available which offer faster processing speeds and are equipped with GPS to allow more precise recordings.

Table 5.15 details the planned expenditure over the AMP period for each of the above described projects.

Table 5.15 - Distribution Projects ($'000)

ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
-	RPL	Arnold PS, Replace 11 kV Line to Dam	ALD3	0	50	50	0	0	0	0	0	0	0
-	RPL	Kokiri, P Honey, S554 Replace 11 kV Line	ALD3	0	0	0	15	0	0	0	0	0	0
-	RPL	Moana-Ruru, 11 kV Pole Replacement	ALD4	0	28	0	0	0	0	0	0	0	0
-	RPL	Rotomanu, S1497, Marley Replace 11 kV line	ALD4	0	0	0	12	0	0	0	0	0	0
-	RPL	Waikiti Downs, 11 kV Line Replacement	ALD4	0	0	0	0	100	100	0	0	0	0
41012	RPL	Haupiri Line 11 kV Line Upgrade	ALD4	0	80	84	75	75	0	0	0	0	0
-	RPL	Duffers - Wainihinihi River, 11 kV Line Replacement	DIL4	0	30	0	0	0	0	0	0	0	0
-	D	Candellight - Blair Road 11 kV Tie	DOB1	0	0	0	0	0	0	0	0	0	0
-	RPL	Mt Sewell, 11 kV Pole Replacement	DOB1	0	0	50	50	0	0	0	0	0	0
-	RPL	St Kilda, Replace 11 kV Poles to S841	DOB1	0	0	10	0	0	0	0	0	0	0
-	RPL	Omoto Valley Road, Replace 11 kV line to DF30	DOB3	0	35	0	0	0	0	0	0	0	0
-	RPL	Wallsend, Replace 11 kV Line	DOB3	0	30	0	0	0	0	0	0	0	0
41009	RPL	Dobson Straight - 11 kV Line Replacement	DOB3	80	50	0	0	0	0	0	0	0	0
11002	I	Replace Maitahi River Crossing	FOX1	50	0	0	0	0	0	0	0	0	0
41007	RPL	Condons Rd - Relocate 11 kV Poles	FOX1	0	0	0	25	25	0	0	0	0	0
61007	D	Replace 11 kV Cable Fox Hotel	FOX1	0	100	0	0	0	0	0	0	0	0
-	RPL	Docherty Creek Road, Replace Poles to S1160	FRZ3	0	0	12	0	0	0	0	0	0	0
-	RPL	Tatare Franz Josef, Replace 11 kV Poles to S1564	FRZ3	0	0	0	12	0	0	0	0	0	0
41020	RPL	North of Franz Sub to Molloy's - Replace 11 kV Conductor	FRZ3	15	15	16	17	18	0	0	0	0	0

Table 5.15 - Distribution Projects Continued... ($'000)													
ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
61003	D	Construct 11 kV Line to Freyberg Terrace	GYM11	50	0	0	0	0	0	0	0	0	0
61004	D	Grey Hospital to New World - New Feeder Cable	GYM11	0	0	0	0	0	22	0	0	0	0
-	E	Replace Overhead Line with Underground, Arney Street	GYM12	0	0	0	0	0	60	0	0	0	0
-	RPL	Murray St to Herbert Street, 11 kV Line Replacement	GYM12	0	15	0	0	0	0	0	0	0	0
-	RPL	Replace Warehouse 11 kV Cable with Rated Cable	GYM13	0	17	0	0	0	0	0	0	0	0
41030	RPL	Welshmans Road - Reconductor 11 kV Line	GYM6	18	18	0	0	0	0	0	0	0	0
-	RPL	Cobden Bridge - Kaiata 11 kV Line Replacement	GYM8	80	80	0	0	0	0	0	0	0	0
-	RPL	Robertson Road, Replace 11 kV line.	HHI1	0	0	50	20	0	0	0	0	0	0
-	RPL	Athurstown, Replace 11 kV Line	HKK10	0	55	55	0	0	0	0	0	0	0
-	RPL	Awatuna, Replace 11 kV Poles on Te Rakau Property	HKK10	0	15	0	0	0	0	0	0	0	0
-	RPL	Lake Kaniere Lodge 11 kV Line Upgrade	HKK10	0	15	0	0	0	0	0	0	0	0
-	RPL	XD25, Replace 11 kV Poles	HKK10	0	0	0	15	0	0	0	0	0	0
41011	RPL	Hokitika,Golf Links Road - Replace 11 kV Line	HKK10	30	50	0	0	0	0	0	0	0	0
41031	RPL	Hokitika to Ruatapu, 11 kV Line Replacement	HKK10	80	80	0	0	0	0	0	0	0	0
41037	RPL	Awatuna Rail Crossing, Replace 11 kV Poles	HKK10	20	0	0	0	0	0	0	0	0	0
-	RPL	Reconstruct 11 kV Line Bundi Road	KUM1	0	0	22	22	0	0	0	0	0	0
41016	RPL	Kumara Junction to Kumara - 11 kV Line Replacement	KUM1	20	100	100	80	0	0	0	0	0	0
41027	RPL	Taramakau Settlement - 11 kV Pole Replacement	KUM1	0	80	80	0	0	0	0	0	0	0
-	D	Atarau Road, Develop Tie LGN1 - BWR1	LGN1	0	0	0	0	0	0	0	0	0	0
41001	RPL	Blackball - Taylorville Rd - 11 kV Pole Replacement	NGH1	0	33	0	0	0	0	0	0	0	0
41023	RPL	Slatey Creek - 11 kV Line Replacement	NGH1	90	0	0	0	0	0	0	0	0	0
-	D	Bell Hill 11 kV Alternative Feed	NGH3	0	0	0	0	0	0	0	0	0	0
-	RPL	11 kV Spur Balderstone Ngahere	NGH3	0	0	18	0	0	0	0	0	0	0
-	RPL	Balderstone, Trigon Rd Ngahere, 11 kV Pole Replacement	NGH3	0	0	15	0	0	0	0	0	0	0
-	RPL	Mawheraiti Thompsons Road, 11 kV Pole Replacement	NGH3	0	22	0	0	0	0	0	0	0	0
-	RPL	Redjacks Road, Replace 11 kV Line	NGH3	0	0	0	0	50	0	0	0	0	0
-	RPL	Waipuna, Replace 11 kV Line	NGH3	0	0	0	0	80	80	0	0	0	0

Table 5.15 - Distribution Projects Continued... ($'000)													
ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
41024	RPL	Nelson Creek , Sleepy Hollow - Replace 11 kV and LV Line	NGH3	20	0	0	0	0	0	0	0	0	0
41035	RPL	Nelson Creek Road, Replace 11 kV Line	NGH3	30	32	34	0	0	0	0	0	0	0
41017	RPL	Lawsons Creek - 11 kV Line to S1414, Line Replacement	RAP1	7	0	0	0	0	0	0	0	0	0
41032	RPL	Ten Mile Valley, upgrade 11 kV line to service mines.	RAP1	80	30	0	0	0	0	0	0	0	0
-	RPL	Black Reef Mine, Rewanui Replace 11 kV line	RAP3	0	0	0	0	100	0	0	0	0	0
-	RPL	Seven Mile Road, S1693, Griffiths & Ewen, 11 kV Pole Replacement	RAP3	0	0	0	12	0	0	0	0	0	0
-	RPL	Browns Creek Road, 11 kV Line Replacement	RFN4	0	30	0	0	0	0	0	0	0	0
41004	RPL	Boatmans Road - Replace 11 kV Line	RFN4	40	20	20	0	0	0	0	0	0	0
41029	RPL	Waitahu, Douglas Road - Replace 11 kV Line S1363	RFN4	0	30	30	0	0	0	0	0	0	0
41036	RPL	Inangahua Junction T Lees, 11 kV Line Replacement	RFN4	26	0	0	0	0	0	0	0	0	0
-	RPL	Soldiers Road, Replace 11 kV line	RFN5	0	0	50	50	50	0	0	0	0	0
41008	RPL	Crushington-Garveys Creek - 11 kV Line Replacement	RFN5	133	0	0	0	0	0	0	0	0	0
41021	RPL	Reefton to Blacks Point - Replace 11 kV Line	RFN5	60	0	0	0	0	0	0	0	0	0
41034	RPL	Garveys to Craigs Flat Line Replacement	RFN5	11	12	12	0	0	0	0	0	0	0
51002	E	Reefton Ring - Upgrade 11 kV Line, Crampton Rd	RFN5	25	0	0	0	0	0	0	0	0	0
41022	RPL	Ross Township - Upgrade 11 kV Conductor	RSS3	0	20	0	0	0	0	0	0	0	0
-	RPL	Unspecified Distribution Line Replacement	SYS	0	0	0	0	0	0	0	0	0	0
11001	I	Fit Pole Caps to Softwood Poles	SYS	2	2	3	3	3	3	3	4	4	0
11003	I	Purchase of Aerial Photography	SYS	25	25	0	0	0	0	0	0	0	0
11004	I	Replace Condemned Distribution Poles	SYS	212	225	238	252	268	284	301	319	338	358
11005	I	River Protection Works for Distribution Lines	SYS	58	62	66	69	74	78	83	88	93	99
51001	E	Light Conductor Replacement	SYS	100	100	100	100	100	0	0	0	0	0
61005	D	Purchase of PDA's for Condition Assessment	SYS	12	13	13	14	15	16	17	18	19	0
-	RPL	Okarito, 11 kV Line Replacement	WAH1	0	0	40	40	50	0	0	0	0	0
-	D	11 kV Landcorp Sth Whataroa	WAT1	0	0	15	15	0	0	0	0	0	0
41033	RPL	Waitaha, Allen Road, Replace 11 kV Line	WTH1	40	40	0	0	0	0	0	0	0	0
				1464	**1689**	**1233**	**948**	**1058**	**643**	**404**	**429**	**454**	**457**

5.7 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.

Tables 5.16 and 5.17 summarise the planned expenditure over the AMP period by category for the Reticulation assets.

Table 5.16 - Reticulation Projects and Programmes ($'000)

Activity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inspect, Service and Test	322	295	262	214	224	235	212	224	237	250
Faults	21	22	24	25	27	28	30	32	34	36
Repairs	37	39	42	44	47	50	53	56	59	62
Replacement	108	22	0	0	0	0	0	0	0	0
Enhancement	90	60	30	30	30	30	20	20	20	20
Development	0	7	0	0	0	0	0	0	0	0
	578	**445**	**358**	**313**	**328**	**343**	**315**	**332**	**350**	**368**

Table 5.17 - Reticulation Projects ($'000)

ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
52001	E	Iveagh Bay Underground	ALD4	60	0	0	0	0	0	0	0	0	0
42006	RPL	Wallsend, Replace LV Line	DOB3	12	0	0	0	0	0	0	0	0	0
42010	RPL	Thompson Street Greymouth - Replace LV Line	GYM12	12	0	0	0	0	0	0	0	0	0
-	D	Ogilvie Road, Develop LV Link	GYM6	0	7	0	0	0	0	0	0	0	0
42005	RPL	Woodstock - 11 kV and LV Line Replacement	HKK10	60	0	0	0	0	0	0	0	0	0
42007	RPL	Ahaura Bridge LV Replacement	HKK10	12	0	0	0	0	0	0	0	0	0
42009	RPL	3 Mile Hokitika, Replace LV Line	HKK10	12	0	0	0	0	0	0	0	0	0
12003	I	Hokitika, Hampden St - Remove LV	HKK4	0	15	15	0	0	0	0	0	0	0
52002	E	Reefton - Upgrade of LV Network	RFN5	30	30	30	30	30	30	20	20	20	20
42003	RPL	Ruatapu Township - Replace LV	RSS1	0	22	0	0	0	0	0	0	0	0
12001	I	Data Collection of LV Circuits	SYS	21	22	20	5	5	5	5	5	5	5
12002	I	Inspection, GPS and Labeling of LV Pillar and Link Boxes	SYS	45	45	10	10	7	7	5	5	5	5
12004	I	Replace All Motor Rated Fuses	SYS	2	2	0	0	0	0	0	0	0	0
12005	I	Replace Condemned Reticulation Poles	SYS	150	100	100	75	80	84	89	95	100	106
12006	I	South Westland - Ripple Relay Replacement	SYS	25	27	28	30	32	33	0	0	0	0
52003	E	Hokitika - Upgrade Link Boxes to 3 Way Switching	SYS	0	30	0	0	0	0	0	0	0	0
				441	**300**	**203**	**150**	**154**	**159**	**119**	**125**	**130**	**136**

5.7.1 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.

5.7.1.1 Maintenance

(i) Routine Patrols and Inspections

As with distribution lines, the 2008-09 financial year will see the continuation of the condition assessment programme. Each line (feeder) is to be inspected on a rolling five-year basis, covering 20% of the route length per year. During the inspection every aspect of the line is checked.

As for other areas, it is expected that this will form the basis of a repair programme involving individual component replacements throughout the planning period.

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

(ii) Faults

Faults are limited to the occasionally substation fuse blowing or the failure of a pole, either during high winds, or when hit by a vehicle.

Fault staff in the area are able to handle these faults locally.

(iii) Repairs and Refurbishment

Any poles identified as reaching replacement criteria as a result of the pole inspection programme will be replaced as required, and if the level in particular sections of line exceeds 50% of the line value, this will be upgraded to a replacement programme for that section.

It is expected that most remedial work will be accomplished through simple component replacement.

(iv) Replacement

Due to previous reticulation line upgrades in the Reefton area, replacements are not required in this financial year. The ongoing condition assessment programme may identify replacements for later years.

5.7.1.2 Enhancement

With the development of the Oceana Gold Limited mine, the economic outlook for Reefton is expected to be bullish. Some upgrading of the LV network will be required to meet expected growth demand in the area.

Project 52002: Reefton, Upgrade of LV Network

This project will be run in conjunction with the “Upgrade 11 kV Line - Reefton Ring”. An upgrade of the 400 V reticulation supplying Reefton will help alleviate any anticipated shortfall in capacity, along with the replacement of any poles not capable of withstanding new design loads.

5.7.1.3 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.

5.7.2 Greymouth Area

The comments that applied to Reefton reticulation assets apply also to Greymouth, except that the relative amount of very old wood pole lines is greatly reduced. The reason for this is the major replacement programme completed in the 1990's as discussed in section 5.3.1.

5.7.2.1 Maintenance

(i) Routine Patrols and Inspections

As with Reefton, a detailed condition assessment programme will be continued.

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

(ii) Faults

Faults are limited to the occasional 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. 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 09-42010: Thompson Street, Greymouth - Replace LV Line
The four hardwood poles in Thompson Street Greymouth are in need of replacement due to their substandard condition.

Project 09-42006: Wallsend - Replace LV Line
Attending a recent fault in the Wallsend area the faultman found that a number of LV poles in the area require replacement due to very poor condition. A subsequent inspection confirmed this and these poles are to be replaced.

5.7.2.2 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 09-52001: Iveagh Bay Underground
There are a number of subdivisions planned for the Iveagh Bay area, the full extent is not yet known. The existing 11 kV and 400 V assets in the bay are at the end of their economic life and may not be positioned correctly for the future. With the increased load that is likely to come on and the new layout, some funds will be required to bring new supply to the developers lots. A provisional sum is included.

5.7.2.3 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.

5.7.3 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.

5.7.3.1 Maintenance

(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 09-42007: Ahaura Bridge LV Replacement
A recent assessment found that four LV poles at Arahura are in need of replacement.

Project 09-42009: 3 Mile Hokitika, Replace LV Line
A recent inspection concluded that four LV poles at 3 Mile near Hokitika are in need of replacement.

Project 09-42005: Woodstock - 11 kV and LV Line Replacement
The intended project to replace the LV line at Woodstock was re-evaluated and it was decided that the condition of the 11 kV line over private property was also in need of replacement. With this in mind, a new route has been determined and the 11 kV will be conjoint with the LV in the area.

5.7.3.2 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.

5.7.3.3 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.

5.7.4 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.

5.7.4.1 Maintenance

(i) Routine Patrols and Inspections

No inspections are planned on the underground reticulation.

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

(ii) Faults

Faults are limited to the occasional substation fuse blowing or the failure of a pole, or when a pillarbox 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.

5.7.4.2 Enhancement

No enhancement projects are planned for this area, as there is ample capacity generally available.

5.7.4.3 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.

5.7.5 System Wide Reticulation Projects

Project 09-12004: Replace All Motor Rated Fuses

Motor rated fuses were installed to allow a certain amount of overload to be applied to prevent fusing. This situation is quite legal but general purpose fuses of Q1 or Q2 characteristic may be more appropriate. As motor rated fuses are found they shall be replaced.

Project 09-12005: Replace Condemned Reticulation Poles

The Condition Assessment programme frequently identifies the need to replace individual poles within a section of line to ensure the security of that line. A sum has been allocated in the maintenance budget to replace such reticulation poles.

Project 09-12002: Inspection, GPS and Labelling of LV Pillar and Link Boxes

An audit carried out by the Energy Safety Service found that several service pillar boxes within the Westpower network were in a unsatisfactory condition. This audit prompted a detailed inspection programme. With this

inspection being carried out, the opportunity has arisen to affix identification numbers, capture geospatial information and other relevant data for all service pillars.

Project 09-12001: Data Collection of LV Circuits

To help ensure all of Westpower's assets are recorded in the Asset Management System and associated systems such as GIS, data relating to LV lines and underground cables that is missing, must be collected and transferred to the relevant systems.

Project 09-12006: South Westland Ripple Relay Replacement

As part of a programme to improve the reliability and flexibility of Westpower's Ripple Control capabilities in the South Westland area, Westpower has initiated the replacement of older Plessey rythmatic relays south of Hokitika. This will provide the capability of switching interruptible loads in smaller blocks, which is essential for maintaining the demand supply balance when South Westland is being supplied from Wahapo power station islanded from the rest of the grid.

5.8 Services

In general, Westpower does not carry out maintenance on customer owned service lines. These are the responsibility of the customer to maintain and they can use any competent contractor to do so. There are several exceptions to this general rule however including;

- Replacement of blown service fuses due to faults.
- Repair of substandard service lines where these were never brought up to standard prior to transferring to the customer.
- Replacement of service poles on the street where these were previously shared with Telecom and are now substandard.
- Repairs to network connection equipment.
- Repairs to service spans across road reserve.

Financial control procedures mean that only approved work is carried out, and that the customer will be required to pay for most work on customer-owned service lines.

Table 5.18 summarizes the planned expenditure by category for Service related projects during the AMP period.

Table 5.18 - Service Projects and Programmes ($'000)

Activity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inspect, Service and Test	85	89	83	88	93	99	106	111	118	125
Faults	80	84	89	95	100	106	113	120	127	135
Repairs	11	11	12	13	13	14	15	16	17	18
Replacement	0	0	0	0	0	0	0	0	0	0
Enhancement	0	0	0	0	0	0	0	0	0	0
Development	108	115	121	128	137	145	154	162	173	183
	284	**299**	**305**	**324**	**343**	**364**	**388**	**409**	**435**	**461**

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.

5.8.1 System Wide Service Projects

Project 09-13001: Greymouth, Upgrade Underveranda Lighting

In the Greymouth CBD a lighting system is supplied along the veranda of the adjacent buildings. This system is nearing the end of its economic life and in need of replacement. A sum has been allocated to have this lighting system replaced.

Project 09-63001: New Service Connections

Westpower provides a connection service free of charge to any party wishing to connect to the network. This connection includes constructing the fuse point, be it 11 kV or LV.

5.8.2 Service Poles

The condition assessment programme includes the assessment of service poles not on private property. Any poles found to be in need of replacement will be done so as a high priority. These poles pose a health and safety risk which must be mitigated as soon as possible.

Project 09-13002: Service Pole Replacement

This project has been initiated to ensure funds are available to replace any substandard service pole found on the network. These poles pose a health and safety risk so therefore the risk must be mitigated on a high priority basis.

Table 5.19 lists the planned expenditure for service projects over the AMP period.

Table 5.19 - Service Projects ($'000)

ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
13001	I	Greymouth, Upgrade Underveranda Lighting	SYS	11	11	0	0	0	0	0	0	0	0
13002	I	Service Pole Replacement	SYS	40	42	45	48	50	54	57	60	64	68
63001	D	New Service Connections	SYS	90	96	101	107	114	121	128	135	144	153
				141	**149**	**146**	**155**	**164**	**175**	**185**	**195**	**208**	**221**

5.9 Zone Substations

5.9.1 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.

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 two years.
- Major service - every four 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.

Table 5.20 summarizes the planned expenditure by category for Zone Substations projects during the AMP period.

Table 5.20 - Zone Substation Projects and Programmes ($'000)										
Activity	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Inspect, Service and Test	881	835	688	705	732	753	853	868	908	957
Faults	11	11	12	13	13	14	15	16	17	18
Repairs	65	28	30	32	33	35	38	40	42	45
Replacement	449	377	367	164	20	21	22	1423	24	185
Enhancement	480	0	0	72	0	0	665	0	0	560
Development	620	0	0	0	0	257	0	595	0	0
	2506	**1251**	**1097**	**986**	**798**	**1080**	**1593**	**2942**	**991**	**1765**

09-14014: Carry Out Thermovision Inspections of Zone Substation Equipment
To identify high resistant joints present in zone substations, a thermovision inspection programme is to be carried out at all zone substations. Strategic lines shall also be inspected on a rotational basis, with each line being reviewed every three years.

09-14015: Corona Discharge Testing at Various Zone Substations
To identify any failing insulation in zone substations, a corona discharge inspection programme is to be carried out at zone substations. Strategic lines shall also be inspected on a rotational basis, with each line being reviewed every three years.

09-14017: Update Zone Substation Drawings & Filing System
Funds have been allocated to update backlog of station drawings and develop new filing system/audit trail for all future drawing updates.

09-14018: Earthing Review of Zone Substations and Associated Remedial Works
Westpower is required to carry out regular earth testing of its zone substations as a regulatory and health and safety issue. The company must also ensure that damage to other plant such as Telecom equipment is minimised in the event of an earth fault, and a survey is currently being carried out of all zone substation earth mats to ensure compliance.

09-14019: Oil Filter & Dry Out System For Transformers
A number of the zone sub transformers have moisture ingress which severely shortens their life. The portable filter and dry out system is to be moved around the zone substation transformers to remove much of this moisture via online filtering.

09-14020: Perform Oil Tests at Zone Substations (DGA)
An enhanced baseline analysis of transformer oil conductivity and dissolved gases will be continued this year to gain a better understanding of the asset.

09-14023: Zone Substation Lightning Protection Review
Carry out lightning protection review of all zone substations this year. Implement recommendations identified in review to provide adequate lightning protection.

09-14025: Network Study to Determine Feasibility of Connection of Remote Ends of Feeders
Carry out a network study to determine *feasibility* of connecting remote ends of feeders to improve security of supply, switching options, etc. Areas of study to include: Nelson Creek/Haupiri, Ruatapu/Kowhitirangi, Rutherglen/Boddytown, Slatey Creek/Grey Valley, Ngahere/Stillwater.

09-14026: Zone Substation - Purchase & Installation of Earthing Spigots
It had been practice to directly place portable earths onto the conductor leading to equipment. This is no longer acceptable as it causes damage to equipment and at some locations earths are difficult to apply. It is more appropriate to have spigots installed for earths to be applied to. This project proposes to have spigots installed as equipment is released for maintenance.

09-14027: Purchase of Portable Earths and Authorisation Equipment
Ensure an adequate supply of portable earths and permit equipment required for operating to be available on site.

09-14028: Adapt Transformer & Regulator Pipework for Oil Treatment Plant Connection
To be able to connect the mobile oil treatment plant to several transformers and regulators at zone substations the pipework needs to be extended (during planned outages) to allow in-service safe connection of the plant.

09-14029: Westpower Store - Storage of Key Assets in a Controlled Environment
Carry out a study this year to determine requirements for storing Westpower assets in a controlled environment. Study to include - list of assets and location, database, controlled procedure for booking in/out assets, location of store, indoor/outdoor temperature controlled environment, etc.

09-14030: Zone Substation - Building Climate Control
This project was initiated to ensure that equipment, especially that of the electronic kind, enclosed in Westpower's zone substation buildings are kept at the correct temperature and humidity levels. Logburn Road, Hokitika and Reefton substations have been completed and Greymouth is the last of the larger substations and is to be completed this year. It is planned to have all zone substations completed by 2012.

09-14031: Zone Substation - Landscaping & Beautification
This is an ongoing project which incorporates, as the title suggests, landscaping and gardening work aimed at improving the amenity values at Westpower's zone substation sites.

09-14032: Zone Substation – OLTC & Regulator Maintenance
A planned maintenance/refurbishment cycle has been developed for all OLTC and regulator assets to prolong the life of these crucial assets. Funds have been available for the ongoing costs required each year.

09-14033: Zone Substation – Seismic Repairs
The Lifelines seismic assessment carried out on Westpower's substations listed remedial action required. Much of this work has been completed, with remaining upgrades to be completed this year.

09-14034: Zone Substation – Transformer Refurbishment & Maintenance
A planned maintenance/refurbishment cycle has been developed for all zone substation transformer assets to prolong the life of these crucial assets. Funds have been made available for the ongoing costs required each year.

09-14035: Zone Substation - Building Maintenance
This is an ongoing project which can include building maintenance such as cladding repairs, spouting repairs etc on all of Westpower's zone substation buildings.

09-64009: WMS (Mobile Substation) Storage
Covered storage is required to protect the mobile substation for the periods when it is not in use.

09-14037: Zone Substation – WMS Relocation, Site Installation, Disconnection Costs
This is an ongoing project which incorporates as the title suggests, mobile substation relocation, installation, disconnection and transportation costs.

09-14009: Replace Exterior Cladding/Windows/Door etc...
Rapahoe control room cladding is rusting and requires to be replaced. The windows and door are leaking and will be replaced at the same time.

09-14039: Greymouth Substation - Paint Exterior and Replace Roof
The control room building at the Greymouth Substation is deteriorating and in need of painting and roof replacement. This will ensure the area is tidy, dry and no damage occurs to the building and equipment within.

09-14028: Adapt Zone Transformers & Regulators Pipework for Oil Treatment Plant Connection
To be able to connect the mobile oil treatment plant to several transformers and regulators at zone substations the pipework needs to be extended (during planned outages) to allow in-service safe connection of plant.

09-14024: Operator Training, Site Inductions and Site Familiarisation
A fund has been made available for operator training, site familiarization, inductions, etc, at zone substations and remote locations in the network.

5.9.1.1 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.

5.9.1.2 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.

5.9.1.3 Power Transformer Servicing and Testing

As part of Westpower's maintenance programme, all major power transformers have an annual minor maintenance service which encompasses a visual inspection, routine diagnostic tests and minor repair work in accordance with Westpower standards which incorporate manufacturers' recommendations and Westpower's experience.

In general, maintenance on the transformers consists of maintaining oil within acceptable dielectric and acidity standards, patching up corrosion, fixing oil leaks and annual diagnostic tests on the insulating oil. In addition the units fitted with on-load tapchangers require periodic inspection of the tapchangers and the contacts are dressed or replaced as necessary. Additional remedial work required outside the scope of the maintenance contract is referred to Westpower for further action and budgeted as repairs and refurbishment.

(i) Oil Testing- Oil Conductivity and Dissolved Gas Analysis

Over the last seven years, all zone substations have had dissolved gas analysis tests carried out and this identified potential problems that need monitoring. This will be followed up by further annual Oil Conductivity and DGA tests until trends are reliably established. Once this is done, the period will be reviewed, possibly on an individual unit basis.

Costing for minor maintenance is very dependent on location and based on the present maintenance expenditure.

Costing for major maintenance, i.e. on-load tapchangers, is not only dependent on the location of the site but also the usage and types of unit and is such that some units have to be serviced every two years and others every six years.

5.9.1.4 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 two years but this is extended up to four 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 four 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 five years, and this will become the practice in future.

5.9.1.5 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 of $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.

5.9.2 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 substation asset category given the range of faults, which can occur.

5.9.3 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.

5.9.3.1 Power Transformers

The major causes of power transformer failures are winding and internal connection faults. These are caused in general by electrical through faults or lightning strikes.

The other major internal maintenance on a power transformer is oil refurbishment and desludging which is carried out as required based on oil acidity test results. It is not expected that this will be required on any of Westpower's units within the planning period.

At mid-life, a full dry out and core retighten is recommended.

(i) Radiator Replacement

Radiator replacement is only carried out on coolers where the design of the radiators or extent of corrosion means repairs cannot be carried out satisfactorily.

The corrosion occurs after 20 or more years of age in transformers in corrosive environments (such as coastal). The radiators are replaced only once in the life of a transformer. Only two of Westpower's current power transformers meet this criteria.

(ii) Repainting

Painting is carried out on a regular basis at a period of generally between 10 to 15 years depending on site conditions. It is planned to paint approximately 1 unit per year over the period 2010-2019.

(iii) Other Equipment

Ongoing repairs are required to a variety of other station equipment including portable earthing equipment and battery banks.

5.9.4 Replacement Programmes

Westpower has formulated its replacement programme based on the following criteria:

5.9.4.1 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.

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 two 66 kV minimum oil circuit breakers, and a replacement strategy is being formulated that will ensure ongoing performance at these sites.

09-44001: Dobson Substation - Replace CB1 & CB3 with Vipers & Upgrade Protection
KFEs are starting to give variable performance. Their settings selection is limited and there have been several auxiliary switch failures. It is proposed that as their setting limitations are identified as to cause nuisance, these

reclosers are to be replaced. Replace CB1 and CB3 Cooper oil filled reclosers with Viper reclosers. Upgrade protection with SEL 351S relays.

09-44003: Dobson - T6 - Remove AVR, Control Cabinet & Metering - Replace/Relocate NCT Protection
Dobson CB1 and CB3 and protection are being replaced this year. This provides a ideal opportunity to relocate T6 older protection and ion meters to a new protection cabinet and de-commission the old cabinet.

09-44004: Franz Josef Substation – Replace CB1 & 3 with Vipers & Upgrade Protection
KFEs are starting to give variable performance. Their settings selection is limited and there have been several auxiliary switch failures. It is proposed that as their setting limitations are identified as to cause nuisance, these reclosers are to be replaced. Replace CB1 and CB3 Cooper oil filled reclosers with Viper reclosers. Upgrade protection with SEL 351S relays.

09-44006: Franz Josef - T1 Combiflex & Tripping Relay Replacement/Protection (Cabinet & 24Vdc Charger)
FRZ CB1 and CB3 and protection are being replaced this year. This provides a ideal opportunity to replace T1 older combi flex protection relays, re-locate to new protection cabinet and de-commission old cabinet.

09-44008: Greymouth Substation – Replace ODJBs
The steel outdoor junction boxes have reached the end of their serviceable life due to corrosion. Replace outdoor junction boxes during protection upgrade.

09-44001: Wahapo Zone Substation - Replace CB1 & Protection Relay
KFEs are starting to give variable performance. Their settings selection is limited and there have been several auxiliary switch failures. It is proposed that as their setting limitations are identified as to cause nuisance, these reclosers are to be replaced. Replace CB1 Cooper oil filled reclosers with Viper reclosers. Upgrade protection with SEL 351S relays.

09-44014: Ngahere Zone Substation - CB3812 Replacement with WVE38x Type
Replace older “R” type 33 kV reclosers with VWVE38X type.

09-44013: Harihari Zone Substation - Replace CB1 & CB3 with Vipers & Upgrade Protection
KFEs are starting to give variable performance. Their settings selection is limited and there have been several auxiliary switch failures. It is proposed that as their setting limitations are identified as to cause nuisance, these reclosers are to be replaced. Replace CB1 and CB3 Cooper oil filled reclosers with Viper reclosers. Upgrade protection with SEL 351S relays.

09-44012: Grey Transformer Room Upgrade Test Bay Cubical and CB
The CB and test bay in the transformer room used for testing has become obsolete and unsafe. An upgrade is required to ensure that Westpower staff can carry out HV equipment testing in a safe environment.

09-44015: Wahapo Zone Substation - Replace Combiflex Relays, Protection Setting Upgrade
Wahapo CB1 and protection is being replaced this year. This provides a ideal opportunity to replace T1 older combiflex protection with modern SEL relays. A protection setting upgrade is also to be completed as part of project.

09-44010: Battery Replacement Programme
A fund has been made available for battery replacements as required.

5.9.4.2 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, the only SO-HI type in Westpower’s area, being replaced in 2003.

As contractors work in close proximity to the equipment and the equipment is oil filled there is an increased risk of personal injury. Overseas utilities have adopted designs such that new oil filled equipment is not installed indoors and blast walls have been installed between old equipment and places where contractors are required to work for extended periods.

Modern SF6/vacuum replacement installations with air insulated bus chambers rather than the old compound insulated types are virtually maintenance free. There is a high cost associated with maintenance of old oil filled and compound insulated equipment, which requires annual major service and frequent fault maintenance.

The typical economic life of Westpower’s indoor metalclad switchgear installations (typically 11 kV) has been assessed to be 50 years based on past experience. At present only a small percentage are over 20 years old.

5.9.4.3 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.

5.9.4.4 Instrument Transformers

Aged instrument transformers are only replaced when they fail, or when they are about to fail as diagnosed by testing. They are then replaced with a similar unit, usually a spare. Other replacements occur during site development works and depending on whether the condition and ratings etc of the transformer are suitable for use at another site they may be scrapped.

At Greymouth Substation, the 66 kV instrument transformers will be replaced over time with vandal resistant units using composite insulators because of the risk of failure due to ongoing vandal damage.

5.9.4.5 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 preemptive 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.

5.9.5 Maintenance Summary

In summary, the zone substations maintenance expenditure is shown in the above table (Table 5.20 - Zone Substation Projects and Programmes).

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.

5.9.6 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.

09-54003: Greymouth Zone Substation – Replace Protection
Although the existing protection equipment on the banks and feeders 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 and control panels with SEL units.

09-54004: Greymouth Zone Substation - Install New 110Vdc (DC2) Battery Bank Installation
All Westpower's larger zone substations are to have a second battery bank for reliability and security of supply to protection relays and other essential supplies.

09-54006: Harihari Zone Substation - Prepare Site for WMS Connection
A site is to be prepared for mobile substation access and connection. Requires extension of earth math, installation of 33kV disconnector, 33 and 11kV links to enable connection of WMS and isolation of zone substation.

09-54013: Hokitika Substation - Install New 110 V DC System and Rearrange Protection
All Westpower's larger zone substations are to have a second battery bank for reliability and security of supply to protection relays and other essential supplies.

09-54015: Capacitor Bank Control Upgrade (SEL)
A complete review of the Hokitika substation capacitor bank control circuitry is required to ensure the efficient and reliable operation of the units which are under Transpower operational control.

09-54011: Wahapo Zone Substation - Prepare Site for WMS Access
Allowing the Wahapo site to connect to the Mobile Substation will ensure that critical maintenance can be conducted in a safe and efficient manner. Additionally outages will be minimised during the maintenance period.

09-54014: Dobson Substation - Install ION Statistical Meters
Ion meters are to be installed at zone substations to provide remote access to statistical data for analysis and deliver improved quality of supply to Westpower's customers.

09-64001: Greymouth Substation - Install Ground Fault Neutraliser
A ground fault neutraliser is to be installed at the Greymouth Substation. Greymouth will be used as a test site to evaluate benefits in increased safety to personnel/public, reduced fire hazard and any reduction of unplanned outages (SAIDI).

09-64007: Wahapo Zone Substation - Install Ripple Plant
Upgrades of various zone substation ripple plants have provided excess parts and with minimal additional cost Westpower can install a ripple plant at Wahapo. This should reduce SAIDI and when Wahapo is islanded we will be able to strategically control shedding and load in the Wahapo area.

5.9.6.1 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.

5.9.7 Development

All development projects are dependent either on new investment agreements being reached with large customers or a clear economic justification.

Project 09-64009: Blackwater Zone Substation - Complete Build

A new zone substation is required in the Ikamatua area to support the Pike Coal off loading area. Previously a zone substation existed at the Blackwater junction and this area has been identified as suitable.

Project 09-64005: Purchase Generator Trailer, Step Transformer and Set Up

Last year a generator was purchased to provide network support to disasters and outages. To maximise the use of the generator a trailer is required to transport the generator to strategic locations. A step up transformer will also be fitted to the trailer to take full advantage of this asset.

Project 09-64008: Emergency Backup Control Room

An Emergency Backup Control Room is to be established in a transportable container and located at the Chapel St comms site. This control room will have connection to SCADA, UPS, computers, communications required, etc. All documentation, drawings, contact lists, etc will be prepared on site and be ready to go live.

Table 5.21 - Zone Substation Projects ($'000)

ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
-	RPL	Arnold Zone Substation - Replace CB 3 & 4 with Vipers & upgrade protection	ALD	0	0	87	0	0	0	0	0	0	0
-	D	Blackwater Zone Substation - Complete build	BWR	445	0	0	0	0	0	0	0	0	0
-	RPL	Cronadon - Replace regulator with new single phase units	CRN	0	0	0	0	0	0	0	0	0	160
-	E	Dobson Substation - Install ION statistical meters	DOB	15	0	0	0	0	0	0	0	0	0
-	RPL	Dobson CB1 & 3 - Upgrade to Viper & SELR Protection	DOB	20	0	0	0	0	0	0	0	0	0
-	RPL	Dobson T6 Protection - Replace Prot Relays, Remove AVR & Old Cabinet	DOB	15	0	0	0	0	0	0	0	0	0
-	RPL	Dobson Zone Sub - Replace T6 (TX:2240)	DOB	0	0	0	0	0	0	0	700	0	0
-	RPL	Fox Zone Substation - Replace CB 1 with Viper	FOX	0	46	0	0	0	0	0	0	0	0
-	RPL	Fox Zone Substation - Replace T1 (TX:2438)	FOX	0	0	0	0	0	0	0	700	0	0
-	RPL	Fox Zone Substation - T1, Replace combiflex, tripping relay & prot upgrade + 2032	FOX	0	20	0	0	0	0	0	0	0	0
-	E	Capacitor Bank Control Upgrade (SEL)	FRZ	10	0	0	0	0	0	0	0	0	0
-	E	Franz Install 2nd Transformer Bank and Associated Switchgear (identical units)	FRZ	0	0	0	0	0	0	335	0	0	0
44004	RPL	Franz Josef Substation - Replace CB 1 & 3 with Vipers & Upgrade Protection	FRZ	16	0	0	0	0	0	0	0	0	0
44006	RPL	Franz Josef - T1 Combiflex & Tripping Relay Replacement/ Protection (Cabinet & 24Vdc Charger)	FRZ	53	0	0	0	0	0	0	0	0	0
-	RPL	Grey Transformer Room Upgrade Test Bay Cubical & CB	GREY	120	0	0	0	0	0	0	0	0	0
-	I	Greymouth Substation - Paint exterior and replace roof	GYM	22	0	0	0	0	0	0	0	0	0

Table 5.21 - Zone Substation Projects ($'000) Continued...

ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
14005	I	Greymouth Substation - Paint Gantry Steelwork	GYM	0	75	0	0	0	0	0	0	0	0
44008	RPL	Greymouth Zone Substation - Replace ODJB's	GYM	15	0	0	0	0	0	0	0	0	0
54003	E	Greymouth Zone Substation - Replace Protection	GYM	180	0	0	0	0	0	0	0	0	0
54004	E	Greymouth Zone Substation - Install new 110Vdc (DC2) Battery Bank Installation	GYM	20	0	0	0	0	0	0	0	0	0
64001	E	Greymouth Substation - Install Ground Fault Neutraliser	GYM	100	0	0	0	0	0	0	0	0	0
44013	RPL	Harihari Zone Substation - Replace CB 1 & 3 with Vipers & upgrade protection	HHI	88	0	0	0	0	0	0	0	0	0
54006	E	Harihari Zone Substation - Prepare site for WMS Connection	HHI	30	0	0	0	0	0	0	0	0	0
-	D	Hokitika Substation - De-commission T4, T5 & 33kV switchgear	HKK	0	0	0	0	0	67	0	0	0	0
-	D	Hokitika Substation - Install new 66kV bay at HKK to feed South Westland	HKK	0	0	0	0	0	190	0	0	0	0
-	E	Hokitika Protection Upgrade Design and Installation and As Built Drawings	HKK	0	0	0	0	0	0	300	0	0	0
54013	E	Hokitika Substation - Install new 110 V DC System and Rearrange Protection	HKK	60	0	0	0	0	0	0	0	0	0
14007	I	Hokitika Substation - Apply silicon recoat to building exterior	HKK	0	0	2	0	0	3	0	0	3	3
-	D	Build New Zone Sub - Kokatahi	KOKATAHI	0	0	0	0	0	0	0	595	0	0
-	E	Kumara - Design & drawings for new 11kV switchroom, 66kV bus extension, etc	KUM	0	0	0	0	0	0	30	0	0	0
-	E	Kumara Zone Substation - Construct a new 11 kV switchroom	KUM	0	0	0	0	0	0	0	0	0	560
14008	I	Kumara Zone Substation 66 kV CB Maintenance (3)	KUM	0	0	0	0	0	0	90	0	0	0
-	RPL	Longford Corner replace regulator with single phase units	LCRR1	0	0	142	0	0	0	0	0	0	0
-	I	Logburn Road Zone Substation - Apply silicon coat to building exterior	LGN	0	0	2	0	0	3	0	0	3	3
-	RPL	Ngahere Zone Substation - CB 1 & 3 replacement	NGH	0	86	0	0	0	0	0	0	0	0
44014	RPL	Ngahere Zone Substation - CB 3812 replacement with WVE38x type	NGH	42	0	0	0	0	0	0	0	0	0
-	RPL	Rapahoe Zone Substation - 33kV disconnector upgrade (1002 structure)	RAP	0	25	0	0	0	0	0	0	0	0
-	RPL	Rapahoe Zone Substation - Replace 11kV metalclad switchgear	RAP	0	0	120	0	0	0	0	0	0	0
14009	I	Replace exterior cladding/ windows/door etc	RAP	18	0	0	0	0	0	0	0	0	0
14010	I	Rapahoe Substation - Paint Gantry Steelwork and Reinsulate	RAP	0	33	0	0	0	0	0	0	0	0

Table 5.21 - Zone Substation Projects ($'000) Continued...

ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
14011	I	Reefton Substation - apply silicon recoat to exterior	RFN	0	0	2	0	0	3	0	0	3	3
-	E	Ross Zone Substation - Prepare site for WMS connection	RSS	0	0	0	36	0	0	0	0	0	0
-	RPL	Ross Zone Substation - Replace CB 1 & 3 with Vipers & upgrade protection	RSS	0	0	0	97	0	0	0	0	0	0
14014	I	Carry out Thermovision Inspections of Zone Substation Equipment	SYS	6	6	7	7	8	8	9	9	10	10
14015	I	Corona Discharge Testing at various Zone Substations	SYS	12	12	13	14	15	16	17	18	19	20
14017	I	Update Zone Substation Drawings & Filing System	SYS	12	12	13	14	15	16	17	18	19	20
14018	I	Earthing Review of Zone Substations and Associated Remedial Works	SYS	55	0	0	0	0	0	0	0	0	0
14019	I	Oil Filter and Dry Out System for Transformers	SYS	22	23	25	26	28	29	31	33	35	37
14020	I	Perform Oil Tests at Zone Substations (DGA)	SYS	22	23	25	26	28	29	31	33	35	37
14023	I	Zone Substation Lightning Protection Review	SYS	12	0	0	0	0	0	0	0	0	0
14024	I	Operator Training, Site Inductions and Site Familiarisation	SYS	12	12	13	14	15	16	17	18	19	20
14025	I	Network Study to determine feasibility of connection of Remote Ends of Feeders	SYS	15	0	0	0	0	0	0	0	0	0
14026	I	Purchase and Installation of Earthing Spigots	SYS	12	0	0	0	0	0	0	0	0	0
14027	I	Purchase of Portable Earths and Authorisation Equipment	SYS	12	2	2	2	2	2	2	2	2	2
14028	I	Adapt Zone Transformers & Regulators Pipework for Oil Treatment Plant Connection	SYS	5	5	5	0	0	0	0	0	0	0
14029	I	Westpower Store - Storage of Key Assets in a Controlled Environment	SYS	10	10	10	10	10	5	5	5	5	5
14030	I	Zone Substation Building Climate Control	SYS	44	44	44	1	1	1	1	1	1	1
14031	I	Zone Sub Landscaping and Beautification	SYS	12	12	13	14	15	16	17	18	19	20
14032	I	Zone Sub OLTC & Regulator Maintenance	SYS	104	91	99	137	139	114	124	172	175	186
14033	I	Zone Substations Seismic Repairs	SYS	15	0	0	0	0	0	0	0	0	0
14034	I	Zone Substation Transformer Refurbishment and Maintenance	SYS	160	170	92	103	103	120	102	131	130	138
14035	I	Zone Substation Building Maintenance	SYS	35	37	39	41	43	46	48	51	54	57
44010	RPL	Battery Replacement Programme	SYS	16	17	18	19	20	21	22	23	24	25
64005	D	Purchase Generator trailer, step transformer and set up	SYS	145	0	0	0	0	0	0	0	0	0
64006	I	WMS (Mobile Substation) Storage	SYS	10	12	13	14	15	16	17	18	19	20
44001	RPL	Wahapo Zone Substation - Replace CB 1 & protection relay	WAH	44	0	0	0	0	0	0	0	0	0
44015	RPL	Wahapo Zone Substation - Replace combiflex relays, protection setting upgrade	WAH	20	0	0	0	0	0	0	0	0	0

Table 5.21 - Zone Substation Projects ($'000) Continued...													
ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
54011	E	Wahapo Zone Substation - Prepare site for WMS access	WAH	30	0	0	0	0	0	0	0	0	0
64007	E	Wahapo Zone Substation - Install Ripple Plant	WAH	35	0	0	0	0	0	0	0	0	0
-	RPL	Whataroa Zone Substation - Replace CB 1 & protection relay	WAT	0	41	0	0	0	0	0	0	0	0
-	RPL	Whataroa Zone Substation - Replace CB 1412 with WVE38x type	WAT	0	42	0	0	0	0	0	0	0	0
14037	I	WMS Relocation, Site Installation/Disconnection Costs, etc	WMS	34	25	26	27	28	29	30	31	32	34
64008	D	Emergency Backup Control Room	WSP	30	0	0	0	0	0	0	0	0	0
-	RPL	Waitaha Zone Substation - Replace CB 1 & Protection Relay	WTH	0	0	0	48	0	0	0	0	0	0
-	RPL	Waitaha Zone Substation - Replace regulator with single phase units	WTH	0	100	0	0	0	0	0	0	0	0
54012	E	Waitaha Zone Substation - Prepare site for WMS access	WTH	0	0	0	36	0	0	0	0	0	0
				2210	981	812	686	485	750	1245	2576	607	1361

5.10 Distribution Substations

Table 5.22 summarises the planned expenditure by category for Distribution Substation related projects during this AMP period.

Table 5.22 - Distribution Substation Projects and Programmes ($'000)										
Activity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inspect, Service and Test	449	437	459	434	461	489	518	549	582	617
Faults	16	17	18	19	20	21	23	24	25	26
Repairs	11	11	12	13	13	14	15	16	17	18
Replacement	55	37	39	42	44	47	50	53	56	59
Enhancement	74	30	35	35	35	35	35	35	35	0
Development	165	118	121	125	129	133	138	92	94	100
	770	650	684	668	702	739	779	769	809	820

5.10.1 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.

Project 09-15006: Sub (Site) Upgrades

To ensure Westpower's distribution substations comply with the Electricity Regulations and Codes of Practice such as ECP35, a programme has been established to test earthing systems on all distribution substation sites and upgrade if necessary. This is an ongoing project, with all earth test results and upgrade notes recorded in the Electrical Network System.

Project 09-15005: Moana - S817 Johns Road, Extend Pad and Replace 400 V Board

The 400 V board at S817, Johns Road, Moana is in need of replacement. The limited space on the existing pad prohibits this and coupled with the fact that a larger transformer cannot be placed on the pad, the existing pad is to be extended. This will allow all required work to be carried out on the site.

Project 09-15003: Replacement of Live Line Taps

Previous experience has determined that live line connectors are to be employed only as a temporary connection until AMP connectors can be applied. This has come from a series of conductor drops due to the effect the live line taps have had on the conductor. All live line taps on the Westpower network are to be removed and replaced with AMP connectors, particularly in the 'salty zone'.

Project 09-15002: Hokitika - Remove Pilot Conductor from Subs and Pillar Boxes

Many distribution substations and pillar boxes in Hokitika were wired with a pilot conductor for the control of water heating in the area. With the introduction of ripple control, these wires and control boxes have become redundant and shall be removed from service.

Table 5.23 lists the expenditure for the Distribution Substation Projects planned for this AMP period as described above.

Table 5.23 - Distribution Substation Projects ($'000)

ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
15005	I	Moana - S817 Johns Road, Extend Pad and Replace 400 V Board	ALD4	15	0	0	0	0	0	0	0	0	0
61008	D	Frickleton St - Offload S119 (Freyberg Terrace sub)	GYM11	50	0	0	0	0	0	0	0	0	0
15007	I	S1391, Merrick St. Rebuild 400 V Bus and Replace Cover	GYM12	10	0	0	0	0	0	0	0	0	0
55001	E	Greymouth CBD Subs Upgrade	GYM6	44	0	0	0	0	0	0	0	0	0
45002	RPL	Wilson Lane - Substation Rebuild	GYM7	20	0	0	0	0	0	0	0	0	0
15002	I	Hokitika - Remove Pilot Conductor from Subs and Pillar Boxes	HKK12	10	0	0	0	0	0	0	0	0	0
-	E	Upgrade Sub, Hartmount Place, Punakaiki	RAP1	0	0	0	0	0	0	0	0	0	0
-	D	Unspecified Distribution Substation works	SYS	0	0	0	0	0	0	0	0	0	0
15003	I	Replacement of Live Line Taps	SYS	50	50	50	0	0	0	0	0	0	0
15006	I	Sub (Site) Upgrades	SYS	262	278	294	312	331	351	372	394	418	443
45001	RPL	Distribution Substation Replacements	SYS	35	37	39	42	44	47	50	53	56	59
55002	E	Increase Transformer Site Capacity (Uprate)	SYS	30	30	35	35	35	35	35	35	35	0
61006	D	New 11 kV Connections	SYS	55	58	61	65	69	73	78	32	34	36
65002	D	New Transformer Sites	SYS	60	60	60	60	60	60	60	60	60	64
				641	**513**	**539**	**514**	**539**	**566**	**595**	**574**	**603**	**602**

5.10.2 Fault Repairs

Lightning damage or ingress of water causes most transformer faults.

Westpower has had a programme over the last seven years of retro fitting lightning arrestors on all substations that do not yet have these fitted, and this is now nearing completion. Past experience has shown that lightning arrestors greatly reduce the risk of transformer damage.

Regular inspection of transformers will also reduce the number of failures due to water ingress caused by deterioration such as rusty tanks.

Minor repairs such as bushing replacements can be carried out on site if necessary, but most fault repairs involve the swapping out of a transformer unit with a spare from the store.

5.10.3 Planned Repairs and Refurbishment

Corrosion and resulting water contamination of the insulating oil in distribution transformers is a major concern. A programme of identifying badly corroded transformer tanks has been instigated.

Once identified, these transformers will be removed for repair, re-tanking or replacement as dictated by the state and age of the unit.

Major rewinds of transformers are not undertaken unless the transformer size is over 50 kVA and the transformer is less than ten years old. This is based on economics.

(i) Oil Refurbishment/Desludging

Oil refurbishment is planned for ten distribution transformers per year.

5.10.4 Replacement Programmes

There is a major programme in place for replacing older transformers that have failed as a result of old age or lightning damage. The transformer technician individually assesses each transformer when returned to the store and an appropriate recommendation on replacement or repair made by the engineer.

This is a means of prudently managing the asset and ensuring that an appropriate age profile is maintained. A distribution transformer condition monitoring programme is about to be introduced which will identify the condition of the current population and provide a substantial basis for assessing likely costs in future asset management plans.

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

Project 09-45001: Distribution Sub Replacements

Westpower has assessed it’s stock of spare transformers and it’s ability to cover potential failures. At present a contingency allowance is made to cover this work.

Project 09-45002: Wilson Lane Sub Rebuild

Wilson Lane Sub has an 11 kV CB that is nearing the end of its economic life. A fuse unit has been identified as possibly coming surplus at the Fox Hotel should their development proceed. This could be moved to Wilson Lane to replace the 11 kV CB.

5.10.5 Enhancement

Project 09-55001: Greymouth CBD Subs Upgrade

Each year one of the "bunker subs" in the Greymouth area is updated to remove aged 400 V switchgear. It is proposed to continue the project at Badger Lane in the 09-10 financial year.

Project 09-55002: Increase Transformer Site Capacity (Uprate)

From time to time it has been found that a transformer is overloaded. This happens particularly when a new installation has requested connection. A sum has been allowed to fund any work that may be required to replace a transformer on site, with one of a higher capacity.

5.10.6 Development

Project 09-65002: New Transformer Sites

Installation of new Distribution Substations is generally dependant 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.

Project 09-61008: Frickleton Street - Offload S119 (Freyburg Terrace Sub)

To alleviate the high loading issues at S1886 (Murray Street) and S119 (Frickleton St), a new substation location shall be built. A location in Freyberg Terrace is to be investigated.

Project 09-61006: New 11 kV Connections

With Westpower's policy to fund any 11 kV connection onto the network, a sum has been allocated to have this work carried out.

5.11 MV Switchgear

Table 5.24 summarises the planned expenditure by category for MV Switchgear related projects during this AMP period.

Table 5.24 - MV Switchgear Projects and Programmes ($'000)

Activity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inspect, Service and Test	152	159	170	180	190	202	181	192	203	216
Faults	5	5	6	6	6	7	7	8	8	8
Repairs	37	39	42	44	47	50	52	56	59	63
Replacement	485	467	493	455	418	102	105	108	110	117
Enhancement	233	99	104	100	107	113	120	128	136	143
Development	450	501	528	208	221	236	250	267	282	299
	1362	**1270**	**1343**	**993**	**989**	**710**	**715**	**759**	**798**	**846**

5.11.1 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 two to ten 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.

09-16001: Upgrade Earthing at Disconnector Locations
Earthing standards at disconnectors have been reviewed and pipework is now required to have earth lead connected. This is an ongoing project to progressively upgrade all network disconnectors by 2014.

09-16002: Disconnector Maintenance, Operation Check Program
Reliable and safe operation of disconnectors is imperative during switching. Some disconnectors become difficult to operate, padlock seizes up, etc. A two yearly maintenance program is in place to maintain and test operate each disconnector.

09-16001: Upgrade Earthing at Disconnector Locations
Earthing standards at disconnectors have been reviewed and pipework is now required to have earth lead connected. This is an ongoing project to progressively upgrade all network disconnectors by 2014.

09-16004: Perform Partial Discharge on Network Switchgear
Carry out partial discharge tests on selected network switchgear. This is an ongoing project to assist in the early detection of faults.

5.11.2 Fault Repairs

Table 5.25 Lists the expenditure for the MV Switchgear Projects planned for this AMP period as described above.

Table 5.25 - MV Switchgear Projects ($'000)

ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
-	D	Install Capacitors at Various Locations		0	40	40	0	0	0	0	0	0	0
-	D	New Main Line Recloser Sites (3 per year)		180	191	202	60	64	67	71	76	80	85
-	D	New Ganged DDO Fuse Unit Locations		10	10	10	10	10	14	15	16	17	18
-	D	New Spur Line Reclosers on Various Spur Lines (3 per year)		180	191	202	60	64	67	71	76	80	85
-	RPL	Replace Faulty Actuators - (Entec Load Break Switch or Hydraulic Actuator) 5 Per Year		100	60	60	0	0	0	0	0	0	0
-	RPL	Replace KFE Reclosers with Viper-ST & SEL Protection (5 per year)		300	318	337	357	379	60	60	60	60	64
-	D	Rutherglen Voltage Support	SYS	15	0	0	0	0	0	0	0	0	0
-	E	South Westland 33kV Disconnector Automation (7)	SYS	140	0	0	0	0	0	0	0	0	0

Table 5.25 - MV Switchgear Projects ($'000) Continued...													
ID	Activity	Description		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
16001	I	Upgrade Earthing at Disconnector Locations	SYS	23	24	26	27	29	31	0	0	0	0
16002	I	Disconnector Maintenance, Operation Check Program	SYS	58	61	65	69	73	78	82	87	92	98
16003	I	Recloser Maintenance - Protection, Batteries, etc	SYS	27	28	30	32	33	35	38	40	42	45
16004	I	Perform Partial Discharge Tests on Network Switchgear	SYS	12	12	13	14	15	15	16	17	18	19
46003	RPL	Disconnector Replacements	SYS	27	28	30	32	33	35	38	40	42	45
46004	RPL	Remote Locations Battery Replacement	SYS	5	5	6	6	6	7	7	8	8	8
46006	RPL	Ring Main Unit Replacement	SYS	53	56	60	60	0	0	0	0	0	0
56004	E	Distribution Intelligent Fault Isolation System - Study/Design	SYS	10	11	11	2	2	2	2	3	3	3
56005	E	Install Automation to Various Disconnectors 3 Per Year	SYS	60	64	67	71	76	80	85	90	96	101
56006	E	Fit Earth Fault Indicators	SYS	23	24	26	27	29	31	33	35	37	39
66006	D	Install Ring Main Units - Unspecified Locations (1)	SYS	42	45	48	51	54	57	60	64	68	72
66007	D	New Disconnectors	SYS	23	24	26	27	29	31	33	35	37	39
				1288	1192	1259	905	896	610	611	647	680	721

5.11.2.1 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 was replaced in 2002 because of the risk of failure.

5.11.2.2 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.

5.11.3 Planned Repairs and Refurbishment

5.11.3.1 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.

5.11.4 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.

09-46001: Replace KFE Reclosers with Viper-ST & SEL Protection (5 per year)
KFE recloser have been found to be unreliable and increase the risk of fire as they are oil filled. Viper-ST vacuum units have been identified as a suitable replacement. The Viper is safer and requires less maintenance than the KFE. A replacement programme has been initiated and five units will be replaced per year.

09-46002: Replace Faulty Actuators - Entec Load Break Switch or Hydraulic Actuator (5 per year)
A number of actuators throughout the network have been identified as faulty and financially beyond repair. These units are to be replaced with the Entec load break switch or Hydraulic actuator units which are more reliable and require less maintenance.

09-46003: Disconnector Replacements
Disconnectors normally fail due to deterioration of the operating arms with corrosion or from an arc developing across two or more phases. By identifying under rated disconnectors and replacing these, the incidence of arcing faults should be reduced.

09-46004: Remote Locations Battery Replacement
A 5 year replacement program is in place for batteries at remote locations in the network. This is an ongoing project and funds have been allocated to achieve this.

09-46006: Ring Main Unit Replacement
As part of the preventative maintenance programme a number of older, oil filled RMU units have been identified as exceeding their expected life and require replacing.

5.11.4.1 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.

It is internationally recognised that 40 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.

5.11.4.2 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 was instituted five years ago to gradually replace all these units with new SF6 Ring Main Unit type. At present there is one remaining Andelect Ring Main Unit in Westpower's network and therefore, strict operational procedures have been developed to mitigate the risk to operators of the equipment under the particular circumstances.

5.11.5 Enhancements

Several reclosers and sectionalisers (circuit breakers used to isolate faults on rural lines) are reaching the end of their economic life and are becoming unreliable. This results in prolonged and more widespread power outages than necessary during fault conditions.

It is no longer possible to source replacement parts for many of these units and because of the bulk oil design of the earlier models, the maintenance costs will increase significantly.

It is proposed that the older models of reclosers and sectionalisers be replaced over the next two years.

Project 09-56005: Install Automation to Various Disconnectors (3 per year)

Remote automated disconnectors have provided significant benefits to the network and allow controllers to open and close switches without having to call on standby staff. Each year Westpower is upgrading strategic switches with automated units. Three units are identified each year.

Project 09-56006: Fit Earth Fault Indicators

Fit earth fault indicators to chosen unprotected cables to detect current passage due to a fault down them. These will allow fault people to quickly identify a faulty cable to speed it's isolation and prompt restoration of the feeder.

Project 09-56004: Distribution Intelligent Fault Isolation System (DIFIS)
A detailed study of Westpower's network is to be carried out to determine the best location for reclosers, GEDO's, sectionalising disconnectors, automated disconnectors, etc. for isolation of faults and automatic restoration of supply to customers. Number of customers affected, length of line, possible alternative points of supply etc, are some of the items to be considered in the study.

Project 09-56007: South Westland 33 kV Disconnector Automation (7)

South Westland is a remote area of the network. Deploying staff to operate switchgear is time consuming and expensive. A programme has been initiated to fit automated units to 33 kV disconnectors on the main line supplying South Westland so switching can be operated remotely.

5.11.6 Development

Reclosers are pole-mounted circuit breakers, which automatically isolate a faulted section of the line from the rest of the network. Where a large radial network exists, reclosers are often fitted on spur lines to prevent the main line from tripping out due to a spur fault. The addition of extra reclosers to the network improves system reliability and fault selectivity. Justification of each project is carried out on a case by case basis.

Supply to the West Coast in general is voltage constrained and this is partly due to the long inductive transmission lines. When a line outage occurs due to fault or planned maintenance events, voltage collapse can occur unless significant support is available from local generation; this in turn may depend on water availability.

Investigations are continuing with Transpower on the need for further reactive voltage support on the West Coast and the most efficient way of providing this.

Project 09-66006: Install Ring Main Units - Unspecified Locations (1)

Often a developer requires a new supply which includes the need for a RMU. An allowance is being made for one site to meet this unplanned demand.

Project 09-66007: New Disconnectors

Several new disconnectors are to be installed to further sectionalise the network and reduce the number of customers affected by 11 kV switching operations. These disconnector installations will also assist in the location of faults.

Project 09-66001: New Main Line Recloser Sites (3 per year)
Main line reclosers are being strategically positioned throughout the Westpower Network to reduce the number of consumer outages incurred during faults, therefore reducing SADI.

Project 09-66002: New Spur Line Reclosers on Various Spur Lines (3 per year)
Reclosers are being strategically positioned throughout the Westpower Network to isolate problematic spur lines and reduce inconvenience to consumers and SADI. Reclosers are being fitted to spur lines where the number and size of consumers are too great to fit DDOs.

Project 09-66008: New Ganged DDO Fuse Unit Locations

Ganged DDO fuse units are being strategically positioned throughout the Westpower Network to isolate problematic spur lines and reduce inconvenience to consumers and SADI.

Project 09-66009: Rutheglen Voltage Support

On occasions the Rutherglen area is required to be supplied from Kumara substation. At present this is not possible and a capacitor bank is required to be installed in the Rutherglen area to allow for the use of this alternative supply.

5.12 SCADA, Comms and Protection

Table 5.26 summarises the planned expenditure by category for SCADA, Comms and Protection related projects during this AMP period.

Table 5.26 - SCADA and Comms Projects and Programmes ($'000)										
Activity	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Inspect, Service and Test	267	282	278	295	312	331	353	373	395	443
Faults	35	37	39	42	44	47	50	53	56	59
Repairs	35	37	39	42	44	47	50	53	56	59
Replacement	146	458	207	161	119	206	237	381	332	359
Enhancement	101	82	135	59	81	83	165	78	108	150
Development	372	290	268	156	156	184	128	142	156	235
	956	**1186**	**966**	**755**	**756**	**898**	**983**	**1080**	**1103**	**1305**

5.12.1 Periodic Inspections, Servicing and Testing

5.12.1.1 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.

5.12.1.2 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 every two or three years.

Antennae are to be checked annually with a "Bird" RF Wattmeter and Spectrum Analyzer.

5.12.1.3 Protection

The policy in this area is to maintain protection schemes with alternate major and minor services every two years, on each circuit.

It should be noted that "maintenance" on protection equipment is essentially "recalibration/testing" rather than the conventional view of maintenance, which would imply replacement of consumable parts. Protection maintenance is mainly required to reaffirm that the protection is calibrated within tolerance and will operate when called upon to do so.

There are international trends towards reduced maintenance. Typically intervals are being increased to between three and four 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.

5.12.2 Planned Repairs and Refurbishment

5.12.2.1 Communications

Westpower maintains communications assets at approximately 28 base sites and on five repeater sites. The planned repair and refurbishment estimates are based on past expenditure.

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

5.12.2.2 Protection

The protection expenditure planned over the review period is mainly in the following areas

- Replacement of outdoor junction boxes.
- Replacement of aged feeder protection and controls.
- Replacement of lead acid batteries with sealed cells.
- Seismic strengthening of protection panels.
- Seismic restraints for batteries.
- Installation of DC monitoring and distribution panels.

Project 09-17007: Repeater Site Co-Location Fees

Westpower currently has several radio repeater sites and an annual fee is paid to each site owner.

5.12.3 Replacement Programmes

5.12.3.1 Communications

Communications equipment has in general a shorter life expectancy than heavy electrical equipment. Typically electronic equipment reaches technical obsolescence in 5-10 years although generally the equipment can be supported in service for 10-15 years.

5.12.3.2 SCADA

As with all computer-based systems, it is expected that several upgrades of the operating system, software-applications and hardware will be required throughout the planning period.

Project 09-47013: Arnold IP Switch

Aging IP switches are to be replaced during the planning period with modern rugged models.

Project 09-47015: Reefton Voice Repeater

This unit has reached the end of its life and is due to be replaced.

Project 09-67003: Aprisa Radio Link Chapel St to Paparoa

This radio link will replace the Greymouth depot radio link and will carry Transpower mirror bits and Westpower mirrorbits for the ripple plants. Stage 1 is to mount a mux shelf in the Westpower Server Room and Stage 2 is to install a new mux shelf at the Greymouth Substation.

Project 09-47014: Reefton Substation IP Switch

Aging IP switches are to be replaced during the planning period with modern rugged models.

Project 09-47001: SCADA Master Station Replacement

The SCADA master system needs to be kept up to date with software changes to enable the system to have maximum functionality and extend the life of the current system. Also for the Planned System replacement in 2010 an RFI process will be started.

Project 09-47007: HKK IP Switch

Aging IP switches are to be replaced during the planning period with modern rugged models.

Project 09-57011: DOB Replacement of Modicon PLC

Modicon Compac PLCs have reached the end of their life and spares are no longer available. This unit will be replaced.

Project 09-47012: NGH IP Switch

Aging IP switches are to be replaced during the planning period with modern rugged models.

Project 09-47004: DOB IP Switch

Aging IP switches are to be replaced during the planning period with modern rugged models.

5.12.4 Maintenance Summary

The table at the beginning of this section summarizes expected system maintenance expenditure.

5.12.5 Enhancement

There are several small upgrade jobs planned for the SCADA, Communication and Protection systems throughout the planning period.

5.12.5.1 Remote Controlled Disconnectors

With the advent of industry-wide performance monitoring, Westpower is now being bench marked against other Electricity Companies in terms of system reliability and continuity of supply. Furthermore, customers are becoming more aware of fault outages, this being partly due to the increase in the number of electronic home appliances and the resulting reliance on a continual supply of electricity. For these reasons, it is becoming increasingly important to cut down on fault restoration times.

One way to do this is by automating remote air break switches. This greatly reduces the travelling time required for a faultman during sectionalising of faulted line sections. This also means that fewer staff are required to isolate the fault, reducing the overall cost of fault restoration.

Project 09-57012: IP Fire Wall / Security / Remote Secure Access

With the increased number of radio links using public band frequencies, security of the communications network, data and equipment from hackers and viruses need to be addressed and kept current.

Project 09-57003: Mt Bonar, Upgrade Repeater Site

The current repeater site at Mt Bonar is a Department of Conservation (DOC) site and DOC want to relieve themselves of this responsibility. Westpower needs to firm up its position on Mt Bonar or a hill nearby. It is proposed to carry out an investigation of options.

Project 09-57009: PAP Move Microtik Boards to Base of Tower

Microtik radios at Paparoa have been identified as a critical link for SCADA communications. To aid in the ability to quickly resolve any fault it has been identified that the system needs to be brought down the tower to a cabinet that ElectroNet staff can access.

Project 09-57010: Solar Site Enhancements

Due to technology changes and the load growth of solar sites, enhancement may be required during the planning period.

Project 09-57013: Paparoa Radio Site Battery Bank Capacity Upgrade/Security

With the increased loading on the batteries at this site, extra capacity needs to be installed.

Project 09-57008: Central Mux at Paparoa

Current radio, serial channel and mirror bit, interconnections at Paparoa are due to be enhanced to a digital mux system.

Project 09-57015: Waitaha Development

During sub protection upgrade the comms equipment will be upgraded.

5.12.6 Development

Project 09-67009: Whataroa Communications

SCADA communications modifications will be required during substation protection upgrades.

Project 09-67016: IP Expansion up Coastline to Punakaiki

Investigate the option of an IP Radio link along the Coast Road to Punakaiki.

Project 09-67014: Fast IP Comms to All Recloser Sites for DIFIS Project

Investigate and implement the best comms options to all new pole top comms sites. This is required for the implantation of Distribution Intelligent Fault Isolation System (DIFIS). The new circuit breakers and switches being installed into Westpower's lines network require a new high speed communications link to each site. This link will give the control system the ability to automatically, within the allowed times, reconfigure the power flow through the network to isolate the fault, thus saving valuable SAIDI's.

Project 09-67012: South Westland, IP Expansion VHF Digital Radio

An investigation is required to determine the best options for high speed radio south of Hokitika.

Project 09-67013: Paparoa Proposal to Move all Aerial to Single Tower

The change in rating of the Paparoa site by Kordia to a G2 site means Westpower staff can now no longer climb the large tower to maintain critical aerial equipment. It is proposed that Kordia replace the smaller tower and move all aerials to this structure to allow workers to climb this tower.

Project 09-67017: 61850 Rollout

With the planned change to the international Standard 61860 communications protocol, new equipment will be required for testing and implementation.

Project 09-67018: Meter Reading

The installation of the new metering equipment modification to the network and reading software is required.

Project 09-67019: VMWare Server Configuration/Equipment

As the creation of new virtual servers is required on VMWare hardware, licences and extra equipment may need to be purchased.

Project 09-67005: Mt Kakawau, New Repeater

For several years, Westpower has been using it's existing VHF speech radio channels to provide SCADA communications facilities to outlying areas. While this has worked well and made efficient use of existing channel capacity, the number of Remote Terminal Units (RTU's) connected to the system has increased rapidly

over recent times as a result of Westpower's Distribution Automation Programme. The situation has now reached the stage where a separate VHF SCADA channel is warranted.

Project 09-67020: Wahapo PLC Upgrade

Modicon Compac PLCs have reached the end of their life and spares are no longer available. This unit will be upgraded.

Project 09-67010: Disaster Recovery Equipment

As the company BCP plans have been completed, equipment needs to be purchased to ensure Westpower is ready for all contingences.

Project 09-67010: IP Phone Connection to Zone Substations

There is a requirement for phones to be installed at all major substations for Health and Safety reasons.

Project 09-67002: Greymouth Substation Communications Processor

SCADA communications modifications will be required during substation protection upgrade.

Project 09-67007: Development of Mt St Patrick's Repeater Site

General Site development as required.

Project 09-67021: Greymouth Substation Mux Shelf Development

With a new Aprisa radio installed at Chapel St, a remote mux shelf is now required at the Greymouth substation to reduce system complexity.

Project 09-67006: Spring Creek SCADA
To connect the new Spring Creek substation to SCADA.

Project 09-67001: Mt Bonar Repeater
General hardware and site development as required for this radio repeater.

Project 09-67025: Kumara IP Equipment
With the growth of this site an IP switch is now required.

Project 09-67024: Wahapo Comms to Metering and Relays
SCADA and communications modifications will be required during substation metering upgrade.

Project 09-67022: Harihari Regulator Development
With changes being made to the ageing South Westland communications system, comms to this site will be modified.

Project 09-67003: Greymouth Substation IP Switch
With the growth of this site an IP switch is now required.

Project 09-67014: St Patrick Solar Regulator
Due to technology changes and load growth of solar sites, enhancement may be required during the planning period.

Project 09-67023: Harihari Sub Development
With changes being made to the ageing South Westland communications system, comms to this site will be modified.

Table 5.27 - SCADA, Communications and Protection

ID	Activity	Description	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
-	D	Blackwater Comms	0	0	0	0	0	0	0	0	0	0
-	D	FOX New Communications Processor	0	30	0	0	0	0	0	0	0	25
-	D	Globe GFN Upgrade	0	0	0	0	0	0	0	0	0	0
-	D	Herc Repeater	0	0	0	0	0	0	0	0	0	0
-	D	Wahapo install 2032 and New Abbey	0	0	0	0	0	20	0	0	0	0
57014	D	St Patrick Solar Regulator	10	0	0	0	0	15	0	0	0	0
67001	D	Mt Bonar Repeater	3	3	4	4	4	4	5	5	5	5
67002	D	Greymouth substation communications processor	20	0	0	0	0	0	0	0	0	20
67003	D	Greymouth Substation IP Switch	10	0	0	0	0	0	0	5	0	0
67005	D	Mt Kakawau	5	5	6	6	30	7	8	8	9	9
67006	D	Spring Creek SCADA	5	0	0	0	0	10	0	0	0	0
67007	D	Development of Mt St Patricks repeater site	5	0	0	0	0	0	0	0	0	0
67009	D	Whataroa communications	5	0	0	0	0	20	0	0	0	0
67010	D	Disaster Recovery Equipment	16	17	18	19	20	21	23	24	25	27
67010	D	IP Phone Connection to Zone Substations	5	5	6	6	25	7	7	8	8	8
67012	D	South Westland, IP Expansion VHF Digital Radio	20	100	100	50	6	6	6	7	7	8
67013	D	Paparoa Proposal to move all aerial to single tower	40	10	10	10	11	11	12	13	13	14
67014	D	Fast IP Comms to All Recloser sites for DIFIS Project	50	50	53	20	21	23	24	25	27	28
67016	D	IP Expansion up Coastline to Punakaiki	0	0	0	0	0	0	0	0	0	0
67017	D	61850 Rollout	50	25	25	10	11	11	12	13	13	14
67018	D	Meter Reading	25	25	25	10	11	11	12	13	13	14
67019	D	VMWare Server Configuration/Equipment	10	10	10	10	11	11	12	13	13	14
67020	D	Wahapo PLC Upgrade	30	0	0	0	0	0	0	0	0	5
67021	D	Greymouth Substation Mux Shelf development	12	0	0	0	0	0	0	0	15	0
67022	D	Harihari Regulator Development	15	0	5	0	0	0	0	0	0	15
67023	D	Harihari Sub Development	15	5	0	0	0	0	0	0	0	15
67024	D	Wahapo Comms to Metering and Relays	10	0	0	5	0	0	0	0	0	0
67025	D	Kumara IP Equipment	6	0	0	0	0	0	0	0	0	6
-	E	ATU IP Switch	0	0	4	0	0	0	0	0	0	0
-	E	Chapel St IP Switch	0	0	0	0	0	0	0	0	0	5

Table 5.27 - SCADA, Communications and Protection Continued...												
ID	**Activity**	**Description**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
-	E	DOB Fibre	0	0	0	0	0	0	0	0	0	0
-	E	Fibre Link to Greymouth Depot from Chapel St	0	0	0	0	0	0	0	0	0	45
-	E	Ross communications processor	0	20	0	5	0	0	0	0	0	0
57003	E	Mt Bonar, Upgrade Repeater Site	5	0	0	0	0	0	105	0	0	0
57008	E	Central Mux at Paparoa	15	15	2	2	15	2	2	2	15	2
57009	E	PAP Move Microtik Boards to Base of Tower	5	0	0	0	0	0	0	0	0	0
57010	E	Solar Site Enhancements	11	11	12	13	13	14	15	16	17	18
57012	E	IP Fire Wall / Security / Remote Secure access	5	5	6	6	20	7	7	8	8	8
57013	E	Paparoa Radio site Battery Bank capacity Upgrade/Security	15	0	20	0	0	0	0	0	0	0
57015	E	Waitaha Development	5	0	35	0	0	0	0	15	0	0
-	I	FRZ Abbey Topcat	0	20	0	0	0	0	0	0	0	25
17007	I	Repeater Site Co-Location Fees	80	84	89	95	100	106	113	120	127	134
-	RPL	ALD Panel View	0	0	2	0	0	0	0	0	0	0
-	RPL	Arnold Substation Allen Bradley SLC500	0	0	38	0	0	0	0	0	0	0
-	RPL	Ataru Fibre Media Converters	0	0	0	0	1	0	0	0	0	0
-	RPL	ATU SEL2411	0	0	0	0	0	0	0	0	3	0
-	RPL	DIL Advantys STB remote IO	0	0	0	0	0	0	8	0	0	0
-	RPL	Dobson communications processor	0	0	0	0	0	0	0	20	0	0
-	RPL	Franz communications processor	0	0	0	0	0	0	0	18	0	0
-	RPL	Franz Substation Modicon PLC	0	0	15	0	0	0	0	0	0	0
-	RPL	FRZ Modicon PLC Caps	0	0	0	0	7	0	0	0	0	0
-	RPL	Globe Substation communications processor	0	0	0	0	0	0	0	0	20	21
-	RPL	Greymouth depot - Replace UPS batteries	0	0	0	0	0	0	0	0	0	11
-	RPL	GYM CHAPEL depot microtik horz	0	0	0	0	0	10	0	0	0	0
-	RPL	GYM CHAPEL depot microtik vert	0	0	0	0	0	10	0	0	0	0
-	RPL	HKK SEL2030s	0	0	0	0	0	0	0	55	0	0
-	RPL	HKK SEL2100	0	0	0	0	0	0	0	0	0	0
-	RPL	HKK-PAP Radio Link	0	0	0	0	0	0	0	76	0	0
-	RPL	Landing Hill repeater Abbey Topcat	0	0	0	0	0	6	0	0	0	0

Table 5.27 - SCADA, Communications and Protection Continued...												
ID	Activity	Description	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
-	RPL	Landing Hill repeater Radio	0	0	2	0	0	0	0	4	0	0
-	RPL	Landing Hill to IGH Radio Link	0	0	0	0	0	0	0	0	0	60
-	RPL	PAP Allan Bradley PLC	0	0	0	8	0	0	0	0	0	0
-	RPL	PAP SEL2100	0	0	7	0	0	0	0	0	9	0
-	RPL	PAP-ALD Radio Link	0	0	0	0	0	60	0	0	0	0
-	RPL	PAP-ATU microtik horiz	0	0	0	0	10	0	0	0	0	0
-	RPL	PAP-ATU microtik vert	0	0	0	0	10	0	0	0	0	0
-	RPL	PAP-ATU Radio Link	0	0	0	0	0	0	0	0	80	0
-	RPL	PAP-CHAPEL microtik horiz	0	0	0	10	0	0	0	0	0	0
-	RPL	PAP-CHAPEL microtik vert	0	0	0	10	0	0	0	0	0	0
-	RPL	PAP-DOBSON Radio	0	0	0	0	0	0	67	0	0	0
-	RPL	PAP-Kumara Radio Link	0	0	0	0	0	0	67	0	0	0
-	RPL	PAP-NGH radio link	0	0	0	0	0	0	0	76	0	0
-	RPL	PIK SEL2032	0	0	0	0	0	0	0	0	22	0
-	RPL	Pike Substation IP Switch	0	0	0	0	0	0	0	0	6	0
-	RPL	Rapahoe IP Switch	0	0	0	0	0	0	0	0	7	7
-	RPL	Rapahoe Radio Link	0	0	0	0	0	0	0	0	0	25
-	RPL	RFN - Landing Hill Radio Link	0	0	0	0	0	0	0	0	0	40
-	RPL	RFN BCL to RFN Sub Radio Link	0	0	0	60	0	0	0	0	0	0
-	RPL	RFN SEL2032s	0	0	0	0	0	0	0	40	0	0
-	RPL	RFN-GLB Radio Link	0	0	0	0	0	0	0	0	80	85
-	RPL	Westpower control SEL2100 mirror bits processor	0	0	0	0	0	6	0	6	0	0
-	RPL	Westpower Control to Greymouth Substation Fibre Link	0	0	0	0	0	35	0	0	0	0
-	RPL	WSP Ripple Master Injector	0	15	0	0	0	0	20	0	0	0
47001	RPL	SCADA Master Station Replacement	21	400	100	25	27	30	32	34	36	38
47003	RPL	Aprisa Radio Link Chapel st to Paparo	15	0	0	0	0	0	0	0	0	0
47004	RPL	DOB IP Switch	7	0	0	0	0	0	0	0	0	0
47007	RPL	HKK IP Switch	12	0	0	5	0	0	0	0	0	0
47011	RPL	DOB Replacement of Modicon PLC	20	0	0	0	0	0	0	0	25	26
47012	RPL	NGH IP Switch	10	0	0	0	6	0	0	0	0	0
47013	RPL	Arnold IP Switch	8	0	0	0	0	0	0	0	0	0
47014	RPL	Reefton Substation IP Switch	5	0	0	0	0	0	0	8	0	0
47015	RPL	Reefton Voice Repeater	5	0	0	0	0	6	0	0	0	0
			611	855	594	389	359	469	557	632	603	777

5.13 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 resulting in long lives for the cores and windings. Provided that the tanks and oil are 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.

