Electricity Invercargill Ltd

Pole with Multiple Voltage Tiers and Circuits - Bluff

Asset Management Plan Update 2019 - 2029

Publicly disclosed in March 2019

Update Overview

EIL's Asset Management Plan update 2019-29 is presented as the sections shown below under contents, which have been updated from EIL's Asset Management Plan 2018-29. The headings shown in the contents retain the same numbering as the previous AMP for convenient referencing. Updates are highlighted by a green shaded background generally to indicate where project implementation timeframes have varied from those indicated in the previous AMP, where new projects have been added to the capital or maintenance programmes, or where projects have been completed and therefore do not form part of the updated work plan for future years.

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4.3 Development Programme

EIL's development programme is shown in Table 43 at the end of this section and is described in the remainder of this section, except for replacement and renewal capital expenditure programmes which are described in Lifecycle Planning.

Customer Connections

These budgets provide allowance for new connections to the network including subdivisions where a large number of customers may require connection. Each specific solution will depend on location and customer requirements.

Planning for new connections uses averages based on historical trending, modified by any local knowledge if appropriate however customer requirements are generally unpredictable and quite variable. Larger customers especially, which have the greatest effect on the network, tend not to disclose their intentions until connection is required (perhaps trying to avoid alerting competitors to commercial opportunities), so cannot be easily planned for in advance.

Various options are considered generally to determine the least cost option for providing the new connection. Work required depends on the customer's location relative to existing network and the capacity of that network to supply the additional load. This can range from a simple LV connection at a fuse in a distribution pillar box at the customer's property boundary, to upgrade of LV cables or replacement of overhead lines with cables of greater rating, up to requirement for a new transformer site with associated 11kV extension if required. Even small customers can require a large investment to increase network capacity where existing capacity is already fully utilised.

The district plan requires all new network to be underground in Invercargill, however, Bluff may utilise overhead construction which tends to be a lower cost option.

Distributed generation as a network alternative tends to be intermittent so cannot be relied on without energy storage which could make an installation uneconomic. Some schemes may be becoming cost competitive with supply from the network however the upfront cost is generally not attractive to most customers and generally a connection to the network is still desired as backup, supplementation and sometimes the ability to sell surplus energy. Customers may be encouraged to better manage diversity of load within their facilities where details are known and there is perceived benefit to the customer or network.

Budgets for subdivisions and distributed generation are separated from other connections to support trending analysis; however these budgets are set low as it is expected that spend will occur against them only once every few years.

$0.5M to $2.5M per annum on-going; CAPEX - Consumer Connections.

The scope and timing of works for years 2019/20 – 2022/23 have been adjusted to customers' most recent plans as communicated to EIL.

Bluff LV Service Lines

This is a new project for remediating the relatively high number of LV faults in Bluff. The majority of LV faults in Bluff appear to be due to failure of service main components. Some portion of these failures are due to defects on customer owned components.

Historic demarcation of ownership has been the customer's physical boundary (fence etc.). Maintenance and repair of the customer owned portion of the service line is the responsibility of the customer. However, this is often not understood by customers.

Customers may perceive customer side LV faults to be due to network failure. Customers are not equipped to locate and diagnose faults, and call network staff who attend to it as a first response. The result is that EIL incurs costs that are difficult to recover from the initiating customer.

The initial phase of the project is to survey the condition of customer side and network side LV components to ascertain the scope of the issue and formulate appropriate responses. The budgets for years 2020/21 – 2022/23 are for replacement of LV service mains, and where appropriate, transfer ownership of the service main to EIL.

Cost under $0.5M per annum 2019/20 - 2023/24; Consumer Connection.

Unspecified Development Projects

This budget is an estimate of costs for projects that are as yet unknown, but are considered likely to arise in the longer term. Certainty for these estimates is obviously low.

The most likely source of material impact, in the first half of the planning period, is anticipated to be from energy and environmental policies driven by local and national government. The staggered prohibitions on coal burners are expected to drive the conversion of small-scale process heating, residential and commercial space heating, to electrical heating in a phased manner.

In the second half of the planning period, electric vehicle uptake is expected to show material impact on LV and MV network capacity. Other likely drivers include: increased regulatory requirements, subsequent growth flow on from current city developments

Cost $0.5M - $2.5M per annum 2024/25 onwards; Consumer Connection.

No material change.

Asset Relocation Projects

This budget captures costs for general minor relocation works required such as shifting a pole or pillar box to a more convenient location. Costs budgeted represent a long term average with actual spend being reactive and typically above or below budget in any year.

Under $0.5M per annum on-going; CAPEX – Asset Relocations

No material change.

Stead St StopBank

This project was previously managed and disclosed under the title "Undergrounding Programme" and is described as follows.

While the great majority of the City network has been converted to underground cable, the westernmost conductor toward the airport and Otatara is currently overhead construction. This line runs along a stopbank which is scheduled for a major upgrade. The nature of the terrain is such that the stopbank upgrade cannot be completed without encroaching within an unsafe distance of the overhead conductors. Therefore the line must be de-energised for the duration of the upgrade project.

The line feeds emergency drainage pumps that are essential to the local flood protection scheme, and therefore cannot be de-energised for significant periods. The most economic option for providing an alternative supply to the pumps involves replacing a section of the overhead line with cable. The budget required is relatively small, as all earthworks associated with the installation will be carried out under the stopbank upgrade project with no expense to EIL.

Cost under $0.5M 2021/22; CAPEX – Asset Relocations.

This project was deferred to 2021/22 to align with Council's current plans for the stopbank.

Supply Quality Upgrades

On the LV network operation beyond capacity manifests as low voltage experienced by customers during periods of peak loading. This may occasionally require a new transformer site with associated 11kV extension if required. However in most cases replacing LV cables with larger cables will be a more economic option to maintain acceptable voltage for all customers. The minimum standard cable size which provides the existing and spare capacity for expected growth will be used.

An alternative to network upgrade is demand side management however cost incentives to reduce demand are proving ineffective due to the retailers repackaging of line charges into their billing. As EIL's 11kV feeders have high load density supplied over a relatively short distance, low voltage is not seen as an issue on these feeders. Harmonics have not caused any known issues to date.

Costs budgeted represent a long term average with actual spend being reactive typically being above or below in any year. As the rollout of smart meters on the EIL network progresses, clarity and scope of network issues identified (such as voltage constraints, harmonics) is expected to increase.

Under $0.5M per annum on-going; CAPEX – Quality of Supply.

The anticipated increase in work from smart meter low voltage information has not yet eventuated, due to delays in smart meter rollout combined with difficulties in accessing the data.

EIL is starting to see an increase in customer complaints, with harmonics as a suspected cause.

The allowance for this work will be adjusted with more accurate projections of work volume.

Network Automation Projects

Network Automation Projects: This budget is to allow implementation of network automation initiatives on the Invercargill and Bluff networks to add additional remote controllable switching points and automation technologies. The resulting improvements in reliability are intended to offset the reduction in reliability that is to be expected as the cable network is allowed to age back to the optimal average asset life remaining of 50%; the extensive underground programme and other recent or near future capital intensive projects have made EIL into an unusually young network.

Under $0.5M per annum on-going; CAPEX – Quality of Supply.

Earlier automation efforts in Bluff township have shown considerable reliability benefits. Two additional remote controllable switching points are planned for in 2021/22. The additional depth to the Bluff network automation scheme is expected to improve reliability to EIL's least reliable feeders.

Cost under $0.5M 2021/22; CAPEX – Quality of Supply

Pillar Box Lid Upgrade

EIL has traditionally used concrete pillar boxes with aluminium lids on the front to enclose the fusing for individual customers' supplies. However in very rare cases the internal cables can come into physical contact with the lid, and the cable insulation can be gradually abraded, e.g. as a result of minute vibrations caused by nearby traffic. If the insulation were to abrade sufficiently between pillar box inspections, this situation could result in livening of the aluminium lid.

A supplier has been sourced for plastic lids that offer similar mechanical protection to the aluminium lids whilst being electrically nonconductive. These plastic lids will be installed as a part of the next inspection round, at a rate of 20% of the pillar box fleet per year.

Under $0.5M per annum 2017-22; CAPEX – Other Reliability, Safety and Environment.

No material change.

Doon Street Reconfiguration

The 33kV oil cables previously supplying Doon St Substation were paralleled and extended with an XLPE cable to form the second feeder to the Spey Street substation (refer to EIL's 2016 AMP).

Along with the 33kV cable termination, the Doon St Substation still contains:

- the RTU which provides remote monitoring for the oil cable
- the Doon Street T1 transformer, which is planned to be moved to Southern Substation
- remnant circuit breakers to be disassembled for spare components

Furan analysis of oil and DP testing of a paper sample from the 23MVA Doon Street T1 transformer indicate that the winding insulation is significantly aged. The unit was planned to be removed from site refurbished and stored until completion of upgrades at Southern substation where the unit would then be put back into service to complete the upgrade to AAA security.

However given the age indicators it is considered an unacceptable risk to spend the additional costs for the refurbishment, storage and transformer movements when the unit may still fail soon after installation. The un-refurbished unit should still provide several years of life, allowing deferment of capital expenditure on a new 23MVA transformer.

Deferring the demolition works at Doon Street allows the unit to remain in situ until Southern substation is made ready to install the Doon T1 transformer, thus reducing relocation cost.

The planned demolition and reinstatement works for the remaining Doon Street site have been deferred until 2024/25, when remediation of earthquake prone buildings is due.

Under $0.5M 2024/25; CAPEX – System Growth.

> The remaining Doon St Substation works have been deferred to 2024/25 due to the delay of the Southern Substation project and to better manage other network safety risks.

Earth Upgrades

Ineffective earthing may create, or fail to control, hazardous voltage that may occur on and around network equipment affecting safety for the public and for staff. Ineffective earthing may prevent protection systems from operating correctly which may affect safety and reliability of the network. Routine earth site inspection and testing identifies any sites that require upgrades.

The analysis to determine what upgrade options are appropriate can be quite complex but essentially it looks to find the best trade-off between cost and risk reduction. Generally in EIL the earthing upgrades required will be minimal with safety being achieved by simple connection to the large urban MEN (multiple earthed neutral) system. However, for sites where risk of potential exposure to EPR is high additional measures for example insulating barriers will be required to ensure public safety.

Routine testing is completed five yearly with the entire network tested in one year.

This project has been increased to cover remediation of non-compliant / un-maintainable sites discovered in the most recent earth inspection / testing round.

Under $0.5M 2019/20 – 2022/23, 5-yearly thereafter; CAPEX – Other Reliability, Safety and Environmental.

Spey St Fibre Chamber/Cable

The fibre run outside Spey St substation follows a sufficiently tortuous path that two individual fibres were damaged when the fibre cable was installed. While there are sufficient surplus fibres in the cable to meet the current requirement, there remains the possibility that other fibres were pressed during installation and may fail prematurely in the future.

