WSP Action Plan

Annual Progress Report

Aurora ENERGY

31st July 2020

Report Contents

1. Introduction
2. Report Summary
3. Update on key asset fleets:
    a) secondary systems
    b) zone substation circuit breakers
    c) zone substation transformers
    d) support structures
    e) overhead conductor
    f) underground cables (cast-iron potheads)
    g) distribution transformers
    h) distribution switchgear
4. Further Information

INTRODUCTION

In 2018, Aurora Energy commissioned an independent review of its electricity network. The main aims of the review were to confirm the state of the network and to determine any resulting risk to customers and the wider public.

The review was undertaken by WSP an independent engineering consultancy. Its final report was published in November 2018 and can be found on our website. We also provide a summary of its main findings on page 6.

On 31 July 2019, we published a plan (*Action Plan,* available here) setting out our approach to addressing the asset risks identified by WSP in its independent risk review. Since then we have published quarterly updates on our progress against this action plan. These are also available on our website.

This document is an **Annual Progress Report** on the Action Plan. Building on the quarterly status updates, it provides a further, more detailed update of how we've addressed the issues raised in the WSP review.

Future Updates

As discussed in this report, we continue to make good progress in delivering the Action Plan and ensuring WSP's recommendations are addressed. While we recognise these reports provide important information for stakeholders, we expect the need for dedicated publications will reduce over time. Going forward we will:

- publish two further **quarterly updates** in September 2020 and December 2020
- provide an update as part of our **Asset Management Plan** in March 2021
- from April onwards, we propose including any further Action Plan related updates in our **CPP reporting.**

Report Summary

THE WSP REVIEW

The WSP risk review provided important insights on our network assets and related risks. It included independent assurance that most of our assets pose a low risk to public safety.

WSP independently assessed our network infrastructure in terms of:

- **resilience:** can the network withstand or recover from high impact, low frequency events (e.g. earthquakes)
- **security:** does the network provide appropriate capacity, redundancy and switching capability
- **performance**: how assets and areas of the network perform in terms of risk, on historical rates and durations of asset outages
- **network risk:** what assets pose risks in terms of public safety, reliability of supply or the environment.

In summary WSP found that:

- **resilience:** most key assets have been installed clear of earthquake fault lines, flood zones, and other risk areas
- **security:** the topology of the network is appropriate for its geographical location and distribution of customers
- **performance**: overall performance of the network was generally found to be appropriate
- **network risk:** most assets pose little or no risk to public safety, reliability or the environment, with risks no greater than those observed in other networks. However, they identified a number of 'exceptions' i.e. fleets with higher levels of network risk.

Addressing these higher risk fleets (see next slide) was the focus of our action plan.

KEY FINDINGS OF THE WSP REPORT

The review provided important insights and conclusions, including independent assurance that most of our assets pose little or no risk to public safety, reliability or the environment. It agreed that we were targeting our proposed investments in areas that need it most and would deliver the greatest safety, reliability, and resilience benefits.

The report included a prioritised list of asset/process risks that needed to be addressed and highlighted the following key fleets that had a portion of assets whose condition carried a higher public safety risk.

- **secondary systems:** over 500 ageing protection relays and maintenance/calibration issues had contributed to increased safety risk
- **zone substation circuit breakers:** elevated risk due to ageing assets and type issues (e.g. models with historically poor failure performance)
- **zone substation transformers:** eight units with elevated risk due to internal condition and component issues
- **support structures:** pole risk remains elevated, though has been reduced due to replacement programmes. There are emerging issues with the large proportion of ageing crossarms
- **underground cables (cast-iron potheads):** explosive failure modes in an ageing population pose a public safety risk
- **distribution switchgear:** some units were defective impacting reliability, while others presented a safety risk to field crews.

The purpose of our Action Plan was to provide visibility of how we would ensure the risks associated with the above higher risk assets were assessed, prioritised and addressed. Our progress in this respect has been set out in a series of quarterly updates and in this annual update.

OVERVIEW OF OUR PROGRESS

We have made significant progress on the actions identified in the Action Plan, completing the majority of our strategic, investment planning, and operations and maintenance improvement initiatives. Many of the initiatives are now ongoing business as usual processes which are strengthening our asset management capability.