Project 09-15006: 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. An upgrade may comprise of the replacement of many components such as HV and LV fuses, lightning arrestors and associated fittings. This is an ongoing project, with all earth test results and upgrade notes recorded in Westpower's asset management system.

Project 09-15003: Replacement of Live Line Taps

Previous experience has determined that live line connectors are to be employed only as a temporary connection until AMP connectors can be applied. This has come from a series of conductor drops due to the effect the live line taps have had on the conductor. All live line taps on the Westpower network are to be removed and replaced with AMP connectors, particularly in the 'salty zone'.

Project 09-15005: Moana - S817 Johns Road, Extend Pad and Replace 400 V Board

The 400 V board at S817, Johns Road, Moana is in need of replacement. The limited space on the existing pad prohibits this and coupled with the fact that a larger transformer cannot be placed on the pad, the existing pad is to be extended. This will allow all required work to be carried out on the site.

Project 09-15002: Hokitika - Remove Pilot Conductor from Subs and Pillar Boxes

Many distribution substations and pillar boxes in Hokitika were wired with a pilot conductor for the control of water heating in the area. With the introduction of ripple control, these wires and control boxes have become redundant and shall be removed from service.

Table 5.28summarises the planned expenditure by category for Distribution Transformer related projects during this AMP period.

Table 5.28 - Distribution Transformers Projects and Programmes ($'000)

Activity	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inspect, Service and Test	90	96	101	107	114	120	128	136	143	152
Faults	3	3	4	4	4	4	5	5	5	5
Repairs	0	0	0	0	0	0	0	0	0	0
Replacement	58	62	66	69	74	78	83	88	93	98
Development	488	517	548	581	616	653	692	733	777	824
	639	**678**	**719**	**761**	**808**	**855**	**908**	**962**	**1018**	**1079**

5.13.1 Maintenance

5.13.1.1 Routine Patrols and Inspections

Smaller pole-mounted distribution transformers are regularly inspected on a rolling five-year basis in conjunction with Westpower's substation earth testing programme.

The inspection includes checks for;

- Tank corrosion.
- Paint chips.
- Breakdown.
- Oil leaks.
- Insulator damage.
- Breather condition.
- Termination faults.

Where possible, the oil level is checked and recorded, and if an oil sample valve is available (standard issue on all new transformers), a sample of the oil is taken and checked for dielectric breakdown.

Larger pole-mount and all pad-mount units have Maximum Demand Indicators (MDI's) which are read every quarter. These indicate loading trends to be monitored and allow for early intervention should a unit become overloaded.

Very large transformers in areas such as the CBD of Greymouth and Hokitika have annual thermograph surveys carried out to check the tank and termination temperatures as well as to identify any other potential hotspots. Any indications suggesting that the transformer requires attention results in prompt on-site repairs, or if this is not possible, the transformer is swapped with a spare unit from the store and sent back to the contractor's workshop for refurbishment.

5.13.1.2 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.

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.

5.13.1.3 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.

5.13.1.4 Replacement

Project 09-45001: Distribution Substation Replacements

Occasionally the need to replace a distribution substation may arise. A substation may need to be relocated or poor condition may warrant a complete replacement. A contingency sum has been included to cover this work.

Project 09-45002: Wilson Lane - Substation Rebuild

A recent seismic survey has revealed that the Wilson Lane substation would not withstand a substantial earthquake. The building currently houses two transformers and an RMU. The building will be demolished and a pad mounted substation and RMU will be installed. Easements have already been obtained.

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.

5.13.2 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.

Project 09-55001: Greymouth CBD Subs Upgrade

Each year one of the "bunker subs" in the Greymouth area is updated to remove aged 400 V switchgear. It is proposed to continue the project at Badger Lane in the 09-10 financial year.

Project 09-55002: Increase Transformer Site Capacity (Uprate)

From time to time it has been found that a transformer is overloaded. This happens particularly when a new installation has requested connection. A sum has been allowed to fund any work that may be required to replace a transformer on site, with one of a higher capacity.

5.13.3 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.

Project 09-61006: New 11 kV Connections

With Westpower's policy to fund any 11 kV connection onto the network, a sum has been allocated to have this work carried out.

Project 09-65002: New Transformer Sites

Installation of new Distribution Substations is generally dependant 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.

Project 09-61008: Frickleton St - Offload S119 (Freyberg Terrace Sub)

To alleviate the high loading issues at S1886 (Murray Street) and S119 (Frickleton St), a new substation location shall be built. A location in Freyberg Terrace is to be investigated.

Table 5.29 Lists the expenditure for the Distribution Transformer Projects planned for this AMP period as described above.

Table 5.29 - Distribution Transfomers Projects ($'000)													
ID	**Activity**	**Description**		**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
45003	RPL	Transformer Replacements	SYS	58	62	66	69	74	78	83	88	93	98
61009	D	Purchase of New Transformers	SYS	488	517	548	581	616	653	692	733	777	824
				546	**579**	**614**	**650**	**690**	**731**	**775**	**821**	**870**	**922**

5.14 Other

Westpower's three original ripple injection plants are all of the same make (Enermet SFU-K series) making lifecycle management easier to implement.

Later this year we will be installing a stand alone ripple plant at Wahapo zone substation. This will be installed in the existing shed and will be used on occasion to provide ripple control to the South Westland area when Wahapo generation is running islanded from the remainder of Westpower's network.

This plant will consist of the best available parts from the de-commissioned Plessey TR series 75 kVA plants at Reefton, Greymouth and Hokitika.

Table 5.30 summarises the planned expenditure by category for the Other related projects during this AMP period.

Table 5.30 - Other Projects and Programmes ($'000)										
Activity	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Inspect, Service and Test	18	19	20	21	23	24	26	27	29	30
Faults	6	6	7	7	7	8	8	9	9	10
Repairs	1	1	1	1	1	1	2	2	2	2
Replacement	0	0	0	0	0	0	0	0	0	0
Enhancement	0	0	0	0	0	0	0	0	0	0
Development	40	5	0	0	0	0	0	0	0	0
	65	**31**	**28**	**29**	**31**	**33**	**36**	**38**	**40**	**42**

5.14.1 Maintenance

5.14.1.1 Routine Patrols and Inspections

Monthly checks are carried out as part of regular Zone Substation visits which include the visual inspections of the;

- Converters
- Coupling transformers
- Coupling cells
- GPS time base receivers

Every three years independent experts determine injection levels, current balance, optimum tuning and load sharing with other units during a full inspection.

5.14.1.2 Faults

The solid state construction of the injection plants, and the fact that they operate well below their maximum power levels, means that faults are very uncommon.

On rare occasions the high-power output transistors may require replacement or the logic board may require repair. At other times, vermin may get into the high voltage coupling cells causing flashover.

The redundancy built into the injection network means that the failure of any single plant will not severely impact on overall ripple signal propagation and faults are able to be handled without undue time pressure on restoration.

5.14.1.3 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.

5.14.1.4 Replacement

Replacement of all of the original TR series units is planned over the next three years.

5.14.2 Enhancement

The capacity of the existing equipment is fixed and provides ample room for network expansion. No enhancement work is planned.

5.14.3 Development

No new ripple plants (except Wahapo which has already been budgeted for) 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.

A full summary of the expenditure by Activity and Asset Type is available in Section 7 - Financial Summary.

6.0 ASSET LIFECYCLE MANAGEMENT

6.1 Introduction

This section describes the processes used by Westpower to manage the lifecycle of its assets from Design and Planning through to Disposal. A typical lifecycle of any asset consists of the following stages:

- Design and Planning.
- Acquisition and Installation.
- Maintenance and Operation.
- Disposal.

The main drivers for this decision making process are:

- Reliability/Security and Quality of Supply - to meet customer levels of service and contractual obligations.
- Occupational Health and Safety - to establish a safe working environment and comply with OSH legislative safety requirements.
- Regulatory - to meet regulations imposed by external organisations.
- Environmental - to comply with emission regulations to air, land and water.
- Asset Performance/Condition - use of historical data to asses the performance and condition of the assets and predict potential remaining life.
- Cost Efficiency - to ensure that maximum cost efficiency is achieved in accordance with asset management policy.
- Corporate Image - to ensure that any activity carried out by the Asset Management Team and subcontractors will not damage Westpower's image.

6.2 Design and Planning

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

6.2.1 Reliability and Security of Supply

6.2.1.1 Security Guidelines

The security guidelines are the basis for analysis and for determining the future performance of the distribution system. The Table 6.1 is presented below, which outlines some of the security guidelines for Distribution planning. Sub-transmission security is also outlined for each zone substation in Appendix C.

Table 6.1 - 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
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.	2 x 3-phase units Firm supply of peak demand using any short term overload capacity.

With regards to design of system changes or network extensions, due consideration should be made to the level of security required for the connected consumers. An industrial customer for instance may require a non-interruptible supply for a specific manufacturing process, whilst a domestic customer can tolerate occasional supply interruption. Specific criteria for interruption and quality of supply may need to be developed for individual customers both for design consideration and commercial contractual obligations.

Table 6.2 shows minimum-security levels for Westpower Distribution Systems.

Table 6.2 - Minimum Security Levels for Distribution Networks

Circuit Type	Maximum Demand Under Normal Conditions	Minimum Circuit Arrangement
Overhead	Up to 1 MVA	Single circuit
Underground	Up to 300 kVA Up to 1 MVA (customer)	Single circuit
Overhead	Greater than 1 MVA and up to two thirds of feeder capacity	Feeder backstopping

Customers who are prepared to enter into commercial agreements can be provided with enhanced levels of security.

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

In particular, probabilistic techniques can be used to provide measurable performance indices such as:

- System Availability.
- Estimated unsupplied energy (VoLL).
- Number and size of Load Curtailments (NLC).
- Number of Hours of Interruption.
- Excursions beyond set voltage limits.

While the use of a probabilistic planning approach offers significant benefits in terms of targeted capital expenditure, the proper application of this technique also involves significant investment, both in terms of cost and resources. In particular, the following prerequisites apply:

- Competent staff, including experienced reliability engineers familiar with the application of probabilistic techniques to power systems.
- Accurate and complete historical fault outage records over a large number of years.
- Expensive and complex reliability evaluation software packages, user friendly versions of which have only become generally available in the last two years.

Notwithstanding the above, an affordable Reliability Engineering tool has recently become available which interfaces directly with ETAP software that was purchased by Westpower. Once experience has been gained with the use and application of this tool, it will be used to objectively assess the relative benefits of competing reliability enhancement projects.

It is expected that as probabilistic techniques become more widely accepted in the electricity distribution industry, practitioners become more widely trained and the cost of reliability engineering software continues to fall, then this technique will become a new standard for professional distribution asset management.

6.2.1.2 Protection Policy

The function of the protection system is to isolate faults on the power system as quickly as possible. The main objective is to protect the continuity of supply by removing each disturbance before it leads to widespread loss of synchronism and consequent collapse of the power system.

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

- Detect faults between phases or between phases and earth.
- Allow a plant to carry rated emergency loads without disconnection.
- Disconnect faulty plants from the system with minimum damage.
- Disconnect faults as quickly as possible 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 equipment affected.
- Prevent damage due to faults.

6.2.1.2.1 Sensitivity

Sensitivity is a term frequently used when referring to the minimum operating level, current voltage etc. of protection relays. The relay is said to be sensitive if the primary operating parameter is low.

Westpower's policy is to setup the protection system to detect and clear any faults on the protected equipment circuit and allow supplying the emergency load without spurious trips.

6.2.1.2.2 Selectivity

When the fault occurs, the protection system is required to trip only those circuit breakers whose operation is required to isolate the fault.

Westpower's protection system is required to satisfy the property of selective tripping by employing two methods of discrimination:

- Time/pick-up grading scheme - this is based on successive protection zones arranged to operate in times that are graded through the sequence of circuit breakers.

- Unit protection scheme - unlike the time/pick-up grading scheme, the unit protection scheme will respond only to fault conditions occurring within a clearly defined zone.

6.2.1.2.3 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.

6.2.1.2.4 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.

6.2.1.2.5 Protection Reliability

To achieve a higher degree of protection system reliability, Westpower's policy is to use both multiple primary protection systems and a back-up protection system. In the event of failure or non-availability of the primary protection, the backup protection system should clear the fault.

The extent and type of back-up protection system applied will be related to the failure risks and relative economic importance of the system.

6.2.1.3 Faults

The level of fault occurrence is closely linked to the 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. Lines have 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. However Asset Management staff have now employed the use of failure codes to allow analysis of faults.

6.2.2 Regulatory Factors and Quality of Supply

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.

Power Quality is considered to be the standard of the power supplied in an energised system. It includes voltage regulation, level of harmonic distortion, and frequency and magnitude of power sags and surges. Sags and surges are momentary voltage dips or increases with a duration of less than a second, generally from a few milliseconds to half a second. Power interruptions of more than a second are considered to be outages, a factor of power reliability.

Voltage Regulation

Where customers are fed from a low voltage distribution system which supplies more than one customer, the distribution system shall normally be designed so that the phase to earth voltage at the customer's point of supply is maintained within the limits as set out in the Electricity Regulations (the Electricity Regulations 1997 allow voltage variations of ± 6%, except for momentary fluctuations of the nominal voltage). The customer's point of supply will usually be taken as the customer's service fuse or property boundary.

In special situations, or where the customer is supplied at a voltage other than the standard low voltage, the distribution system should be designed so that the delivered voltage is maintained within the limits agreed by the customer and Westpower. Where no such limits are specifically agreed on, the limits as stated in the Electricity Regulations shall be applied (the Electricity Regulations 1997 allow for voltage variations of ± 5% of the agreed voltage for installations supplied at other than standard low voltage).

Voltage Drop Allowances

Regulated 11 kV busbars on Westpower's distribution network are regulated to a voltage of 102 % of nominal voltage. The voltage drop across the network should accordingly be distributed as follows under maximum design load conditions:

11 kV system	2 %
Low Voltage system	4 %
Service main	2 %

In rural areas the allocation of voltage drops must be determined on a case by case basis. The actual 11 kV voltage drop will depend on the distance of the customer from the regulated busbar and this voltage drop could exceed 2 %. A voltage drop of less than 4 % on the low voltage system is thus required. In general the

design should endeavour to place the 11 kV supply point to the low voltage network as close to the customer as possible, resulting thus in relatively short low voltage networks.

Harmonics

Harmonic voltages and currents are generally generated by customer's equipment. The limits of harmonic voltage or current permitted at the point of connection between the network and the customer's installation, or the point of common coupling with any other customer are as specified in the New Zealand Electrical Code of Practice for Harmonic Levels, NZECP 36:1993. In general, this restricts harmonic voltages at less than 66 kV to 4 % for any odd numbered harmonic, 2 % for any even harmonic, and 5 % for total harmonic distortion.

6.2.3 Rating of Network Equipment

All equipment to be installed on the network shall be adequately rated both in terms of load capacity and in terms of fault level withstand capability. In assessing the current or load rating, due regard should be paid to future load growth. Where appropriate, allowance may be made for the cyclical nature of any load.

In terms of fault ratings, before selecting the fault level withstand rating of a network component, the actual fault level at the location on the network at which the network component is to be installed should be determined. Any anticipated network reconfiguration should also be taken into account.

After Diversity Maximum Demand (ADMD) is the most critical variable factor in LV system design as its accurate selection directly affects the optimum costs of an installation and quality of supply.

It is therefore important that emphasis is applied to the optimum selection of ADMD. Accordingly, ADMD has been revised and depends mainly on the development type as presented below:

- Commercial Areas

  In new commercial developments, where small factories, retail shops or similar require low voltage distribution, no ADMD can be predicted, as it is not known what operations will occupy the premises. Load estimates should be generous because the cost of later LV cable reinforcement can be considerable. Transformer load estimates may be more conservative. The designer should discuss each case with developers and Westpower before proceeding.

- Urban Residential Areas

  The network shall be designed for a normal residential after diversity maximum demand of 5kW per dwelling. In special areas, identified by Westpower, this may be insufficient and the design ADMD shall be as specified by Westpower. In areas where zoning allows multiple residential dwellings and the property area permits, an allowance must be made for multiple dwellings per lot.

- Rural Areas

  Care must be taken to determine the ADMD per consumer in rural areas. Appropriate allowance must be made if large irrigation pumps are to be connected or if significant electrical heating is to be installed in large residential accommodation.

The design and selection of the equipment used for the construction of overhead lines must meet, at least, the following requirements:

Safety - The line must be safe for linemen to construct and maintain, and must offer no hazard to the general public.

Electrical Performance - The line must adequately serve the purpose for which it has been designed. It must safely carry any load current which it may be called upon to do without creating problems of unacceptable voltage drop. It must also be able to withstand any fault current that it may from time to time carry.

Mechanical Performance - The line must be able to withstand reasonable natural forces such as wind, rain, snow and earthquake.

Financial Performance - The line should be designed to be as economical as possible, taking into account original cost of maintenance and cost of line losses.

Appearance - Consideration must be given to the impact of the line on the environment in choosing the line route and the aesthetic appearance of the line.

6.2.4 Enhancement and Development

6.2.4.1 Historical Drivers

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

Some of the drivers that effect future load include:

- Climatic conditions.
- Economic activity.
- Commodity prices.
- Foreign exchange rates.
- Major step load increases/decreases.

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

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

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

A careful and rigorous approach has been taken to developing future load projections based on historical trends, available information and estimates on future changes. A Load-watch spreadsheet is a key data receptacle used to store information for later input into the demand forecasting process. The load growth projections were used as a basis for determining the likely timing of those projects, which are justified by load growth.

Firstly, load trends at each Grid Exit Point (GXP) over the previous seven 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 GXP data, and general knowledge of the local economy and other drivers discussed above, an estimate is made of the likely future trend in load growth on a Grid Exit Point basis. This then provides a new baseline for further work.

These trends are used to develop regional forecasts and assist with the development of plans for investment in Transpower's grid*, which is normally the binding constraint for new loads on the West Coast.

* *Refer to West Coast Upgrade Project - Covec Load Forecast February 08 document.*

6.2.4.2 Enhancement and Development

This activity outlines work which is planned to enhance and develop the system. This means increasing the capacity of the system and eliminating any limitations in order to:

- Provide more load.
- Enhance voltage regulation.
- Improve security and reliability.

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

Network limitations which relate to system peak loading are:

- Acceptable standards of reliability of supply cannot be maintained.
- Acceptable network rating of plant and equipment cannot be maintained.
- The thermal rating of plant and equipment is exceeded.

Additional network limitations are:

- The fault rating of equipment is exceeded.
- The age of equipment renders its continued use operationally unsafe or uneconomic.
- Continued operation of the existing network is not economic, e.g. small conductor sizes or high reactive power flows causing excessive losses.

The process for evaluating network limitations shall be systematic and it shall cover all items of equipment and all circuits. Particular attention to all the most common limitations is required. Refer to Table 6.3 - Common Network Limitations.

Table 6.3 - Common Network Limitations

Equipment	Common Limitations
Transformers	Rating, ageing conditions, tapping range, voltage regulation.
Switchgear	Rating, age, insulation, fault rating, bus zone protection, spare feeder units, sensitive earth fault protection.
Cables	Rating, age, leaks, faulty joints, long repair time, fault rating.
OH Lines	Rating, physical conditions, reliability, losses, clearances, voltage drops, fault rating.

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.

6.2.4.3 Options for Handling Load Increases

A number of strategies are available for dealing with load increases (refer to Table 6.4).

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.

Table 6.4 - Options for Handling Load Increases	
Strategy	**Application**
Economic tariff structure models	These options include demand based tariffs, off peak discounts and penalties for poor power factor. By signaling the true marginal economic costs of network extensions, the consumer is able to respond to these pricing signals by modifying their consumption behaviour and reducing their costs. This is best applied in the case of marginal load growth where optimization of the network is able to unlock its full potential.
Demand Side Management	Demand side management is typically applied by means of ripple control switching of interruptible loads such as water heating and night store heaters. Westpower routinely applies this method to reduce regional peak demand, which assists Transpower in managing existing transmission constraints.
Line Drop Compensation	On long rural feeders where most of the load is situated toward the middle or far end of the feeder, line drop compensation is a valid means of improving receiving end voltage regulation and maximis-ing the line capacity. This is generally not applicable for 11 kV feeders with distributed load as near end customers would be adversely affected by voltage rise. Cost effective, but only applicable in limited cases.
Distributed Generation	Distributed generation is actively encouraged throughout Westpower's network, but Westpower is reliant on others investing in this technology. Furthermore, unless the generation is very reliable, or sufficiently diverse, the network must still be sized to provide full load without the benefit of generation to cater for times when the generation is unavailable or being maintained. Distributed Generation is not seen as applicable where it is the only means to supply continuous loads, but may be used by a customer who is happy to put up with occasional interruptions or constraints.
Voltage Regulation	On long 11 kV or 33 kV feeders, voltage constraints can be dealt with by installing either continuously variable or stepped voltage regulators. Westpower applies this technology in areas where either marginal or step loads increases would otherwise result in unacceptable voltage profiles. These are routinely applied in Westpower's 33 kV or 11 kV networks to cater for an increase in dairy farm loading in the rural area.
System Reconfiguration	Where significant loads are situated at the end of a meshed feeder, it is sometimes possible to provide enhanced capacity by switching the load to a nearby feeder. In the case of one bulk customer, a planned load increase (situated near the tie point between two feeders) will be catered for by spreading the factory load across two feeders. This is very cost effective, but depends very much on factors such as location of the load and therefore has limited application.
Reactive Compensation	This technique involves installing capacitors on the 11 kV distribution network to boost voltage and improve capacity. Westpower uses this technique extensively to support rural feeders and support the transmission grid voltage throughout the West Coast. Since only a certain number of fixed capacitors can be installed throughout the network before voltage rise problems occur, much more expensive switched banks are then required and the cost benefit balance is shifted. Switched capacitor banks are also used to support large motor starting applications.
Reconductoring	Reconductoring is usually applied where a line is reaching its thermal capacity limit or losses are very high. In Westpower's situation, most of the network constraints are voltage related due to the long rural nature of the network and reconductoring has very limited benefit in this situation.
Overlaying with a higher voltage	Upgrading the operating voltage often involves the construction of new zone substations and this ad-ditional investment on top of the need to re-arm and re-insulate the associated power line can lead to a very capital intensive solution. However in some cases such as the feed into South Westland, this will eventually be required after all voltage regulation and reactive support options have been exhausted.

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

Where very short time frames are involved, and permanent solutions are not possible before the load comes on stream, demand side management is often employed by making at least part of the additional load interruptible until a long term solution can be put in place.

Ignoring such increases, the first three solutions identified in the table, are essentially non-asset intensive.

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

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

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

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

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

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

Notwithstanding the above comments, the quantum of the load increase that Westpower is currently facing, as depicted in Figure 5.1, means that energy conservation, distributed generation or small renewable generation projects are not, in themselves, viable solutions to the constraints now being faced. They do however improve the quality of supply and reduce the marginal costs and losses associated with transmitting energy into the area.

6.3 Acquisition and Installation

All equipment supplied shall be new, unless used equipment is accepted by Westpower on an item by item basis, and such equipment will be accepted only on conditions specified by Westpower. Westpower will in no situation be obliged to accept used equipment.

All equipment supplied shall meet manufacturing and safety standards specified by Westpower, and shall be manufactured by manufacturers acceptable to Westpower.

6.3.1 Distribution Transformers

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

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

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

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

6.3.2 Surge Arrestors

Distribution class arresters with a duty cycle rating of 5000 Amps for 30 cycles (10000 Amps for 10 cycles) and designed for cross-arm mounting are to be installed on both sides of reclosers, at line to cable terminations and at line to transformer terminations. Arresters should conform to the requirements of AS 1307.2:1996 "Metal-oxide surge arresters without gaps for AC Systems" or IEC 60099-4 (2004). All lightning arresters are to be fitted with explosive disconnect earth terminals.

The following arrester types may be used:

- Arresters for 11 kV lines should be rated at 12 kV.
- Arresters for 33 kV lines should be rated at 36 kV.

6.3.3 Insulators

Insulator mechanical and electrical ratings are to be taken into account when selecting insulators. Porcelain tension insulators are not to be used.

The in service load capability of individual components should generally be established from the manufacturer's test results and recommendations.

6.3.4 HV Disconnectors

HV Disconnector switches are not designed to make or break significant load or fault currents and are usually operated only when disconnected from the source of supply. Three pole, single throw, rocking insulator type HV Disconnector Switches are to be selected for installation on the Westpower network. The following minimum electrical characteristics are to apply:

System Voltage	11 kV	33 kV
Rated Current (Continuous)	400 Amps	800 Amps
Short time current	16 kA/3 Sec	13.1 kA/3 Sec

6.3.5 Poles

Structural Design Requirements for Utility Service Poles are covered by the Standard AS/NZS 4676:2000. Timber design shall comply with the requirements of NZS 3603:1993, 'Timber Structure Standards'. The standard provides the design strengths for NZ softwood timbers. The strength of Australian timbers are covered in AS 1720:1997, 'Timber Structures Code'.

Softwood timber poles shall comply with NZS 3605:1992 'Specification for Timber Piles and Poles for use in Building'. Treatment of softwood poles is according to AS 1604.1: 2005 'Specification for preservative treatment – Sawn and round timber'.

Hardwood timber poles shall comply with AS 2209:1994 'Timber Poles for Overhead Lines'.
Westpower's preferred pole type is reinforced pre-stressed concrete poles. Depending on the environmental situation, softwood poles may be preferred. All wood poles shall be fitted with pole caps.

All poles used on lines of voltages of 11 kV and above are to be fitted with possum guards.

6.3.6 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.

6.4 Maintenance and Operation

6.4.1 Replacement V Maintenance Trigger

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

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

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

Table 6.5 - Maintenance Triggers by Asset Category

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

Table 6.5 - Maintenance Triggers by Asset Category Continued...		
Asset category	**Components**	**Maintenance trigger**
Distribution substations	Poles, arms & bolts	• Evidence of dry-rot. • Loose bolts, moving stays. • Displaced arms.
	Enclosures	• Visible rust. • Cracked or broken masonry or fibreglass.
	Transformer	• Excessive oil acidity (500kVA or greater). • Visible signs of oil leaks. • Excessive moisture in breather. • Visibly chipped or broken bushings.
	Switches & fuses	• Corona discharge monitoring annually.
Distribution lines & cables	Poles, arms, stays & bolts	• Evidence of dry-rot. • Loose bolts, moving stays. • Displaced arms.
	Pins, insulators & binders	• Evidence of pin corrosion - rusting/necking of the pins. • Visibly chipped or broken insulators.
	Conductor	• Evidence of “birds nesting” following strand/s breaking. • Evidence of vibration - fit damper.
	Ground-mounted switches	• Evidence of pin corrosion - rusting/necking of the pins. • Long rod types chalking if EPDM type.
	11 kV Switchgear	• Corona discharge monitoring annually.

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

The Maintenance triggers are outlined in Table 6.5.

6.4.2 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.

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.

6.4.2.1 Maintenance

(i) Routine Patrols and Inspections

An aerial and ground patrol of sub-transmission lines are performed annually. Fault patrols and fault repairs are carried out on an as required basis.

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

A tree trimming regime has been established due to the high growth experienced on the West Coast.

The following Table shows patrol and inspection freguencies.

Table 6.6 - Routine Patrol and Inspection Frequencies

Voltage	Routine Patrol	Condition Assessment	Thermographic Survey	Corona Discharge Survey	Vegetation* Survey
33 kV +	6 monthly	5 yearly	2 yearly	2 yearly	2-5 yearly
11 kV	as required	5 yearly	as required	-	2-5 yearly
400 V	as required	5 yearly	-	-	2-5 yearly
33 kV Hendrix Cable	Monthly	5 yearly	-	12 monthly	Monthly

**Note: Vegetation survey dependant on environmental factors.*

6.4.3 Replacements

(i) Major Refurbishments

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, increased line reliability, and increased 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 mm^2, 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 five years to avoid an unnecessary risk of line drop or fault outages. These insulators have been proven to deteriorate rapidly after ten years, therefore a pro-active approach is required to manage the risk of failure.

The replacement of such insulation is 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.

6.4.4 Rectifying Westpower Assets

Network defect data captured in the field is incorporated into the general work plan via relevant processes. Although the primary focus of the condition assessment program is the monitoring of pole and span assets, all asset types are to be included in the near future, with each awarded equal consideration.

Dependant on the priority of the identified defect, work could be carried out immediately to rectify the problem, or alternatively the job could be scheduled to be undertaken at a more suitable time.

The status of the work order generated indicates the jobs completion, from which regular audits ensure all follow up administration tasks are completed.

All asset data is returned with an updated “Condition Code”. These are separated and analyzed for action where needed. Below is a list of the condition codes and the corresponding action that takes place;

Excellent	No further action is required on these assets.
Good	These assets have more than ten years life expectancy and will be assessed again within this term.
Fair	These assets have less than ten years life expectancy and will be assessed again within this term.
Poor	This asset could last up to five years, however it is in poor condition and future assessment will be required.
Needs Replacing	Any assets with this code are grouped into areas along with any other urgent work required. A work order is raised for the asset(s) to be replaced as soon as possible.
Red Tagged	All Red-tagged assets are urgently in need of a replacement and because of this, work orders are raised individually for these assets for prompt action.

As well as condition codes, a ‘Work Required’ table is utilised to drive any maintenance or replacements to assets. The work required table is split into two categories, ‘Urgent’ and ‘Non-Urgent’.

- **Urgent work** is grouped into geographical areas. A work order is then generated for this area including any assets marked as Needs Replacing or Red Tagged in the ‘Condition’ attribute in the asset data. Any asset that requires instant action will have a separate work order raised in order to rectify this issue as soon as possible.

- **Non Urgent work** is also grouped into areas and depending on the situation, a work order will be raised straight away or the work is set aside for action during planned outages or when time allows.

6.5 Disposal

Decommissioned equipment or materials are only disposed of when they are not required as critical spares and there is a low likelihood of them being required in the future.

Where the equipment involves potentially hazardous materials, this is clearly stated and the recipient is required to provide documentary evidence that any further disposal is carried out in an approved manner.

All decisions to transfer or dispose of fixed assets must be authorised by the Westpower Asset Manager. The Westpower Asset Manager signs a Disposal / Transfer Authority Request (DTAR) form.

Following authorisation, the appropriate Network Manager is responsible for the reallocation/disposal of all equipment.

These managers are responsible for maintaining a register of Westpower Assets which are available for disposal or transfer. This information is used to enable the effective reallocation of plant and equipment within the network. Importantly, this information also enables Westpower to assess opportunities to defer capital expenditure by reallocating assets between sites.

7.0 FINANCIAL SUMMARY

7.1 Financial Forecasts

The financial expenditures in this section are forecast for a ten year period. These forecasts have been built up from the individual project and programme expenditures developed in Section 5 – Network Development Plan, and demonstrate a generally stable expenditure over the duration of the planning period.

For more details regarding expenditure forecasts and reconciliation please refer to Appendix D.

Table 7.1 below shows the projected ten-year asset management plan expenditure, by activity and Tables 7.2, 7.3 and 7.4 show this expenditure by asset type. A graphical representation of Table 7.1 is shown in Figure 7.2.

Table 7.1 - Summary of Activity ($000)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inspection, Service & Testing	4322	4440	4314	4414	4552	4797	5061	5359	5637	5962
Faults	503	531	566	599	633	672	715	758	801	848
Repairs	304	278	297	316	331	352	376	399	421	446
Maintenance Total	5129	5249	5177	5329	5516	5821	6152	6516	6859	7256
Replacement	3201	3575	2837	2226	1368	735	527	2085	649	854
Enhancement	1103	371	504	476	433	401	1085	341	399	873
Development	2321	2316	3114	3327	4074	4646	3879	2009	4501	4641
Capital Total	6625	6262	6455	6029	5875	5782	5491	4435	5549	6368
Total	**11754**	**11511**	**11632**	**11358**	**11391**	**11603**	**11643**	**10951**	**12408**	**13624**

Table 7.2 - Opex - Summary by Asset Type (‘000)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sub-transmission	706	863	832	874	820	872	921	986	1040	1096
Distribution	1785	1823	1907	2011	2128	2250	2378	2544	2671	2806
Reticulation	380	356	328	283	298	313	295	312	330	348
Service	176	184	184	196	206	219	234	247	262	278
Zone Substation	957	874	730	750	778	802	906	924	967	1020
Distribution Substation	476	465	489	466	494	524	556	589	624	661
MV Switchgear	194	203	218	230	243	259	240	256	270	287
SCADA Comms	337	356	356	379	400	425	453	479	507	561
Distribution Transformer	93	99	105	111	118	124	133	141	148	157
Other	25	26	28	29	31	33	36	38	40	42
Total	**5129**	**5249**	**5177**	**5329**	**5516**	**5821**	**6152**	**6516**	**6859**	**7256**

Table 7.3 - Replacement Capex - Summary by Asset Type ('000)										
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Sub-transmission	960	990	867	840	95	101	30	32	34	36
Distribution	940	1162	798	495	598	180	0	0	0	0
Reticulation	108	22	0	0	0	0	0	0	0	0
Service	0	0	0	0	0	0	0	0	0	0
Zone Substation	449	377	367	164	20	21	22	1423	24	185
Distribution Substation	55	37	39	42	44	47	50	53	56	59
MV Switchgear	485	467	493	455	418	102	105	108	110	117
SCADA Comms	146	458	207	161	119	206	237	381	332	359
Distribution Transformer	58	62	66	69	74	78	83	88	93	98
Other	0	0	0	0	0	0	0	0	0	0
Total	**3201**	**3575**	**2837**	**2226**	**1368**	**735**	**527**	**2085**	**649**	**854**

Table 7.4 - Development and Enhancement Capex - Summary by Asset Type ('000)										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Sub-transmission	0	0	100	80	80	80	80	80	100	0
Distribution	203	213	128	129	115	98	17	18	19	0
Reticulation	90	67	30	30	30	30	20	20	20	20
Service	108	115	121	128	137	145	154	162	173	183
Zone Substation	1100	0	0	72	0	257	665	595	0	560
Distribution Substation	239	148	156	160	164	168	173	127	129	100
MV Switchgear	683	600	632	308	328	349	370	395	418	442
SCADA Comms	473	372	403	215	237	267	293	220	264	385
Distribution Transformer	488	517	548	581	616	653	692	733	777	824
Other	40	5	0	0	0	0	0	0	0	0
All	0	650	1500	2100	2800	3000	2500	0	3000	3000
Total	**3424**	**2687**	**3618**	**3803**	**4507**	**5047**	**4964**	**2350**	**4900**	**5514**

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

Figure 7.1 shows the relative percentages of the total expenditure as a pie chart for 2009/10 based on the figures shown in Table 7.1. Figure 7.3

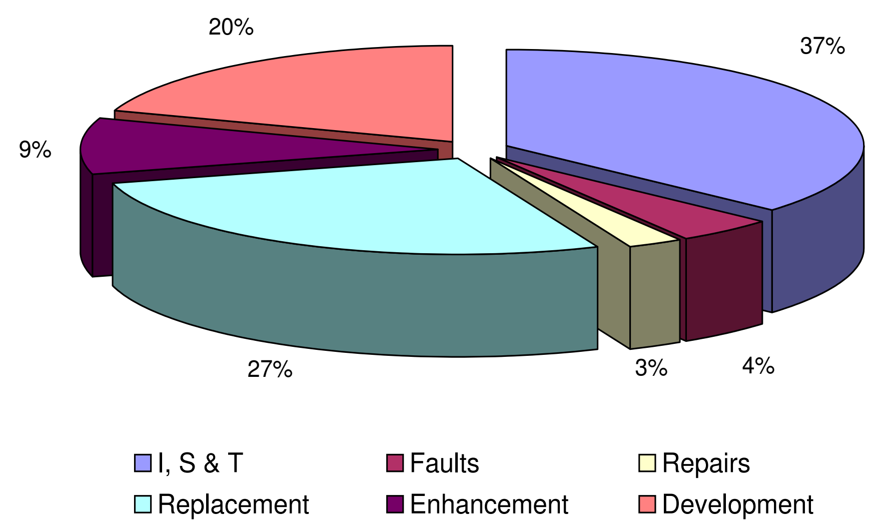


Figure 7.1 - Relative Expenditure by Activity 2009-10

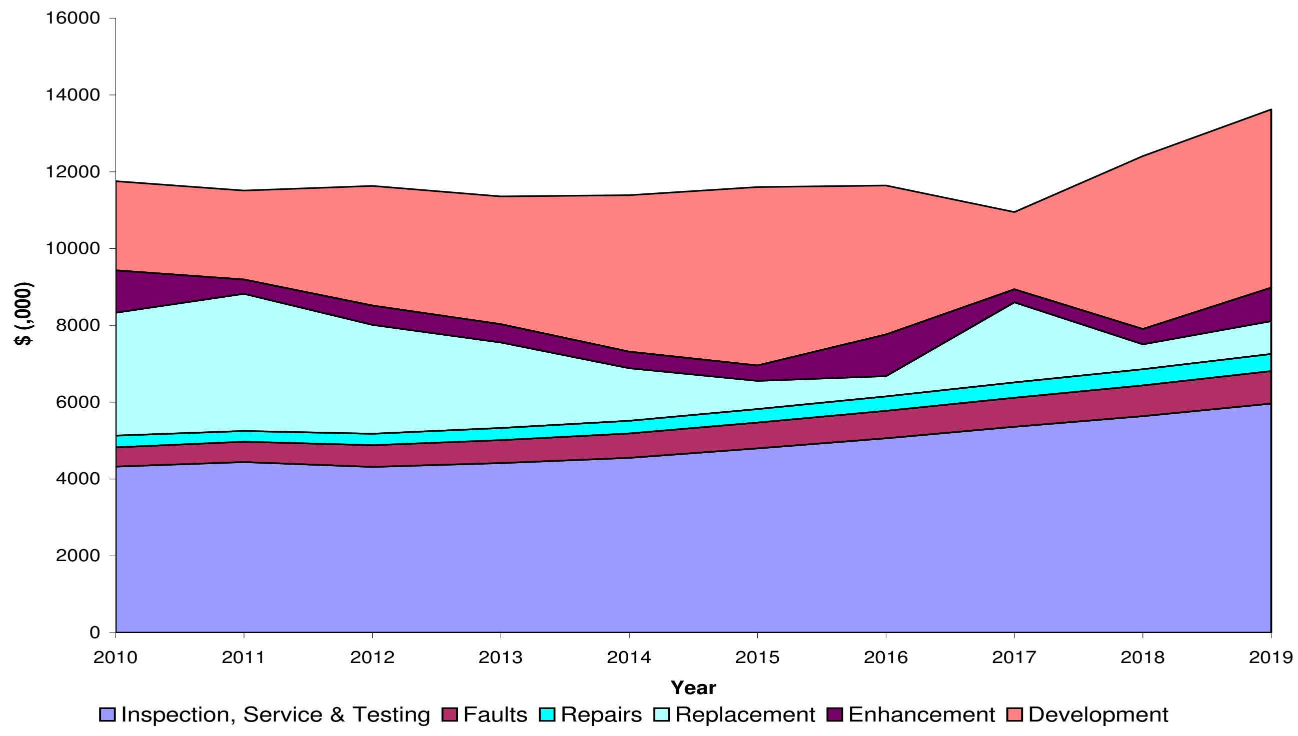


Figure 7.2 - Expenditure by Activity for the Planning Period 2010-19

shows the relative percentages of the total expenditure as a pie chart for 2008/9 based on the figures shown in Table 7.2.