This budget provides for replacement of the damaged section of cable together with a new fibre chamber that will allow installation to occur over a less tortuous path.

Under $0.5M 2021/22; CAPEX – Other Reliability, Safety and Environment.

No material change.

LV Tie Point Disconnectors

Distribution substations are routinely de-energised to carry out necessary maintenance on the ring main units. In order to prevent disruption of supply to customers, the substation's load is transferred to neighbouring substations prior to de-energisation. This load transfer is currently carried out by manually connecting live conductors together at tie points using cable taps.

While the risks of this procedure are largely mitigated by the use of administrative controls, insulating mats, and personal protective equipment (PPE), the residual safety risk may be deemed inappropriate for a modern electricity distribution business working under current health and safety legislation.

This project provides for the installation of disconnector switches at all LV tie points on the network. In addition to the safety benefit, this project is expected to reduce the switching time associated with a de-energisation and reduce wear / tear from manual handling of cables. Initial focus will be on pillar boxes expected to be used for upcoming distribution substation maintenance and replacements.

Upon completion of the pillar retrofits, the focus will shift to switches that require pillar replacement. This will most likely involve replacing existing pillars with a larger injection moulded pillar box. Overall nearly 1000 pillars will be upgraded in a project that extends beyond the end of the planning period.

Under $0.5M 2021/22 onward

No material change.

Neutral Earth Resistor Protection Upgrade

Open-circuited Neutral Earth Resistors (NERs) are a known problem in New Zealand that can lower fault current to the point that normal earth fault protection will not operate. EIL will upgrade its NER protection to detect and trip when a fault occurs on an open-circuited NER.

A new feature recently offered on the SEL 751 relay allows improved modelling of the heating and cooling of the NER. This feature allows thermal protection to be retained whilst lowering the risk of an NER tripping due to the current imbalance that can result when substations are paralleled for switching. EIL will take the opportunity to improve thermal protection whilst carrying out the upgrade for open-circuit protection.

EIL's Racecourse Road substation relies on the feeder breaker at the nearby Invercargill Grid Exit Point (GXP) for backup protection in the event of an 11 kV bus/winding fault. The installation of an NER reduces the effectiveness of this backup protection due to the lower level of fault current flowing at 33 kV. A redundant communications path between substation and GXP is required to ensure adequate backup protection.

This project addresses all three of the above issues on EIL's substations.

Cost under $0.5M 2017/18; CAPEX – Other Reliability, Safety and Environment

This project is expected to be completed by the end of the 2018/19 year.

4.6 EIL's Forecast Capital Expenditure

These figures are also provided in the information disclosure schedule 11a included in Appendix 3.

Table 43: EIL's Forecast Capital Expenditure ($'000)

CAPEX: Consumer Connection	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Customer Connections (≤ 20kVA)	58	58	58	58	58	58	58	58	58	58
Customer Connections (21 to 99kVA)	52	52	52	52	52	52	52	52	52	52
Customer Connections (≥ 100kVA)	259	590	670	771	110	110	110	110	110	110
Distributed Generation Connection	3	3	3	3	3	3	3	3	3	3
New Subdivisions	3	3	3	3	3	3	3	3	3	3
Bluff LV Service Lines	44	199	199	199	199					
Unspecified Development Projects						515	515	515	515	515
	419	**904**	**985**	**1,086**	**425**	**741**	**741**	**741**	**741**	**741**

CAPEX: System Growth	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Doon Street Reconfiguration						388				
						388				

CAPEX: Asset Replacement and Renewal	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Underground Substation Replacements	273									
Link Box Replacement	156	156	156	156	156	156	156	156	156	156
RTU Replacement	35			166						
Southern Substation Upgrades	3,400	1,928								
Power Transformer Refurbishment		159	159							
Racecourse Road Switchboard Replacement				130	1,546					
Seismic Remedial Distribution		273	334	334	267					
Maximum Demand Indicator Upgrade			50	50	50	50				
Zone Substation Minor Replacement	4	4	4	4	4	4	4	4	4	4
Transformer Replacement - City	167	100	391	452	452	452	452	452	452	452
Transformer Replacement - Bluff	52	94	94	94	94	94	94	94	94	94
RMU Replacements	491	432	1,129	1,588	1,184	1,184	565	565	565	565
Reactive 11 kV Cable Replacement	20	20	20	20	20	20	20	20	20	20
Planned 11 kV Cable Replacement	193		284	284	284	284	284	284	284	284
Fibre Installation	32	32	32	32	32	32	32	32	32	32
General Technical Replacement	18	54	54	54	54	54	54	54	54	54
General Dist Replacement - City	20	20	20	20	20	20	20	20	20	20
General Dist Replacement - Bluff	100	100	100	100	100	100	100	100	100	100
LV Board Replacement	29	29	29	29	29	29	29	29	29	29
Pillar Box Replacement	68	68	68	68	68	68	68	68	68	68
LV Cable Replacement	66	66	66	66	66	66	66	66	66	66
Unspecified Asset Replacement & Renewal Projects						611	1,223	1,223	1,223	1,223
Bluff Conductor Replacement										572
	5,123	**3,535**	**2,989**	**3,645**	**4,424**	**3,223**	**3,165**	**3,165**	**3,165**	**3,737**

CAPEX: Asset Relocations	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Asset Relocation Projects	6	6	6	6	6	6	6	6	6	6
Undergrounding Programme			20							
	6	**6**	**26**	**6**	**6**	**6**	**6**	**6**	**6**	**6**

CAPEX: Quality of Supply	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Supply Quality Upgrades - City	34	13	13	13	13	13	13	13	13	13
Supply Quality Upgrades - Bluff	1	1	1	1	1	1	1	1	1	1
Network Automation Projects	68	29	274	29	29	29	29	29	29	29
	103	**43**	**288**	**43**	**43**	**43**	**43**	**43**	**43**	**43**

CAPEX: Legislative and Regulatory ($000)	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29

CAPEX: Other Reliability, Safety and Environment	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Earth Upgrades - City	131	105	105	131						13
Earth Upgrades - Bluff		26	26						1	1
Pillar Box Lid Upgrade	93	93	93							
Spey St Fibre Chamber/Cable			18							
LV Tie Point Disconnectors			233	233	233	233	233	233	233	233
	224	**224**	**475**	**364**	**233**	**233**	**233**	**233**	**234**	**248**

Total Network CAPEX ($000)	5,876	4,712	4,763	5,144	5,132	4,634	4,189	4,189	4,190	4,775

5.2 Routine Corrective Maintenance & Inspection

Maintenance and Inspection Programmes

Budget descriptions for routine corrective maintenance and inspection activities are set out in Table 45 and forecasts are provided in Table 51 at the end of this section. These budgets tend to be ongoing at similar levels year after year but may be adjusted from time to time to allow for improvements in maintenance practice.

No material change to these budgets except where otherwise indicated.

Table 45: Routine and Corrective Maintenance and Inspection Budget Descriptions

Budget	Description	Expenditure Range/Type
Routine Distribution Inspections	All work where the primary driver is the five yearly network inspections (20% inspected annually), or other routine tests on distribution assets. Includes any minor maintenance works carried out during these inspections.	Under $0.5M p.a. OPEX
Routine Technical Inspections	All work where the primary driver is routine inspection and testing of Technical assets, for example oil DGA, earth mat testing, and protection testing. Includes any minor maintenance carried out during these inspections.	Under $0.5M p.a. OPEX
Technical Routine Maintenance	All work where the primary driver is inspection, testing and maintenance of Technical assets. Includes any servicing activities (such as oil processing, CB oil replacement, or recalibration of relays) and testing or maintenance that requires the asset to be de-energised.	Under $0.5M p.a. OPEX

This budget has been re-named to better reflect the primary activity undertaken.

Distribution Corrective Maintenance	Permanent repairs carried out on faulted Distribution assets that had been temporarily been made safe/functional during the initial incident response.	Under $0.5M p.a. OPEX
Technical Corrective Maintenance	Permanent repairs carried out on faulted Technical assets that had been temporarily been made safe/functional during the initial incident response.	Under $0.5M p.a. OPEX
Zone Substation Routine Maintenance	All work where the primary driver is routine scheduled maintenance (other than preventative maintenance) on zone substations. For example SEPA unit cleaning, mowing, and minor weed control.	Under $0.5M p.a. OPEX

Budget	Description	Expenditure Range/Type
Distribution Substation Routine Maintenance	All work where the primary driver is routine scheduled maintenance (other than preventative maintenance) on distribution substations. For example cleaning, minor weed control, enclosure repainting.	Under $0.5M p.a. OPEX
Earth Testing	Routine testing of earthing assets and connections to ensure safety and functional requirements are met completed five yearly, next due 2022/23.	Under $0.5M 2022/23 and five yearly thereafter; OPEX
Partial Discharge Survey	Partial discharge condition monitoring of equipment to identify abnormal discharge levels before failure occurs.	Under $0.5M p.a. OPEX
Infra-Red & Corona Survey	Infra-Red and Corona Discharge condition monitoring survey of bus-work, connections, contacts etc. An Infra-Red survey checks for abnormal heating as an indication of poor electrical contact between current carrying components, which may lead to voltage quality issues and/or failure of equipment; while Corona Discharge testing looks for ionisation of air around insulators, as evidence of insulation defects or contamination.	Under $0.5M p.a. OPEX
Supply Quality Checks	Investigations into supply quality which are generally customer initiated.	Under $0.5M p.a. OPEX
Spare Checks and Minor Maintenance	A budget for checks to confirm what equipment is kept in spares and perform minor maintenance required to ensure spares are ready for service.	Under $0.5M p.a. OPEX
Customer Connections	Operational portion of expenditure for the customer connections process is captured in this budget.	Under $0.5M p.a. OPEX
Distribution Substation Seismic Survey	A one-off budget to assess the seismic risk associated with EIL's distribution substations. Budget is allocated in 2018/19 to gather measurements for seismic analysis, and in 2019/20 for carrying out that analysis. Remedial works to correct any deficiencies found will commence as a capital project in 2020/21.	Under $0.5M p.a. 2019/20 OPEX

Systemic Issues

EIL has been made aware of a potential systemic weakness in the 33 kV oil filled cables which supply Spey St and Southern substations. Similar cables on other distribution company's networks have been found showing signs of insulation damage due to weakness in the cable joints allowing movement of the cores with thermodynamic expansion and contraction. The reliability risk associated with this weakness has been mitigated through ensuring that all oil-filled cables on the network have an alternate supply option through an XLPE cable.

EIL's underground substations have been identified as confined spaces and therefore require special operational procedures to manage the associated risks making these sites burdensome to access and maintain. Despite these controls, a significant level of residual risk remains. A further concern is the approaching end of life of these substations; their underground nature and their location in the CBD mean that renewal of these sites in situ would cause significant disruption for the public. The costs and risks associated with these substations make it appropriate to replace them with above ground sites. This replacement programme is detailed in Asset Replacement and Renewal.