The work programme originally outlined in the Action Plan is being refined as we better understand the health and the associated risks of our assets. Some delivery dates may shift as priorities change, this reflects our developing asset management maturity, and the effective use of available resources to manage asset health and safety risk. We are confident that the highest priority risks are being addressed in a priority manner.

The latest version of our work programme is summarised in our 2020 asset management plan (AMP). We continue to address the key risks including through the following initiatives:

- accelerating the replacement of high-risk protection relays
- increasing the volume of proactive crossarm and conductor renewals
- prioritising our zone substation switchgear replacement programme
- increased levels of asset maintenance including the use of improved inspection techniques.

As described later in this report, the COVID-19 pandemic has impacted on the operational delivery of some work programmes. The works programming, delivery team, and service providers are now working towards reprioritising the programme. We are confident that high-priority work will continue to remain on-track.

INDEPENDENT VERIFIER VIEW

In its final verification report (available here) the Independent Verifier of our CPP application assessed how we proposed to address the network risks identified by WSP. It also assessed how our proposed asset strategies and expenditure forecasts address those risks, summarising its view as follows:

> *Aurora Energy's proposed asset strategies for the asset fleets that we reviewed appear reasonable given the existing asset management system maturity, data availability, and deliverability constraints – although risks for some asset fleets are presently high, the proposed strategies appear to adequately address these.*

Page 460, Verification Report, 8 June 2020

It found that we have generally specified inspection, testing and maintenance cycles that are comparable to peers in New Zealand and Australia, and that we are therefore in a position to manage the maintenance of our assets at similar risk levels to our peers.

Update on Asset Fleets

SECONDARY SYSTEMS (1 of 2)

WSP found that many protection relays were beyond their nominal life and included obsolete technology. At the time, maintenance was incomplete with units losing calibration between maintenance cycles. They identified over 500 relays that should be replaced. In addition to a work programme we implemented initiatives focussing on:

- strategic approach: revising equipment choice, scheme design and settings
- investment planning: timely, prudent replacement to ensure assets deliver reliable operation
- operations and maintenance: implement maintenance and operational measures to achieve reliable operation.

STRATEGIC APPROACH	INITIATED	IN PROGRESS	COMPLETE	OVERALL STATUS	COMMENTS
Develop a protection design philosophy	✓	✓	✓	●	The philosophy is intended to align our protection approach with industry best practice
Develop a protection design standard	✓	✓		●	Being finalised at time of drafting
Protection coordination review	✓	✓	--	●	The review is an ongoing task and is refined as a part of capital works and maintenance programmes. See **Note 1**
INVESTMENT PLANNING	**INITIATED**	**IN PROGRESS**	**COMPLETE**	**OVERALL STATUS**	**COMMENTS**
Develop replacement prioritisation plan	✓	✓	✓	●	See **Note 2**
Identify settings / coordination gaps	✓	✓	--	●	Ongoing task, linked to coordination review.
Identify gaps against standard	✓	✓		●	Will be completed based on finalised design standard
OPERATIONS & MAINTENANCE	**INITIATED**	**IN PROGRESS**	**COMPLETE**	**OVERALL STATUS**	**COMMENTS**
Review maintenance procedures	✓	✓	✓	●	Reviewed, updated procedures being applied. See **Note 3**
Provide contractor training	✓	✓	✓	●	Monitor/initiate training as new technology enters the network, addressed through service provider contracts
Review maintenance timing	✓	✓	✓	●	Shorter maintenance cycles adopted
Address contractor resource constraints	✓	✓	✓	●	Service provider / consultant panels introduced to mitigate risk of resource constraints. Workload actively monitored

SECONDARY SYSTEMS (2 of 2)

Overview of Work Programme

Below we highlight the current status and our progress on some key projects addressing protection assets.