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 have a major impact on the annual result.

The higher levels for Development and Enhancement are due to the 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 over the last ten years has substantially overcome this issue.

The I, S & T expenditure has increased due to a more rigorous vegetation control programme along with an upward movement in contractor rates.

The enhancement expenditure reflects a continued emphasis on distribution automation as reclosers and disconnectors are progressively automated. By doing this, Westpower is able to greatly reduce outage

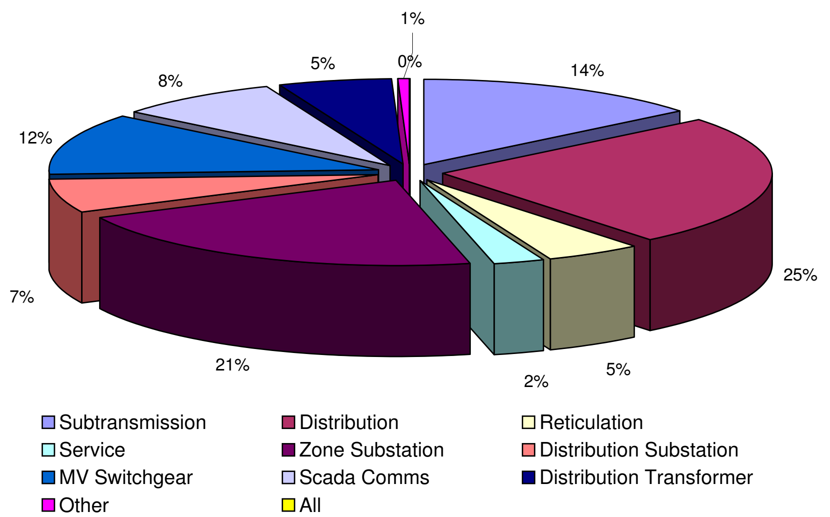


Figure 7.3 - Relative Expenditure by Asset Type 2009-10

durations and switching times, resulting in an improved SAIDI reliability statistic.

Asset types such as Zone Substations and SCADA Comms and Protection exhibit 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, while at the same time performing within the regulatory limits set by government regulations.

Other factors that will impact on network expenditure include;

- Weather (which affects fault expenditure).
- Load Growth / Decline.
- Price Control (through regulation).
- Inflationary Pressures.
- Resource availability.

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.

As prices are forced downward, costs will have to be reduced accordingly through reduced capital and 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. On the other hand, any reduction in monitoring in the medium to long term is likely to be reflected in increased forced outages and so this would be a last resort.

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. 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 reduce the level of non-critical work carried out.

A considerable tightening in the labour market has been experienced over the last few years and this is not expected to ease any time soon, particularly within the power industry. At the same time, a number of major new

projects have been announced and there is a risk that Westpower may be faced with reduced skilled labour to carry out its network maintenance and capital programmes.

7.3 Actual Deviations from Previous Asset Management Plans

7.3.1 Unallocated Works

The following explains additional works (over $10,000) that were not included in the 2008-09 Asset Management Plan, but which for various reasons, were undertaken;

Lay 11 kV Duct Waterwalk Rd St Johns Ambulance
The opening of a trench for an LV connection required for the new St Johns Ambulance building in Waterwalk Road provided the opportunity to bury ducts to accommodate future 11 kV cables in the area. These ducts were laid at a cost of $15,445.

Kokiri, 11 kV - Replace Poles
During construction of a new spurline off pole 25356 at Kokiri it was identified that several poles in the area were condemned. Three 11 kV poles along with one stub pole required replacement. Total costs for this work was $13,603.

Arnott Heights - Replace 11 kV Cable
The PILC 11 kV cable supplying Arnott Heights was in very poor condition and required immediate replacement. The XLPE replacement was encased in a wooden enclosure to provide adequate protection. Costs for the cable and wooden enclosure totaled $58,178.

S326, Van Der Geest - Replace 11 kV Line
Work in the Atarau area highlighted the extremely poor condition of the 11 kV line to S326 (Van Der Geest) on Logburn Road. The existing line included a river crossing and traversed some terrain where access is difficult and vegetation threats are prevalent. A Mullet conducted was used. With this in mind, an alternate line route along the race adjacent to the existing transformer pole was utilised, intersecting the LGN1 11 kV cct near S422. The total expenditure was $35,248.

Mawheraiti, S1492, Sturkenboom - Replace 11 kV Line
An inspection revealed that the 11 kV line to S1492, Sturkenboom in Mawheraiti was in dire need of replacement. This line had very low conductors and the poles were condemned, both elements raising health and safety concerns. With this in mind, the line was replaced and optimum pole positions will need to be determined to avoid any clearances that may not meet the regulations. The total expenditure was $20,386.

Build New Blackwater Substation
Following the Pike River Coal decision to build the coal load out facility at Ikamatua a new 33 kV to 11 kV substation was required to supply this facility and is being constructed at Blackwater. The Blackwater substation will have two 11 kV feeders which in addition to supplying the load out facility will provide much needed security of supply to the Grey Valley area. The total amount budgeted for this project is $1,400,000. An amount of $445,000 has been allocated for the 2010 AMP to complete this project.

7.3.2 Uncommenced Works

The following explains projects (over $10,000) that were not commenced in the 2008-09 Asset Management Plan;

7.3.2.1 11 kV Distribution

09-11002: Mahitahi - Replace Pole 19855 with H-Pole - $10,000
In 2006 the intermediate pole in the middle of the Mahitahi River at Bruce Bay was washed out. This structure was never replaced, and to ensure the security of the conductors spanning the river a H-structure was to be built to replace the existing single pole (19855) on the northern bank. A design was carried out, however another washout in December 2008 prompted a revision of this design as the terrain and the river route has altered dramatically.

09-41001: Blackball - Taylorville Rd - 11 kV Pole Replacement - $33,000
Uncertainty regarding the proposed road re-alignment at S51 has delayed the upgrade of the remaining 11 kV poles in the area.

09-41004: Boatmans Road - Replace 11 kV Line - $30,000
The timing of the Boatmans Road 11 kV pole upgrade was largely dependant on the status of the mine in the area. This project has been delayed until confirmation of the reinstatement of the mine is received.

09-41007: Condons Rd - Relocate 11 kV Poles - $25,000
This project was to be carried out if the land on which the poles are situated was developed. This has not yet taken place, therefore the project shall be shelved until development is confirmed.

09-41020: North of Franz Sub to Molloy's - Replace 11 kV Conductor - $15,000
This 11 kV conductor replacement was included in the AMP due to the significant growth in the northern area of Franz Josef. At present this upgrade is not required but will be included in future plans as development continues.

09-41022: Ross Township - Upgrade 11 kV Conductor - $33,000
Originally programmed for later in the 2008-09 financial year, this project has been deferred due to the significant outage required. Deemed not to be urgent, this work will now be carried out in the 2009-10 year.

09-61003: Construct 11 kV Line to Freyberg Terrace - $25,000
Difficulty in obtaining a line route has stalled this project and it will now be included in the works plan for the 2009-10 financial year.

09-61004: Grey Hospital to New World - New Feeder Cable - $11,000
Dependant on possible road upgrades in the area surrounding the Greymouth Hospital, this project did not take place as the road work was not carried out.

7.3.2.2 11 kV Distribution Substation

09-61008: Frickleton St - Offload S119 (Freyberg Terrace Sub) - $30,000
Dependant on the 11 kV line construction to Freyberg Terrace, this project will now be carried included next years works programme.

7.3.2.3 Reticulation

09-12003: Hokitika, Hampden St - Remove LV - $15,000
Deemed to be non-urgent, this project was deferred as higher priority work was carried out. This work has now been included in the 2009-10 works programme.

09-42003: Ruatapu Township - Replace LV - $22,000
Similar to the project above, the upgrade of the LV at Ruatapu has not been deemed urgent and has been included in the 2009-10 works programme.

09-15005: Moana S817 Johns Road, Extend Pad and Replace 400 V Board - $15,000
Resource constraints have stalled the upgrade of S817 at Johns Road Moana. This project has now been included in the 2009-10 works programme.

7.3.2.4 33 kV Sub-transmission

09-10002: Arnold Dobson 33 kV Line Pole Replacement - $27,500
The scope of this project has been largely dependant on the line route required for the proposed hydro station in the area. Pole replacement will not be carried out until this route has been finalized and affected poles are identified.

09-40002: Mapourika, Replace Substandard Poles - $60,000
This project was dependant on the pole replacement on the HKK-HHI 33 kV cct. The intention is to utilize

any good quality hardwood poles extracted from the HKK-HHI upgrade and use them to replace substandard poles at Mapourika. The late start of the HKK-HHI project has pushed out the Mapourika upgrade until the next financial year.

09-40004: Replace All 33 kV EPDM Strain Insulators - $27,500
Recent years have seen many EPDM insulators replaced, however an accurate record of those remaining is not available. Until exact numbers and locality of these non-standard units are determined this project will be deferred.

7.3.2.5 Zone Substation

09-54012: Waitaha Zone Substation – Prepare Site for WMS Access - $20,000
The funds for this project have been transferred to 09-54002 Fox Zone Substation – Prepare site for WMS access.

09-54011: Whataroa Zone Substation – Prepare Site for WMS Access - $20,000
Whataroa substation is a difficult site to set up for WMS access. Prioritising resources and difficulty of project completion have resulted in this project being deferred.

09-54006: Harihari Zone Substation – Prepare Site for WMS Access - $20,000
Prioritising resources have resulted in this project being deferred.

7.3.2.6 Other

09-13001: Greymouth, Upgrade Under Veranda Lighting - $11,000
The logistics of this project have become more difficult than anticipated. With this in mind the under veranda lighting project will be carried out over the next two financial years.

09-64006: WMS (Mobile Substation) Storage Facility - $50,000
A decision is yet to be made on what course of action to take for this storage facility, i.e. rent or buy. Options are being looked at and a decision will be made later this year.

09-44009: Longford Corner Regulator – Replace Disconnectors - $22,000
A large outage is required to replace these disconnectors. Project has been deferred in anticipation of the purchase of a mobile generator.

09-56004: Distribution Intelligent Fault Isolation System – Study/Design - $20,000
Most of the study/design for this project has been completed in house, hence no costs.

7.3.3 Uncompleted Works

The following explains projects that were started and have more than $20,000 remaining in the 2008-09 Asset Management Plan.

09-64007: Wahapo Zone Substation – Install Ripple Plant - $50,000
Delays in obtaining an easement from DOC necessitated $35,000 of this project to be deferred to 2009 AMP.

09-54003: Greymouth Zone Substation – Replace Protection - $325,000
Most of the equipment required for this project has been ordered. Delays with project design/drawings necessitated $180,000 being deferred to 2010 AMP for installation of protection equipment.

09-54004: Greymouth Zone Substation – Install 110 Vdc (dc2) Battery Bank - $60,000
Most of the equipment required for this project has been ordered, however delays with project design/drawings necessitated $20,000 being deferred to 2010 AMP for equipment installation.

09-14022: Software Development – SEL Metering Data to Vaewin System - $100,000
Delays with design and metering software have resulted in an approximate $50,000 underspend.

09-14032: Zone Sub OLTC and Regulator Maintenance - $108,000

The plan this year was to overhaul GYMT2 during the protection upgrade, which has been deferred, resulting in an approximate $35,000 underspend.

09-14034: Zone Sub-transformer Refurbishment and Maintenance - $120,000

As in the above project, this project has been deferred resulting in an approximate $85,000 underspend.

8.0 ASSET MANAGEMENT PRACTICES

8.1 Introduction

The electricity distribution system is comprised of assets with long lives. The management of these assets (including maintenance of existing assets and development of new assets) is Westpower's primary focus in providing an effective and efficient distribution service to its customers. Furthermore, because distribution is only one part of an integrated electricity system, consultation and coordination of plans is an essential ingredient for the effective functioning of that system.

This is an annually produced plan covering the next ten years and documents likely, or intended asset management requirements. The plan provides a focus for ongoing analysis within Westpower aimed at continuously improving the management of the distribution system and it provides a vehicle for communicating asset management plans with customers.

In many cases, particularly where asset development is involved, the work will be driven directly by customer requirements and associated financial commitments. This plan is based on Westpower's present understanding of its customers' requirements. It is part of the process of communication with customers and Westpower will be responsive to customer input, with regard both to actual expenditure commitment and to long term future planning.

The plan is also intended to demonstrate responsible stewardship of assets by Westpower to its customers and shareholders. The plan shows the maintenance and replacement requirements which are intended to maintain the operating capability of the system over the long term. Each year a process is carried out which reviews Westpower's achievement with respect to this plan and the results of this are summarised in the previous section.

This section broadly outlines Westpower's Network Services, current and desired Asset Management practices and specific improvement initiatives.

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 manage the data.

Data is that required for effective decision making (ie for managing using information systems).

Tables throughout this section broadly describe the current Westpower Asset Management practices and possible future (desired) business practices it is intended to ultimately develop. The Asset Management Improvement plan discusses improvement priorities, timetables and resources for the next three years.

The following are specific issues and asset management procedures that are currently being addressed.

8.2 Asset Management Policy

The asset management policy is a means for management to communicate to its directors, employees and stakeholders the organisation's position and intentions with regard to asset management. It provides a high level statement of the organisations principles, approach and expectations relating to asset management.

8.2.1 AM Policy

1. Westpower are committed to maximising shareholder's investments in a legally and environmentally compliant and sustainable manner, without compromising the health and safety of our employees, consumers, or the public.

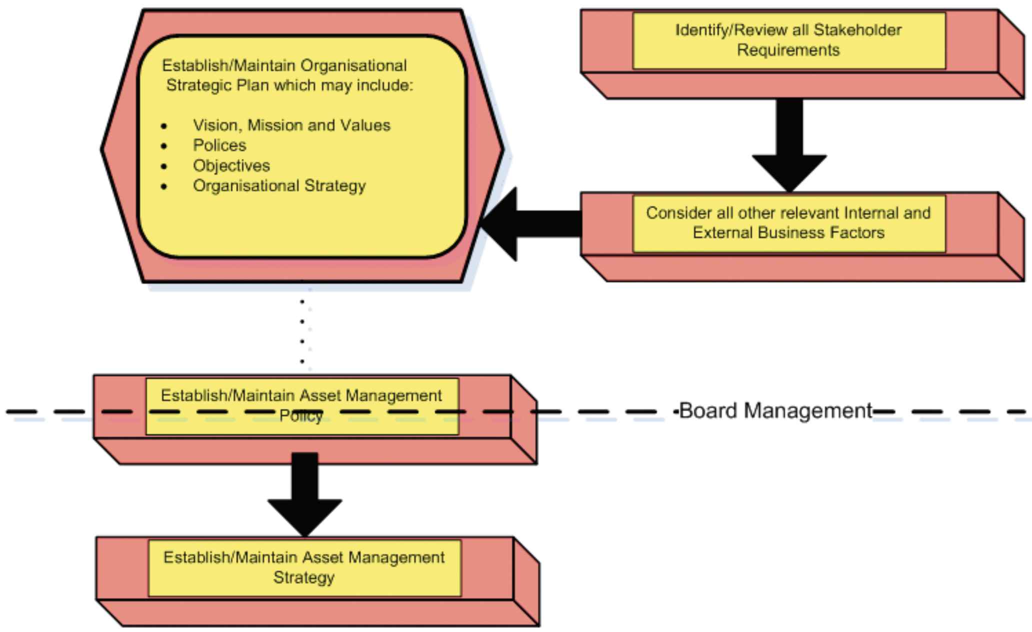


Figure 8.1 - Asset Management System Elements

2. Elements

- Safety - Is of paramount importance in everything that we do and will not be compromised for cost, time or any other reason.

- Quality of Supply - Commensurate with the load type and criticality, will be closely monitored and remedial action will be taken where the quality does not meet Westpower's stated standards.

- Legislative Compliance - All asset management planning and associated activities will be carried out in accordance with the relevant legislation. Where non-compliance issues are identified, these will be dealt with promptly and transparently.

- Cost Efficiency - Prudent asset stewardship requires that careful budgeting and robust financial review processes are used to ensure that maximum cost efficiency is assured.

- Environmental Impact - Westpower is environmentally responsible and carefully considers the environmental impact of any of its actions. Furthermore, the company works hard to mitigate any negative affects and provide a net environmental benefit where this is practical.

- Reliability of Supply (SAIDI, SAIFI) - Through continued investment in relevant technology and system configuration, reliability will continue to be a key focus of all asset management planning.

- Security of Supply - Acceptable security of supply will be developed and maintained through prudent planning based on sound engineering processes.

- Energy Efficiency - Energy efficiency will be encouraged in all areas of Westpower's activities and this will be a key outcome from the design process. Where opportunities exist to enhance energy efficiency for existing assets, these will be actively pursued and implemented where technically and economically feasible.

- Technology - Seen as a key enabler in providing improved service and value to our consumers. We will continue to keep abreast of developments in the field of new and emerging technology and apply these to Westpower's network where appropriate.

- Maintain Service Potential - The future of Westpower's business is wholly dependent on the ability of the network to continue to provide service for the foreseeable future. To this end, every effort will be made to maintain the ongoing service potential of the network where this is appropriate.

- Supporting Economic Growth - We recognise that electricity infrastructure is a key enabler of economic growth and will work with current and future developers to provide electricity with the capacity, security and quality required to support their business.

- Productivity - Opportunities for improved productivity through training, technology, process improvement or other means will be constantly pursued.

- Continual Improvement - We will never be satisfied with where we have come from and will continue to look forward at ways of improving what we do and standards we apply.

- Strategic and Long Term - The infrastructure business involves long term investments. We will be cognisant of the impact of our decisions on the long term health of the business and future generations of consumers.

8.3 Rationalisation of Responsibilities and Procedures

The structure of ElectroNet's asset management group continues to develop to meet business needs and legislative change. Responsibilities, reporting lines, work flows and procedures have been implemented for the different activities carried out in the office. These activities include action, planning, monitoring and reporting.

8.4 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. Development projects may be put out to tender and outside contractors may carry out the work.

Service level agreements are currently in place with ElectroNet Services for Asset Management and Asset Maintenance. Larger Enhancement and Development projects have contracts prepared on a specific basis.

8.5 Information Systems Development

The Asset Management Group has implemented the Maximo Asset Works Management System (MAWMS), that is used for asset and works management processes. Expenditure can be tracked by activity and by asset type and is audited monthly.

Also improvements have been made to the Electrical Network System which keeps information on types of equipment installed at a site. This information tracks maintenance history of transformers and other associated equipment.

8.6 Specifications, Procedures and Manuals

Westpower has spent considerable effort in preparing a set of manuals for use by contractors, which denote 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 on Westpower's network.

8.7 Deregulation/Compliance with MED and Commerce Commission Requirements

The specific external environment in which Westpower operates is the power supply industry in general.

8.8 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 is delivered to the consumer.

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.

8.8.1 Economies of Scale

A time of relative stability appears to have been reached within the industry with a commensurate reduction in merger and acquisition activity. While there is no direct imperative for mergers and acquisitions intrinsic in the current legislation, market forces are likely to continue to act on inefficient operators with high fixed costs relative to their asset base.

If Westpower is to remain profitable it needs to compare favourably with other lines businesses. The challenge for Westpower is to remain viable through appropriate cost control and superior standards of asset management. Cost reduction alone is insufficient as it ignores the impact on asset performance, which is a vital factor in the continued operation of the company.

A spin-off benefit from an intensified maintenance programme is a major reduction in fault outages, the benefits of which will be ongoing. When combined with a reduction in planned outages through lower planned maintenance activity, a significant improvement in reliability can be expected.

8.9 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 (Table 8.1).

Table 8.1 - Asset Renewal Criteria

Priority	Renewal Criteria
1 (High)	Asset Failure has occured. 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.

8.10 CAPEX Analysis

Capital expenditure needs to be carefully targeted to ensure that the greatest benefit is reaped from each capital dollar expended.

Westpower has always had a policy of producing well-researched business cases for major capital projects. A Discounted Cash Flow (DCF) is used to derive the Internal Rate of Return (IRR) of a project and then to compare this with the hurdle rate. In general this hurdle rate is equivalent to the Weighted Average Cost of Capital (WACC) for the business.

Any project that demonstrates a higher rate of return than the hurdle rate will add value to Westpower’s business. If several projects are competing for capital funding, these may be ranked in terms of their rate of return; however caution is needed if the projects are of markedly different size.

8.11 Distributed Generation

Distributed Generation is electricity generation equipment connected to the Customer’s installation, and capable of generating electricity back to the electricity Network, as well as supplying electricity for the Customer’s own use at the location it is installed.

Usually it will be a fixed installation but it may be disconnectable and moveable if required. The installation will include all necessary protection equipment required for the safe operation of the Distributed Generation system.

In the context of Westpower’s guides for connection, Distributed Generation comprises:

- Small systems of less than 5 kW capacity.
- Medium systems of between 5 kW and 30 kW capacity.
- Large systems between 30 kW and 1000 kW capacity.

Large systems would normally be associated with industrial sites or as dedicated generation facilities. Westpower's policy is to actively encourage Distributed Generation as a means of reducing system losses and improving both the reliability and quality of supply to the area.

Customers interested in developing such facilities are invited to contact Westpower's agent ElectroNet Services to request a copy of the Distributed Generation Information Pack. This pack will provide valuable assistance in planning and engineering an acceptable solution.

Formal application forms will be available to ensure that the appropriate information is provided to allow Westpower to approve connection to its network and ensure compatibility with the existing reticulation network.

Any new Distributed Generation installation also requires contractual arrangements to be put in place with a retailer to purchase any excess electricity generated. Westpower may then credit the retailer for the energy that is exported at the same price that the retailer is charged for the delivery of energy, providing a net benefit to the Distributed Generator.

8.12 Asset Management System Improvement Process

8.12.1 Introduction to PAS-55

Westpower considers the need to re-evaluate its Asset Management Improvement Processes as very important. As a consequence of what is happening globally, Westpower consider it appropriate to use the U.K PAS-55 system as the basis for this.

As a first step, Westpower commissioned a review of its processes in 2008 and has produced the following benchmark Gap Analysis.

PAS-55 is the Publicly Available Specification for the optimized management of physical assets and infrastructure. Development of PAS-55 was sponsored in the United Kingdom by the Institute of Asset Management in response to a need identified by regulators and asset owners. This was developed in order to define asset management in the context of physical infrastructure by setting out the key attributes of effective asset management systems.

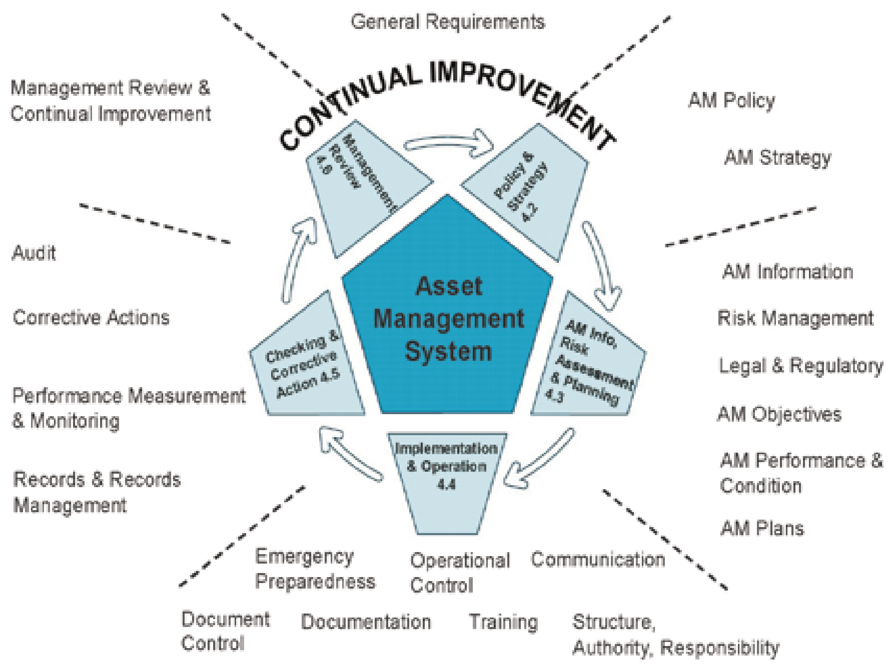


Figure 8.2 - PAS-55 Asset Management System Elements

PAS-55 consists of 21 key requirements which together provide a framework defining current best practice for the whole of life management of physical assets. The 21 key elements shown diagrammatically above in Figure 8.2 work together to provide a rigorous process based on the plan-do-check- act cycle. The requirements link strategic business objectives to detailed operational plans ensuring that operating and capital investment is targeted at realising asset performance and risk profiles that meet stakeholder expectations and business objectives.

PAS-55, while not having the status of a British or an ISO standard is an auditable specification. As such organisations may seek to obtain independent external certification verifying compliance with the documented requirements. Such external certification is becoming recognized by asset owners and regulators internationally as a useful means to demonstrate good governance, due diligence in the management of asset related risk and optimized asset management decision making.

8.12.2 Purpose and Objectives of this Review

A high level gap analysis of Westpower's asset management processes has been conducted against the requirements of PAS-55 with a view to future alignment or certification against the document. The objectives of this review were to:

1. Provide an understanding of Westpower's current position with regard to alignment with PAS-55.

2. Identify areas where changes to asset management processes would yield improvements in financial performance, asset performance and risk management.

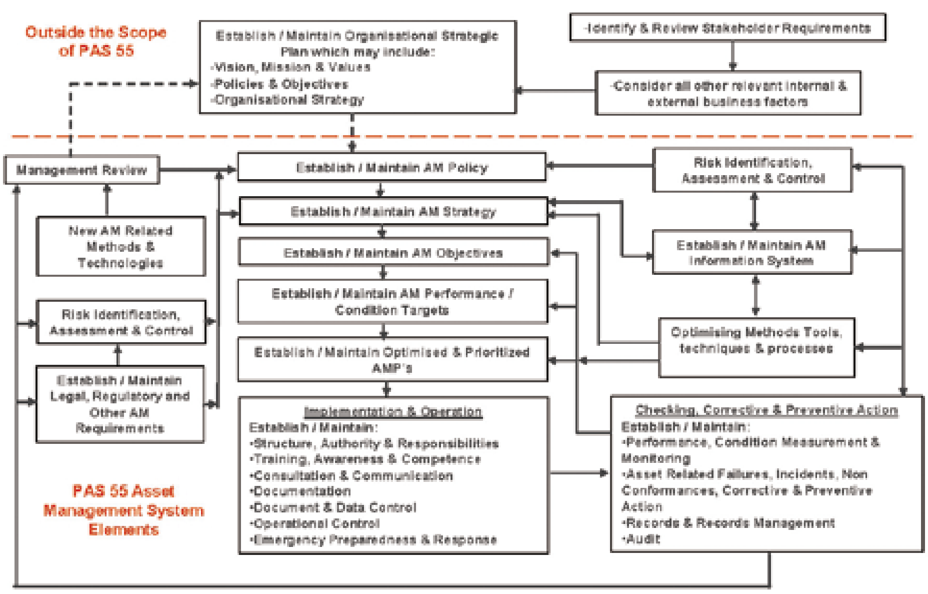


Figure 8.2 - PAS-55 Asset Management Framework

8.12.3 Improvement Plan

Westpower has adopted progression towards PAS-55 compliance as a key performance indicator in the overall business Strategic Plan.

As part of this process, the Board has now signed off on the Asset Management Policy, which provides the governance framework within all asset management activities must take place. This also ensures strategic alignment between Westpower's business goals and management of the asset.

Over the next year, Westpower plans to complete a number of initiatives aimed at reducing the compliance gaps that have been identified in the rest of this section.

Key targets for the coming year include:

- Specification and rollout of a formal Document Management System based on Microsoft Sharepoint® technology.
- Development of an Asset Management Strategy covering all asset types.
- Reviewing conformance requirements with the updated PAS-55:2008.
- Preparing a compliance strategy and timeframe.

8.12.4 Gap Analysis Assessment Criteria

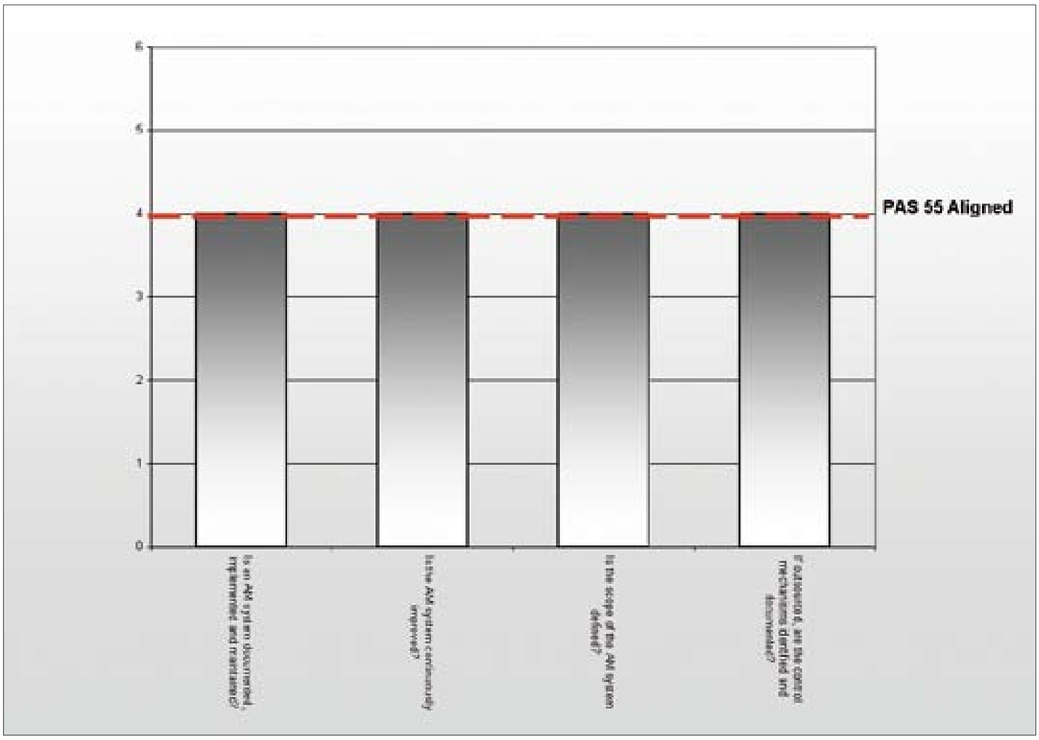
PAS-55 contains 21 key mandatory requirements which can be further subdivided to a total of 179 discrete elements for evaluation. Questions chosen to reflect the intent of these elements were scored semi quantitatively to provide a measure of the organisation alignment or maturity in that area. A summary of the scoring methodology is shown in Table 8.2 below.

Table 8.2 - Gap Analysis Assessment Criteria

Rating	%	PAS-55 Maturity Level	Evaluation Criteria
1	**0**	Innocence	This element of PAS-55 is not in place, the organisation is unaware of the need for this element.
2	**20**	Aware	The organisation has a basic understanding of the requirements of this element of PAS-55 and is in the process of deciding how this element will be applied.
3	**40**	Developing	The organisation has a sound understanding of this element of PAS-55. It has been decided how this PAS-55 element will be applied and work is progressing on implementation.
4	**60**	Compliant	This element of PS-55 is implemented as required, minor inconsistencies may exist.
5	**80**	Excellence	This element of PAS-55 is comprehensively implemented and integrated with other elements.
6	**100**	Beyond PAS-55	Using processes and approaches that go beyond the requirements of PAS-55, pushing the boundaries of asset management to develop new concepts and ideas.

8.13 Detailed Findings

8.13.1 General Requirements



"The organisation shall establish, document and maintain an asset management system and shall continually improve its effectiveness."

Review Against PAS-55 Requirements

Q #	Criteria	Score	Maturity Level	Comments
General Requirements				
1	Is an AM system documented, implemented and maintained?	4	Compliant	Westpower's AMP documents an overarching asset management system. For example Figure 1.4 indicates an overall asset management process similar to that suggested by PAS-55-2.
2	Is the AM system continuously improved?	4	Compliant	There is ample evidence of a continual improvement culture in Westpower. In particular the gap analysis section of the AMP.
3	Is the scope of the AM system defined?	4	Compliant	The scope of the AM system is clearly defined in the AMP. The AMP outlines the asset classes covered, and lists exclusions (eg vehicles).
4	If outsourced, are the control mechanisms identified and documented?	4	Compliant	Not applicable.

Observations and Improvement Opportunities

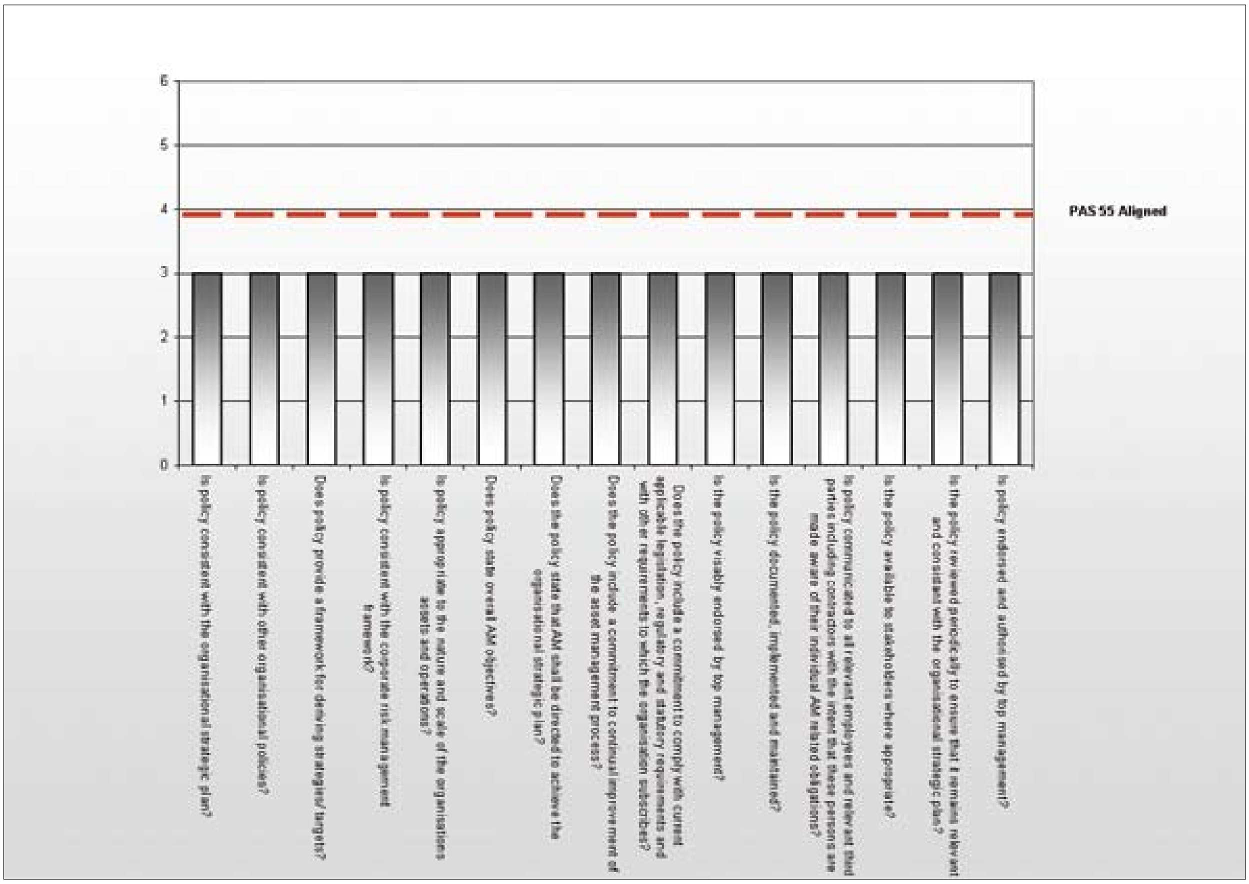
The intent of this group of requirements is that the organisation recognises asset management as a core business function and demonstrates commitment to the development and continual improvement of the asset management function. This is clearly evident within Westpower through the AMP, the statement of corporate intent and the organisation structure.

While the asset management system is documented within the AMP, this is not ideal. The AMP, being a disclosure document is written in a narrative form for an external audience. A concise and auditable document defining Westpower's Asset Management System would clarify asset management processes, and enhance Westpower's ability to demonstrate compliance with PAS-55.

Recommended Actions

That Westpower develop an over-arching Asset Management System document defining the processes, roles and responsibilities for asset management within the business. Ideally this document should be separate to the annual AMP, and be written as an auditable specification of business requirements.

8.13.2 Asset Management Policy



"The organisations top management shall authorise an overall asset management policy."

Review Against PAS-55 Requirements

Westpower does not at presently have a stand alone asset management policy as described by PAS-55. It is noted however that most essential asset management policy elements can be found within or may be inferred from the current Asset Management Plan (AMP). For the purpose of this review, asset management policy requirements have been assessed using information from the current AMP.

Observations and Improvement Opportunities

The intent of requiring an asset management policy is to provide a reference document, endorsed by the most senior management of the business, defining the boundaries or framework within which asset management decisions must be made within the organisation. Westpower has developed a draft policy which is aligned with this requirement. Completion and endorsement of the policy would see the above ratings increase to the Compliant level.

Recommended Actions

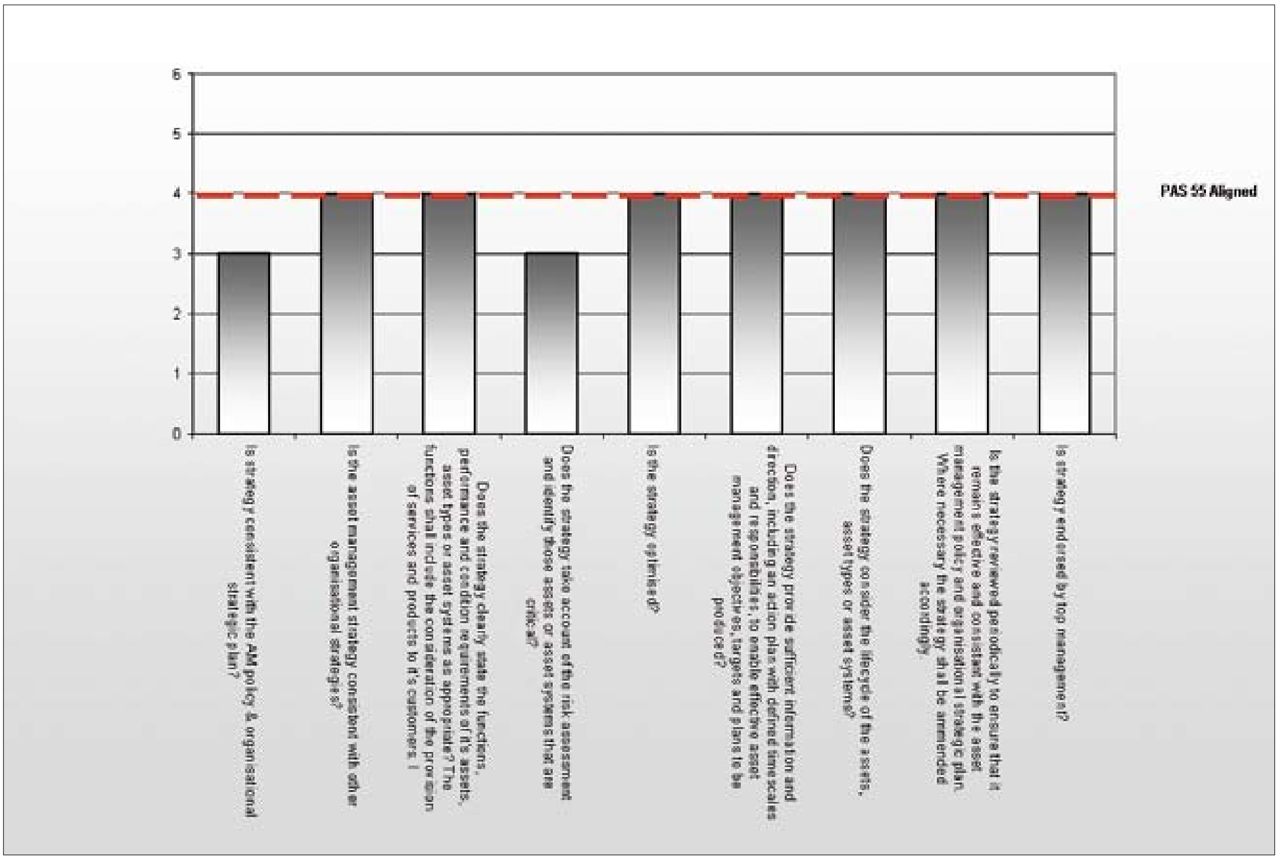
That the draft asset management policy be completed with the following improvements:

- Add an explicit clause into policy document to require that assets are managed in a way so as to achieve the corporate strategic goals to meet this specific PAS-55 requirement.
- Consider refining the language of the document to consistently read as a directive policy of requirements to be complied with, rather than a narrative of what is currently done.