Underground link boxes have also been identified as a safety issue with potential for arc-flash hazard, and are presently being replaced.

EIL has many oil filled RMUs with operating restrictions in place to mitigate arc flash safety risk. Short term solutions have been able to be developed for some models of RMU, which allow safe operation without the inconvenience and reliability impact of operating restrictions. Longer term management of these issues is likely to require early replacement of many RMUs.

Some models of RMU have exhibited faster than usual corrosion which is likely to adversely affect the service life of the assets. Repairs will be carried out where economic and practical to do so, but it is expected that many of these assets will need to be replaced ahead of their nominal life, causing their replacement to overlap with the older but sturdier models that preceded them. It is expected that the majority of the "Unspecified Projects" budget in years 6 to 10 of forecast CAPEX will be devoted to RMU replacements.

EIL has experienced water ingress issues with early ABB SD type RMUs that utilise high voltage busbar insulation tape (HVBT) in the bus couplings. All such RMUs are having their bus coupling boxes converted to the Guroflex insulating filling compound that succeeded the original HVBT bus coupling kit.

There are no other systemic issues presently being investigated. Examples of past investigations and outcomes are shown below. Some of these examples represent learnings from issues found on other networks managed by PowerNet but which are common to the EIL network.

- Kidney strain insulators: Replaced with new polymer strains.
- DIN LV fuses: Sourced units that can be used outdoor.
- Parallel-groove clamps: Replaced with compression joints.
- Non-UV stabilised insulation: Exposed LV now has sleeve cover, with new cables UV stabilised.
- Opossum faults: Extended opossum guard length.

5.3 Asset Replacement and Renewal

The overall objective for replacement and renewal programmes is to get the most out of the network assets by replacing assets as close as possible to their economic end of life. This is balanced by the need to manage workforce resources in the short term and delivery of desired service levels over the long term.

Inspection and testing programmes identify assets that are reaching the end of their economic life while critical assets may be replaced on a fixed time basis. For example, 11 kV switchboards at zone substations are generally replaced at the end of their nominal year life. Less critical assets or assets provided with redundancy as part of security arrangements may be run to failure and replaced reactively. Assets such as cables may be run to failure several times and repaired before the fault frequency increases to a point that complete replacement is more economic. This approach requires monitoring of failure rates.

Apart from whole of lifecycle cost analysis, there are several other drivers for replacement (though they can often be reduced to a cost analysis) including operational/public safety, risk management, declining service levels, accessibility for maintenance, obsolescence and new technology providing options for additional features or alternative solutions. Replacement of assets may also be heavily influenced by the development drivers discussed in the Development Criteria section.

Innovations That Defer Asset Replacement

There are a number of innovations that EIL uses to defer asset replacement. These include;

- Thermal (Infrared) and Partial Discharge (Corona) camera inspections of Zone Substation equipment
- Mid-life refurbishment of power transformers
- Dissolved Gas Analysis (DGA) of large distribution transformers
- Thor hammer analysis of poles
- Automation of switchgear to enable faster restoration in the event of faults

Table 46 sets out the approach to making decisions around when to undertake replacements or renewals applicable to each network asset category.

Table 46: Replacement and Renewal Decisions by Asset Category

Asset Category	Sub Category	Replacement and Renewal Decision Approach
Subtransmission	O/H	Reactive replacements after failure due to external force. Poles replaced when structural integrity indicated as low by pole scan or visual inspection. Generally poles cross arms, pins, insulators, binders and bracing etc. replaced when inspection indicates deterioration that could cause failure prior to next inspection and maintenance is uneconomic. Conductor replaced when reliability declines to an unacceptable level or repairs become uneconomic.
	U/G	XLPE cables replaced when reliability declines to an unacceptable level or repairs become uneconomic. Oil cables may be damaged beyond economic repair depending on nature of failure.
	Distributed Sub Transmission Voltage Switchgear (ABSs)	When inspection indicates deterioration sufficient to lose confidence in continued reliable operation and maintenance is considered uneconomic.
Zone Substations	Sub Transmission Voltage Switchgear	Replaced at end of standard life (fixed time), may be delayed in conjunction with condition monitoring to achieve strategic objectives. Significant damage from premature failure could require replacement.
	Power Transformers	Major refurbishment for transformers is undertaken when units reach half of their expected life. Replaced after failure causing significant damage that is not economic to repair; most units will be allowed to run to failure to utilise entire lifespan unless failure risk is unacceptable. May be replaced if tank and fittings are deteriorating, spare parts are unavailable and not economic to maintain for aged units. May be scrapped if not economic to relocate (transport and installation costs) after aged transformers displaced e.g. for a larger unit. Paper, Furan or DGA analysis used to indicate insulation remaining life.
	Distribution Voltage Switchgear	Replaced at end of standard life (fixed time), may be delayed in conjunction with condition monitoring to achieve strategic objectives. Significant damage from premature failure could require replacement.
	Other (Buildings, RTU, Relays, Batteries, Meters)	Instrumentation/Protection at end of manufacturers stated life (fixed time) or when obsolete/unsupported or otherwise along with other replacements as economic e.g. protection replaced with switchboard or transformer. Batteries replaced prior to the manufacturers stated life expectancy (typically 10 years) or on failure of testing.

Asset Category	Sub Category	Replacement and Renewal Decision Approach
		Buildings and fences when not economic to maintain after significant accumulating deterioration or seismic resilience concerns. Bus work and conductors not economical to maintain. Greater than standard life and maintenance required.
Distribution Network	O/H	Reactive replacements after failure due to external force. Poles replaced when structural integrity indicated as low by pole scan or visual inspection. Generally poles cross arms, pins, insulators, binders and bracing etc. replaced when inspection indicates deterioration that could cause failure prior to next inspection and maintenance is uneconomic. Conductor replaced when reliability declines to an unacceptable level or repairs become uneconomic.
	U/G	XLPE or paper lead cables replaced when reliability declines to an unacceptable level or repairs become uneconomic.
	Distributed Distribution Voltage Switchgear	Replaced at end of projected life, depending on known type failures and current condition. Significant damage from premature failure or deterioration could require replacement.
Distribution Substations	Distribution Transformers	Replaced if rusting is advanced or other deterioration/damage is significant and maintenance becomes uneconomic. Otherwise units generally run to failure but transformers supplying critical loads may be replaced early based on age or as part of other replacements at site. Units removed from service <100 kVA and older than 20 yrs are scrapped; otherwise units testing satisfactory recycled as stock.
	Distribution Voltage Switchgear (RMUs)	Replaced at end of projected life, depending on known type failures and current condition. Significant damage from premature failure or deterioration could require replacement.
	Other	Instrumentation/Protection at end of manufacturers stated life (fixed time) or when obsolete/unsupported or otherwise along with other replacements as economic e.g. protection replaced with switchboard or transformer. Batteries replaced prior to the manufacturers stated life expectancy (typically 10 years) or on failure of testing. Enclosures not economic to maintain after significant accumulating deterioration or seismic resilience concerns.
LV Network	O/H	Reactive replacements after failure due to external force. Poles replaced when structural integrity indicated as low by pole scan or visual inspection. Generally poles cross arms, pins, insulators, binders and bracing etc. replaced when inspection indicates deterioration that could cause failure prior to next inspection and maintenance is uneconomic. Conductor replaced when reliability declines to an unacceptable level or repairs become uneconomic.

Asset Category	Sub Category	Replacement and Renewal Decision Approach
	U/G	Generally run to failure. Replaced when condition declines to an unreliable level e.g. embrittlement of insulation.
	Link and Pillar Boxes	Replaced if damaged or deterioration is advanced and could lead to failure before next inspection (or if public safety concerns exist).
Other	SCADA & Communications	RTUs or radios at end of manufacturers stated life (fixed time) or when obsolete/unsupported or otherwise along with other replacements as economic.
	Earths	Replaced when inspections find non-standard arrangements, deteriorated components or test results are not acceptable.
	Ripple Plant	Becoming obsolete as smart meters are installed across the network. Run to failure but security provided by backup plant.

Non-Routine Replacement and Renewal Projects

Replacement and renewal projects that are not ongoing are described in Table 42 and often represent one-off replacement or renewal of significant assets that have reached end of life or a significant milestone in its life. Other projects may target a number of assets of similar age that will be replaced or renewed as part of short or medium term programme.

Table 47: Non-routine Replacement and Renewal Projects

Project and Description	Cost and Timing
Underground Substation Replacements: EIL owns several underground distribution substations in and around the Invercargill CBD. These substations contain 11 kV switchgear, distribution transformers, LV distribution boards and several other minor components. Equipment has now reached end of life at some sites and requires replacement as risk of failure increases to ensure acceptable service levels are maintained. Each underground substation is a fully enclosed space with limited access. They have been deemed "confined spaces" due to the risk of toxic or oxygen deficient atmosphere and the difficulties of rescuing an unconscious person due to an accident or health condition. Extensive measures have been put in place to manage these risks however some residual risk remains and accessing these sites has become rather cumbersome and ultimately expensive. EIL has determined that the best option is to relocate these sites above ground; and while finding suitable locations within the Invercargill CBD is difficult, it is the only way to eliminate the confined space risks. Negotiating sites within carparks is desirable as this will also help avoid future traffic management in the busy CBD, pavement disruption and pavement reinstatement works (often stylized with paving stones) when working around these sites in future. This programme was initiated in 2014/15 when the Kelvin Hotel substation was replaced with an above ground substation in the Southland Times building carpark. The replacement programme has continued at an average rate of four underground sites per year, with all but one of the sites to be removed by the end of the 2018/19 year. Replacement of the remaining site will be delayed until plans for a substantial nearby commercial development are finalised; the safety risk associated with this site will be eliminated by banning energised switching at the site, and the reliability risk associated with the switching ban will be minimal once all neighbouring sites are aboveground.	CAPEX Under $0.5M 2019/20
All but 2 of the underground substations have been replaced. Replacement of network equipment at one of those remaining underground substations will be completed before the end of 2018/19, with site reinstatement to follow in the 2019/20 year. The replacement of the last remaining underground substation is related to the Invercargill CBD development, and will commence once a new site has been designated.	
Link-box Replacements: These LV link boxes have been identified as a safety issue due to their below ground arrangement, the need to work above exposed conductors, and the potential for items to fall into the link-box creating arc-flash incidents. While the conductors are protected from ground water by a bell arrangement, the outer enclosure of the link boxes are often found filled with water making them difficult to access. These link boxes are also aged with	CAPEX Under $0.5M on-going