- Set a review cycle, it is suggested that this coincide with finalisation of the statement of corporate intent or other strategic planning documents.

That the document be formally endorsed by senior management.

8.13.3 Asset Management Strategy



“The organisation shall establish and maintain a long-term asset management strategy.”

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Management Policy				
5	Is policy consistent with the organisational strategic plan?	3	Developing	Westpower is aware of the need for a formal asset management policy and has developed a draft document. The draft document appears to be derived from the Corporate Statement of Intent, and is therefore consistent with business strategic plans.
6	Is policy consistent with other organisational policies?	3	Developing	No inconsistencies are apparent between the draft policy document and other material presented.
7	Does policy provide a framework for deriving strategies/targets?	3	Developing	The draft policy does provide a number of key focus areas for deriving strategies and targets. Language could be re-phrased to be more reflective of a policy setting requirements and obligations, rather than a commentary of what is done.
8	Is policy consistent with the corporate risk management framework?	3	Developing	An overarching risk management framework is yet to be developed.
9	Is policy appropriate to the nature and scale of the organisations assets and operations?	3	Developing	Draft policy appears to be appropriate.
10	Does policy state overall AM objectives?	3	Developing	Draft policy sets high level objectives.
11	Does the policy state that AM shall be directed to achieve the organisational strategic plan?	3	Developing	No - this should be added.
12	Does the policy include a commitment to continual improvement of the asset management process?	3	Developing	Yes - a clause specifically refers to continual improvement.
13	Does the policy include a commitment to comply with current applicable legislation, regulatory and statutory requirements and with other requirements to which the organisation subscribes?	3	Developing	Yes - a clause specifically refers to legislative compliant.
14	Is the policy visibly endorsed by top management?	3	Developing	No - document provided does not appear to have official status.
15	Is the policy documented, implemented and maintained?	3	Developing	No - policy is in draft, does not appear to have been implemented.
16	Is the policy communicated to all relevant employees and relevant third parties including contractors with the intent that these persons are made aware of their individual AM related obligations?	3	Developing	No - document does not yet have official status.
17	Is the policy available to stakeholders where appropriate?	3	Developing	No - document does not yet have official status.
18	Is the policy reviewed periodically to ensure that it remains relevant and consistent with the organisational strategic plan?	3	Developing	No evidence at present.
19	Is policy endorsed and authorized by top management?	3	Developing	Not at this time. Document presented appears to be a draft.

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Management Strategy				
20	Is strategy consistent with the AM policy and organisational strategic plan?	3	Developing	The Westpower AMP contains a reasonable description of asset strategies by asset class, as well as some further guidance in Section 6 (life cycle plans). That said, to align with PAS-55 it would be beneficial to rework these two sections to provide a lifecycle strategy which defines Westpower's approach to inspect, replace, upgrade etc. These strategies then drive the detailed investment plans.
21	Is the asset management strategy consistent with other organisational strategies?	4	Compliant	No evidence found to suggest otherwise.
22	Does the strategy clearly state the functions, performance and condition requirements of it's assets, asset types or asset systems as appropriate? The functions shall include the consideration of the provision of services and products to it's customers. It shall also identify and consider the requirements of other relevant stakeholders including health, safety, sustainability and environmental performance requirements.	4	Compliant	The asset justification section of the asset management plan makes a good start towards this requirement. The intent is to be clear what the asset owner requires the asset to do, then to identify strategies to achieve those requirements.
23	Does the strategy take account of the risk assessment and identify those assets or asset systems that are critical?	3	Developing	Discussion within the AMP shows that risk has been considered in developing asset management strategies. This process could however be improved through the implementation of a formal risk management system.
24	Is the strategy optimised?	4	Compliant	Commentary in the AMP indicates that a good level of thought and analysis appropriate to the size of the asset base has gone into defining the asset management approach or strategy.
25	Does the strategy provide sufficient information and direction, including an action plan with defined timescales and responsibilities, to enable effective asset management objectives, targets and plans to be produced?	4	Compliant	The strategy discussions provide guidance to develop detailed plans, however timescales and responsibilities for developing plans do not appear to be formally defined.
26	Does the strategy consider the lifecycle of the assets, asset types or asset systems?	4	Compliant	The AMP contains good discussion of asset condition, failure modes and lifecycle management issues.
27	Is the strategy reviewed periodically to ensure that it remains effective and consistent with the asset management policy and organisational strategic plan? Where necessary the strategy shall be amended accordingly.	4	Compliant	The AMP is reviewed annually.
28	Is strategy endorsed by top management?	4	Compliant	The AMP is endorsed by top management.

Observations and Improvement Opportunities

In the PAS-55 context, asset strategies refer to the overall approach to managing an asset class i.e, defining how the asset is to be managed, so that detailed operational plans for individual assets can be derived. The Westpower AMP contains a reasonable description of asset strategies by asset class. Improvements could be made by documenting these asset strategies in a manner more aligned with the requirements of PAS-55 and by linking asset strategies to a risk management process.

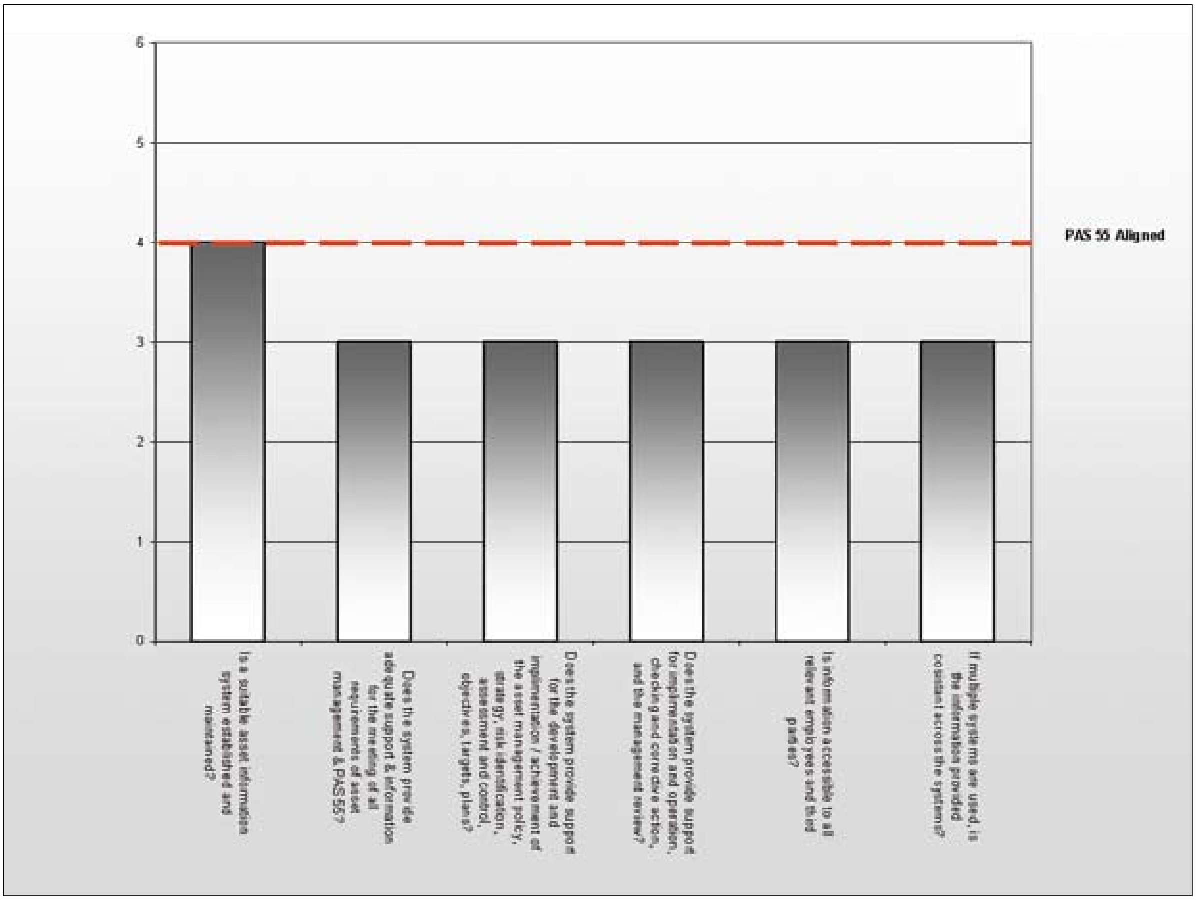
Recommended Actions

That Westpower Implement a formal risk management system which provides input to the asset strategy process (see later recommendations).

That Westpower consider presenting asset strategies in the AMP in a format that more clearly aligns with the requirements of PAS-55.

Document responsibility and target timeframes for implementation of the asset management strategy (for example an annual asset planning calendar) for the development of detailed operational plans.

8.13.4 Asset Management Information System



“The organisation shall establish and maintain (an) asset management information system(s).”

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Management Information System				
29	Is a suitable asset information system established and maintained?	4	Compliant	Yes - Maximo and GIS see “new installation workflow” document.
30	Does the system provide adequate support and information for the meeting of all requirements of asset management and PAS-55?	3	Developing	Partially - just maximo for support information and GIS for asset location.
31	Does the system provide support for the Developing and implementation / achievement of the asset management policy, strategy, risk identification, assessment and control, objectives, targets, plans?	3	Developing	Partially - just maximo for condition assessment monitoring and GIS for asset location.
32	Does the system provide support for implementation and operation, checking and corrective action, and the management review?	3	Developing	Partially - just maximo and GIS, some risk assessment carried out on a reactive basis.
33	Is information accessible to all relevant employees and third parties?	3	Developing	Partially, via Maximo - Maximo not directly accessible outside the asset management team.
34	If multiple systems are used, is the information provided consistent across the systems?	3	Developing	Majority of asset information on Maximo, however some asset information quality questionable and only partial, more work is needed in this area.

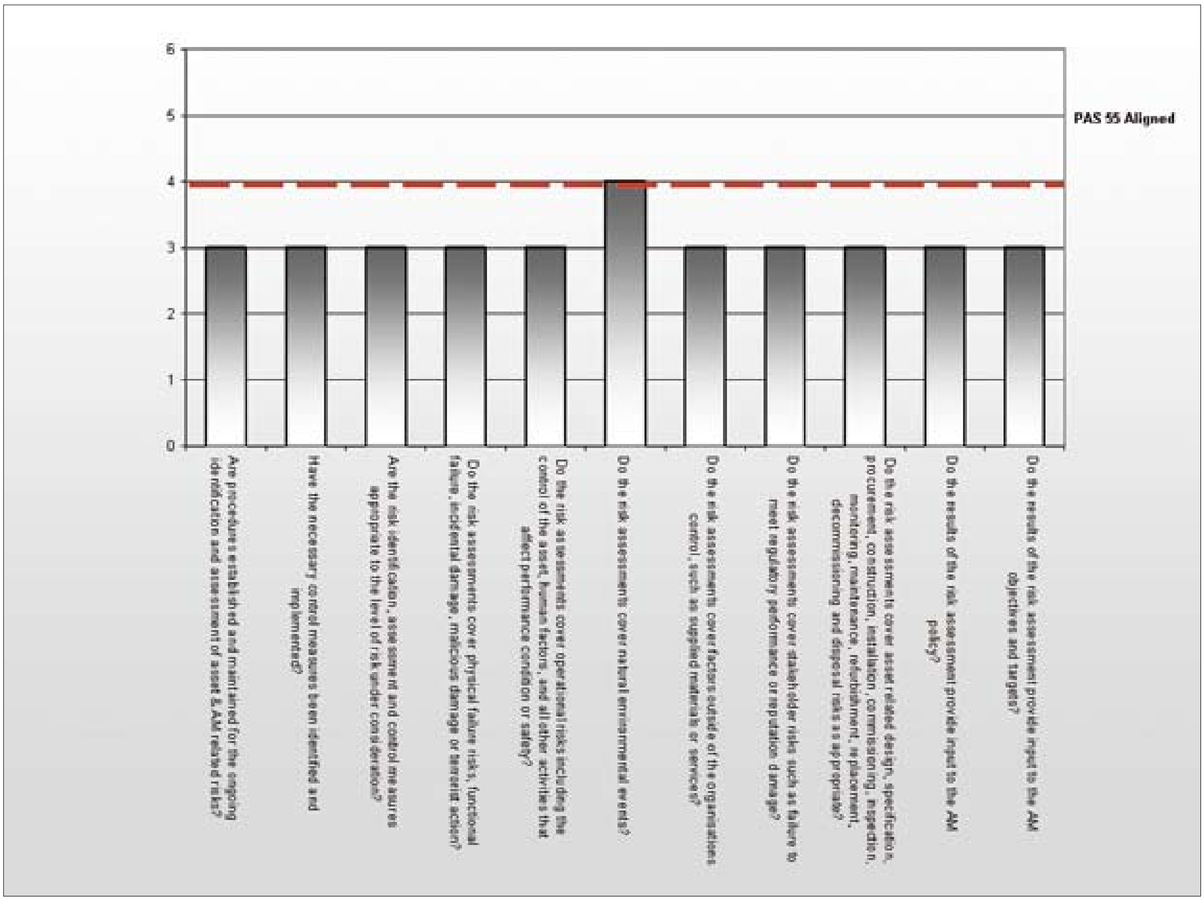
Observations and Improvement Opportunities

In evaluating this criteria, consideration must be given to the size and complexity of the business and asset base and the strategies that are to be used to manage the assets. To demonstrate compliance with this requirement it would be beneficial to perform a more detailed gap analysis to identify the key information requirements necessary to support each requirement of the overall asset management system. This would create documentary evidence to demonstrate compliance where it exists, create a justification where it is deemed appropriate to not collect data, and identify areas where improved data would improve asset management capability and outcomes.

Recommended Actions

That a data gap analysis be conducted to document information requirements to support each element of the asset management system and identify areas where changes will cost effectively improve the overall asset management outcomes. Care should be taken to ensure that information requirements are realistic given the scale and scope of Westpower’s assets.

8.13.5 Risk Identification, Assessment and Control



"The organisation shall establish and maintain procedures for the ongoing identification assessment and treatment of asset and asset management related risks."

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Management Policy				
35	Are procedures established and maintained for the ongoing identification and assessment of asset and AM related risks?	3	Developing	No formal overarching risk management process is in place. There are however risk management activities performed, for example, the Safety Management System and the Periodic lifelines survey.
36	Have the necessary control measures been identified and implemented?	3	Developing	AMP cites many examples where Westpower have identified network related risks and have implemented controls. The Lifelines survey is comprehensive, but limited in scope (natural disasters). A formal risk process including a risk register would tie together existing knowledge into a PAS-55 compliant system.
37	Are the risk identification, assessment and control measures appropriate to the level of risk under consideration?	3	Developing	Formal risk management process not yet implemented.
38	Do the risk assessments cover physical failure risks, functional failure, incidental damage, malicious damage or terrorist action?	3	Developing	Formal risk management process not yet implemented. Tailgate operational risk assessments would consider this at a local level.

Q #	Criteria	Score	PAS-55 Maturity	Comments
Risk Identification, Assessment and Control				
39	Do the risk assessments cover operational risks including the control of the asset, human factors, and all other activities that affect performance condition or safety?	3	Developing	HEIR - Human Element Incident Reports will provide information on events that have occurred.
40	Do the risk assessments cover natural environmental events?	4	Compliant	Comprehensively - see lifelines survey.
41	Do the risk assessments cover factors outside of the organisations control, such as supplied materials or services?	3	Developing	Formal risk management process not yet implemented.
42	Do the risk assessments cover stakeholder risks such as failure to meet regulatory performance or reputation damage?	3	Developing	Formal risk management process not yet implemented.
43	Do the risk assessments cover asset related design, specification, procurement, construction, installation, commissioning, inspection, monitoring, maintenance, refurbishment, replacement, decommissioning and disposal risks as appropriate?	3	Developing	Formal risk management process not yet implemented.
44	Do the results of the risk assessment provide input to the AM policy?	3	Developing	Formal risk management process not yet implemented.
45	Do the results of the risk assessment provide input to the AM objectives and targets?	3	Developing	Formal risk management process not yet implemented.
46	Do the results of the risk assessment provide input to the AMP's?	3	Developing	Formal risk management process not yet implemented.
47	Do the results of the risk assessment provide input to the determination of requirements for the design, specification, procurement, construction, installation, commissioning, inspection, monitoring, maintenance, refurbishment, replacement, decommissioning and disposal of assets?	3	Developing	Formal risk management process not yet implemented.
48	Do the results of the risk assessment provide input to the identification of adequate resources including staffing levels?	3	Developing	Formal risk management process not yet implemented.
49	Do the results of the risk assessment provide input to the identification of training needs and skills?	3	Developing	Formal risk management process not yet implemented.

Q #	Criteria	Score	PAS-55 Maturity	Comments
Risk Identification, Assessment and Control				
50	Do the results of the risk assessment provide input to the developing of operational controls?	3	Developing	Formal risk management process not yet implemented.
51	Do the results of the risk assessment provide input to the organisations overall risk management framework?	2	Aware	Formal risk management process not yet implemented.
52	Is the organisations methodology for risk assessment defined with respect to it's scope, nature and timing to ensure it is proactive rather than reactive?	2	Aware	Formal risk management process not yet implemented.
53	Does the methodology for risk assessment include the assessments of how risks change or can be avoided, eliminated or controlled by asset management objectives, targets and plans?	3	Developing	The intent of this requirement is to create a link between identified risk and how that risk is affected by the Asset Management Plan.
54	Does the organisations methodology for risk assessment provide for the classification of risks and identification of those that are to be avoided, eliminated or controlled by asset management objectives, targets and plans?	3	Developing	Formal risk management process not yet implemented.
55	Is the organisations methodology for risk assessment consistent with the organisations operating experience and capabilities of risk control measures employed?	3	Developing	Formal risk management process not yet implemented.
56	Does the organisations methodology for risk assessment provide for the monitoring of required actions to ensure both the effectiveness and timeliness of their implimentation?	3	Developing	Formal risk management process not yet implemented.

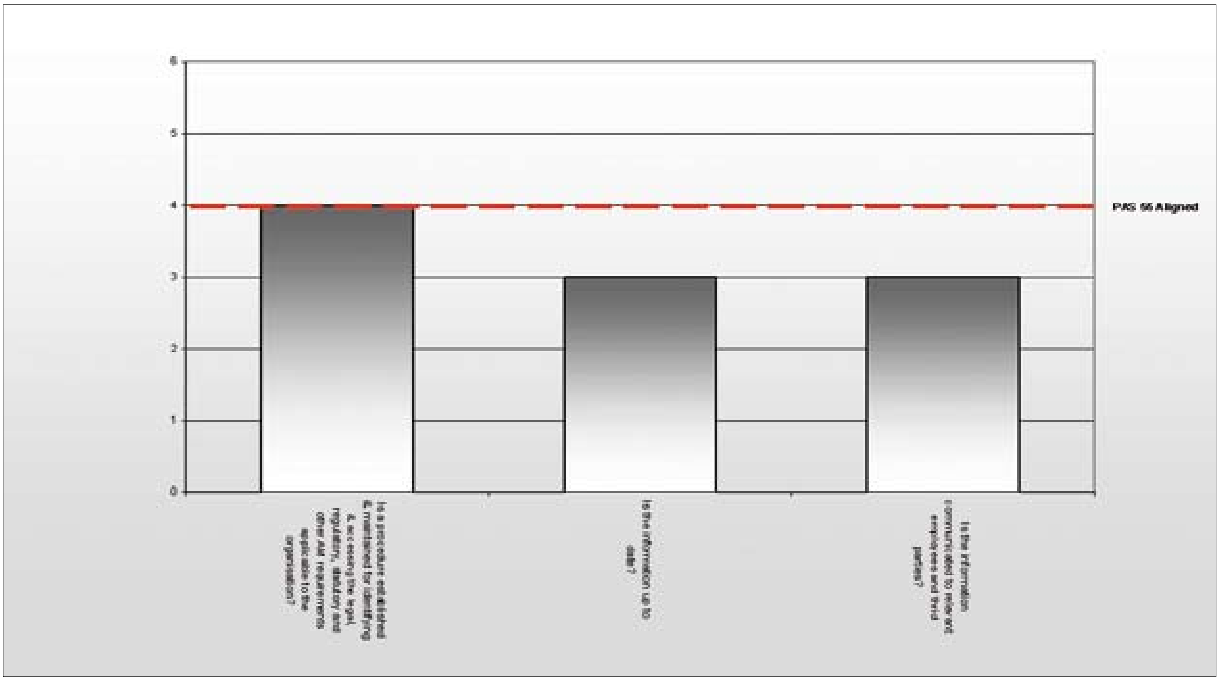
Observations and Improvement Opportunities

PAS-55 recognises risk management as a critical feature of an overall asset management system, and requires that a comprehensive process be in place that ensures that key risks are identified and appropriately considered and acted on. Westpower at present manages asset related risk through several separate means. These means include the safety management system, periodic external reviews and informal processes that occur during the routine asset management process. Westpower could benefit from the establishment of an overarching risk management that transparently groups asset related risks for assessment and treatment. It is suggested that NZ/AS 4360 – Risk Management would provide an appropriate framework.

Recommended Actions

That Westpower implement an overarching risk management process based upon the requirements of NZ/AS 4360 – Risk Management.

8.13.6 Legal, Regulatory, Statutory and Other Asset Management Requirements



"The organisation shall establish and maintain a procedure for identifying and accessing the legal, regulatory, statutory and other asset management requirements that are applicable to it."

Review against PAS-55 requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Legal, Regulatory, Statutory and other Asset Management Requirements				
57	Is a procedure established and maintained for identifying and accessing the legal, regulatory, statutory and other AM requirements applicable to the organisation?	4	Compliant	A legislation compliant sign off was provided which indicates that Westpower is monitoring and assessing compliance.
58	Is the information up to date?	3	Developing	As above.
59	Is the information communicated to relevant employees and third parties?	3	Developing	As above.

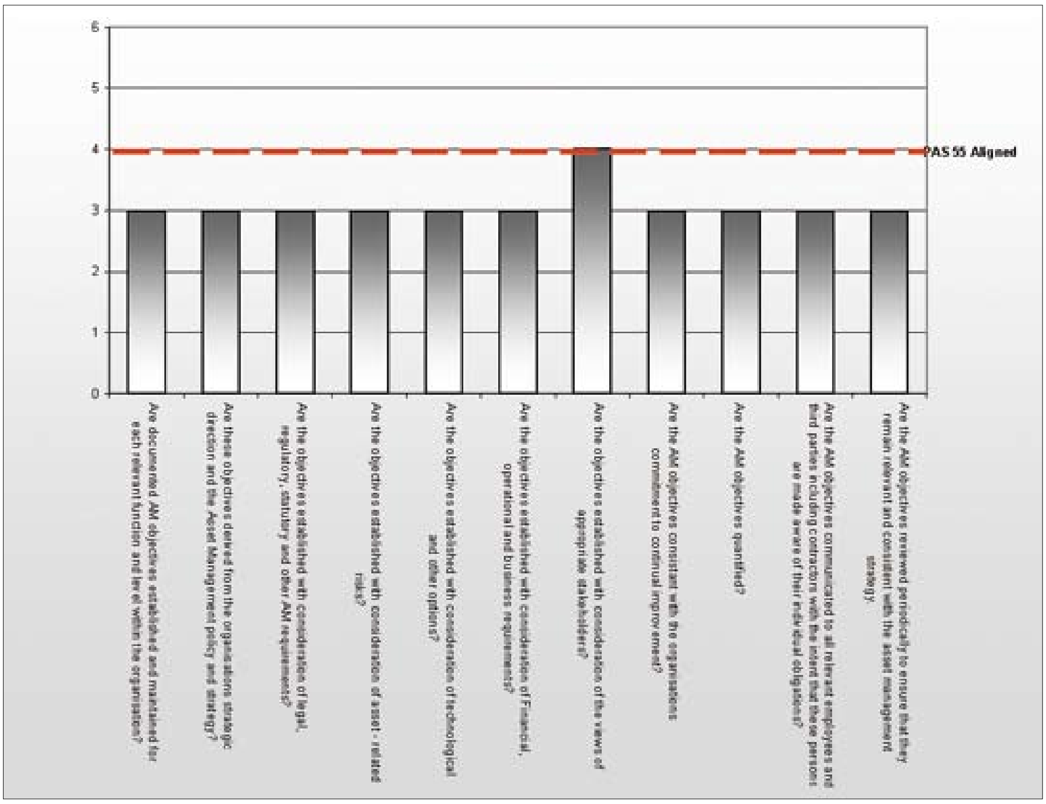
Observations and Improvement Opportunities

This element requires that the organisation have a process for monitoring relevant legislation, codes, guides and standards. Any changes should be assessed for relevance and required actions implemented. A legislation sign off was viewed, which indicates that Westpower is a aware of it's obligations and that it has assessed compliance. No evidence was presented indicating an on going process for monitoring and reacting to changes.

Recommended Actions

That Westpower develop a register of legislation, codes, guidelines and standards that are of sufficient importance to the asset management system to warrant monitoring and assign responsibility to an individual to periodically check for amendments, revisions etc. Each revision/amendment would be checked for relevance and required action identified and documented.

8.13.7 Asset Management Objectives



"The organisation shall establish and maintain documented asset management objectives at each relevant function and level within the organisation."

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Management Objectives				
60	Are documented AM objectives established and maintained for each relevant function and level within the organisation?	3	Developing	Westpower has a number of objectives published in the asset management plan (levels of service section) and in the SCI that would meet the intent of this requirement. These however are not clearly identifiable as key objectives for the asset management system.
61	Are these objectives derived from the organisation's strategic direction and the Asset Management policy and strategy?	3	Developing	No.
62	Are the objectives established with consideration of legal, regulatory, statutory and other AM requirements?	3	Developing	No.
63	Are the objectives established with consideration of asset related risks?	3	Developing	No.
64	Are the objectives established with consideration of technological and other options?	3	Developing	No.
65	Are the objectives established with consideration of financial, operational and business requirements?	3	Developing	No.

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Management Objectives				
66	Are the objectives established with consideration of the views of appropriate stakeholders?	4	Compliant	The Levels of Service section of the AMP indicates that customers have been taken into consideration. The threshold show that the regulators view has been taken into consideration with setting the price/quality tradeoff.
67	Are the AM objectives consistant with the organisations commitment to continual improvement?	3	Developing	No.
68	Are the AM objectives quantified?	3	Developing	No.
69	Are the AM objectives communicated to all relevant employees and third parties including contractors with the intent that these persons are made aware of their individual obligations?	3	Developing	No.
70	Are the AM objectives reviewed periodically to ensure that they remain relevant and consistent with the asset management strategy.	3	Developing	No.

Observations and Improvement Opportunities

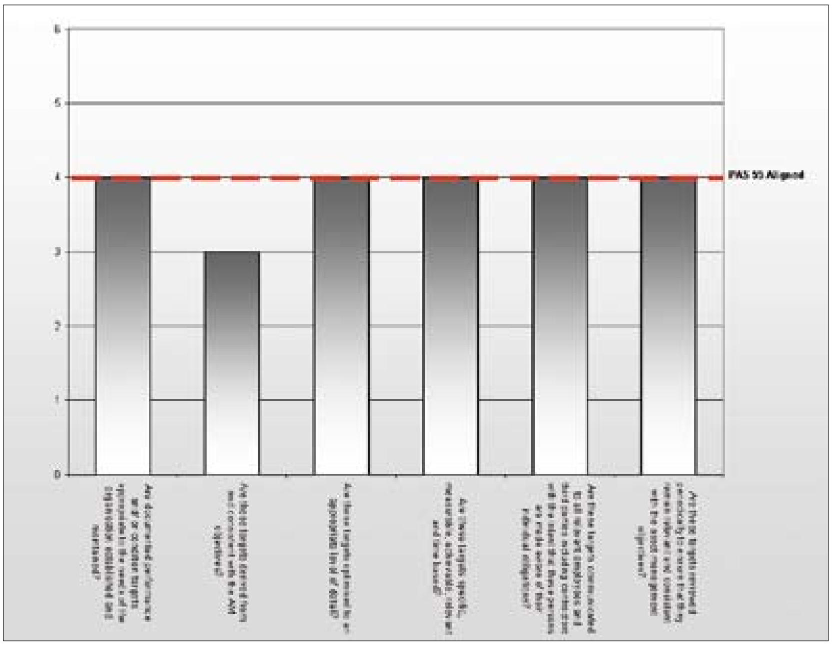
The intent of this requirement is that the asset management organisation identifies a small number of key asset management objectives that set the direction for the detailed planning process. These could be high level direction statements regarding asset performance, asset creation/replacement, safety and risk and financial performance.

Westpower has a number of objectives published in the asset management plan (levels of service section) and in the SCI that would meet the intent of providing broad objectives that can be further broken down into specific operational targets and plans. Westpower could however benefit from clearly and concisely identifying and documenting key asset management objectives flowing directly from the corporate strategy.

Recommended Actions

That Westpower identifies key asset management objectives and clearly communicate these within the AMP. Ensure that when developing objectives that all requirements of PAS-55 - 4.3.4 are taken into consideration and documented.

8.13.8 Asset Performance and Condition Targets



"The organisation shall establish and maintain documented performance and/or condition targets appropriate to the needs of the organisation."

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Performance and Condition Targets				
71	Are documented performance and/or condition targets appropriate to the needs of the organisation established and maintained?	4	Compliant	The service levels section describes asset performance targets consistent with the requirements of PAS-55.
72	Are these targets derived from and consistent with the AM objectives?	3	Developing	Not fully implemented because the Asset Management Objectives are not explicitly defined.
73	Are these targets optimised to an appropriate level of detail?	4	Compliant	There is a significant discussion regarding the basis for the targets set. It can be argued that the level of detail and optimisation is appropriate given the size of Westpower's asset base.
74	Are these targets specific, measurable, achievable, relevant and time based?	4	Compliant	Yes, the key performance targets are defined as specific measurable KPI's. Targets are annual targets.
75	Are these targets communicated to all relevant employees and third parties including contractors with the intent that these persons are made aware of their individual obligations?	4	Compliant	Asset Management Plan is publicly released. Key targets (e.g. SAIDI) communicated through organisation and to contractors.
76	Are these targets reviewed periodically to ensure that they remain relevant and consistent with the asset management objectives?	4	Compliant	Asset Management Plan is reviewed annually.

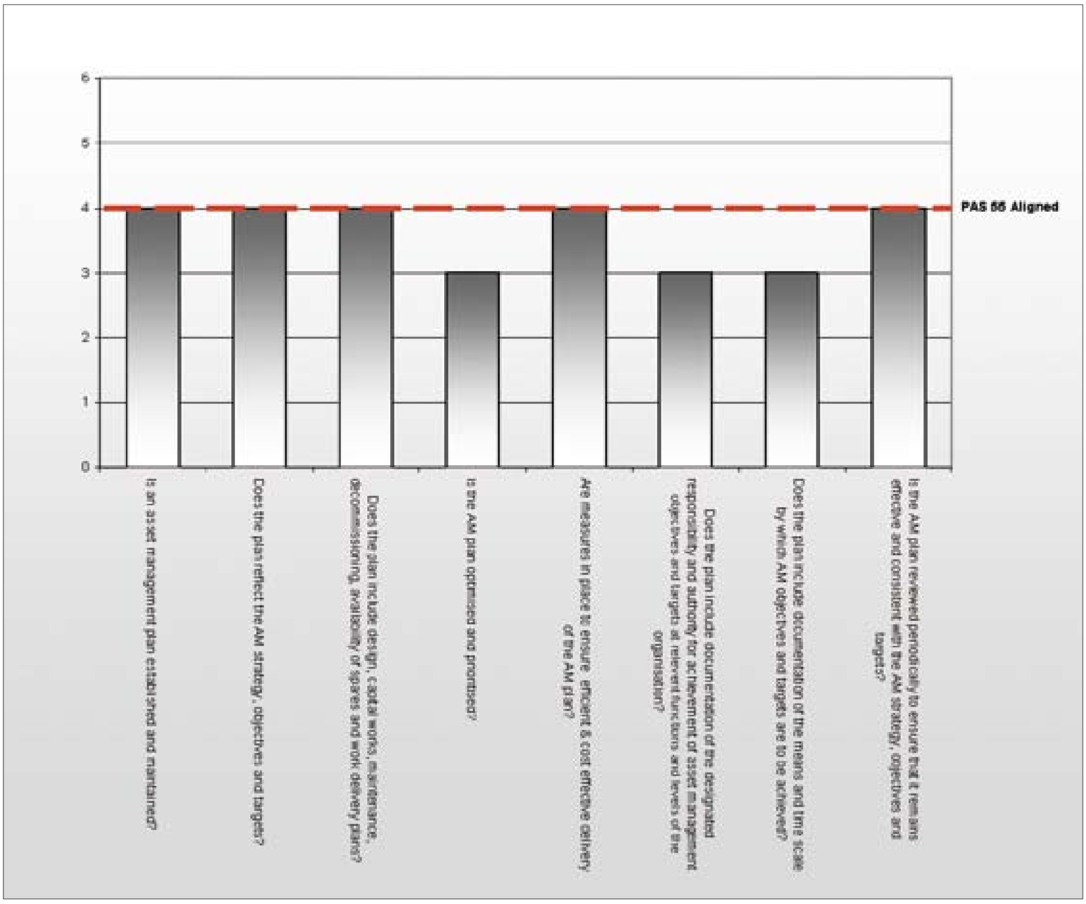
Observations and Improvement Opportunities

Westpower has asset performance targets in place for a suite of key measures such as SAIDI, SAIFI etc. Westpower should consider whether additional targets linked to asset management objectives could cost effectively drive further improvement.

Recommended Actions

Review performance and condition targets once asset management objectives have been clarified. Ensure that targets are consistent with objectives.

8.13.9 Asset Management Plans



"The organisation shall establish and maintain asset management plans for achieving it's asset management strategy."

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Management Plans				
77	Is an asset management plan established and maintained?	4	Compliant	A detailed AMP is produced annually.
78	Does the plan reflect the AM strategy, objectives and targets?	4	Compliant	Yes – operational plans appears to reflect asset management strategy, objectives and targets.
79	Does the plan include design, capital works, maintenance, decommissioning, availability of spares and work delivery plans?	4	Compliant	The asset management plan contains a plan for capital and maintenance investments. Detailed operational plans (i.e work orders) are delivered through the Maximo system.

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Management Plans				
80	Is the AM plan optimised and prioritised?	3	Developing	The asset management plan is optimised using the collective experience of the asset management team, no formal means of project ranking to document/assist with the process.
81	Are measures in place to ensure efficient and cost effective delivery of the AM plan?	4	Compliant	Details of the works planning/ management system not available to the reviewer, however it is understood that the Maximo work management drives cost control through setting targets for labour hours and materials at the work order level, measuring actuals and managing variances.
82	Does the plan include documentation of the designated responsibility and authority for achievement of asset management objectives and targets at relevant functions and levels of the organisation?	3	Developing	Documentation was not available that demonstrates clear allocation of responsibility for the delivery of asset management targets and objectives.
83	Does the plan include documentation of the means and time scale by which AM objectives and targets are to be achieved?	3	Developing	Asset management plan does set time boundaries for targets. Projects are defined by the year in which they are budgeted/planned.
84	Is the AM plan reviewed periodically to ensure that it remains effective and consistent with the AM strategy, objectives and targets?	4	Compliant	Asset Management Plan is reviewed annually.

Observations and Improvement Opportunities

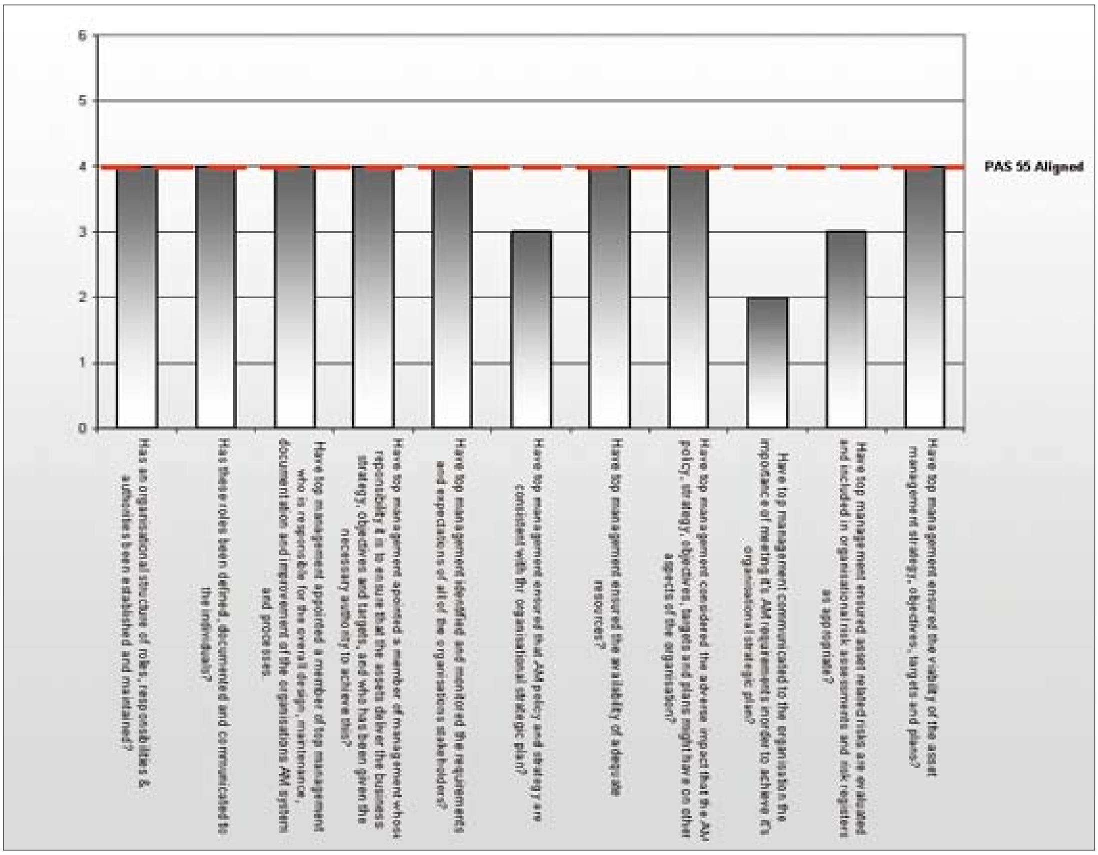
While it is almost certain that activities are optimised and prioritised by the asset management team using collective experience, Westpower should consider implementing a formal project ranking/prioritisation scheme incorporating the risk management methodology. Such an approach could be of assistance in managing any gap between available funds/resources and proposed projects. It was not apparent from the material presented that Westpower clearly allocates accountability to individuals for all asset management objectives or outcomes, if this is the case then clear benefits can be obtained by clarifying this point. Also not apparent from material provided is a process to clearly control and manage project timing and costs.

Recommended Actions

That Westpower implement a methodology for ranking/rating asset management initiatives to assist in the optimisation, and documentation of the optimisation process.