Project and Description	Cost and Timing
significant rusting and melting pitch insulation indicating insufficient rating at higher load. The above issues in general and the safety concerns in particular have led to these below-ground link boxes are being replaced with urgency. Consideration is given to rationalising the number of link-boxes on the LV network to provide sufficient switching flexibility as each is identified for replacement. However for the most part the existing link-boxes are providing a necessary function and are simply replaced with an above ground equivalent. The link-boxes are generally shifted a few metres from the pavement to a convenient location that satisfies the councils requirements – for example the link-boxes replaced along Esk Street were incorporated into recreational features to minimise clutter and visual impact. A portion of the budgeted cost is devoted to extending cables to a new offset location, and to the associated ground works and reinstatement. All underground link boxes are expected to be replaced by the end of 2018/19. The remaining link boxes marked for replacement are above ground.	
RTU Replacements: RTUs provide the SCADA interface between PowerNet's System Control room and the devices located at remote substations. They allow remote indication and control for connected devices; for example the ability to open and close circuit breakers, view their status and receive alarms (such as a circuit breaker trip). RTUs are a critical part of maintaining service levels on the network, because the remote indication and the ability to remotely operate the network greatly reduce the time to respond to faults on the network. Replacements of the RTU at the Leven Street zone substation and of eight mini GPT RTUs at automated distribution substations in the Invercargill CBD are being carried out. The Kingfisher RTU at Racecourse Road substation reaches end of life in 2020. Its replacement is scheduled for 2022/23 to align with the switchboard replacement. Replacement is ideally done on a fixed time basis to minimise probability of a failure which could have a large impact on network reliability due to the loss of indication and ability to control zone substation equipment. The RTUs at Leven Street zone substation and five of the eight mini GPT RTUs at automated distribution substations in the Invercargill CBD have been replaced. The remaining three mini GPT RTUs will now be replaced in the 2019/20 year. The replacement of the Kingfisher RTU has been deferred to 2022/23 to align with the Racecourse Road switchboard replacement. Should the unit show signs of failing, replacement timing may be accelerated.	CAPEX Under $0.5M 2019/20 and 2022/23
Power Transformer Refurbishment: EIL has recently introduced a strategy to refurbish power transformers beyond half of their expected life. This refurbishment is aimed at ensuring the expected life of transformers and potentially extending life; the resulting deferral of replacements will achieve cost efficiencies in maintaining service for EIL's customers. Three of EIL's 23MVA zone substation transformers are beyond their midlife and unrefurbished. However, the ex-Doon Street transformer which is to be relocated to Southern substation will not be refurbished. Furan and paper sample analysis	CAPEX Under $0.5M p.a. 2020/21 and 2021/22

Project and Description	Cost and Timing
show that this unit's insulation is consistent with its age and therefore the cost of refurbishment is considered uneconomic given the likely level of remaining life that can be achieved. Refurbishment of the other two transformers has been deferred until after April 2020 to best manage capital investment in respect of the regulator imposed revenue limits. The older of the Leven Street units is scheduled for refurbishment in 2020/21 and the Southern substation transformer in 2021/22. No material change.	
Racecourse Road Switchboard Replacement: The 11 kV switchboard at Racecourse Road substation consisting of 12 circuit breaker cubicles will reach the end of its nominal standard life in 2020/21. Its replacement was scheduled for 2020/21 with design costs allowed for in 2019/20. Failure of the switchboard could have a major impact on network reliability and security, potentially over an extended period depending on the nature of the damage. Risks associated with continued operation of the 11 kV switchboard near end of expected life are being mitigated by regular condition monitoring of the switchgear with modified access and work practices. Replacement will be based on a modern equivalent selected through a tender process to obtain the best price for equipment able to meet the functional requirements for the new switchboard. This project was deferred to 2022/23 to allow for replacement of higher risk RMUs. There is a consistent level of partial discharge suspected to be from a few cable boxes and CTs. Repair will be attempted in the intervening years till replacement.	CAPEX Cost Under $0.5M 2022/23 and $0.5-2.5M 2023/24
Seismic Remedial Distribution: This project will implement seismic remedial solutions at EIL's distribution substations following seismic assessments. Various options will be available depending on the site characteristics and include strengthening of buildings, enclosures or structures or replacement with self-contained freestanding equipment if more economic. Many sites are unique however there are several common "themes" to enclosures used for ground mounted distribution substations and therefore common solutions can be applied to groups of sites. This programme has been deferred until the next default price path period (from April 2020) to best manage capital investment in respect of the regulator imposed revenue limits as well as available resource being utilised on higher risk management programmes. The probability of an earthquake in the interim remains low and as the damage from a credible earthquake in this period is not expected to be catastrophic across the network the risk is considered acceptable. Remedial work will be spread across three years to manage workload; beginning in 2020/21 and being completed in the 2023/24 year. Once the full network survey is completed, the full scope of remediation works can be costed and planned for. More refined budgets will be provided in following AMPs	CAPEX Cost Under $0.5M 2020/21, 2021/22 and 2022/23

Project and Description	Cost and Timing
Maximum Demand Indicator Upgrade: EIL system planning relies on monitoring of distribution transformer loads. Currently, this is done through the use of maximum demand indicators (MDIs), which are read manually. A recent review of the current state of MDIs shows defects in a not insignificant portion of the MDI population. Many MDIs are also at or approaching end of life. The increasing gaps in network load monitoring is beginning to encroach on EIL's ability to optimally manage equipment life and operational planning. This need becomes increasingly stark with substantial changes in power consumption. One such change anticipated is the uptake of electric vehicles (EVs). The effects on the network are expected to be most pronounced on the LV network, where the lesser diversity and lower power capacity increases the probability that a clustering of downstream EVs will cause some cables to experience a substantial increase in demand. The future location of such clusters is relatively unpredictable. In such cases, the ability for EIL to closely monitor LV power flows would be invaluable. It is expected that EIL will be able to gather the necessary data at the load end of the LV network after the rollout of smart meters in the EIL area is completed. EIL is exploring the use of data aggregation from customer smart meters as a substitute measure to MDIs. This has advantages over traditional MDIs, which are unable to distinguish between load transfers and genuine load increase, and are incapable of recording the time series data necessary for a comparison with load end data. However, there is the possibility that smart meter rollout may be stalled at levels insufficient to make reasonable inferences of transformer load. For example, customers may refuse smart meter installation on their premises, or there may be a change in commercial terms with the meter data provider. EIL has therefore considered a plan to replace the network's MDIs with smart meters. Where possible existing MDI CTs will be reused and the smart meter will be mounted in the space vacated by the MDI. Replacements will be targeted where smart meter rollout is anticipated to be difficult, and where existing MDIs are defective. Where an LV board is being replaced in the next few years, a smart meter MDI will be installed (costs for smart meter MDIs are comparable to traditional MDIs). It is expected that load end smart meters will be operational in time. This project is to retrofit smart meter MDIs to the remaining substations where smart meter installation may be at risk, or uneconomic. The MDI upgrade will commence in 2021/22 and take place over the four years to 2024/25. This timeframe should allow for at least two years' data collection before EV clusters start to significantly affect voltage on the network, an issue which is not expected to occur before 2026. EIL will continue to evaluate alternatives to MDI installation as opportunities arise. If an alternative solution is found to be superior on a benefit/cost basis, then the Maximum Demand Indicator Upgrade project may be altered or cancelled in future AMPs. Alternatively, if the smart meter installation programme is not expected to complete on time, the Maximum Demand Indicator Upgrade project may expand to acquire the necessary data.	CAPEX Under $0.5M p.a. 2021/22, 2022/23, 2023/24, and 2024/25

No material change.

Southern Substation Upgrades

A major renewal and upgrade project has been planned for the Southern substation site as a combined solution for several development drivers.

The key drivers for this project are:

- The 11kV switchboard has been in service for longer than industry standard life (was due for replacement in 2014). Its condition is currently serviceable, but has had repairs for defects of type indicating end of life.
- The outdoor structures are showing signs of cracking and reinforcement rust, and have been assessed as below seismic standards
- Air break switches and earth switches will exceed Maximum Practical Life in 2019, and show signs of significant deterioration
- One of the two 33 kV circuit breakers is in poor condition with cracked insulators
- The other 33kV circuit breaker has had significant rusting (ex-Bluff), and corona discharge at the bushing tank interfaces
- The existing in-service transformer T1 is due for replacement or refurbishment in 2023
- There is no alternate supply to a large number of customers normally supplied from the substation during the winter period
- The current substation equipment and configuration does not meet network security standards for current demand levels

The substation load has reached the threshold in EIL's security standard for upgrade to AAA security (no interruption for any single failure event). Load transfers have been used to control substation load to a certain extent, but at the cost of long term reliability.

<u>Planned upgrades</u>

A staged approach toward an indoor substation is planned providing for due replacements, seismic resilience and AAA security for the substation's growing load.

The upgrade in 2019/20/21 will install a new 11 kV switchboard, auxiliary services and a new 33 kV switchboard to replace the outdoor circuit breakers, CTs, air break switches, earth switches, VTs and associated structures. The 11 kV switchboard will be expanded – converting the existing four feeders into five, providing better long-term reliability.

Both substation transformers in the AAA configuration will remain outdoor units. Initially Doon St T1 will be installed alongside the existing Southern T1 unit. After the ex-Doon St transformer has been in service long enough for any potential defects arising from extended de-energisation/transport/reinstallation to manifest, Southern T1 will be temporarily removed for refurbishment; the unit's good insulation condition and light loading history indicate that the refurbished unit will perform well beyond normal service life. After reinstallation of Southern T1 the substation will operate as a dual transformer site, with the ex-Doon St transformer expected to be replaced on condition beyond the end of the planning period.

The oil cable termination and associated pressure tanks would most likely remain outdoor but shielded from stone throwers (an ongoing issue at the site) until ultimately due for replacement well beyond the planning horizon. Completion of the substation upgrade will allow this cable to be tested.

For EIL, single events have the potential to significantly affect SAIDI and SAIFI reliability measures. Therefore it is particularly important for EIL to look for any opportunities to design out failure modes which have the potential to affect a large proportion of customers. A complete outage at Southern substation would have widespread impact on customers where "Value of Lost Load" quickly adds up for an outage at such a critical supply point.

Impact of Commerce Commission IRIS Scheme

The IRIS scheme is designed to penalise electricity distribution businesses for inefficient completion of projects that their 2014 AMP said would be commissioned in the 2015-20 RCP. The IRIS interprets any negative variance between actual spend and (a percentage of) the 2014 AMP forecast as an inefficiency in one of these projects. Crucially, it does not allow for other possible causes of a variance.

Unanticipated safety-driven work associated with underground substations and link boxes, together with improved substation renewal budget estimation, have forced EIL's spend in the 2015-20 Regulatory Control Period (RCP) well above the levels forecast in EIL's 2014 AMP.

Commissioning a full Southern Substation upgrade within the current RCP would therefore force EIL to absorb an Incremental Recovery Incentive Scheme (IRIS) reduction on approximately 40% of its income from assets commissioned between 2015 and 2020.

The IRIS scheme places EIL in an untenable position with regard to financial, safety, and network risks. Similarly the expenditure of several million dollars on a Customised Price Path application to avert the IRIS penalty cannot be justified for such a small network. This left EIL little choice but to defer the project beyond the originally planned 2015/16 commissioning to manage capital revenue constraints.