That Westpower confirms that it has in place a detailed programme of work defining projects and inspection and maintenance programmes. The programme should allocate accountability for outcomes, target dates, and budgets. The program should be supported by a robust process for monitoring delivery, quality, safety and cost. This is driven further in information disclosure requirements 2008.

8.13.10 Structure, Authority and Responsibility for Asset Management



“The organisation shall establish and maintain an organisational structure of roles, responsibilities and authorities consistent with the achievement of its asset management policy strategy, objectives and plan.”

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Structure, Authority and Responsibility for Asset Management				
85	Has an organisational structure of roles, responsibilities and authorities been established and maintained?	4	Compliant	Yes - through job profiles.
86	Have these roles been defined, documented and communicated to the individuals?	4	Compliant	As above.
87	Has top management appointed a member of top management who is responsible for the overall design, maintenance, documentation and improvement of the organisations AM system and processes.	4	Compliant	Yes - Asset Manager position.
88	Have top management appointed a member of management whose responsibility it is to ensure that the assets deliver the business strategy, objectives and targets, and who has been given the necessary authority to achieve this?	4	Compliant	Yes - Asset Manager.

Q #	Criteria	Score	PAS-55 Maturity	Comments
Structure, Authority and Responsibility for Asset Management				
89	Have top management identified and monitored the requirements and expectations of all of the organisations stakeholders?	4	Compliant	Yes via customer consultation and through the threshold process administered by the Commerce Commission.
90	Have top management ensured that the AM policy and strategy are consistent with the organisational strategic plan?	3	Developing	Westpower's policy and strategy elements of PAS-55 are still to be fully implemented, however evidence reviewed suggests strong alignment between asset management activity and the Statement of Corporate Intent.
91	Have top management ensured the availability of adequate resources?	4	Compliant	Resources appear to be adequate.
92	Have top management considered the adverse impact that the AM policy, strategy, objectives, targets and plans might have on other aspects of the organisation?	4	Compliant	Discussion within the AMP shows an awareness of the need to balance conflicting requirements of reducing real income, improving performance and managing safety risk. Implementing a risk management framework would be of assistance in demonstrating this requirement as adverse impacts of any issue can be considered and recorded.
93	Have top management communicated to the organisation the importance of meeting its AM requirements in order to achieve it's organisational strategic plan?	2	Aware	No - not outside of asset management group.
94	Have top management ensured asset related risks are evaluated and included in organisational risk assessments and risk registers as appropriate?	3	Developing	The intent of this requirement is to ensure that senior management (eg. board level) are aware of asset related risks. There is some evidence of this via the annual AMP, however a more direct and confidential communication of risk to this management level might be appropriate.
95	Have top management ensured the viability of the asset management strategy, objectives, targets and plans?	4	Compliant	Annual asset management plan is scrutinised in detail by the Commerce Commission.

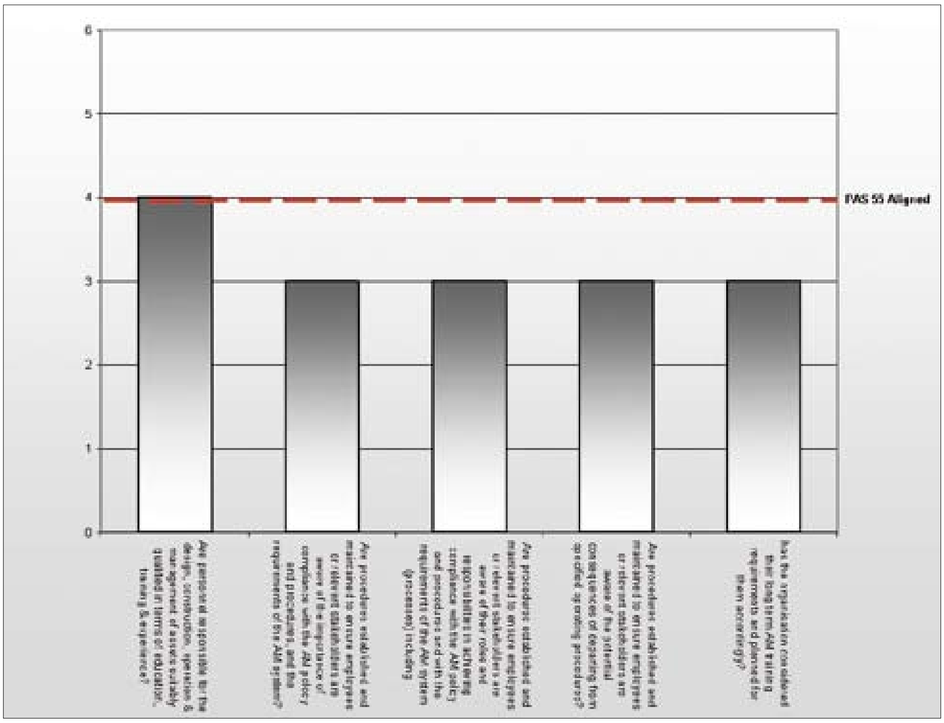
Observations and Improvement Opportunities

Westpower has an appropriate organisational structure within which to implement an effective asset management system. Areas for improvement are centred around implementation of policy and strategy documents and an effective risk management system.

Recommended Actions

- Implement risk management methodology. In addition to asset related risks, include some assessment of intangible risks such as reputation, staff morale etc.
- Consider benefits of providing a regular summary risk report to senior management and board for consideration. This should form part of the recommended risk management process.
- Ensure that management communicates the importance of delivering asset management plans (e.g. work programs) to achieve the organisations goals.
- Communication throughout the organisation of AM Strategy and Policy.

8.13.11 Training, Aware and Competence



"The organisation shall ensure that personnel responsible for the design, construction, operation and management of assets are appropriately qualified in terms of education, training and/or experience."

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Training, Aware and Competence				
96	Are the personnel responsible for the design, construction, operation and management of assets suitably qualified in terms of education, training and experience?	4	Compliant	Yes - assessed against job role requirements and in accordance with the training matrix.
97	Are procedures established and maintained to ensure employees or relevant stakeholders are aware of the importance of Compliant with the AM policy and procedures, and the requirements of the AM system?	3	Developing	Yes - but not documented.
98	Are procedures established and maintained to ensure employees or relevant stakeholders are aware of their roles and responsibilities in achieving Compliant with the AM policy and procedures and with the requirements of the AM system (processes) including emergency preparedness and response procedures?	3	Developing	Partially - the safety management system provides guidance for an emergency response plan but a detailed plan is still in production.
99	Are procedures established and maintained to ensure employees or relevant stakeholders are aware of the potential consequences of departing from specified operating procedures?	3	Developing	Yes - uses tailgate system for individual jobs, also control room sequential operating procedures in place for network control and operation.
100	has the organisation considered their long term AM training requirements and planned for them accordingly?	3	Developing	Partially - as new requirements arise training requirements are reviewed.

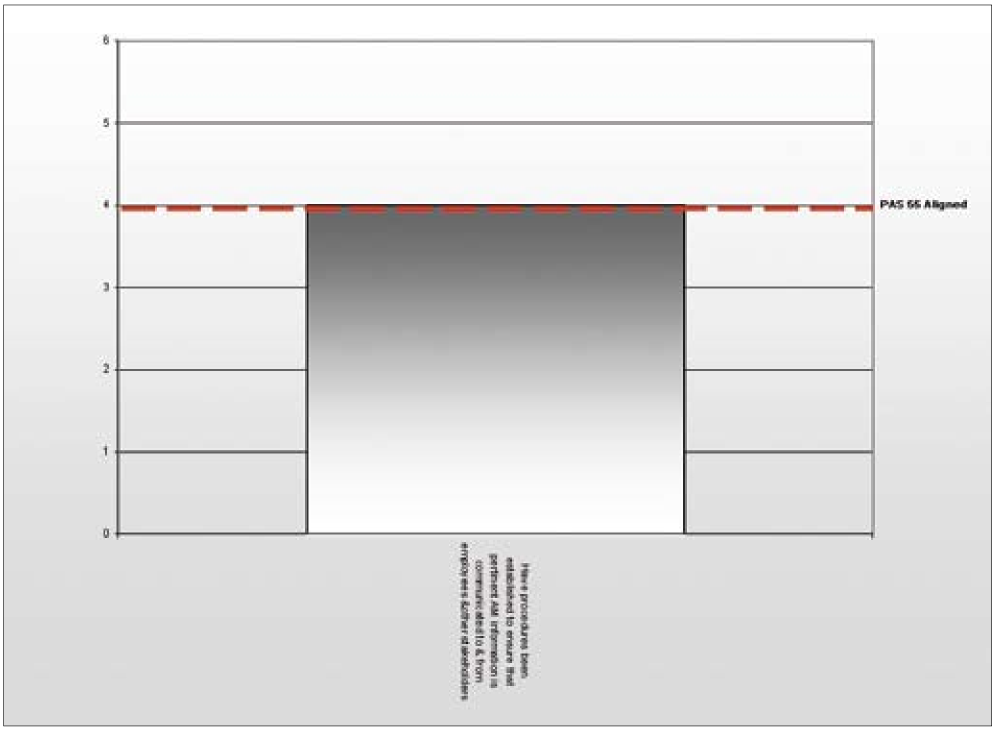
Observations and Improvement Opportunities

The intent of this group of requirements is to ensure that personnel involved in the asset management process have the appropriate skills and competencies necessary to operate all aspects of the asset management system.

Recommended Actions

- Identify policies, procedures and requirements that are relevant to each parts of the organisation.
- Implement a program of process/procedure discussion and review. Ensure that discussions cover individuals roles and responsibilities and that records are kept.
- Ensure that staff are aware of why key asset management activities are necessary and the consequences of not performing the activity as required.
- Develop a long term skill development plan to ensure that key skills are available to Westpower into the longer term.

8.13.12 Consultation and Communication



"The organisation shall have procedures for ensuring that pertinent asset management information is communicated to and from employees and other relevant stakeholders."

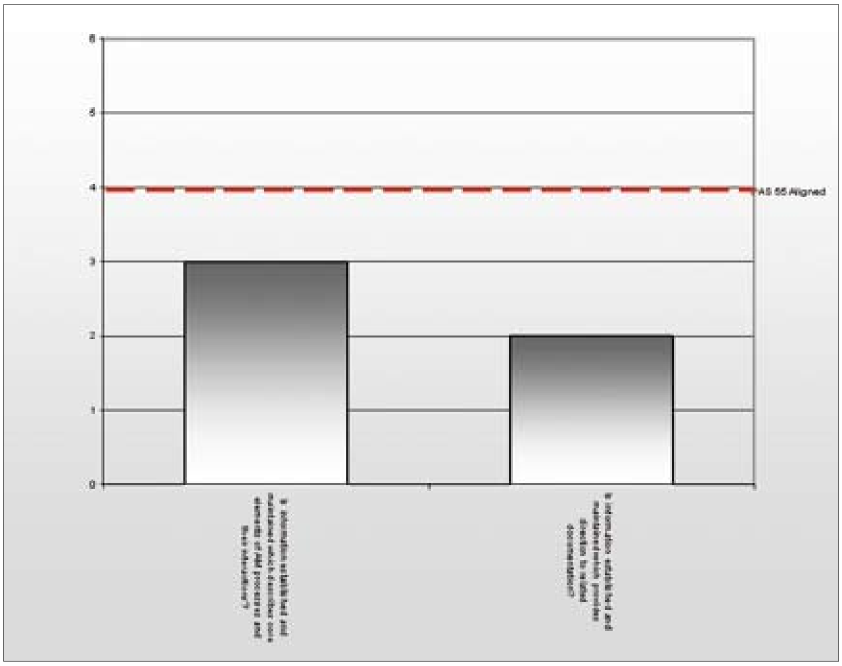
Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Consultation and Communication				
101	Have procedures been established to ensure that pertinent AM information is communicated to and from employees and other stakeholders.	4	Compliant	Yes - Monthly meetings with contractor representatives, weekly meetings with the Asset Management Group, project meetings as required, notice boards, Asset Management Plan and annual report.

Observations and Improvement Opportunities

Westpower appears to have a consultation and communication program appropriate to the scale and scope of it's asset management business.

8.13.13 Documentation



"The organisation shall establish and maintain information, in a suitable medium such as paper or electronic form that describes the core elements of the management system."

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Documentation				
102	Is information established and maintained which describes core elements of AM processes and their interactions?	3	Developing	Yes - Asset Management Plan.
103	Is information established and maintained which provides direction to related documentation?	2	Aware	No - not documented.

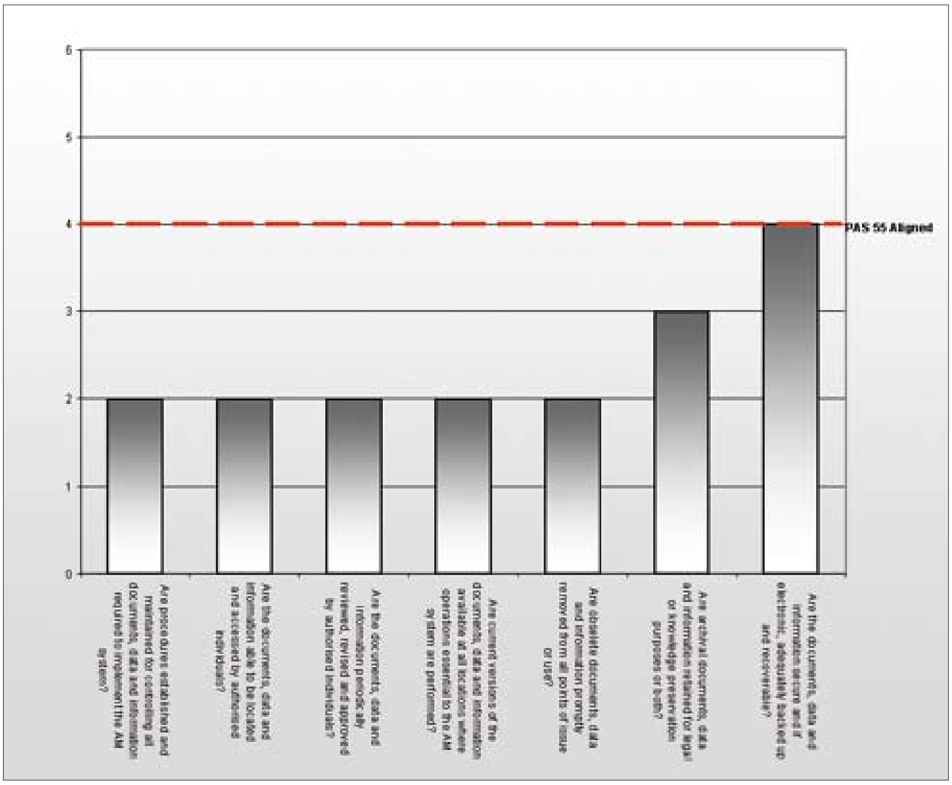
Observations and Improvement Opportunities

While the annual Asset Management Plan contains much information regarding Westpower's asset management capability, this information is not in a form that succinctly describes Westpowers's asset management systems and processes.

Recommended Actions

Westpower should give consideration to developing an overarching document dedicated to defining Westpower's Asset Management system. The document should provide references to all relevant internal policies and procedures. It is preferable that the document be external to the AMP so that the documents language can be as a direct policy/procedure and in line with PAS-55 phraseology, rather than as a narrative for public consumption.

8.13.14 Data and Information Control



"The organisation shall establish and maintain procedures for controlling all documents, data and information required by the asset management system."

Review Against PAS-55 Requirements

Q #	Criteria	Score	PAS-55 Maturity	Comments
Document, data and information control				
104	Are procedures established and maintained for controlling all documents, data and information required to implement the AM system?	2	Aware	No - document control system in place.
105	Are the documents, data and information able to be located and accessed by authorised individuals?	2	Aware	Yes - through local knowledge and word of mouth.
106	Are the documents, data and information periodically reviewed, revised and approved by authorised individuals?	2	Aware	Partially - mainly network diagrams and as projects require drawings and operating procedures to be updated.
107	Are current versions of the documents, data and information available at all locations where operations essential to the AM system are performed?	2	Aware	Partially - Network diagrams and operating orders, other documentation not controlled.
108	Are obsolete documents, data and information promptly removed from all points of issue or use?	2	Aware	Partially - Network diagrams and operating orders only.
109	Are archival documents, data and information retained for legal or knowledge preservation purposes or both?	3	Developing	Partially - Project files retained and some asset management files.
110	Are the documents, data and information secure and if electronic, adequately backed up and recoverable?	4	Compliant	Yes - documents and data backed up.

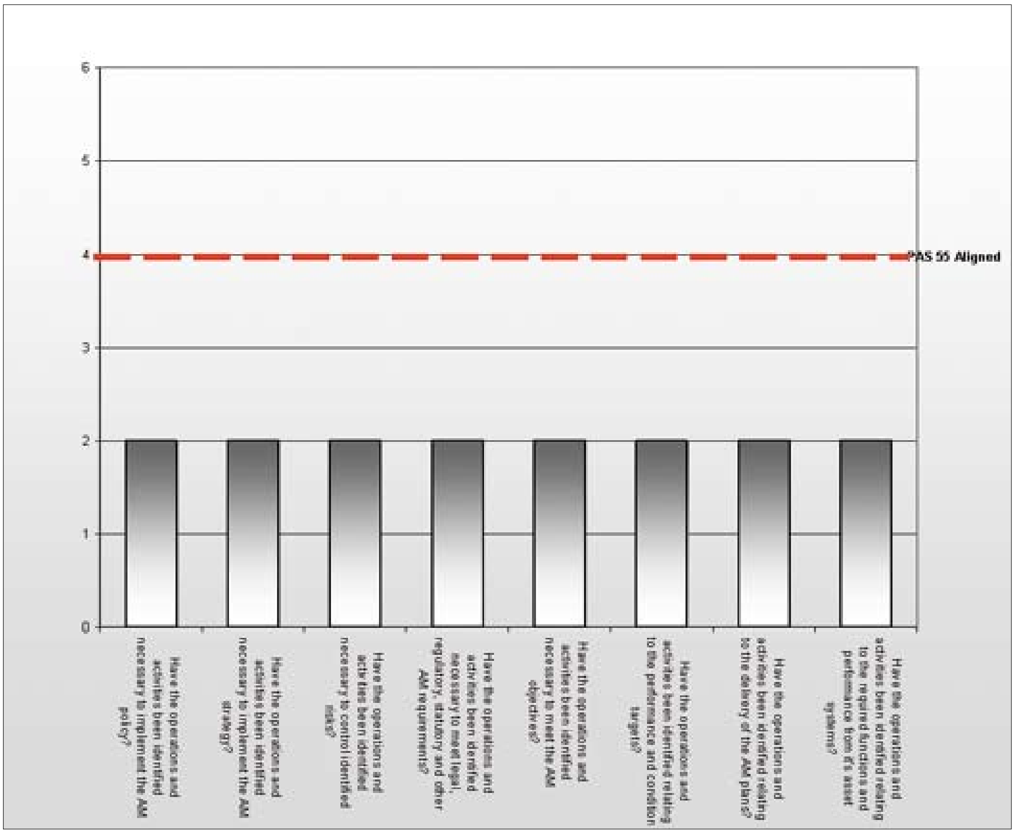
Observations and Improvement Opportunities

The intent of this requirement is to ensure that controls are in place to ensure that documentation necessary for the operation of the asset management system is authorised, available and current. At present Westpower does not appear to have a formal document control system in place that would meet the requirements of PAS-55.

Recommended Actions

Westpower should evaluate the document control requirements of it's asset management system necessary to meet the intent of PAS-55 and implement improvements as required. Care should be taken to ensure that the level of complexity is appropriate given the size and scope of Westpower's asset management activities.

8.13.15 Operational Control

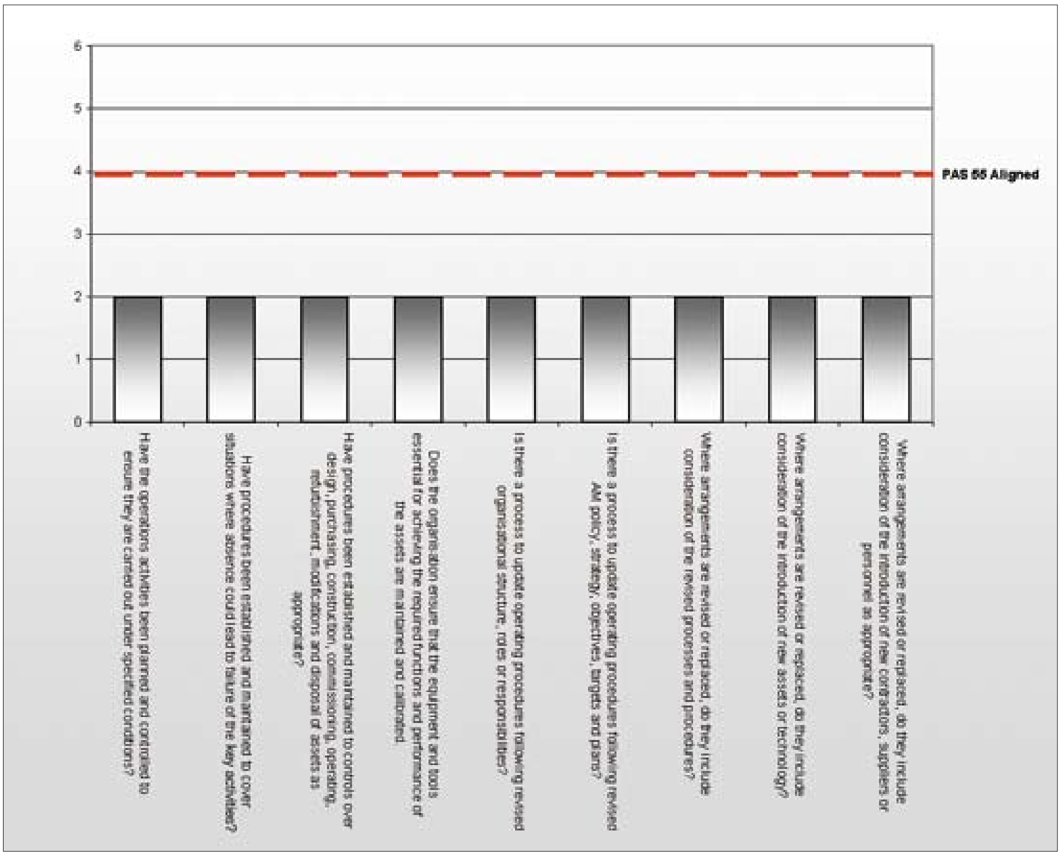


"The organisation shall identify those operations and activities that are necessary for achieving the requirements of the asset management system."

__Review Against PAS-55 Requirements__

Q #	Criteria	Score	PAS-55 Maturity	Comments
Operational Control				
111	Have the operations and activities been identified necessary to implement the AM policy?	2	Aware	This group of elements requires that the organisation understand operations and activities important to the asset management system, and that where necessary documented procedures are in place to ensure consistency. Requirements of this element are similar to that of a quality system.
112	Have the operations and activities been identified necessary to implement the AM strategy?	2	Aware	See above.
113	Have the operations and activities been identified necessary to control identified risks?	2	Aware	See above - Risk management process yet to be defined.
114	Have the operations and activities been identified necessary to meet legal, regulatory, statutory and other AM requirements?	2	Aware	See above.
115	Have the operations and activities been identified necessary to meet the AM objectives?	2	Aware	See above.
116	Have the operations and activities been identified relating to the performance and condition targets?	2	Aware	See above.
117	Have the operations and activities been identified relating to the delivery of the AM plans?	2	Aware	See above.
118	Have the operations and activities been identified relating to the required functions and performance from it's asset systems?	2	Aware	See above.
119	Have the operations activities been planned and controlled to ensure they are carried out under specified conditions?	2	Aware	See above.
120	Have procedures been established and maintained to cover situations where absence could lead to failure of key activities.	2	Aware	See above.
121	Have procedures been established and maintained to controls over design, purchasing, construction, commissioning, operating, refurbishment, modifications and disposal of assets as appropriate?	2	Aware	See above.
122	Does the organisation ensure that the equipment and tools essential for achieving the required functions and performance of the assets are maintained and calibrated.	2	Aware	No - there is checking and calibrating of essential equipment but no centrally maintained database.
123	Is there a process to update operating procedures following revised organisational structure, roles or responsibilities?	2	Aware	No.
124	Is there a process to update operating procedures following revised AM policy, strategy, objectives, targets and plans?	2	Aware	No.
125	Where arrangements are revised or replaced, do they include consideration of the revised processes and procedures?	2	Aware	See above.
126	Where arrangements are revised or replaced, do they include consideration of the introduction of new assets or technology?	2	Aware	See above.
127	Where arrangements are revised or replaced, do they include consideration of the introduction of new contractors, suppliers or personnel as appropriate?	2	Aware	See above.

8.13.16 Operational Control (Cont)



The organisation shall plan and control operations and asset management activities in order to ensure that they are carried out under specified conditions."

Observations and Improvement Opportunities

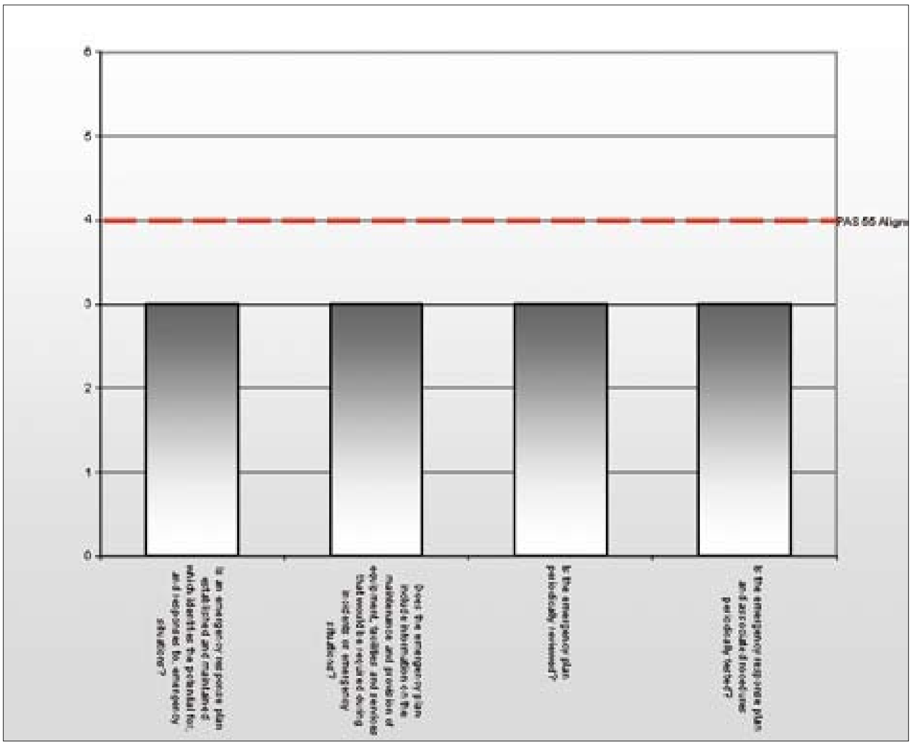
This group of elements requires that the organisation understands which operations and activities are important to the asset management system, and that where necessary documented procedures are in place to ensure that these activities are consistently performed. Requirements for this element are similar to that of an ISO9001 quality system.

Evidence presented to the reviewer suggests that Westpower does not have any rigorously documented processes and procedures for all key asset management activities. To resolve this it is suggested that Westpower consider the core operational requirements of the asset management system and identify those parts that warrant some form of documentation and quality control. Due care will be needed to ensure that documentation and process burden is appropriate to the scale of the organisation. It is suggested that by actively analysing and documenting the key requirements of the asset management system then it will be possible for Westpower to justify a lower requirement for process documentation based on the scale and scope of it's business.

Recommended Action

That Westpower document the key processes essential to the performance of the asset management system and implement changes necessary to ensure consistency and compliance.

8.13.17 Emergency Preparedness and Response



"The organisation shall establish and maintain appropriate plans and procedures to identify the potential for, and responses to incidents and emergency situations."

Q #	Criteria	Score	PAS-55 Maturity	Comments
Emergency Preparedness and Response				
128	Is an emergency response plan established and maintained which identifies the potential for, and responses to, emergency situations?	3	Developing	An emergency response plan is being developed.
129	Does the emergency plan include information on the maintenance and provision of equipment, facilities and services that would be required during incidents or emergency situations?	3	Developing	See above - work in progress.
130	Is the emergency plan periodically reviewed?	3	Developing	See above - work in progress.
131	Is the emergency response plan and associated procedures periodically tested?	3	Developing	See above - work in progress.

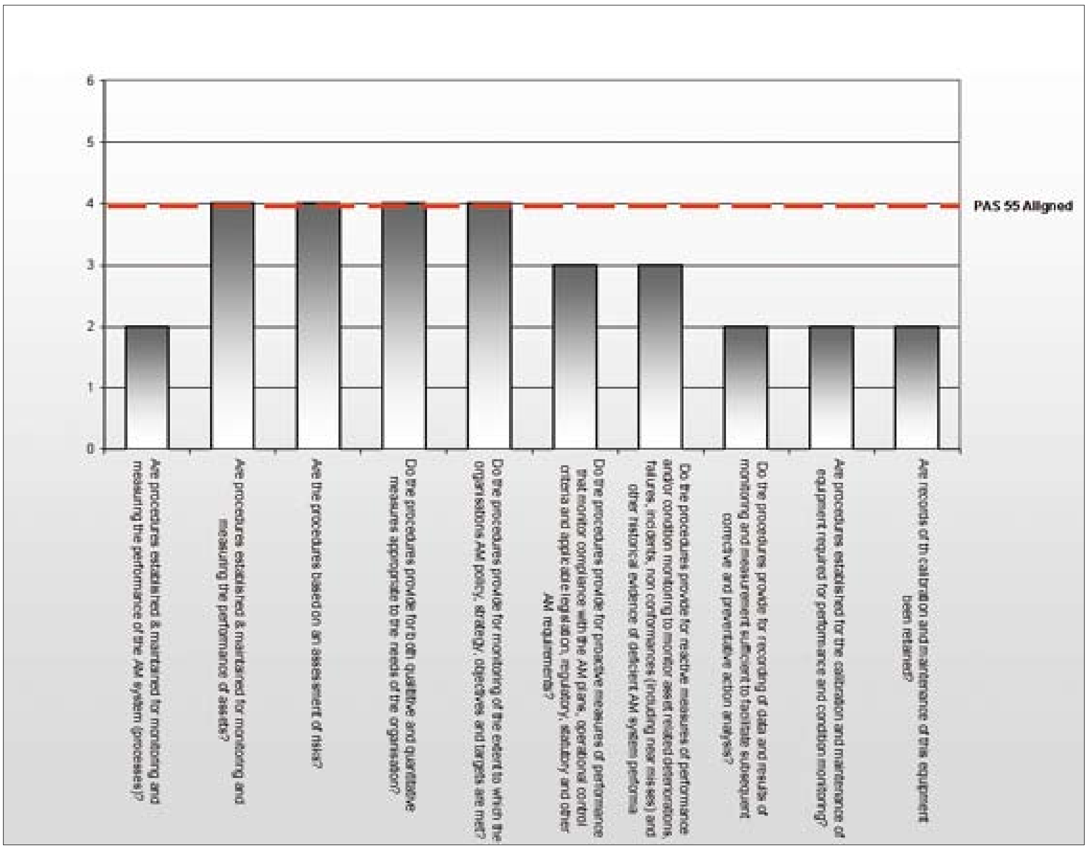
Observations and Improvement Opportunities

PAS-55 requires that credible emergency scenarios are considered and that an emergency response plan is in place. It is understood that Westpower is in the process of actively developing an emergency response plan.

Recommended Action

That the emergency response plan currently under development be completed and implemented.

8.14.18 Performance, Condition Measurement and Monitoring



"The organisation shall establish and maintain procedures to monitor and measure the performance of the asset management system (processes)."

Q #	Criteria	Score	PAS-55 Maturity	Comments
Performance and Condition Measurement and Monitoring				
132	Are procedures established and maintained for monitoring and measuring the performance of the AM system (processes)?	2	Aware	Not at this time, as all core asset management processes do not appear to be formally defined.
133	Are procedures established and maintained for monitoring and measuring the performance of assets?	4	Compliant	Key performance measures have been defined in the AMP and are reported. SAIDI/SAIFI data collection process is defined.
134	Are the procedures based on an assessment of risks?	4	Compliant	Condition assessment guidelines and the discussion in the AMP on inspection and condition shows awareness of risks.
135	Do the procedures provide for both qualitative and quantitative measures appropriate to the needs of the organisation?	4	Compliant	Condition assessment guidelines contain both highly quantitative (e.g.DGA), and qualitative inspections.
136	Do the procedures provide for monitoring of the extent to which the organisations AM policy, strategy, objectives and targets are met?	4	Compliant	SAIDI, a key measure is monitored, there is a process to support collection of outage data.

Q #	Criteria	Score	PAS-55 Maturity	Comments
Performance and Condition Measurement and Monitoring				
137	Do the procedures provide for proactive measures of performance that monitor. It complies with the AM plans, operational control criteria and applicable legislation, regulatory, statutory and other AM requirements?	3	Developing	It is good practice to include lead indicators as well as lag indicators when measuring performance. Lead indicators might be compliant to maintenance policies, numbers of outstanding defects etc.
138	Do the procedures provide for reactive measures of performance and/or condition monitoring to monitor asset related deteriorations, failures, incidents, non conformances (including near misses) and other historical evidence of deficient AM system performance?	3	Developing	Partially, SAIDI, SAIFI etc is a reactive measure of performance, HEIR reports record safety related near misses.
139	Do the procedures provide for recording of data and results of monitoring and measurement sufficient to facilitate subsequent corrective and preventative action analysis?	2	Aware	No - not at present.
140	Are procedures established for the calibration and maintenance of equipment required for performance and condition monitoring?	2	Aware	Yes - but no centrally controlled database, distributed patchy information.
141	Are records of calibration and maintenance of this equipment been retained?	2	Aware	Yes - but distributed and held by individual departments.

Observations and Improvement Opportunities

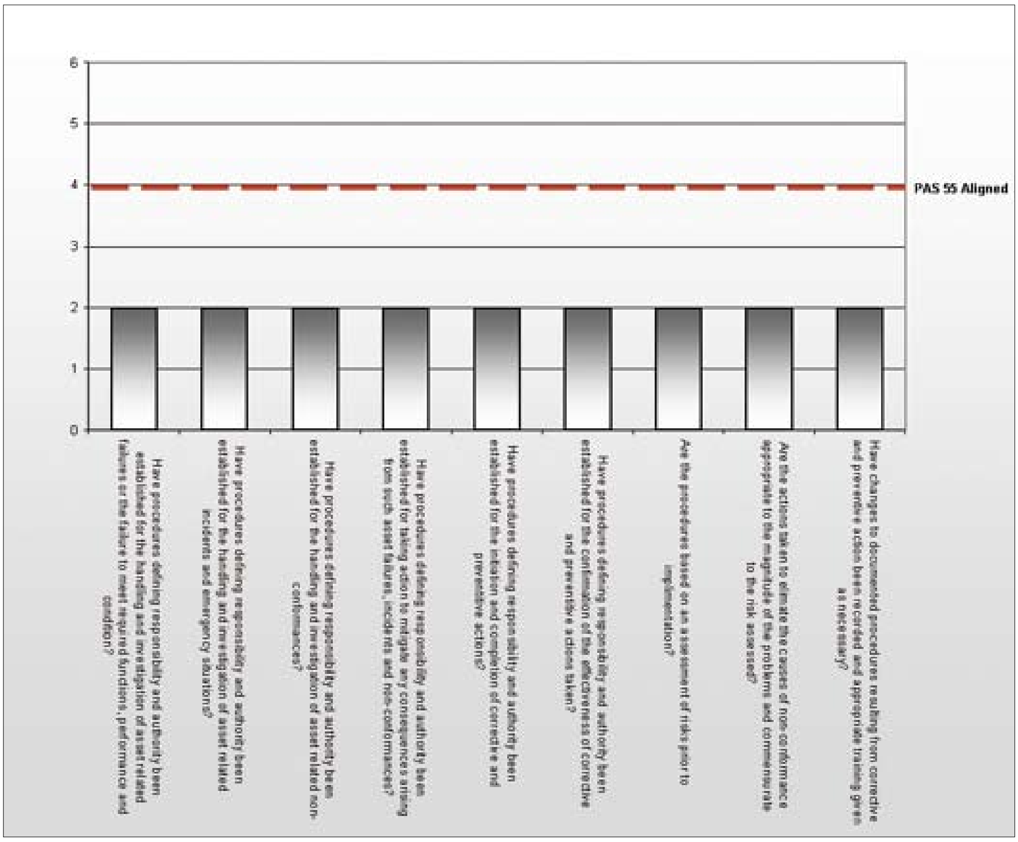
The intent of this group of requirements is to ensure that the asset management system has effective feedback loops for measurement control and continual improvement. While Westpower have a number of key performance indicators in place for essentials such as SAIDI and SAIFI, it is not clear that all information necessary for operational control and continual improvement of the overall asset management system is in place.

Recommended Actions

Following documentation of business processes, implement performance measures to provide improved measurement and control of the asset management processes. In developing KPI's ensure that the results of risk assessments are taken into consideration to ensure that risk issues have appropriate levels of measurement and control.

Implement an appropriate control mechanism for calibration and testing of tools and equipment that are used on the network.

8.13.19 Asset Related Failures, Non-Conformances, Corrective and Preventative Action



"The organisation shall establish and maintain procedures for defining the responsibility and authority for the investigation and management of asset related failures or incidents."

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Related Failures, Non-Conformances and Corrective and Preventive Action				
142	Have procedures defining responsibility and authority been established for the handling and investigation of asset related failures or the failure to meet required functions, performance and condition?	2	Aware	No - Not documented.
143	Have procedures defining responsibility and authority been established for the handling and investigation of asset related incidents and emergency situations?	2	Aware	No - Not documented.
144	Have procedures defining responsibility and authority been established for the handling and investigation of asset related non-conformances?	2	Aware	No - Not documented procedure.
145	Have procedures defining responsibility and authority been established for taking action to mitigate any consequences arising from such asset failures, incidents and non-conformances?	2	Aware	No - Not documented.
146	Have procedures defining responsibility and authority been established for the initiation and completion of corrective and preventative actions?	2	Aware	No - Not documented.
147	Have procedures defining responsibility and authority been established for the confirmation of the effectiveness of corrective and preventative actions taken?	2	Aware	No - Not documented.

Q #	Criteria	Score	PAS-55 Maturity	Comments
Asset Related Failures, Non-Conformances and Corrective and Preventive Action				
147	Have procedures defining responsibility and authority been established for the confirmation of the effectiveness of corrective and preventative actions taken?	2	Aware	No - Not documented.
148	Are the procedures based on an assessment of risks prior to implementation?	2	Aware	No - Not documented.
149	Are the actions taken to eliminate the causes of non-conformance appropriate to the magnitude of the problems and commensurate to the risk assessed?	2	Aware	No.
150	Have changes to documented procedures resulting from corrective and preventive action been recorded and appropriate training given as necessary?	2	Aware	No.