EIL has managed the situation by conducting targeted seismic reinforcement work on the switchroom in 2017/18, to mitigate the workplace safety risk, but delaying the remainder of the upgrade to a commissioning date of 2020/21. In doing so EIL will be carrying must still absorb an IRIS reduction on over a quarter of its income from assets commissioned between 2015 and 2020.

Cost $2.5M - $5M 2019/20 – 2020/21; CAPEX – Asset Replacement and Renewal

Seismic reinforcement work on the existing substation building was completed in 2017/18. This brought the seismic strength from 17% of new building standard to 85%. The remaining outdoor structures are still below sufficient strength for sufficient resilience in a significant earthquake.

The budget has been revised for more complex demolition, construction, and safety management required for working around existing equipment in a constrained space. Limited transfer capacity to the area eliminates construction options involving extended outages. Furthermore, there were substantial unfavourable foreign exchange rate variations, adding to the budget increase.

Cost $2.5M - $5M 2019/20; $0.5M - $2.5M 2020/21; CAPEX – Asset Replacement and Renewal

Bluff Conductor Replacement

This is a new budget item for conductor renewals in Bluff towards the end of the planning period.

Cost $0.5M - $2.5M 2028/29 onwards; CAPEX – Asset Replacement and Renewal

RMU Replacements

EIL's Ring Main Unit (RMU) replacement programme has been curtailed in recent years, as limited resources have been directed at the higher priority underground substations and link box replacement programmes.

The age, condition, and safe operation of these RMUs is one of the leading asset management concerns on the EIL network.

10% of EIL's fleet of 460 RMUs is aged beyond industry good practice, and an operational risk analysis shows mid-level risk factors that are beyond EIL's normal tolerance for risk. While many years of investment will be required to fully restore the RMU fleet to acceptable levels, some individual units present a disproportionate level of risk.

Adequately-skilled resource will be available to complete this RMU work as soon as the higher-priority underground substation and link box replacements have been completed, in March 2019. If not for the presence of Commerce Commission financial dis-incentives, RMU replacements would have been accelerated, even further than currently proposed, in the 2019/20 year.

EIL has managed the situation by increasing RMU replacement in 2019/20, so as to manage the riskiest RMU sites and arrest the deterioration in the RMU fleet. Beyond 2019/20, the budget is increased so as to aggressively replace sites at heightened risk, and to bring the condition of the RMU fleet back to acceptable levels.

$0.5-$2.5M per annum 2019/20 onwards; CAPEX – Asset Replacement and Renewal

The budget has been increased for early replacement of RMUs with faster than expected deterioration, detected from the most recent inspection round.

Table 49: Non-routine Replacement and Renewal Projects - Considered for remainder of the planning period

Project and Description	Cost and Timing
Unspecified Projects: This budget is an estimate of costs for projects that are as yet unknown but from experience are considered likely to arise in the longer term (six to ten year time frame). Certainty for these estimates is quite low. However with EIL's current demand growth and asset age profile, the bulk of this expense is considered most likely to be allocated to replacement of RMU and cables with greater than previously forecast condition deterioration and failures.	CAPEX $0.5-$2.5M p.a. 2024/25 on

Ongoing Replacement and Renewal Programmes

The remaining replacement and renewal budgets are for ongoing work that tends to recur year after year. These budgets are listed and described in Table 50 and expenditure forecasts are provided in Table 43 (CAPEX) and Table 51 (OPEX). A redefinition of work programmes to more closely align to Information Disclosure Determination definitions has resulted in a transfer of some distribution work from Routine Maintenance to Replacement & Renewal. A one-off adjustment in 2018/19 adapts the OPEX budgets below for a change in the financial treatment of these costs under a revised network management agreement.

No material change to these budgets except where otherwise indicated.

Table 50: Replacement and Renewal Programmes

Budget	Description	Expenditure
Link Box Replacement	On-going replacement of above ground link boxes, beyond the priority replacement of the underground link-boxes described above, which have deteriorated with age or have been damaged and are unfit for service/unsafe.	CAPEX Under $0.5M
Zone Substation Minor Replacement	On-going replacement of minor components at zone substations such as LTAC panels and battery banks.	CAPEX Under $0.5M p.a.
Transformer Replacement	On-going replacements of distribution transformers which are generally identified during distribution inspections and targeted inspections based on age. Some removed units are refurbished.	CAPEX Under $0.5M p.a.
RMU Replacements	On-going replacement of Ring Main Units as they reach end of life and risk of failure increases. Budget gradually increases from 2019/20 to meet asset replacement targets on above-ground RMU replacements that had been deferred to make room for underground substation/link box replacements in terms of resource constraints and regulator-imposed revenue limitations.	CAPEX $0.5M-$2.5M p.a. 2019/20 onward
Reactive 11 kV Cable Replacement	On-going reactive replacement of 11 kV cables as identified by condition after fault occurrence.	CAPEX Under $0.5M p.a.
Planned 11 kV Cable Replacement	An ongoing programme to proactively identify and replace 11 kV cables as they reach their economic end of life rather than continue to patch repair old cables beyond this point.	CAPEX Under $0.5M p.a. 2019/20 and 2021/22 onward
Spend has been brought forward for replacement of poor condition cables in the CBD which have had a number of failures in the last year.		
Fibre Installation	The copper communications network used for protection and SCADA in the Invercargill CBD is approaching end-of-life. Much of the existing network is not ducted; therefore excavation would be required for replacement, which is expensive and disruptive in the CBD environment. Solutions involving radio	CAPEX Under $0.5M p.a.

Budget	Description	Expenditure
	communications or lease of existing fibre have been investigated and found not to be practical. However several utilities maintain underground services in the CBD that need to be excavated on occasion for maintenance or renewal. Where such excavations coincide with a communications path needing replacement, there is an opportunity for EIL to co-operate and lay fibre/duct at reduced cost. $30k p.a. has been set aside to allow EIL to take advantage of such opportunities as they arise, effectively taking a piecewise approach to replacing the copper network while it is still within its operating life. This figure may be revised in future AMPs as the level of incidence of such opportunities becomes clearer.	
General Technical Replacement	On-going replacement of assets other than transformers, RMUs an LV boards as they reach end of life and risk of failure increases at distribution substations to maintain reliability of supply and safety in the vicinity of the substation.	CAPEX Under $0.5M p.a.
General Distribution Replacement	On-going replacements of distribution assets other than cables. These are identified through routine inspection.	CAPEX Under $0.5M p.a.
LV Board Replacement	Replacement of hazardous old LV distribution boards with modern touch safe boards – on-going for 10 years.	CAPEX Under $0.5M p.a.
Pillar Box Replacement	On-going replacement of pillar boxes which have deteriorated with age or have been damaged and are unfit for service or unsafe.	CAPEX Under $0.5M p.a.
LV Cable Replacement	On-going replacement of LV cables as by age with coincident works on underlying 11 kV cable, or as they reach their economic end of life rather than continue to patch repair old cables beyond this point.	CAPEX Under $0.5M p.a.
Distribution Replacement & Renewal	All OPEX work where the primary driver is the repair of distribution assets that have been found during inspection to fall short of the required standard; also includes scheduled replacements of parts/fluids under a preventative maintenance programme, and expenses incurred due obsolescence. Excludes CAPEX (work that will have a material effect on the functionality or the life of capital assets). Covers items like crossarms, insulators, strains, re-sagging lines, stay guards, straightening poles, pole caps, ABS handle replacements etc.	OPEX Under $0.5M p.a.
Zone Substation Replacement & Renewal	All OPEX work where the primary driver is the repair of zone substation assets that have been found during inspection to fall short of the required standard; also includes scheduled replacements of parts/fluids under a preventative maintenance programme, and expenses incurred due obsolescence. Excludes CAPEX (work that will have a material effect on the functionality or the life of capital assets). Covers items like earth sticks, safety equipment, buildings, battery systems etc.	OPEX Under $0.5M p.a.

Budget	Description	Expenditure
Distribution Substation Replacement & Renewal	All OPEX work where the primary driver is the repair of distribution substation assets that have been found during inspection to fall short of the required standard; also includes scheduled replacements of parts/fluids under a preventative maintenance programme, and expenses incurred due obsolescence. Excludes work that will have a material effect on the functionality or the life of capital assets, i.e. CAPEX. Covers items like enclosure repairs, paint touch-ups, spouting & roof repairs, etc.	OPEX Under $0.5M p.a.

5.4 EIL's Forecast Operational Expenditure

The forecast operational expenditure for EIL is shown in Table 44. These figures are also provided in the information disclosure schedule 11b included in Appendix 1. Two further categories not described earlier complete EIL's forecasted operational expenditure budget as follows.

Vegetation Management

Annual tree trimming in the vicinity of overhead network is required to prevent contact with lines maintaining network reliability. The first trim of trees has to be undertaken at EIL's expense as required under the Electricity (Hazards from Trees) Regulations 2003. While some customers have received their first free trim, some are disputing the process and additional costs are occurring to resolve the situation. As EIL's network is mostly underground, tree issues are minimal and therefore costs are relatively low.

$1,400 per annum; OPEX

No material change.

Service Interruptions and Emergencies

These budgets provide for the provision of staff, plant and resources to be ready for faults and emergencies. Fault staff respond to make the area safe, isolate the faulty equipment or network section and undertake repairs to restore supply to all customers.

$0.5M per annum; OPEX – Service Interruption and Emergencies

No material change.