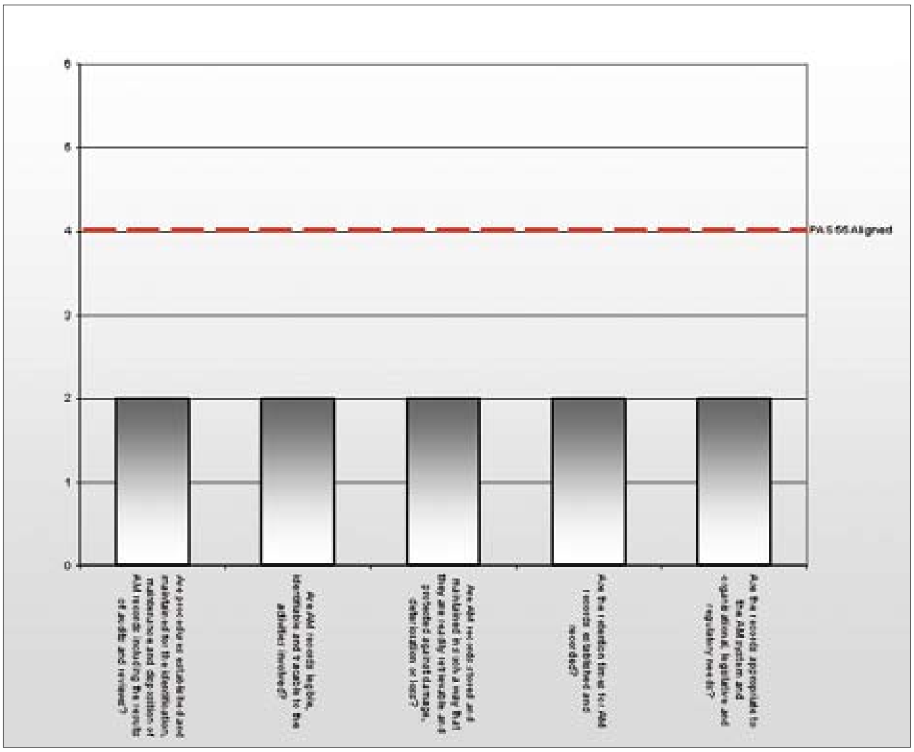
Observations and Improvement Opportunities

Westpower does not at present have formalised processes for investigating, learning from and correcting the root causes of equipment failures and process non-conformances. Such a process would provide guidance on what level issues need to be escalated based on severity, provide for timeframes for completion of investigations and process for tracking the progress of corrective actions.

Recommended Action

That Westpower develop a formalised process for investigating asset failures and asset management system non conformances including a process for tracking the progress of corrective actions.

8.13.20 Records and Records Management



"The organisation shall establish and maintain procedures for the identification, maintenance and disposition of asset management records."

Q #	Criteria	Score	PAS-55 Maturity	Comments
Records and Records Management				
151	Are procedures established and maintained for the identification, maintenance and disposition of AM records including the results of audits and reviews?	2	Aware	No
152	Are AM records legible, identifiable and traceable to the activities involved?	2	Aware	No
153	Are AM records stored and maintained in such a way that they are readily retrievable and protected against damage, deterioration or loss?	2	Aware	No
154	Are the retention times for AM records established and recorded?	2	Aware	No
155	Are the records appropriate to the AM system and organisational, legislative and regulatory needs?	2	Aware	No

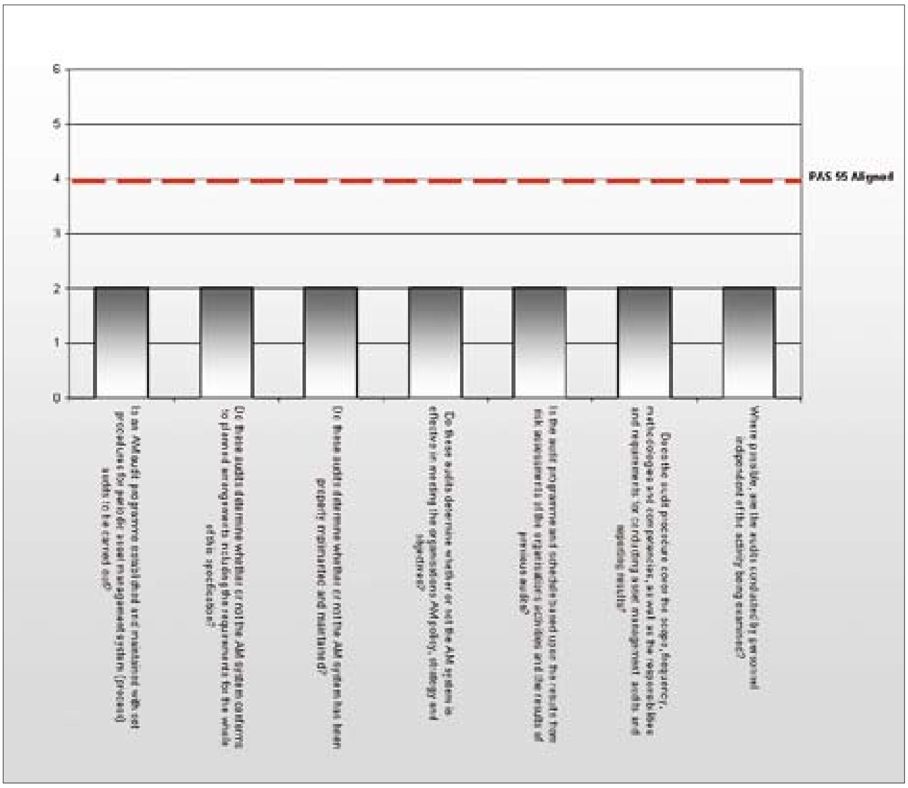
Observations and Improvement Opportunities

Westpower's response to these questions indicates that no formal processes exist for the management of asset and asset management documentation and records. It is recommended that this should be addressed in a manner that is appropriate to the size and scope of Westpower's asset management operation.

Recommended Action

That Westpower develop and implement a policy for the management of asset and asset management system and records.

8.13.21 Audit



"The organisation shall establish and maintain an asset management audit program and shall establish procedures for periodic asset management system (processes) audits to be carried out."

Q #	Criteria	Score	PAS-55 Maturity	Comments
Audit				
156	Is an AM audit program established and maintained with set procedures for periodic asset management system (process) audits to be carried out?	2	Aware	No.
157	Do these audits determine whether or not the AM system conforms to planned arrangements including the requirements for the whole of this specification?	2	Aware	No.
158	Do these audits determine whether or not the AM system has been properly implemented and maintained?	2	Aware	No.
159	Do these audits determine whether or not the AM system is effective in meeting the organisations AM policy, strategy and objectives?	2	Aware	No.
160	Is the audit program and schedule based upon the results from risk assessments of the organisations activities and the results of previous audits?	2	Aware	No.
161	Does the audit procedure cover the scope, frequency, methodologies and competencies, as well as the responsibilities and requirements for conducting asset management audits and reporting results?	2	Aware	No.
162	Where possible, are the audits conducted by personnel independent of the activity being examined?	2	Aware	No.

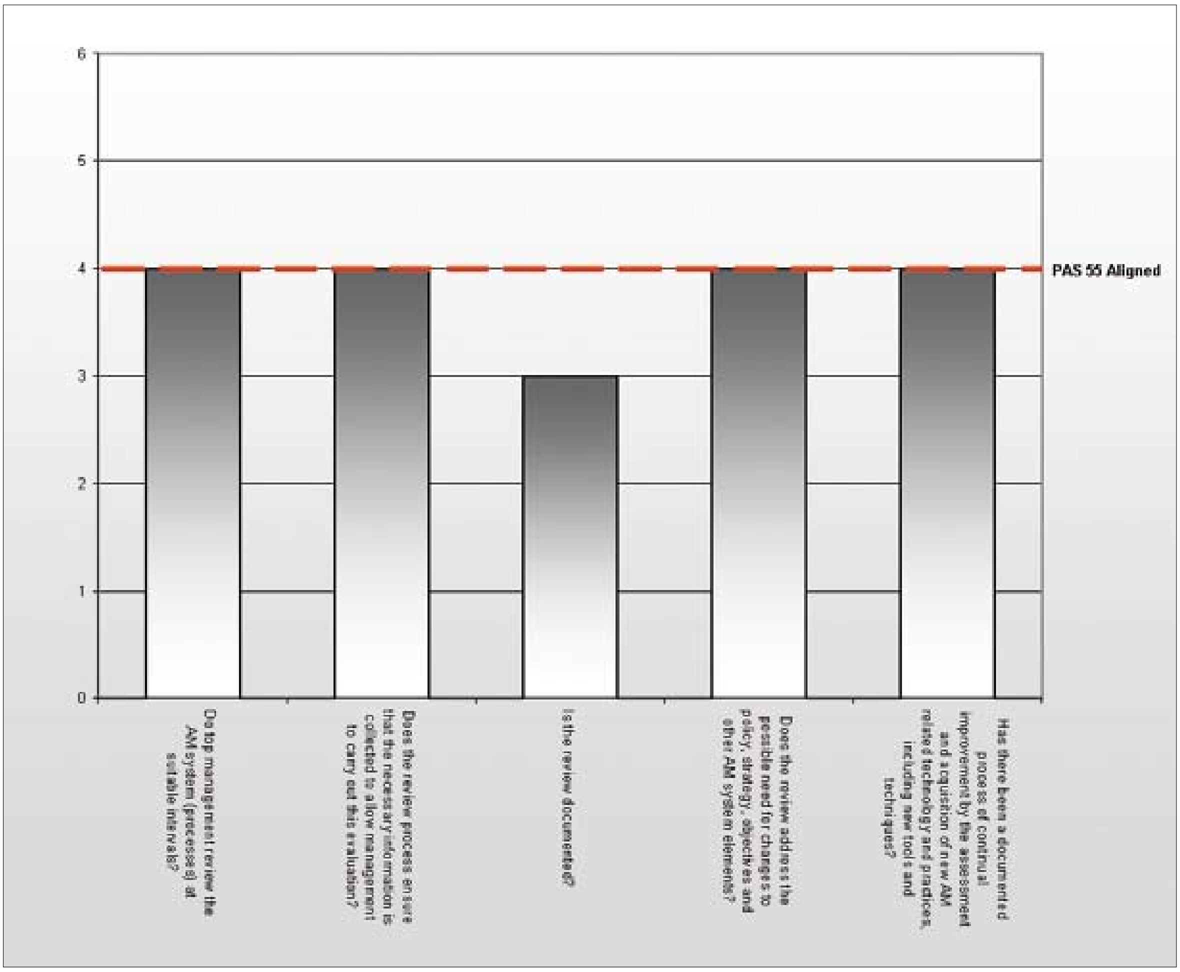
Observations and Improvement Opportunities

Westpower does not appear to have a formal programme of audits of the asset management system and it's processes. It is recommended that an audit program of key processes and activities be implemented following the implementation of formal asset management processes.

Recommended Action

That Westpower implement an audit program to identify non-conformities and improvement opportunities for key asset management system processes.

8.13.22 Audit



"The organisations top management shall at intervals that it determines periodically review the asset management system."

Q #	Criteria	Score	PAS-55 Maturity	Comments
Management Review and Continual Improvement				
163	Do top management review the AM system (processes) at suitable intervals?	4	Compliant	Asset management plan is reviewed and endorsed by senior management each year.
164	Does the review process ensure that the necessary information is collected to allow management to carry out this evaluation?	4	Compliant	Asset management plan contains a comprehensive amount of information from which to base decisions.
165	Is the review documented?	3	Developing	Not documented as such.
166	Does the review address the possible need for changes to policy, strategy, objectives and other AM system elements?	4	Compliant	It is reasonable to expect that management review of the AMP would challenge status quo with regard to policy, strategy and objectives.
167	Has there been a documented process of continual improvement by the assessment and acquisition of new AM related technology and practices, including new tools and techniques?	4	Compliant	Yes - gap analysis section provides good evidence of continual improvement. Sequential AM plans will show documentation of the evolution of the AM system.

Observations and Improvement Opportunities

Evidence was presented indicating the presence of management review and continual improvement processes. The case for this section could however be strengthened by producing evidence of the review process. This need not be onerous, meeting minutes, action plans, records of reviewers comments etc would provide evidence of the review process.

Recommended Action

Implement a simple means of documenting management review of the asset management system. This could take the form of meeting minutes documenting discussions of drafts, audit reports etc.

8.13.23 Conclusions and Recommendations

The intent of the PAS-55 specification is to define a suite of requirements which form an effective asset management system intended ensure the consistent delivery of the organisations asset dependent objectives. The focus of PAS-55 is therefore on end to end process discipline, governance and control.

A summary of Westpower's current position with respect to compliance with PAS-55 requirements is shown in Figure 8.3.This chart highlights a number of areas where Westpower's current processes and systems do not address PAS-55 requirements.

While Westpower can demonstrate a sound asset management capability which is evident from it's annual asset management plan, this review has not found the level of process rigour and associated documentation that is considered necessary to demonstrate compliance with many PAS-55 elements. This apparent lack of formal process does not necessarily imply that such capability does not exist, or that various processes are not being performed, it simply means that Westpower either does not have or is not able to demonstrate systems and processes at the level suggested as necessary by PAS-55.

It should be noted that PAS-55 is intended to apply to the management of physical assets by organisations of all sizes, ranging from large national infrastructure providers in heavily populated countries (for example the UK National Grid) to small regional infrastructure providers. Organisations of such varying size will have different needs for the level of corporate governance and process documentation. It is important that a relatively small regional infrastructure manager such as Westpower interpret PAS-55 in a manner that will assure consistent risk managed performance, without creating unnecessary administrative burden and cost.

The key findings of this review are centred on Westpower formally identifying, reviewing, documenting and implementing key asset management processes to form an overall asset management system. If done sensitively, Westpower will be able to design a PAS-55 compliant system that minimises the need for administrative burden while assuring consistent risk managed outcomes. The key to achieving this result will be to consciously decide and document how Westpower will respond to each PAS-55 requirement taking into consideration the size and scope of the asset management operation and the resources available.

In order to progress towards achieving a PAS-55 compliant asset management system it is recommended that Westpower take the following broad approach:

1. Identify, review and document the key business processes that will make up Westpower's Asset Management System. Ensure during the review process that the many specific PAS-55 requirements are considered and addressed in an appropriate and cost effective manner.

2. Consider the data requirements and information flow for each of the identified processes to identify and document the 'must have' data and information requirements. If gaps exist implement a data improvement plan.

3. Implement a formal risk management process integrated with the above processes. It is suggested that a formalised risk management process would assist in:
   - Providing assurance that the key asset related risks are identified and understood.
   - Transparently demonstrating the prudence of asset management decisions whether they be to apply resources to mitigate a risk, or to accept a risk as tolerable.

4. Implement an audit and review program to measure process compliance and drive process improvement.

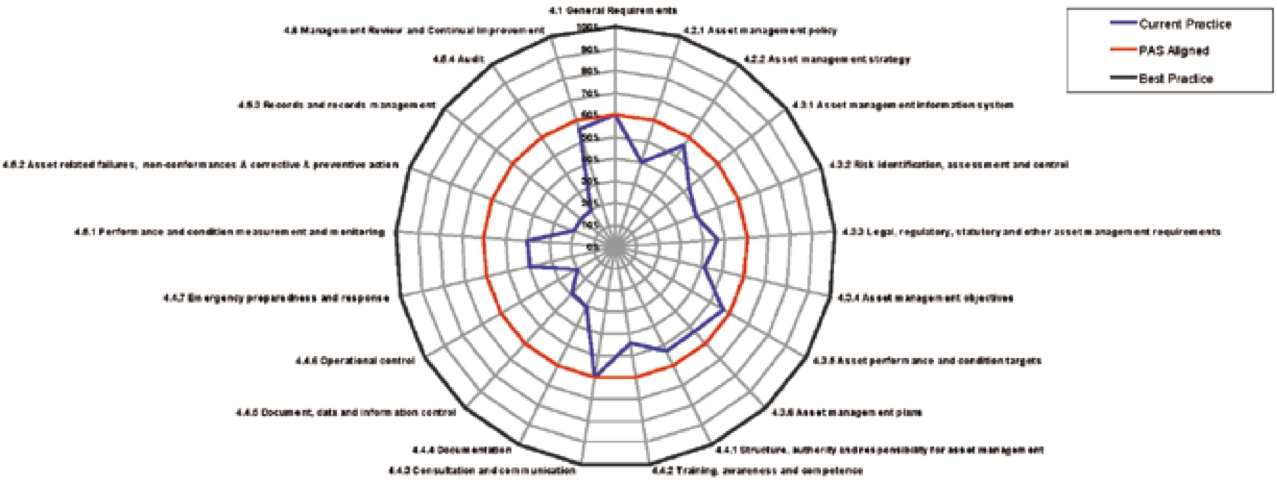


Figure 8.3 - Summary Chart Showing Westpower's Current Compliance with the Requirements of PAS-55.

8.14 Asset and Works Management System Development

8.14.1 Background

In September 2006, Westpower's Asset and Works Management System (AWMS) project went live. UtilityAP in partnership with Westpower's AWMS Project Team provided a comprehensive solution which met functional, financial and time based targets.

Integrated with GIS and FMIS systems Maximo, Enterprise Solution (MXES) embodies comprehensive asset management which supports managers, contractors and customers.

The implementation of MXES has been extremely successful and post implementation Westpower has started to realize genuine benefits. These changes are being embedded into standard business process and are being continually monitored and updated as required.

Although the core module is embedded there are a number of subordinate modules which need varying degrees of customisation before they are added to the Westpower model.

Day to day asset management activities have been fully integrated into Maximo, including monthly invoicing and work order reconciliations. Reports have been developed to assist manger's interpretation of data and strategic planning is becoming more frequent as information and processes improve.

Figure 8.4 shows the model for the current AWMS.

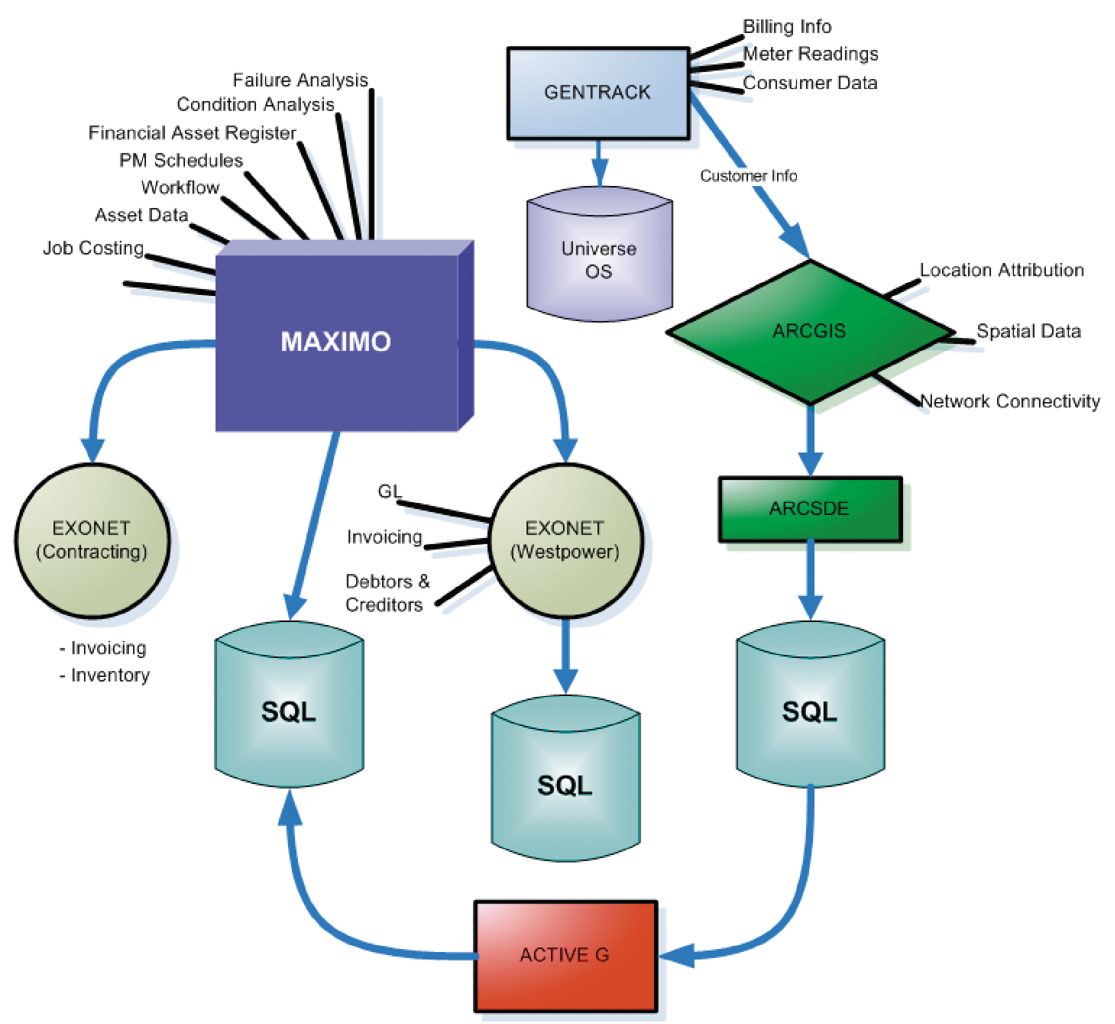


Figure 8.4 - Shows the Model for the Current AWMS

8.14.2 Geographical Information System (GIS)

GIS is the repository for all Network spatial data. It contains and manages attribution data relating to locations, poles and cable spans, which is used to describe the nature and condition of the location. This data assists with the development of the preventative maintenance programme. GIS also provides network connectivity, which is used to evaluate the impact on consumers during outages and package work on feeders during outages. This process minimises consumer disruption, reduces costs and facilitates safe working environments.

8.14.3 Maximo

Maximo is the repository for all asset and works management data. It also stores data relating to locations, which is synchronised each night from GIS. Maximo also manages the following business processes:

- Budgets
- Maintenance – Preventative / Defects
- Workflows
- Outage Management
- Condition Assessment
- ODV

- Asset Register
- General Maintenance
- Inventory
- Invoicing
- Work Order Management and Service Requests

8.14.4 Budget Module

The budget module provides the facility to monitor and report on financial outcomes. Minor customisation is required to this module to create relationships between AMP project numbers and associated budgets. Once customisation is complete, it will be ready to have AMP project budgets loaded. Additionally, projects outside the AMP can also be input and collectively this should provide a comprehensive forecast for materials and costs, resulting in improved material and resource planning, reduced costs and forecasted manpower requirements.

Significant effort will be required to construct work order plans, however the benefits to planning, accuracy and information access make this project extremely beneficial.

8.14.5 Maintenance

Preventative Maintenance (PM) - Considerable effort is being put toward the preventative maintenance plan. PMs are being developed with job plans and routes and the majority of these should be implemented over the next 12 months.

Due diligence needs to be given to the structure applied to the PM process to ensure that it is not overly arduous but at the same time comprehensive. Westpower has conducted an engineering assessment of network assets and in conjunction with manufacturer's recommendations is developing a maintenance programme, which identifies the frequency of maintenance required and list maintenance tasks. The maintenance programme is monitored via the PM Report.

Defects – Fault and failures are now being reported on. A failure report which identifies the problem/cause/ remedy is applied to all faults and assessed by engineers to identify recurring problems. Additionally contractors are encouraged to submit service requests to Westpower identifying any damage or repairs required to the network. Workflow processes direct these to the appropriate Asset Management department.

8.14.6 Workflows

Workflows are an integral part of MXES and provide significant benefits to both Westpower and ENS. A number of workshops have been conducted discussing business processes and formulating workflows. Workflows provide the greatest challenges and have the potential to produce the most significant benefits to business processes.

Westpower has assumed ownership of Workflow creation and maintenance. Having staff within the organisation with these skills simplifies customisation and ensures that changes are timely.

8.14.7 Outage Management

Through regulatory legislation, Westpower is obliged to maintain transparent outage management systems. Westpower has been engaging with Eagle Technology to provide an outage management system which meets legislative requirements while at the same time provides the user with simple and seamless technology. Eagle Technology is looking to customise a Westpower developed programme (Hughes Outage Reporter) to meet both these needs.

8.14.8 Condition Assessment

Eagle Technology was tasked with providing a solution to condition assessment data capture. ArcPad Version 7.1, an 'out of the box' solution, which was recently released, has provided the solution and has considerable

benefits over customised programming. The condition assessment programme has concluded and has been fully adopted by Westpower.

The development of ArcPad to meet the requirements of Westpower's condition assessment has been primarily done in house.

8.14.9 ODV

Modifications to the ODV module are nearing completion. The module provides an integrated and seamless solution which mitigates the use of adhoc database modules. The ODV module will significantly reduce the time spent on data input and preparation of the ODV result and its transparency assures a degree of confidence if Westpower is exposed to future audits.

8.14.10 Asset Register

The asset register is the primary repository for information relating to asset life cycle management and technical performance. The asset register provides the Westpower asset management group with the ability to track equipment, associated costs, histories and failures of all assets. A recent workshop with UtilityAP has identified the requirements for the AVF and a scoping document will be released in the near future.

The current asset model is shown in simplified form in Figure 8.5.

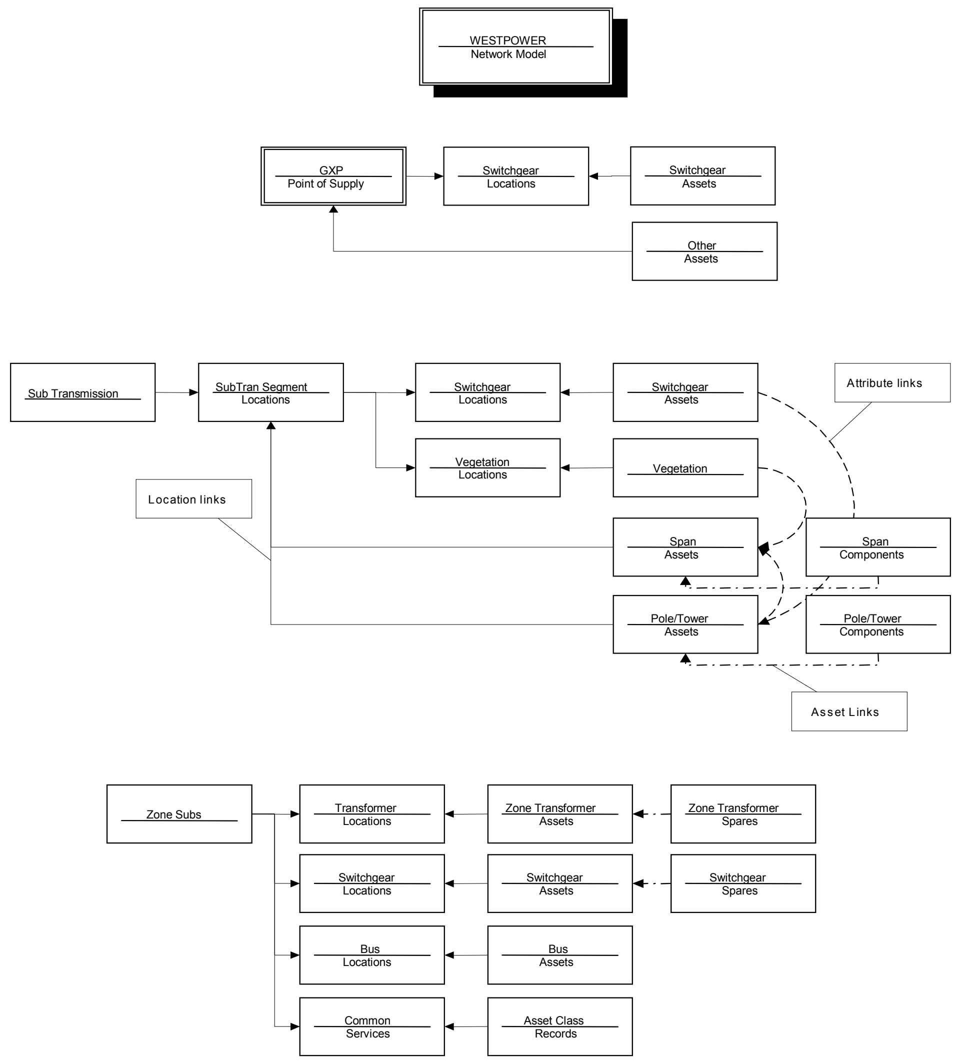


Figure 8.5 - Asset Register Flowchart

8.14.11 Assets Held in Maximo

Attribution, meter and condition data is held for the following asset types:

Asset	Asset Class
Operating Equipment	
Pillar Boxes	
Circuit Breakers	Circuit Breakers (Oil/Vacuum) and Reclosers
Control Panels	
Disconnectors	
Machines	Batteries, Rectifiers, Inverters, DC/Dc Converters
Poles	All Material Types
Radios / SCADA	
Regulators	
Relays	
Transformers	Zone Sub, Distribution, Metering, Voltage, Current, Earthing
Lines and Cable	Underground and Overhead
Capacitors and Inductors	

During the implementation of Maximo data was transferred from Gentrack to Maximo Systems. The majority of this data has since been purified and will continue to be assessed and corrected as required.

Generally all high voltage locations and assets are recorded in GIS and Maximo. Recently a programme has been started to load all 400 V location and asset data. This programme is on going and expected to be completed within the next two years.

8.14.12 General Maintenance

Continual improvement is being made to all AWMS integrated software modules. Dedicated Maximo and GIS administrators are facilitating coordinated system management which will guarantee constant improvement and longevity.

8.14.13 Strategic Management

All the elements of Maximo and GIS mentioned above have provided Westpower with accurate and timely decision making information. Reports have been structured for managers at various levels of the organisation which assist them to effectively manage their respective departments. Improved planning, maintenance and reporting are contributing to an improved network and security of supply for consumers.

9.0 RISK MANAGEMENT PLAN

Westpower has a separate Risk Management Plan completed as part of its overall business planning strategy. This includes 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.

This plan is a living document that is regularly updated.

9.1 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 4360:2004. 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 one of the outputs is shown below.

Table 9.1 - Example Risk Ratings

Risk Factor	Rating	Recommendations
Physical Security	30	Review security requirements for each of the sub-stations.
		Investigate benefits of installing an alarm system in Franz Josef sub-station monitored through SCADA and personnel 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 lifecycle planning and reporting strategy.
		Ensure that the Maximo Asset Works Management System (AWMS) 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.

9.2 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 (Figure 9.1) 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.

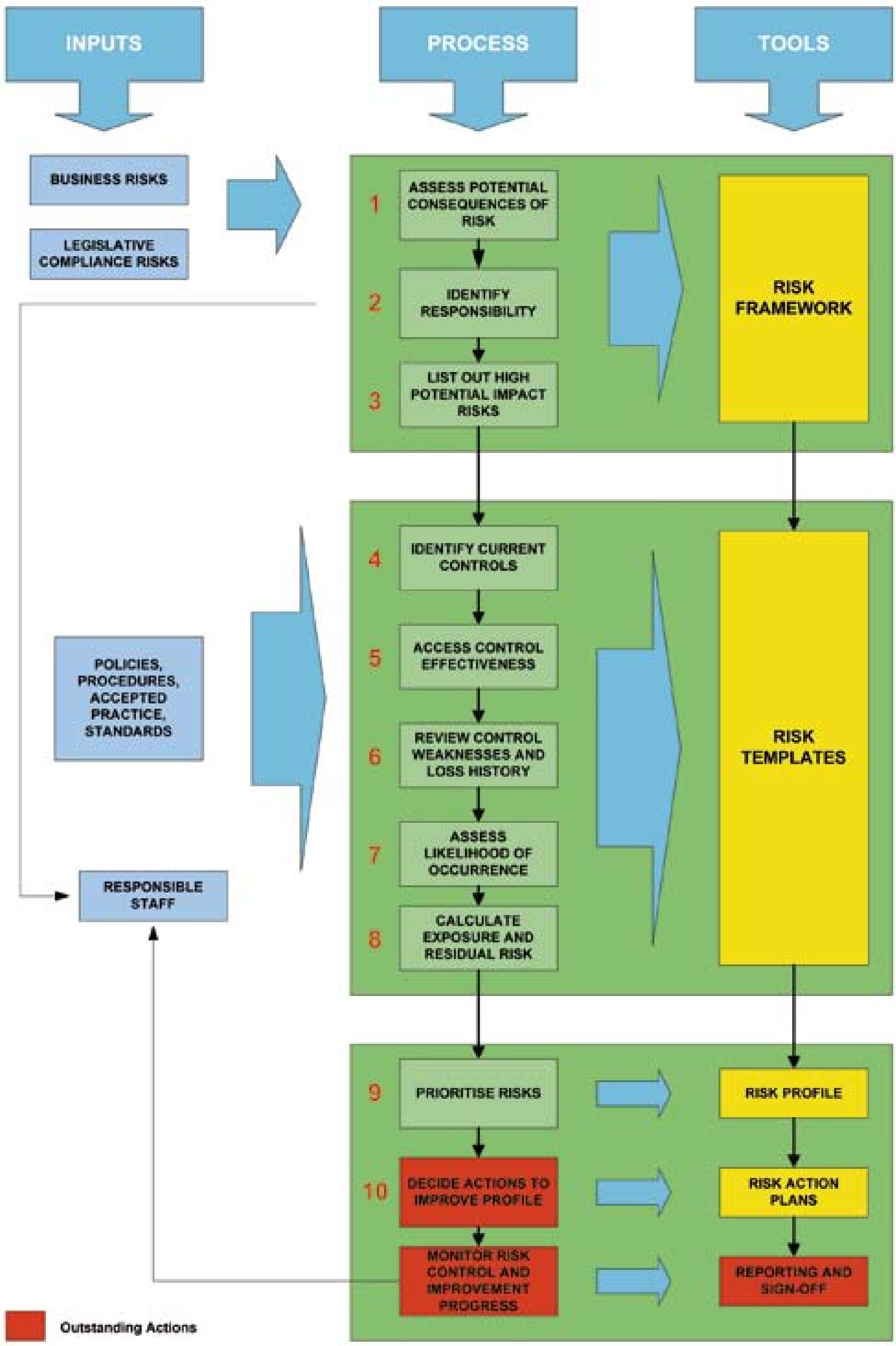


Figure 9.1 - Westpower Risk Planning Methodology

Table 9.2 - Risk Consequences			
Rating	**Level**	**Possible Impact on Company**	**Anualised Financial Impact**
600	Critical	Board approval for actions and ongoing support from the Company's bankers required.	Greater than $5 million
		High Priority actions needed to recover situation.	
		Loss of stakeholder support.	
		Major stakeholder concern.	
		Viability of Company threatened.	
500	Severe	Direct Intervention of the Board.	Between $1 million and $5 million
		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.	
400	Major	Immediate Management action needed to control the situation.	Between $500,000 and $1 million
		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).	
300	Significant	Management action needed to prevent escalation.	Between $100,000 and $500,000
		Multiple incidents affect a significant number of people a year in total (Random).	
		Widespread complaints (public and community organisations).	
		Adverse national media coverage (print).	
200	Moderate	Action needed to confirm controls.	Between $50,000 and $100,000
		Adverse local media coverage (not picked up nationally).	
		Localised complaints (small groups or communities).	
		Single incident affects a small number of people.	
100	Insignificant	Covered under normal Management actions.	Less than $50,000
		Negative local media coverage.	
		Personal grievance claim.	

Stage 2. Identify Responsibility

One of the tasks completed at the workshop was to identify the responsible person for each of the risks given a consequence rating. It is the person identified that is best able to rate the current control methods and weaknesses.

Stage 3. Identify High Consequence Risks

A key aim of the risk workshop was to separate out the significant, high-impact risks for further attention from those with lesser impacts. Using a cut-off risk impact level of 400 we prepared the following list of risks to pursue further. Each of these risks were assessed in detail in interviews conducted with the staff responsible identified at the workshop.

Table 9.3 - High Consequence Risks	
Risk	**Consequence**
Financial Management	400
Illegal or Unacceptable Behaviour	300
Government Regulation	550
Inventory Management and Purchasing	300
Project Management	500
Staff Planning	400
Succession Planning	400
Revenue Protection	400
Business Continuity Planning	500

Stage 4. Identify Current Controls

As part of the interview process, each high impact risk was discussed in detail and a description of the current control methods obtained. These results were captured in Risk Templates .

Stage 5. Assess Control Effectiveness

Next, the control effectiveness of the current control methods was assessed using the following rating scale.

Table 9.4 - Control Effectiveness		
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.

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 (Table 9.5):

Table 9.5 - Likelihood of Occurrence

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.
0.5	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.
0.2	Possible	There is an exposure to the risk (frequency). Some provision to identify higher impact events. Reasonable confidence in controls to prevent realization of potential impact.
		OR
		Some unease that external influences may degrade the internal control environment.
0.1	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 nonexistent or rare with long return periods.

Stage 8. Calculate Exposure and Residual Risk

The residual risk value can be calculated 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 above, we were able to prioritise the top risks for Westpower based upon the residual risk level. The risks are shown in order in Table 9.6.

Table 9.6 - Risk Priority		
Risk	**Residual**	**Rank**
Legislative Compliance	90	1
Business Continuity Planning	55	2
Capacity	50	3
Strategic Planning	45	4
Fire Protection	45	5

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 are six risks in the above.

The suggested action plans developed by Aon were formulated from discussions held with key staff during the interview phase. These will be further developed by Westpower in consultation with the Risk Co-ordinator and Aon.

9.3 Failure Mode and Effects Criticality Analysis

Asset failure will be managed using the failure mode and effects criticality analysis (FMECA) process. This forms part of the “desired practice” for optimised renewal strategy.

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 9.2 and 9.3.

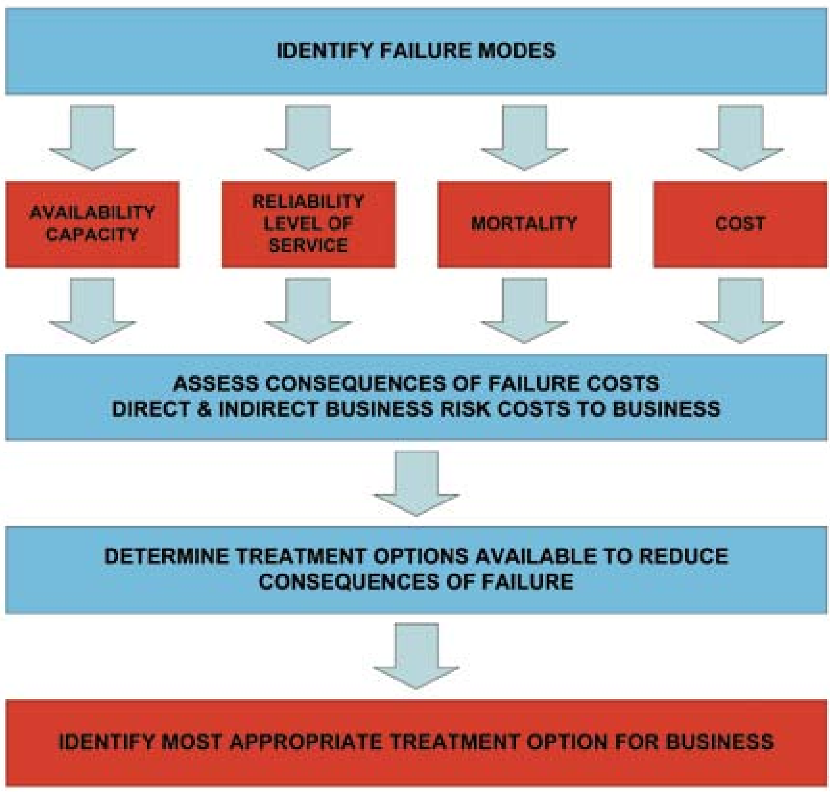


Figure 9.2 - Failure Modes Analysis Process

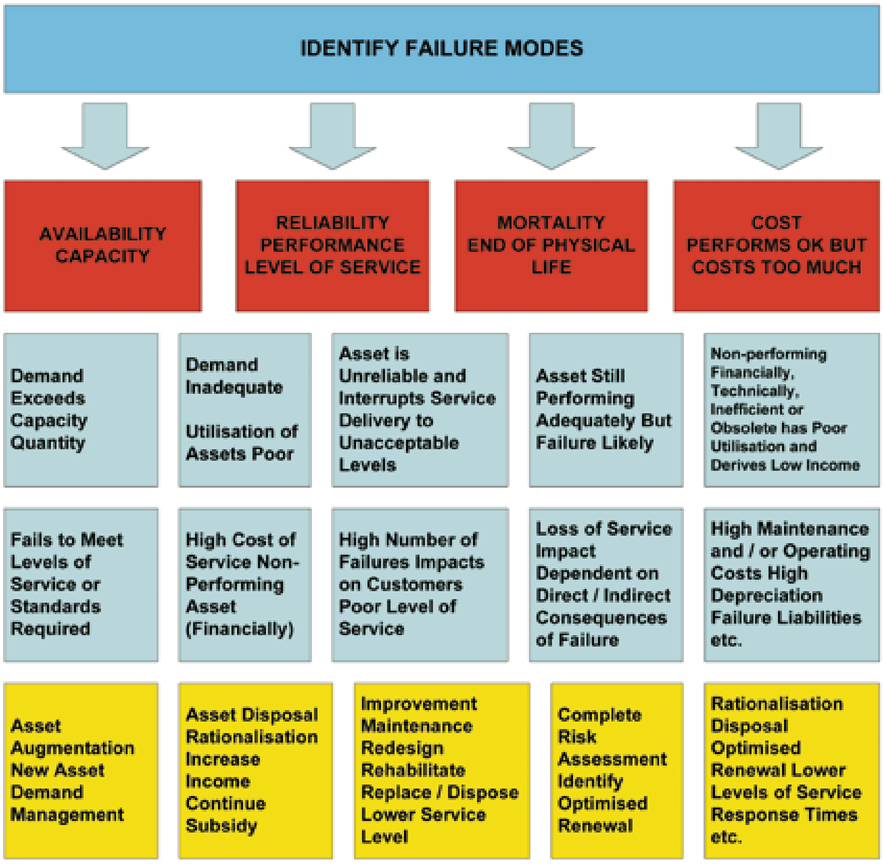


Figure 9.3 - Typical Failure Modes, Effects and Treatments

9.4 Safety

Safety is always a prime driver in any risk management strategy and Westpower takes this seriously. To ensure that these matters are properly addressed, a formal Health and Safety Committee structure has been created and this committee comprises a wide range of staff from all areas of the business.