Table 51: EIL's Forecast Operational Expenditure ($000)

OPEX: Asset Replacement and Renewal	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Distribution Replacement & Renewal - City	79	79	79	79	79	79	79	79	79	79
Distribution Replacement & Renewal - Bluff	36	36	36	36	36	36	36	36	36	36
Zone Substation Replacement & Renewal	19	19	19	19	19	19	19	19	19	19
Distribution Substation Replacement & Renewal	76	76	76	76	76	76	76	76	76	76
	211	**211**	**211**	**211**	**211**	**211**	**211**	**211**	**211**	**211**

OPEX: Vegetation Management	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Vegetation Management - City	1	1	1	1	1	1	1	1	1	1
Vegetation Management - Bluff	1	1	1	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

OPEX: Routine & Corrective Maintenance & Inspection	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Routine Distribution Inspections - City	103	103	103	103	89	89	89	89	89	89
Routine Distribution Inspections - Bluff			17					17		
Routine Technical Inspections - City	111	111	111	111	111	111	111	111	111	111
Routine Technical Inspections - Bluff	1	1	1	1	1	1	1	1	1	1
Tech. Routine Maintenance - City	411	411	411	411	411	411	411	411	411	411
Tech. Routine Maintenance - Bluff	14	14	14	14	14	14	14	14	14	14
Dist. Corrective Maintenance - City	32	32	32	32	32	32	32	32	32	32
Dist. Corrective Maintenance - Bluff	24	24	24	24	24	24	24	24	24	24
Tech Corrective Maintenance - City	135	135	135	135	135	135	135	135	135	135
Tech Corrective Maintenance - Bluff	11	11	11	11	11	11	11	11	11	11
Zone Substation Routine Maintenance	38	38	38	38	38	38	38	38	38	38
Distribution Substation Routine Maintenance	41	41	41	41	41	41	41	41	41	41
Earth Testing - City				18					18	18
Earth Testing - Bluff				15					15	15
Partial Discharge Survey	36	36	36	36	36	36	36	36	36	36
Infra-red & Corona Surveys	11	11	11	11	11	11	11	11	11	11
Supply Quality Checks - City	3	3	3	3	3	3	3	3	3	3
Supply Quality Checks - Bluff	1	1	1	1	1	1	1	1	1	1
Spares Checks and Minor Maintenance	1	1	1	1	1	1	1	1	1	1
Customer Connections	27	27	27	27	27	27	27	27	27	27
Distribution Substation Seismic Survey	43									
	1,044	**1,002**	**1,018**	**1,035**	**988**	**988**	**988**	**1,004**	**1,020**	**1,020**

OPEX: Service Interruptions and Emergencies	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29
Incident Response Dist - City	290	290	290	290	290	290	290	290	290	290
Incident Response Dist - Bluff	97	97	97	97	97	97	97	97	97	97
Incident Response Tech - City	90	90	90	90	90	90	90	90	90	90
Incident Response Tech - Bluff	11	11	11	11	11	11	11	11	11	11
	488	**488**	**488**	**488**	**488**	**488**	**488**	**488**	**488**	**488**

Network Operational Expenditure Total	1,745	1,702	1,719	1,735	1,688	1,688	1,688	1,705	1,721	1,721
System Operations and Network Support	1,177	1,193	1,196	1,196	1,196	1,196	1,196	1,196	1,196	1,196
Business Support	2,139	2,132	2,134	2,134	2,134	2,134	2,134	2,134	2,134	2,134
AMP Total Operational Expenditure	**5,061**	**5,027**	**5,050**	**5,066**	**5,019**	**5,019**	**5,019**	**5,036**	**5,052**	**5,052**

8.3 Staff and Contracting Resources

Each item or project making up the AWP is carefully considered as to the man-hours required using the experience gained over many years of network management. The Works Programme as a whole is then considered to ensure that it is realistic with the resources expected to be available and any adjustments can be made. Low priority work may be delayed short term where a commitment to increase staff or contractor numbers has been made such that the necessary works plan will not fall behind. It is important that the AWP "smooths" the year-to-year work volumes required (to the extent possible acknowledging appropriate risk controls) in order to provide a relatively constant work stream.

The internalising of PowerNet's field services has great benefit in ensuring a longer term approach may be taken to resourcing. Staff numbers can be increased with added confidence that they will be fully utilised in future years given the long term plans developed. Working closely with EIL's contractors is also an important part of the AWP development process, carefully communicating the detailed works plan and getting commitment that sufficient resources will be available for the year ahead. The future Works Programme is also communicated so that contractors can confidently commit to hiring extra staff where appropriate, recognising EIL's on-going development and maintenance requirements.

PowerNet have a number of staff vacancies which limit the resource available to deliver the works required.

PowerNet will build its resources to meet EIL's future asset management requirements and engage additional contractor resources to deliver the works required to meet the expenditure forecast in this AMP.

Appendix 3 – Disclosure Schedules

Schedule 11a. – Capital Expenditure Forecast

Company Name	**Electricity Invercargill Limited**
AMP Planning Period	**1 April 2019 – 31 March 2029**

SCHEDULE 11a: REPORT ON FORECAST CAPITAL EXPENDITURE

This schedule requires a breakdown of forecast expenditure on assets for the current disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms. Also required is a forecast of the value of commissioned assets (i.e., the value of RAB additions)
EDBs must provide explanatory comment on the difference between constant price and nominal dollar forecasts of expenditure on assets in Schedule 14a (Mandatory Explanatory Notes).
This information is not part of audited disclosure information.

sch ref		*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
7												
8	for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24	31 Mar 25	31 Mar 26	31 Mar 27	31 Mar 28	31 Mar 29
9	**11a(i): Expenditure on Assets Forecast**	**$000 (in nominal dollars)**										
10	Consumer connection	254	419	923	1,025	1,152	460	818	834	851	868	886
11	System growth	-	-	-	-	-	-	428	-	-	-	-
12	Asset replacement and renewal	4,186	5,123	3,605	3,110	3,868	4,789	3,559	3,565	3,636	3,709	4,467
13	Asset relocations	93	6	6	27	6	6	6	7	7	7	7
14	Reliability, safety and environment:											
15	Quality of supply	29	104	44	300	46	47	48	49	50	51	52
16	Legislative and regulatory	-	-	-	-	-	-	-	-	-	-	-
17	Other reliability, safety and environment	147	224	228	494	386	252	257	263	268	275	296
18	**Total reliability, safety and environment**	176	328	273	794	432	299	305	312	318	326	348
19	**Expenditure on network assets**	4,709	5,876	4,806	4,955	5,459	5,555	5,116	4,717	4,812	4,909	5,707
20	Expenditure on non-network assets	-	-	-	-	-	-	-	-	-	-	-
21	**Expenditure on assets**	4,709	5,876	4,806	4,955	5,459	5,555	5,116	4,717	4,812	4,909	5,707
22												
23	*plus* Cost of financing	-	-	-	-	-	-	-	-	-	-	-
24	*less* Value of capital contributions	105	126	277	308	314	138	141	144	147	150	153
25	*plus* Value of vested assets	-	-	-	-	-	-	-	-	-	-	-
26												
27	**Capital expenditure forecast**	4,604	5,750	4,530	4,647	5,145	5,416	4,975	4,573	4,665	4,760	5,554
28												
29	Assets commissioned	4,594	2,351	2,564	10,540	5,007	3,743	4,975	4,573	4,665	4,760	5,554

		Current Year CY	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
30												
31	for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24	31 Mar 25	31 Mar 26	31 Mar 27	31 Mar 28	31 Mar 29
32		**$000 (in constant prices)**										
33	Consumer connection	254	419	904	985	1,086	425	741	741	741	741	741
34	System growth	-	-	-	-	-	-	388	-	-	-	-
35	Asset replacement and renewal	4,186	5,123	3,535	2,989	3,645	4,424	3,223	3,165	3,165	3,165	3,737
36	Asset relocations	93	6	6	26	6	6	6	6	6	6	6
37	Reliability, safety and environment:											
38	Quality of supply	29	104	43	288	43	43	43	43	43	43	43
39	Legislative and regulatory	-	-	-	-	-	-	-	-	-	-	-
40	Other reliability, safety and environment	147	224	224	475	364	233	233	233	233	234	248
41	**Total reliability, safety and environment**	176	328	267	763	407	277	277	277	277	278	291
42	**Expenditure on network assets**	4,709	5,876	4,712	4,763	5,144	5,132	4,634	4,189	4,189	4,190	4,775
43	Expenditure on non-network assets	-	-	-	-	-	-	-	-	-	-	-
44	**Expenditure on assets**	4,709	5,876	4,712	4,763	5,144	5,132	4,634	4,189	4,189	4,190	4,775
45												
46	**Subcomponents of expenditure on assets (where known)**											
47	Energy efficiency and demand side management, reduction of energy losses	-	-	-	-	-	-	-	-	-	-	-
48	Overhead to underground conversion	-	-	-	20	-	-	-	-	-	-	-
49	Research and development	-	-	-	-	-	-	-	-	-	-	-
50												

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5	CY+6	CY+7	CY+8	CY+9	CY+10
for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24	31 Mar 25	31 Mar 26	31 Mar 27	31 Mar 28	31 Mar 29
Difference between nominal and constant price forecasts	$000										
Consumer connection	-	-	18	40	66	35	77	93	110	127	145
System growth	-	-	-	-	-	-	40	-	-	-	-
Asset replacement and renewal	-	-	71	121	223	365	335	399	471	543	729
Asset relocations	-	-	0	1	0	0	1	1	1	1	1
Reliability, safety and environment:											
Quality of supply	-	-	1	12	3	4	5	5	6	7	8
Legislative and regulatory	-	-	-	-	-	-	-	-	-	-	-
Other reliability, safety and environment	-	-	4	19	22	19	24	29	35	40	48
Total reliability, safety and environment	-	-	5	31	25	23	29	35	41	48	57
Expenditure on network assets	-	-	94	192	315	423	482	528	623	719	932
Expenditure on non-network assets	-	-	-	-	-	-	-	-	-	-	-
Expenditure on assets	-	-	94	192	315	423	482	528	623	719	932

11a(ii): Consumer Connection

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24
*Consumer types defined by EDB**	$000 (in constant prices)					
Customer Connections (≤ 20 kVA)	56	58	58	58	58	58
Customer Connections (21 to 99 kVA)	75	52	52	52	52	52
Customer Connections (≥ 100 kVA)	112	259	590	670	771	110
Distributed Generation Connection	-	3	3	3	3	3
New Subdivisions	11	3	3	3	3	3
Bluff LV Service Lines	-	44	199	199	199	199
**include additional rows if needed*						
Consumer connection expenditure	254	419	904	985	1,086	425
less Capital contributions funding consumer connection	105	126	271	35	35	128
Consumer connection less capital contributions	149	294	633	950	1,051	298

11a(iii): System Growth

Subtransmission	-	-	-	-	-	-
Zone substations	-	-	-	-	-	-
Distribution and LV lines	-	-	-	-	-	-
Distribution and LV cables	-	-	-	-	-	-
Distribution substations and transformers	-	-	-	-	-	-
Distribution switchgear	-	-	-	-	-	-
Other network assets	-	-	-	-	-	-
System growth expenditure	-	-	-	-	-	-
less Capital contributions funding system growth	-	-	-	-	-	-
System growth less capital contributions	-	-	-	-	-	-

11a(iv): Asset Replacement and Renewal

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24
	$000 (in constant prices)					
Subtransmission	-	-	-	-	-	-
Zone substations	249	3,404	2,091	163	134	1,550
Distribution and LV lines	144	120	120	120	120	120
Distribution and LV cables	20	279	86	370	370	370
Distribution substations and transformers	2,842	1,065	982	2,080	2,765	2,129
Distribution switchgear	-	-	-	-	-	-
Other network assets	932	256	256	256	256	256
Asset replacement and renewal expenditure	4,186	5,123	3,535	2,989	3,645	4,424
less Capital contributions funding asset replacement and renewal	-	-	-	-	-	-
Asset replacement and renewal less capital contributions	4,186	5,123	3,535	2,989	3,645	4,424

11a(v): Asset Relocations

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24
*Project or programme**	$000 (in constant prices)					
Asset Relocation Projects	93	6	6	6	6	6
Stead St Stop Bank	-	-	-	20	-	-
include additional rows if needed						
All other project or programmes - asset relocations	-	-	-	-	-	-
Asset relocations expenditure	93	6	6	26	6	6
less Capital contributions funding asset relocations	-	-	-	-	-	-
Asset relocations less capital contributions	93	6	6	26	6	6