In addition, Westpower's contractor, ElectroNet Services Limited, has been audited by the Accident Compensation Commission (ACC) and received a tertiary level grading for its safety processes and systems, the highest grading available.

Safety is kept to the fore through regular refresher courses and staff training programs designed to enhance the awareness of safety issues throughout all aspects of the workplace.

In addition to the above, Westpower ensures that an active Hazard Identification Program is in place, including the development of registers for specific types of hazard. At Zone Substations, hazard identification notice boards are used to inform all personnel coming on to site of identified hazards. 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.

9.5 Environmental

Oil spills are the most likely form of environmental damage 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. All Zone Substations are now compliant.

Spill response kits are supplied to all major sites and staff are trained in their use to mitigate the impact of any potential spill.

9.6 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

9.6.1 Earthquake

The likelihood of a major earthquake on the West Coast due to slippage on the Alpine Fault is considered to be relatively high within the next 50 years. There is very little that can be done to minimise the risk to overhead lines and cables in the event of an earthquake, but it is also relatively straightforward to straighten poles and restring conductors as long as access and materials are available.

A Seismic Withstand Report was prepared for most Zone Substations in the 2003/04 year to identify any seismic strengthening measures that can be taken to mitigate the impact of a major earthquake. Recommended strenghtening measures identified in this report have been assessed and actioned where necessary.

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.

9.6.2 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 and 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 and in good condition. 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 has 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.

9.6.3 Lightning

The West Coast is renowned as a significant lightning-prone 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 many parts of the country.

For Zone Substations, Station Class (Line Discharge Level 3) Arrestors are fitted on the terminals of all major power transformers and overhead shield wires are fitted on incoming overhead circuits.

A substantial spares holding is maintained for transformers as lightning is a common cause of damage for this plant and severe lightning events can sometimes last for several days.

9.6.4 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 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.

9.6.5 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 in brown-outs or, under extreme circumstances, black-outs.

Over recent years, Westpower has diversified its base of ripple injection plants and now has units installed at Hokitika, Greymouth, Dobson and Reefton. These are synchronized together so that if one unit should fail, coverage is provided from the remaining units. In addition, each unit can be operated locally in an emergency.

9.7 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 is protected.

4. Regular staff training is implemented in system operation and the issue of permits so that access to the network is always carried out in a safe manner.

5. Contingency Plans and emergency procedures are in place. Included amongst these plans are the following:

- Emergency Response Plan
- Regional Emergency Load Shedding Plan
- Electrical Industry Emergency Contact List

- Zone Substations - Emergency Operating Order Templates

As discussed above, a number of engineering measures have been taken to mitigate risk including:

- A healthy complement of spares is maintained so that most eventualities can be covered without resorting to external support.
- A seismic strengthening programme will continue at Zone Substations during the current financial year.
- A fully portable 33/11 kV substation, called the Westpower Mobile Substation (WMS) has been built to provide coverage for single transformer Zone Substations. Sufficient spare power transformers are available to cover long term faults.
- Spare circuit breakers and controllers have been purchased to cover expected failure rates.

9.8 West Coast Engineering Lifelines Plan

Survey 2004 / 2005

Executive Summary

As a part of Westpower's ongoing commitment to the risk management of its West Coast electricity distribution network, a selection of critical facilities within their operating area were surveyed to assess vulnerability to damage from a number of pre-determined natural hazards, for example wind storms and severe earthquakes.

This survey is part of Westpower's means of compliance with the requirements of the Civil Defence and Emergency Management Act 2002. The new act seeks to improve New Zealand's resilience to emergencies through promoting a comprehensive, all-hazards approach to managing risk.

Compliance with the above Act is based upon four "R's", Reduction, Readiness, Response and Recovery. This report broadly covers all four aspects of Westpower's network for the West Coast Area.

The full report contains a detailed summary of findings together with completed vulnerability charts that quantifies risk and importance in a systematic way. These charts are based upon the system originally employed for the Wellington and Christchurch engineering lifeline studies. The quantification level is sufficient to enable relative risk to be assessed to assist a process of mitigating areas of risk in a progressive manner from highest risk/vulnerability/importance to lowest.

The Westpower network is operated from a Control Centre in the Offices at their Depot on Tainui Street, Greymouth. These facilities were inspected. Since then a major upgrading project has been completed at the depot. Wherever possible, the new work has been brought up to the requirements of the latest loadings and materials standards which will significantly reduce future vulnerability in this area.

The following main substations and switchyards were surveyed as part of the exercise:

- Greymouth Substation
- Dobson Substation
- Arnold Power Station Switchyard
- Rapahoe Substation
- Kumara Power Station Switchyard
- Hokitika Substation
- Franz Josef Substation
- Fox Substation

In addition to the above, a selection of less important substations were surveyed to gain an assessment of the overall network. These included substations / switchyards at Badger Lane, Harihari, Mawhera Quay, Ross, Wahapo Power Station, Waitaha, and Wilson Lane.

9.9 Transmission Lines

The major transmission lines feeding into the Westpower portion of the West Coast CDEM area are:

Inangahua – Blackwater A	110 kV single circuit on poles
Dobson – Blackwater A	110 kV single circuit on poles
Arahura (Hokitika) – Otira A	66 kV double circuit on poles
Arahura (Hokitika) – Dobson A	66 kV single circuit on poles (between Dobson and Greymouth)

The major Transmission Lines that Westpower own themselves are:

Greymouth – Kumara	66 kV single circuit on poles	25km
Kumara – Kawaka	66 kV double circuit on poles	11km
Hokitika – Harihari	66 kV single circuit on poles	64km
Two-mile – Hokitika	66 kV single circuit on poles	8km

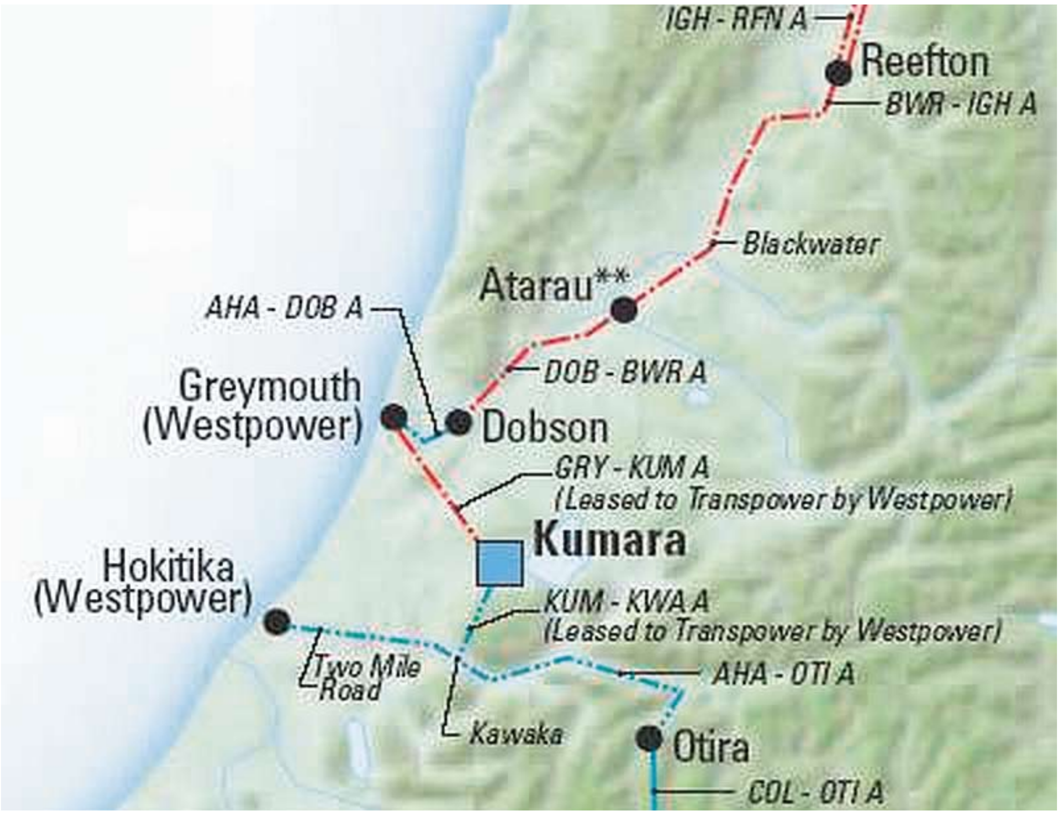


Figure 9.4 - Map showing the Transpower Network supplying the Westpower Distribution Network.

Westpower's transmission / distribution lines cover several routes over widely varying terrain from coastal plains to relatively unstable and rugged hill country. Some redundancy is built into portions of the system whereby an outage on any one particular line, depending upon time of day / time of year, may not affect supply to other areas of the network.

Most poles supporting transmission and distribution lines are well founded to prevent collapse under high wind / ice conditions, and therefore are only moderately vulnerable to earthquake induced slope instability.

Figure 9.4 shows the main Lines feeding into the Westpower network from Reefton and Otira.

9.10 Communications

Westpower is able to use a number of independent means of communication to control its network, namely:

- Two-way radio
- Telecom landline telephone network
- Cellular phone network (in some areas)

Each system is essentially independent of each other and therefore there is significant redundancy in the event of disruption.

The following table (Table 9.7) is a summary of common findings throughout Westpower's network with suggested mitigation measures.

Table 9.7 - Summary of Vulnerabilities and Suggested Mitigations

Vulnerability	Suggested Mitigation
Transmission lines passing over unstable terrain	Add diversification were ever possible (long term planning)
Some transformers and regulators not robustly held down	Modify hold down systems to current EQ standards
Some buswork vulnerable to insulator damage from supporting posts moving differentially	Provide slip joints in buswork at appropriate points
Some prefabricated control buildings not robustly restrained	Upgrade hold down systems to cope with full EQ and wind loadings
Restrain batteries from sliding with support frames and possibly damaging cables and terminals	Provide corrosion proof packing and tie down small communication batteries
Some two way radios and access manuals unrestrained	Provide lips to storage shelves and attach radios to walls etc
Some equipment support stands ungrouted with long hold down bolts vulnerable in bending	Provide suitable non shrink grout under base plates
New control room to be as robust as possible	New control room will be up to latest standards. Ensure all VDU's, computers and communication equipment well restrained
Some critical spares unrestrained and vulnerable	Appropriately restrain all critical spares

9.11 Disaster Recovery

Westpower has adopted procedures and policies which define processes and assign responsibilities for the conduct of emergency response teams and departments in the advent of a disaster.

These procedures and policies include comprehensive Emergency Management Team Standard Operating Procedure (SOP) and Departmental Business Continuity Plans (BCP) as well as the Emergency Response Plan (ERP) and Load Shedding Plan (LSP) as discussed in Section 9.7, Mitigiation Measures.

9.11.1 Emergency Management Team (EMT)

The EMT Standard Operating Procedures (SOPs) prescribes the appropriate processes and assigns responsibilities for the conduct of the Emergency Management Team (EMT) in the event of a disaster of such proportions that requires coordinated command and control.

The SOP applies to all elements of ElectroNet when performing duties assigned by the EMT. The structure of the EMT may alter subject to the nature of the disaster, resources available and the tactical situation.

The EMT is Categorised as follows;

Command & Control Includes definition of roles and responsibilities, operating control and overall command once a 'Disaster' is declared.

Planning When a disaster has been declared, EMT operations will be conducted in three phases.

Phase 1	Establish EMT
Phase 2	Response
Phase 3	Recovery

Admin and Logistics Defines the location of the EMT base of operations, including all communications and materials available and a list of priority services. Also included is a list of personnel available and their contacts.

Please refer to the document *"Standard Operating Procedure WP-01 SOP - Emergency Management Team Procedures"*

9.11.2 Business Continuity Plans (BCP)

The Business Continuity Plans are defined by each department and enable the re-establishment of normal processes and procedures following a major disruptive event which results in either the loss of business premises, resources or people.

Each department has developed a workable plan that can be used to prevent the interruption of critical business functions in the event of a major business interruption.

The departments include Stores, Financial, Asset Management, Electricians and Lines. For an overview of the BCP structure, refer to Figure 9.5.

The Objective of the BCP's are as follows;

- To define and prioritise the critical functions of the department
- To analyse the emergency risks to the department
- To detail the agreed response to an emergency
- To identify key contacts during an emergency

For further information please refer to the document *"Business Continuity Plan WP-BCP"*

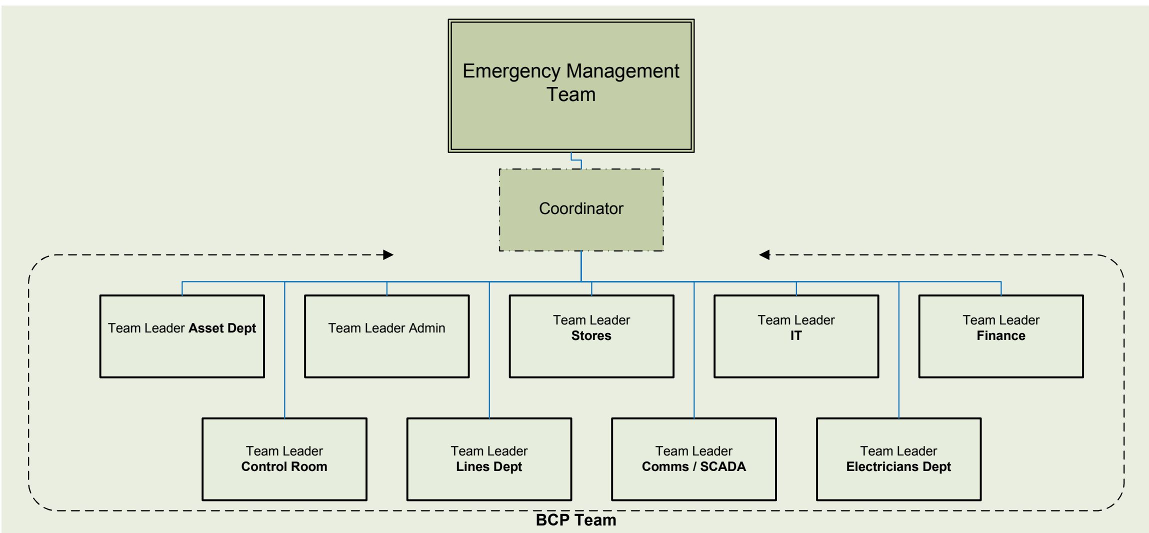


Figure 9.5 - BCP Organisation Structure

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. “Maintenance Contingency” is not a real activity for reporting purposes.

Enhancement and Development Activity Definitions

Enhancement

This is the replacement of an existing asset with a modern equivalent asset, which is materially improved on the original asset, or modifications to an existing asset, which have this effect. Specifically, this will include improvements to the existing asset configuration, which are undertaken with the purpose of:

Further improving the inherent safety of the system (e.g. installing smoke/heat detectors and entry alarms in substations)

Improving the level of customer service (e.g. increasing capacity by replacing a transformer with a larger unit, or adding an extra circuit to it to increase security)

Improving economic efficiency or investing to improve the asset by reducing operating or maintenance costs (e.g. fitting vibration dampers to specific lines to reduce the rate of component deterioration)

Improving environmental risk management (e.g. fitting oil containment facilities at substations)

Improvement to corporate profile (e.g. landscaping station grounds, although this is also fully justifiable on the basis of reduced grounds maintenance)

Note that each aspect of improvement is related to a specific Asset Management performance driver.

Development

This is work which involves installation of new assets in sites or configurations where none previously existed. This may also include substantial upgrade work (e.g. re-building a substation at a higher voltage) in which the original configuration is significantly altered or extended.

Development Contingency

An explicit planning contingency, where it is not feasible to identify all minor work, or where it is expected that work will arise but its classification can not be easily predicted. No implicit contingencies are included in the detailed enhancement and development expenditure projections. For the same reasons as those discussed under "Maintenance Contingency", this activity is not included in financial reports.

Other Activity Definitions

Operating

Any disconnection of customer's services for any reason except non-payment of electricity accounts. This includes activities such as house painting, transportation of high loads and low voltage switching. It also includes operation of the 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 11 kV 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 400 V 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 11 kV 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 with associated equipment and radio communications equipment which may be installed in vehicles, substations or 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.

APPENDIX B: Commerce Commission Cross Reference Table

As our AMP has been structured to suit our purposes it does not strictly follow the order as laid out in schedule 2 of the Electricity information disclosure requirements. To assist in finding specific information this cross reference table will point the reader to correct page(s).

Framework Ref.	Com.Com Schedule 2 Ref	Com.Com Handbook Ref	Westpower AMP Section Ref.
B.2	Item 1	4.5.1	Throughout Section
B2A			1.0
B2B			1.0
B2C			Throughout Section
B3			2.0
B3.1		4.5.2a	2.1.1
B3.1A	Item 2a		2.1.1
B3.1B			2.1.1
B3.1C			2.1.2
B3.2	Item 2b	4.5.2b	2.1.2
B3.2A		4.5.2b (i)	2.1.5
B3.2B		4.5.2b (ii)	2.1.2
B3.2C		4.5.2b (iii)	2.1.1 & 2.1.2
B3.2D			2.1.2
B3.3	Item 2c	4.5.2c	2.1.1
B3.3A		4.5.2c	2.1.1
B3.3B		4.5.2c	2.1.1
B3.4	Item 2d	4.5.2d	2.1.6
B3.4A		4.5.2d	2.1.6
B3.4B		4.5.2d (i)	2.1.6
B3.4C		4.5.2d (ii)	2.1.6
B3.4D		4.5.2d (iii)	2.1.6
B3.4E		4.5.2d (iv)	2.1.6
B3.5	Item 2e	4.5.2e	2.1.5
B3.5A		4.5.2e (i)	2.1.5
B3.5B		4.5.2e (ii)	2.1.5
B3.5C		4.5.2e (iii)	2.1.5
B3.6			2.9
B3.6A	Item 2f	4.5.2f	2.9
B3.6B		4.5.2f	2.9
B3.6C		4.5.2f	2.9
B3.6D		4.5.2f	2.9
B4			3.0
B4.1	Item 3a	4.5.3a	3.0
B4.1A		4.5.3a (i)	3.0
B4.1B		4.5.3a (ii)	3.14
B4.1C		4.5.3a (iii)	3.14
B4.1D		4.5.3a(iv)	5.2.1
B4.2	Item 3b	4.5.3b	3.2 - 3.11
B4.2A		4.5.3b (i)	3.2 & 3.13

Framework Ref.	Com.Com Schedule 2 Ref	Com.Com Handbook Ref	Westpower AMP Section Ref.
B4.2B		4.5.3b (i)	3.2
B4.2C		4.5.3b (ii)	3.3, 3.7 & 6.2.1
B4.2D		4.5.3b (ii)	6.2.1
B4.2E		4.5.3b (iii)	3.4
B4.2F		4.5.3b (iv)	3.8 & 3.9
B4.2G		4.5.3b (v)	3.5 & 3.6
B4.2H		4.5.3b (vi)	3.10 & 3.11
B4.3	Item 3c	4.5.3c	3.0 (throughout Section)
B4.3A		4.5.3c [(i) to (v) and (i) to (vi)]	3.0 (throughout Section)
B4.4	Item 3d	4.5.3d	3.0 (throughout Section)
B4.4A		4.5.3d	3.0 (throughout Section)
B5		4.5.4	4.1 to 4.5
B5.1	Item 4a	4.5.4a	4.2
B5.1A		4.5.4a	4.2
B5.2	Item 4b	4.5.4b	4.3
B5.2A		4.5.4b	4.3
B5.3	Item 4c	4.5.4c	4.0 (throughout Section) & 4.4
B5.3A		4.5.4c	4.0 (throughout Section) & 4.4
B6		4.5.5	6.0
B6.1	Item 5a	4.5.5a	6.2
B6.1A		4.5.5a	6.2
B6.1B		4.5.5a	6.2
B6.2	Item 5b	4.5.5b	6.3
B6.2A		4.5.5b	6.3
B6.3	Item 5c	4.5.5c	5.2 & 5.3
B6.3A		4.5.5c	5.2 & 5.3
B6.3B		4.5.5c	5.2 & 5.3
B6.3C		4.5.5c	5.2 & 5.3
B6.3D		4.5.5c	5.2, 5.3 & 6.2.4.3
B6.3E		4.5.5c	5.2 & 5.3
B6.3F		4.5.5c	5.2 & 5.3
B6.4	Item 5d	4.5.5d	5.2, 5.3, 6.2.4.3 & 8.13
B6.4A		4.5.5d	5.2, 5.3, 6.2.4.3 & 8.13
B6.4B		4.5.5d	5.2, 5.3, 6.2.4.3 & 8.13
B6.5	Item 5e	4.5.5e	5.2 & 5.3
B6.5A		4.5.5e	5.2 & 5.3
B6.5B		4.5.5e	5.2 & 5.3
B6.6	Item 5f	4.5.5f	5.2, 5.3, 6.2.4.2 & 6.2.4.3
B6.6A		4.5.5f	5.2, 5.3, 6.2.4.2 & 6.2.4.3
B6.6B		4.5.5g (i)	5.4 - 5.14
B6.6C		4.5.5g (ii)	5.4.4 - 5.14
B6.6D	Item 5g	4.5.5g (iii)	5.4.4 - 5.14
B6.6E		4.5.5g (note 1)	5.4.4 - 5.14
B6.6F		4.5.5g (note 1)	5.4.4 - 5.14

Framework Ref.	Com.Com Schedule 2 Ref	Com.Com Handbook Ref	Westpower AMP Section Ref.
B6.6G		4.5.5g (note 2)	5.4 - 5.14
B7		4.5.6	6.4
B7.1	Item 6a	4.5.6a	6.4 & 5.4.1
B7.1A		4.5.6a	5.4.1 & 6.4
B7.2	Item 6b	4.5.6b	5.4 - 5.14 & 6.4
B7.2A		4.5.6b	5.4 - 5.14 & 6.4
B7.2B		4.5.6b	5.4 - 5.14 & 6.4
B7.2C		4.5.6b	5.4 - 5.14 & 6.4
B7.2D		4.5.6b	5.4 - 5.14 & 6.4 summary in Section 7
B7.3	Item 6c	4.5.6c	5.3, 5.4, 6.4 & 8.11
B7.3A		4.5.6c	5.3, 5.4, 6.4 & 8.11
B7.3B	Item 6d	4.5.6d	5.4 - 5.14
B7.3C		4.5.6d (i)	5.4 - 5.14
B7.3D		4.5.6d (ii)	5.4 - 5.14
B7.3E		4.5.6d (iii)	5.4 - 5.14
B7.3F	Item 6e	4.5.6e	5.4 - 5.14 & summary in Section 7
B8			9.0
B8A	Item 7	4.5.7	9.0
B8B	Item 7a	4.5.7a	9.0
B8C			9.5, 9.6 & 9.11
B8D	Item 7b	4.5.7b	9.0 (throughout Section)
B8E		4.5.7b	9.7 - 9.11
B9		4.5.8	7.0
B9.1	Item 8a	4.5.8a	7.3
B9.1A		4.5.8a	7.3
B9.1B		4.5.8a	7.3
B9.1C		4.5.8a	7.3
B9.1D		4.5.8a	7.3
B9.2	Item 8b	4.5.8b	4.2 & 4.3
B9.2A		4.5.8b	4.2 & 4.3
B9.2B		4.5.8b	4.2 & 4.3
B9.3	Item 8c	4.5.8c	8.14
B9.3A		4.5.8c	8.0 (throughout Section)
B9.3B		4.5.8c	8.0 (throughout Section)

APPENDIX C: Network Reliability by Zone Substation and Feeder

The table below shows the reliability levels for each of Westpower's 19 Zone Substations.

Substation	Load (MW)	Sub-Trans Security	# HV Feeds	Feeders	Restoration Time (Hrs)	Backup	Comments
Reefton 33 kV	5	n-1	2	CB3012 CB3073	< 0.5	CB3072 at Sub CB3012 at Sub	There are two transformers fed from Inangahua and Ataray through two separate 110 kV circuits. There is no problem with the backup.
Reefton 11 kV	3	n-1	2	CB4	< 0.5	CB5 at Sub	
				CB5	< 0.5	CB4 at Sub	
						NGH CB1 to Maimai	
Globe	5	n	1	Shunt Local Feeds	<5	Mobile Substation	Accepted by Customer. Backup is available just for 11 kV, not for 6.6 kV.
Ngahere	2.6	n	1	CB1	<1	DOB CB1	There is a backup feed from Reefton 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. In a substation fault, alternate feeds are not large enough to supply the major connected load, the Ngahere Gold Dredge.
						ALD CB3	
				CB3	<1	RFT CB15 to Ahaura	
						Mobile Sub for both feeders	
Rapahoe	4	n	1	CB1	<1	CB3 at Sub	There is no backup for a 33 kV feeder fault. Backup is available via a bypass switch for 33 kV and 11 kV circuit breaker faults. Dobson is able to supply the domestic 11 kV load, and minimal industrial load, e.g. mine pumps. A backup transformer is available.
				CB3	<1	DOB CB1	
					<1	Mobile Sub for both feeders	
Dobson 11 kV	2.7	n	1	CB1	<0.5	RAP CB3	This substation is fed directly from the Transpower Dobson 33 kV bus, and so is not subject to Westpower Subtransmission Line Faults. The 33/11 kV transformer also acts as a spare, which can be transported to Ngahere, Rapahoe, Hokitika, Wahapo or Franz Josef if required. Several 11 kV ties exist for the feeders out of this substation and repair times are short.
						ALD CB3	
						NGA CB1	
				CB3	<0.5	GYM CB8	
						Mobile Sub for both feeders	

Substation	Load (MW)	Sub-Trans Security	# HV Feeds	Feeders	Restoration Time (Hrs)	Backup	Comments
Dobson 33 kV	6.6	n	2	CB1322	< 0.5	CB1362 at Sub	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. The mobile substation can be used as a backup for CB1342 and T1.
				CB1342	< 0.5		
				CB1362	< 0.5	CB1322 at Sub	
				CB1382	< 0.5	11kV Tie to Arnold	
						CB3072 Reefton	
Arnold	1.8	n	1	CB3	< 0.5	DOB CB1	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.
				CB4	< 0.5	DIL 4	
					< 0.5	Mobile Sub	
Greymouth	11	n-1	2	CB7	< 0.5	CB12 & CB9	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 11 kV cable network in the CBD is highly intermeshed with a "double-ring" construction. All substations have two, and many three, 11 kV cable feeds.
				CB13	< 0.5	CB6	
						DOB CB3	
				CB6	< 0.5	CB13	
						CB11	
						KUM CB1	
				CB12	< 0.5	CB9	
						CB6	
				CB11	< 0.5	CB6	
						CB12	
				CB9	< 0.5	CB7 CB12	
Kumara	1.1	n	1	CB1	< 1	GYM CB6	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 11 kV feeders can be back fed from Greymouth, Arnold or Hokitika Substations. A spare transformer is available from Greymouth Substation.
				CB2	< 1	ALD CB4	
						HKK CB10	

Substation	Load (MW)	Sub-Trans Security	# HV Feeds	Feeders	Restoration Time (Hrs)	Backup	Comments
Hokitika	12	n-1	2	CB10	< 0.5	CB4	This substation feeds Hokitika and all of South Westland down to Paringa. In addition, it supplies three feeders to the Westland Dairy.
				CB4	< 0.5	CB10	
						CB12	
				CB12	< 0.5	CB4	
				CB5	< 0.5	CB9	
						CB11	
				CB9	< 0.5	CB5	
						CB11	
				CB11	< 0.5	CB5	
						CB9	
Ross	0.8	n	1	CB1	< 0.5	CB3 at Sub	CB1 is a dedicated feeder for the Birchfield Minerals mine site. Domestic load on CB3 can be fed from CB10. Both feeders have a short repair time.
				CB3	< 0.5	HKK 10	
Waitaha	0.1	n	1	CB1	< 0.5	No Backup	The 33 kV substation feed can be from Hokitika 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.
						Mobile Sub	
Harihari	0.7	n	1	CB1	< 0.5	CB3 at Sub	The 33 kV substation feed can be from Hokitika 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.
				CB3	< 0.5	CB1 at Sub	
						Mobile Sub	
Whataroa	0.6	n	1	CB1	< 5	No Backup	The 33 kV substation feed can be from Hokitika 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.
						Mobile Sub	
Wahapo	0.5	n	1	CB1	< 5	No Backup	The 11 kV substation bus can be fed from Hokitika 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.
						Mobile Sub	

Substation	Load (MW)	Sub-Trans Security	# HV Feeds	Feeders	Restoration Time (Hrs)	Backup	Comments
Franz Josef	1.9	n	1	CB1	< 1.5	CB3 at Sub	This substation, fed from Hokitika feeds the Franz Josef area. There are two sections of Aerial Bundled Cable in this feeder, which have significant repair times. The aerial routes and terrain can be very difficult. There is no feasible subtransmission backup. The mobile substation can backup both 11kV feeders.
				CB3	< 1.5	CB1 at Sub	
						Mobile Sub	
Fox Glacier	0.9	n	1	CB1	< 5	No Backup	This substation was constructed in 2003 to supply the Fox Glacier area, south to Paringa.
						Mobile Sub	
Logburn Rd 33 kV	0.8	n	1	CB3602		No Backup	There is no backup available.
Logburn Rd 11 kV		n	1	CB1	< 1	NGH CB1	Backup for CB1 is available from Ngahere CB1 via DD22. There is no backup for CB2 and CB3.
				CB2		No Backup	
				CB3		No Backup	
Pike 11 kV	0.8	n	1	CB1		No Backup	Accepted by Customer.
				CB2		No Backup	
				CB3		No Backup	
				CB4		No Backup	
				CB5		No Backup	
				CB6		No Backup	
				CB7		No Backup	

APPENDIX D: Expenditure Forecast and Reconciliation

	Actual for most recent Financial Year	Previous forecast for Current Financial Year	Forecast Year									
For year ended	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	year 10
Capital Expenditure: Customer Connection	$123,800	105000	163000	173000	182000	193000	206000	218000	232000	194000	207000	219000
Capital Expenditure: System Growth	$2,675,838	685000	1170000	1467000	2360000	2913000	3628000	4109000	3761000	1540000	3995000	4578000
Capital Expenditure: Asset Replacement and Renewal	$1,531,286	3351100	3221000	3625000	2837000	2231000	1368000	755000	527000	2085000	649000	944000
Capital Expenditure: Reliability, Safety and Environment	$1,139,708	8981500	2066000	992000	1070000	686000	643000	693000	963000	608000	689000	618000
Capital Expenditure: Asset Relocations	$3,945											
Subtotal - Capital Expenditure on Asset Management	$5,474,577	13122600	6620000	6257000	6449000	6023000	5845000	5775000	5483000	4427000	5540000	6359000
Operational Expenditure: Routine and Preventative Maintenance	$2,871,971	3254600	3009000	3040000	3162000	3208000	3392000	3591000	3783000	4037000	4253000	4470000
Operational Expenditure: Refurbishment and Renewal Maintenance	$367,114	1240600	1318000	1405000	1158000	1212000	1190000	1213000	1286000	1330000	1393000	1501000
Operational Expenditure: Fault and Emergency Maintenance	$518,818	687500	807000	809000	863000	915000	964000	1024000	1091000	1157000	1222000	1294000
Subtotal - Operational Expenditure on Asset Management	$3,757,903		5134000	5254000	5183000	5335000	5546000	5828000	6160000	6524000	6868000	7265000
Total Direct Expenditure on Distribution Network	$9,232,480	5182700		11511000								
Overhead to Underground Conversion Expenditure	111981	60	60	0	0	0	0	60	0	0	0	0

APPENDIX E: Glossary of Terms

AAAC: All Aluminium Alloy Conductor - Used as bare overhead conductor for primary and secondary distribution. Designed utilizing a high strength aluminum alloy to achieve a high strength-to-weight ratio; affords better sag characteristics. Aluminum alloy gives AAAC higher resistance to corrosion than ACSR.

AAC: All Aluminium Conductor - Compact strand conductor for use in bare overhead applications or for use with weather-resistant coverings or insulations is also available.

ACSR: Aluminium Conductor Steel Reinforced - Used as bare overhead transmission cable and as primary and secondary distribution cable. ACSR offers optimal strength for line design. Variable steel core stranding enables desired strength to be achieved without sacrificing ampacity.

Ampere (A): unit of electrical current flow, or rate of flow of electrons.

AMP: Asset Management Plan

CAIDI: an international index which measures the average duration of an interruption to supply for consumers that have experienced an interruption. Usually calculated on a per annum basis.

$$\text{CAIDI} = \frac{\text{Sum of (number of interrupted consumers x interruption duration)}}{\text{Sum of (number of interrupted consumers)}}$$

Capacity Utilisation: a ratio which measures the utilisation of transformers in the network. Calculated as the maximum demand experienced on an electricity network in a year divided by the transformer capacity on that network.

Circuit Breaker (CB): a device which detects excessive power demands in a circuit and cuts off power when they occur. Nearly all of these excessive demands are caused by a fault of some description on the network. In the urban network, where most of these CBs are, they do not attempt a reclose after a fault as the LCBs do on the rural overhead network.

Continuous Rating: the constant load which a device can carry at rated primary voltage and frequency without damaging and/or adversely effecting it characteristics.

Conductor: is the 'wire' that carries the electricity and includes overhead lines which can be covered (insulated) or bare (not insulated), and underground cables which are insulated.

Current: the movement of electricity through a conductor, measured in amperes (A).

DCF: Discounted Cash Flow - Method for evaluating profitability of an investment decission.

DDO: Dominion Drop out fuse used on overhead lines to provide a point of isolation and protection for distribution substations and feeders.

DGA: Dissolved Gas Analysis - Test carried out on transformer oil quality to measure the levels of dissolved gasses in the oil, this gives an indication of transformer condition.

Distribution Substation: is either a building, a kiosk, an outdoor substation or pole substation taking its supply at 11 kV and distributing at 400 V.

District Substation: a major building substation and/or switchyard with associated high voltage structure where either; voltage is transformed from 66 or 33 kV to 11 kV, two or more incoming 11 kV feeders from a grid exit point are redistributed or a ripple injection plant is installed. Sometimes known as a zone substation.

ELB: Electricity Lines Business as defined by the Commerce commission and excluding Transpower.

EPDM: Ethylene Propylene Diene Monomer rubber is used on dead end insulators. It exhibits satisfactory compatibility with fireproof hydraulic fluids, ketones, hot and cold water, and alkalis, and unsatisfactory compatibility with most oils, gasoline, kerosene, aromatic and aliphatic hydrocarbons, halogenated solvents, and concentrated acids.

Fault Current: the current from the connected power system that flows in a short circuit caused by a fault.

Feeder: a physical grouping of conductors that originate from a district substation circuit breaker.

Flashover: a disruptive discharge around or over the surface of an insulator.

Frequency: on AC circuits, the designated number of times per second that polarity alternates from positive to negative and back again, expressed in Hertz (Hz)

Fuse: a device that will heat up, melt and electrically open the circuit after a period of prolonged abnormal current flow.

GIS: Graphical Information System used by Westpower to show the physical location of assets in their network and is used as a tool with the Asset Works Management System.

Gradient, Voltage: the voltage drop, or electrical difference, between two given points.

Grid Exit Point (GXP): a point where Orion's network is connected to Transpower's transmission network.

Harmonics (Wave Form Distortion): changes an AC voltage waveform from sinusoidal to complex and can be caused by network equipment and equipment owned by consumers including electric motors or computer equipment.

High Voltage: voltage exceeding 1,000 volts (1 kV), in Orion's case generally 11 kV, 33 kV or 66 kV.

Insulator: supports live conductors, is made from material which does not allow electricity to flow through it.

kVA: the kVA, or Kilovolt-ampere, output rating designates the output which a transformer can deliver for a specified time at rated secondary voltage and rated frequency.

Line Circuit Breaker (LCB): a circuit breaker mounted on an overhead line pole which quickly cuts off power after a fault so that no permanent damage is caused to any equipment. It switches power back on after a few seconds and if the cause of the fault has gone (eg. a branch has blown off a line) then the power will stay on. If the offending item is still there then power will be cut again. This can happen up to three times before power will stay off until the fault repaired. Sometimes a LCB is known as a recloser.

Low Voltage: voltage not exceeding 1,000 volts, generally 230 or 400 volts.

Maximum Demand: the maximum demand for electricity, at any one time, during the course of the year.

MOCHED: Major outage causing huge economic damage.

Network Deliveries: total energy supplied to our network through Transpower's grid exit points, usually measured as energy supplied over the course of a year.

Outage: an interruption to the supply of electricity.

Proven Voltage Complaint: a complaint from a consumer concerning a disturbance to the voltage of their supply which has proven to be caused by the network company.

PILCSWA: Form of Cable construction - Paper Insulated Lead Covered Steel Wire Armoured cable.

ROI: Return on Investment - financial ratio for expected return for a given investment usually expressed as a percentage per year.

Ripple Control System: a system used to control the electrical load on the network by, for example, switching domestic water heaters, or by signaling large users of a high price period. Also used to control streetlights.

RTU (Remote Terminal Unit): An RTU is a device installed at a remote location that collects data, codes the data into a format that is transmittable and transmits the data back to a central station, or master. A RTU also collects information from the master device and implements processes that are directed by the master. RTUs are equipped with input channels for sensing or metering, output channels for control, indication or alarms and a communications port.

SAIDI: System Average Interruption Duration Index; an international index which measures the average duration of interruptions to supply that a consumer experiences in a given period.

$$\text{SAIDI} = \frac{\text{Sum of (number of interrupted consumers x interruption duration)}}{\text{Total number of connected consumers}}$$

SAIFI: System Average Interruption Frequency Index; an international index which measures the average number of interruptions that a consumer experiences in a given period.

$$\text{SAIFI} = \frac{\text{Sum of (number of interrupted consumers)}}{\text{Total number of connected consumers}} = \frac{\text{SAIDI}}{\text{SAIFI}}$$

SCADA: System Control and Data Acquisition.

Transformer: a device that changes voltage up to a higher voltage or down to a lower voltage.

Transpower: the state owned enterprise that operates New Zealand’s transmission network. Transpower delivers electricity from generators to various networks around the country.

Voltage: electric pressure; the force which causes current to flow through an electrical conductor.

Voltage Regulator: an electrical device that keeps voltage which is supplied to consumers at a constant level, regardless of load fluctuations.

XLPE: Cross linked Polyethylene - type of cable insulation XLPE contains cross-link bonds which are introduced into the polymer structure, changing the thermoplastic into an elastomer. XLPE-insulated cables have a rated maximum conductor temperature of 90 °C and an emergency rating of up to 140 °C, depending on the standard used to rate XLPE-insulated cables. Cables insulated with XLPE also have a conductor short-circuit rating of 250 °C. XLPE has excellent dielectric properties making it useful for a large range of voltage applications from 600 V to 500 kV.

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

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