11a(vi): Quality of Supply

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24
*Project or programme**	$000 (in constant prices)					
Supply Quality Upgrades - City	-	34	13	13	13	13
Supply Quality Upgrades - Bluff	-	1	1	1	1	1
Network Automation Projects	29	68	29	274	29	29
include additional rows if needed						
All other projects or programmes - quality of supply	-	-	-	-	-	-
Quality of supply expenditure	29	104	43	288	43	43
less Capital contributions funding quality of supply	-	-	-	-	-	-
Quality of supply less capital contributions	29	104	43	288	43	43

11a(vii): Legislative and Regulatory

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24
*Project or programme**	$000 (in constant prices)					
include additional rows if needed						
All other projects or programmes - legislative and regulatory	-	-	-	-	-	-
Legislative and regulatory expenditure	-	-	-	-	-	-
less Capital contributions funding legislative and regulatory	-	-	-	-	-	-
Legislative and regulatory less capital contributions	-	-	-	-	-	-

11a(viii): Other Reliability, Safety and Environment

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24
*Project or programme**	$000 (in constant prices)					
Earth Upgrades - City	-	131	105	105	131	-
Earth Upgrades - Bluff	-	-	26	26	-	-
Neutral Earth Resistor Protection Upgrade	55	-	-	-	-	-
Pillar Box Lid Upgrade	91	93	93	93	-	-
Spey St Fibre Chamber/Cable	-	-	-	18	-	-
LV Tie Point Disconnectors	-	-	-	233	233	233
**include additional rows if needed*						
All other projects or programmes - other reliability, safety and environment	-	-	-	-	-	-
Other reliability, safety and environment expenditure	147	224	224	475	364	233
less Capital contributions funding other reliability, safety and environment	-	-	-	-	-	-
Other reliability, safety and environment less capital contributions	147	224	224	475	364	233

11a(ix): Non-Network Assets

	Current Year CY	CY+1	CY+2	CY+3	CY+4	CY+5
for year ended	31 Mar 19	31 Mar 20	31 Mar 21	31 Mar 22	31 Mar 23	31 Mar 24
Routine expenditure						
*Project or programme**	$000 (in constant prices)					
**include additional rows if needed*						
All other projects or programmes - routine expenditure	-	-	-	-	-	-
Routine expenditure	-	-	-	-	-	-
Atypical expenditure						
*Project or programme**						
**include additional rows if needed*						
All other projects or programmes - atypical expenditure	-	-	-	-	-	-
Atypical expenditure	-	-	-	-	-	-
Expenditure on non-network assets	-	-	-	-	-	-

Schedule 11b. – Operational Expenditure Forecast

Company Name	**Electricity Invercargill Limited**
AMP Planning Period	**1 April 2019 – 31 March 2029**

SCHEDULE 11b: REPORT ON FORECAST OPERATIONAL EXPENDITURE

This schedule requires a breakdown of forecast operational expenditure for the disclosure year and a 10 year planning period. The forecasts should be consistent with the supporting information set out in the AMP. The forecast is to be expressed in both constant price and nominal dollar terms.
EDBs must provide explanatory comment on the difference between constant price and nominal dollar operational expenditure forecasts in Schedule 14a (Mandatory Explanatory Notes).
This information is not part of audited disclosure information.

sch ref		*Current Year CY*	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
7	for year ended	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**	**31 Mar 22**	**31 Mar 23**	**31 Mar 24**	**31 Mar 25**	**31 Mar 26**	**31 Mar 27**	**31 Mar 28**	**31 Mar 29**
8	**Operational Expenditure Forecast**	**$000 (in nominal dollars)**										
9	Service interruptions and emergencies	474	488	498	508	518	529	539	550	561	572	584
10	Vegetation management	0	2	2	2	2	2	2	2	2	2	2
11	Routine and corrective maintenance and inspection	1,073	1,044	1,022	1,060	1,098	1,069	1,090	1,112	1,154	1,196	1,220
12	Asset replacement and renewal	274	211	215	219	223	228	232	237	242	247	252
13	**Network Opex**	1,821	1,745	1,736	1,788	1,841	1,827	1,864	1,901	1,958	2,016	2,057
14	System operations and network support	1,085	1,177	1,216	1,245	1,270	1,295	1,321	1,347	1,374	1,402	1,430
15	Business support	2,232	2,139	2,175	2,221	2,265	2,310	2,356	2,404	2,452	2,501	2,551
16	**Non-network opex**	3,317	3,317	3,391	3,465	3,535	3,605	3,677	3,751	3,826	3,902	3,981
17	**Operational expenditure**	5,138	5,061	5,128	5,254	5,376	5,433	5,541	5,652	5,784	5,919	6,037

		Current Year CY	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
18	for year ended	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**	**31 Mar 22**	**31 Mar 23**	**31 Mar 24**	**31 Mar 25**	**31 Mar 26**	**31 Mar 27**	**31 Mar 28**	**31 Mar 29**
19		**$000 (in constant prices)**										
20	Service interruptions and emergencies	474	488	488	488	488	488	488	488	488	488	488
21	Vegetation management	0	2	2	2	2	2	2	2	2	2	2
22	Routine and corrective maintenance and inspection	1,073	1,044	1,002	1,018	1,035	988	988	988	1,004	1,020	1,020
23	Asset replacement and renewal	274	211	211	211	211	211	211	211	211	211	211
24	**Network Opex**	1,821	1,745	1,702	1,719	1,735	1,688	1,688	1,688	1,705	1,721	1,721
25	System operations and network support	1,085	1,177	1,193	1,196	1,196	1,196	1,196	1,196	1,196	1,196	1,196
26	Business support	2,232	2,139	2,132	2,134	2,134	2,134	2,134	2,134	2,134	2,134	2,134
27	**Non-network opex**	3,317	3,317	3,325	3,331	3,331	3,331	3,331	3,331	3,331	3,331	3,331
28	**Operational expenditure**	5,138	5,061	5,027	5,050	5,066	5,019	5,019	5,019	5,036	5,052	5,052

29	**Subcomponents of operational expenditure (where known)**											
30	Energy efficiency and demand side management, reduction of energy losses	125	125	125	125	125	125	125	125	125	125	125
31	Direct billing*	-	-	-	-	-	-	-	-	-	-	-
32	Research and Development	-	-	-	-	-	-	-	-	-	-	-
33	Insurance	127	277	292	292	292	292	292	292	292	292	292

34 ** Direct billing expenditure by suppliers that direct bill the majority of their consumers*

35

		Current Year CY	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*	*CY+6*	*CY+7*	*CY+8*	*CY+9*	*CY+10*
36	for year ended	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**	**31 Mar 22**	**31 Mar 23**	**31 Mar 24**	**31 Mar 25**	**31 Mar 26**	**31 Mar 27**	**31 Mar 28**	**31 Mar 29**
37	**Difference between nominal and real forecasts**	**$000**										
38	Service interruptions and emergencies	-	-	10	20	30	40	51	62	73	84	95
39	Vegetation management	-	-	0	0	0	0	0	0	0	0	0
40	Routine and corrective maintenance and inspection	-	-	20	41	63	81	103	125	149	175	199
41	Asset replacement and renewal	-	-	4	9	13	17	22	27	31	36	41
42	**Network Opex**	-	-	34	69	106	139	176	213	253	295	336
43	System operations and network support	-	-	24	48	73	99	125	151	178	205	233
44	Business support	-	-	43	86	131	176	222	269	317	366	416
45	**Non-network opex**	-	-	66	135	204	275	347	420	495	572	650
46	**Operational expenditure**	-	-	101	204	310	414	522	633	749	867	986

Schedule 12a. – Asset Condition

Company Name	**Electricity Invercargill Limited**
AMP Planning Period	**1 April 2019 – 31 March 2029**

SCHEDULE 12a: REPORT ON ASSET CONDITION

This schedule requires a breakdown of asset condition by asset class as at the start of the forecast year. The data accuracy assessment relates to the percentage values disclosed in the asset condition columns. Also required is a forecast of the percentage of units to be replaced in the next 5 years. All information should be consistent with the information provided in the AMP and the expenditure on assets forecast in Schedule 11a. All units relating to cable and line assets, that are expressed in km, refer to circuit lengths.

sch ref

					Asset condition at start of planning period (percentage of units by grade)							
	Voltage	Asset category	Asset class	Units	H1	H2	H3	H4	H5	Grade unknown	Data accuracy (1–4)	% of asset forecast to be replaced in next 5 years
10	All	Overhead Line	Concrete poles / steel structure	No.	-	11.00%	-	49.00%	40.00%	-	3	5.00%
11	All	Overhead Line	Wood poles	No.	6.00%	18.00%	10.00%	60.00%	6.00%	-	2	10.00%
12	All	Overhead Line	Other pole types	No.	-	-	-	100.00%	-	-	3	-
13	HV	Subtransmission Line	Subtransmission OH up to 66kV conductor	km	-	-	-	100.00%	-	-	3	-
14	HV	Subtransmission Line	Subtransmission OH 110kV+ conductor	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	HV	Subtransmission Cable	Subtransmission UG up to 66kV (XLPE)	km	-	-	70.00%	-	30.00%	-	2	-
16	HV	Subtransmission Cable	Subtransmission UG up to 66kV (Oil pressurised)	km	-	-	100.00%	-	-	-	2	-
17	HV	Subtransmission Cable	Subtransmission UG up to 66kV (Gas pressurised)	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	HV	Subtransmission Cable	Subtransmission UG up to 66kV (PILC)	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	HV	Subtransmission Cable	Subtransmission UG 110kV+ (XLPE)	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	HV	Subtransmission Cable	Subtransmission UG 110kV+ (Oil pressurised)	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	HV	Subtransmission Cable	Subtransmission UG 110kV+ (Gas Pressurised)	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22	HV	Subtransmission Cable	Subtransmission UG 110kV+ (PILC)	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	HV	Subtransmission Cable	Subtransmission submarine cable	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	HV	Zone substation Buildings	Zone substations up to 66kV	No.	-	15.00%	25.00%	15.00%	45.00%	-	4	-
25	HV	Zone substation Buildings	Zone substations 110kV+	No.	N/A	N/A	N/A		N/A	N/A	N/A	N/A
26	HV	Zone substation switchgear	22/33kV CB (Indoor)	No.	-	-	100.00%	-	-	-	3	-
27	HV	Zone substation switchgear	22/33kV CB (Outdoor)	No.	100.00%	-	-	-	-	-	3	100.00%
28	HV	Zone substation switchgear	33kV Switch (Ground Mounted)	No.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	HV	Zone substation switchgear	33kV Switch (Pole Mounted)	No.	71.00%	-	11.00%	-	18.00%	-	3	71.00%
30	HV	Zone substation switchgear	33kV RMU	No.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
31	HV	Zone substation switchgear	50/66/110kV CB (Indoor)	No.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
32	HV	Zone substation switchgear	50/66/110kV CB (Outdoor)	No.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
33	HV	Zone substation switchgear	3.3/6.6/11/22kV CB (ground mounted)	No.	25.00%	16.00%	24.00%	-	35.00%	-	3	37.00%
34	HV	Zone substation switchgear	3.3/6.6/11/22kV CB (pole mounted)	No.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

36					Asset condition at start of planning period (percentage of units by grade)							
37	Voltage	Asset category	Asset class	Units	H1	H2	H3	H4	H5	Grade unknown	Data accuracy (1–4)	% of asset forecast to be replaced in next 5 years
38												
39	HV	Zone Substation Transformer	Zone Substation Transformers	No.	-	17.00%	33.00%	-	50.00%	-	4	-
40	HV	Distribution Line	Distribution OH Open Wire Conductor	km	2.00%	23.00%	15.00%	55.00%	5.00%	-	2	5.00%
41	HV	Distribution Line	Distribution OH Aerial Cable Conductor	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
42	HV	Distribution Line	SWER conductor	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
43	HV	Distribution Cable	Distribution UG XLPE or PVC	km	2.00%	2.00%	22.00%	66.00%	8.00%	-	3	2.00%
44	HV	Distribution Cable	Distribution UG PILC	km	4.00%	5.00%	73.00%	15.00%	3.00%	-	3	5.00%
45	HV	Distribution Cable	Distribution Submarine Cable	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
46	HV	Distribution switchgear	3.3/6.6/11/22kV CB (pole mounted) - reclosers and sectionalisers	No.	-	-	-	100.00%	-	-	3	-
47	HV	Distribution switchgear	3.3/6.6/11/22kV CB (Indoor)	No.	5.00%	25.00%	12.00%	48.00%	10.00%	-	3	25.00%
48	HV	Distribution switchgear	3.3/6.6/11/22kV Switches and fuses (pole mounted)	No.	5.00%	15.00%	-	70.00%	10.00%	-	2	10.00%
49	HV	Distribution switchgear	3.3/6.6/11/22kV Switch (ground mounted) - except RMU	No.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50	HV	Distribution switchgear	3.3/6.6/11/22kV RMU	No.	8.00%	14.00%	37.00%	30.00%	11.00%	-	3	16.00%
51	HV	Distribution Transformer	Pole Mounted Transformer	No.	3.00%	7.00%	-	75.00%	15.00%	-	2	10.00%
52	HV	Distribution Transformer	Ground Mounted Transformer	No.	5.00%	9.00%	21.00%	50.00%	15.00%	-	3	5.00%
53	HV	Distribution Transformer	Voltage regulators	No.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
54	HV	Distribution Substations	Ground Mounted Substation Housing	No.	10.00%	50.00%	40.00%	-	-	-	2	10.00%
55	LV	LV Line	LV OH Conductor	km	5.00%	10.00%	5.00%	75.00%	5.00%	-	2	5.00%
56	LV	LV Cable	LV UG Cable	km	2.00%	3.00%	20.00%	70.00%	5.00%	-	2	5.00%
57	LV	LV Streetlighting	LV OH/UG Streetlight circuit	km	1.00%	4.00%	85.00%	-	10.00%	-	1	5.00%
58	LV	Connections	OH/UG consumer service connections	No.	6.00%	4.00%	85.00%	2.00%	3.00%	-	2	6.00%
59	All	Protection	Protection relays (electromechanical, solid state and numeric)	No.	25.00%	15.00%	-	25.00%	35.00%	-	3	25.00%
60	All	SCADA and communications	SCADA and communications equipment operating as a single system	Lot	-	20.00%	-	80.00%	-	-	3	20.00%
61	All	Capacitor Banks	Capacitors including controls	No.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
62	All	Load Control	Centralised plant	Lot	N/A	100.00%	N/A	N/A	N/A	N/A	3	-
63	All	Load Control	Relays	No.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
64	All	Civils	Cable Tunnels	km	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Schedule 12b. – Capacity Forecast

Company Name	**Electricity Invercargill Limited**
AMP Planning Period	**1 April 2019 – 31 March 2029**

SCHEDULE 12b: REPORT ON FORECAST CAPACITY

This schedule requires a breakdown of current and forecast capacity and utilisation for each zone substation and current distribution transformer capacity. The data provided should be consistent with the information provided in the AMP. Information provided in this table should relate to the operation of the network in its normal steady state configuration.

sch ref

7 **12b(i): System Growth - Zone Substations**

8

	Existing Zone Substations	Current Peak Load (MVA)	Installed Firm Capacity (MVA)	Security of Supply Classification (type)	Transfer Capacity (MVA)	Utilisation of Installed Firm Capacity %	Installed Firm Capacity +5 years (MVA)	Utilisation of Installed Firm Capacity + 5yrs %	Installed Firm Capacity Constraint +5 years (cause)	Explanation
9	Spey Street	28	36	N-1	40	79%	36	76%	No constraint within +5 years	
10	Leven Street	13	23	N-1	25	55%	23	77%	No constraint within +5 years	Short interruption for changeover (N.O. supply from alt GXP)
11	Racecourse Road	12	-	N	12	-	-	-	No constraint within +5 years	No firm capacity
12	Southern	15	-	N	9	-	23	66%	No constraint within +5 years	Upgrade to N-1 security in 2 yrs time; limited transfer capacity for extended periods. Further transfer of load will result in poorer network reliability. Utilisation projected to increase with planned feeder tie-point shifts from Racecourse Rd to Southern substation in post substation upgrade
13						-				
14						-				
15						-				
16						-				
17						-				
18						-				
19						-				
20						-				
21						-				
22						-				
23						-				
24						-				
25						-				
26						-				
27						-				
28						-				

29 [1] *Extend forecast capacity table as necessary to disclose all capacity by each zone substation*

Company Name	**Electricity Invercargill Limited**
AMP Planning Period	**1 April 2019 – 31 March 2029**

SCHEDULE 12C: REPORT ON FORECAST NETWORK DEMAND

This schedule requires a forecast of new connections (by consumer type), peak demand and energy volumes for the disclosure year and a 5 year planning period. The forecasts should be consistent with the supporting information set out in the AMP as well as the assumptions used in developing the expenditure forecasts in Schedule 11a and Schedule 11b and the capacity and utilisation forecasts in Schedule 12b.

sch ref

12c(i): Consumer Connections

Number of ICPs connected in year by consumer type

		Number of connections					
		Current Year CY	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
	for year ended	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**	**31 Mar 22**	**31 Mar 23**	**31 Mar 24**
*Consumer types defined by EDB**							
Customer Connections < 20 kVA		46	62	62	62	62	62
Customer Connections 21-99 kVA		4	5	5	5	5	5
Customer Connections > 100 kVA		-	3	3	3	3	3
Connections total		50	71	71	71	71	71

**include additional rows if needed*

Distributed generation

Number of connections	5	10	15	15	20	20
Capacity of distributed generation installed in year (MVA)	0	0	0	0	0	0

12c(ii) System Demand

		Current Year CY	*CY+1*	*CY+2*	*CY+3*	*CY+4*	*CY+5*
Maximum coincident system demand (MW)	for year ended	**31 Mar 19**	**31 Mar 20**	**31 Mar 21**	**31 Mar 22**	**31 Mar 23**	**31 Mar 24**
GXP demand		61	62	63	65	66	68
plus Distributed generation output at HV and above		-	-	-	-	-	-
Maximum coincident system demand		61	62	63	65	66	68
less Net transfers to (from) other EDBs at HV and above		2	2	2	2	2	2
Demand on system for supply to consumers' connection points		59	60	61	63	64	66
Electricity volumes carried (GWh)							
Electricity supplied from GXPs		246	247	248	248	249	250
less Electricity exports to GXPs		-	-	-	-	-	-
plus Electricity supplied from distributed generation		0	-	-	-	-	-
less Net electricity supplied to (from) other EDBs		(14)	(15)	(15)	(15)	(15)	(15)
Electricity entering system for supply to ICPs		261	262	263	263	264	265
less Total energy delivered to ICPs		247	248	248	249	250	250
Losses		14	14	14	14	15	15
Load factor		50%	50%	49%	48%	47%	46%
Loss ratio		5.3%	5.5%	5.5%	5.5%	5.5%	5.5%

Schedule 12d. – Reliability Forecast

Note: These forecasts are presented using the SAIDI/SAIFI calculation method detailed in the Electricity Distribution Services Default Price-Quality Path Determination 2015. As such they correlate with the Compliance Statement and the majority of publications in the public domain, but do not correlate with Schedule 10 of year-end disclosures. A rough correlation with Schedule 10 may be obtained through multiplying the Class B figures in rows 11 and 14 by a factor of 2.

Company Name	Electricity Invercargill Limited	
AMP Planning Period	1 April 2019 – 31 March 2029	
Network / Sub-network Name		

SCHEDULE 12d: REPORT FORECAST INTERRUPTIONS AND DURATION

This scheduler equires a forecast of SAIFI and SAIDI for disclosure and a 5 year planning period. The forecasts should be consistent with the supporting information set out in the AMP as well as the assumed impact of planned and unplanned SAIFI and SAIDI on the expenditures forecast provided in Schedule 11a and Schedule 11b.

sch ref	for year ended	*Current Year CY* 31 Mar 19	*CY+1* 31 Mar 20	*CY+2* 31 Mar 21	*CY+3* 31 Mar 22	*CY+4* 31 Mar 23	*CY+5* 31 Mar 24
8							
9	**SAIDI**						
10	Class B (planned interruptions on the network)	2.2	3.6	3.6	3.6	3.6	3.6
11	Class C (unplanned interruptions on the network)	21.8	18.4	18.4	18.1	18.1	18.1
12							
13	**SAIFI**						
14	Class B (planned interruptions on the network)	0.02	0.02	0.02	0.02	0.02	0.02
15	Class C (unplanned interruptions on the network)	0.48	0.55	0.55	0.54	0.54	0.54

Appendix 4 – Directors Approval

We, Thomas Campbell and Sarah Jane Brown, being directors of Electricity Invercargill Limited certify that, having made all reasonable enquiry, to the best of our knowledge-

a) The following attached information of Electricity Invercargill Limited prepared for the purposes of clause 2.6.3 and clause 2.6.6 of the Electricity Distribution Information Disclosure Determination 2012 in all material respects complies with that determination.

b) The prospective financial or non-financial information included in the attached information has been measured on a basis consistent with regulatory requirements or recognised industry standards.

c) The forecasts in Schedules 11a, 11b, 12a, 12b, 12c, and 12d are based on objective and reasonable assumptions which both align with Electricity Invercargill Limited corporate vision and strategy and are documented in retained records.

T Campbell

S J Brown

Date: 28 March 2019