ASSET / SITE	INITIATED	SCOPING/DESIGN	CONSTRUCTION	COMPLETE	COMMENTS
Andersons Bay	✓	✓			Equipment tender underway. Expected to be completed in RY22
Corstophine	✓	✓			Expected to be completed in RY21
Cromwell	✓	✓	✓		Expected to be completed in RY21
Clyde to Alexandra subtransmission	✓	✓	✓	✓	
Green Island	✓	✓			Expected to be completed in RY24
Halfway Bush (GXP)	✓	✓	✓	Partial	Some delays due to COVID-19. High risk relays have been replaced
Neville Street	✓	✓	✓	✓	Decommissioning of Neville Street removed 64 high risk relays
Outram	✓	✓			Construction is out to tender, expected to be completed in RY21/22
Queenstown	✓	✓			33 kV expected to be completed in RY22, with further 11 kV work expected to be complete in RY31
St Kilda	✓	✓			Construction tender awarded, expected to be completed in RY21

NOTES	
Note 1	We have created a two-pronged approach with some areas of protection coordination being reviewed and addressed during renewal projects and other areas being specifically targeted through a protection coordination review.
Note 2	A significant proportion of the protection work plan will be delivered with primary plant works, e.g. zone substation renewal projects.
Note 3	We have revised procedures and introduced shorter inspection cycles (2 years) for solid state and electromechanical relays to address the risk of inter-inspection setting drift or failure.

ZONE SUBSTATION CIRCUIT BREAKERS (1 of 2)

WSP found both safety and reliability risks associated with zone substation circuit breakers (CBs). A number of units (129) had exceeded their expected lives. The inspection, testing and maintenance of some CBs was incomplete. Further risks were identified in relation to arc-flash and specific model and location type issues (e.g. oil-filled units).

In addition to a work programme (next page) we implemented initiatives, focussing on:

- **strategic approach**: including future needs, equipment specification and approach to procurement
- **investment planning**: timely, prudent replacement to ensure assets operate safely and reliably
- **operations and maintenance**: addressing historical shortfalls in delivered maintenance.

STRATEGIC APPROACH	INITIATED	IN PROGRESS	COMPLETE	OVERALL STATUS	COMMENTS
Develop ZS 11kV CB specification	✓	✓	✓	●	Specification complete, providing our core requirements in our 11kV tender (see below)
Tender for supply of 11kV CB	✓	✓	✓	●	Period supply agreement awarded, equipment being purchased
Develop configuration criteria	✓	✓	--	●	Ongoing
INVESTMENT PLANNING	**INITIATED**	**IN PROGRESS**	**COMPLETE**	**OVERALL STATUS**	**COMMENTS**
Develop replacement prioritisation plan	✓	✓	✓	●	Has been reflected in our AMP/CPP investment plans
OPERATIONS & MAINTENANCE	**INITIATED**	**IN PROGRESS**	**COMPLETE**	**OVERALL STATUS**	**COMMENTS**
Review maintenance procedures	✓	✓		●	Work is ongoing, some procedures to be formally approved
Review maintenance practices and test results	✓	✓		●	See **Note 1**
Operational changes	✓	✓	--	●	Ongoing. See **Note 2** for details of changes

ZONE SUBSTATION CIRCUIT BREAKERS (2 of 2)

Overview of Work Programme

Below we highlight the current status and our progress on some key projects addressing risk related to our zone substation circuit breakers.

Asset / site	Initiated	Scoping/Design	Construction	Complete	Comments
Andersons Bay	✓	✓			Equipment tender underway, expected to be completed in RY22
Green Island	✓	✓			Expected to be completed in RY24
Halfway Bush (ZS)					Expected to be completed in RY24
Neville Street	✓	✓	✓	✓	Decommissioning of Neville Street removed 31 at-risk CBs
Outram	✓	✓			Construction is out to tender, expected to be completed in RY22
Queenstown	✓	✓			33 kV expected to be completed in RY22, with further 11 kV work expected to be complete in RY31
South City					Expected to be completed in RY30

Notes	
Note 1	This will help determine an improved understanding of asset health, including consistency in maintenance practice which may require field service contractor training. Abnormal results are reported by the contractor to aid quick resolution
Note 2	Standard safe operating practices being applied, and appropriate PPE worn. High-risk circuit breakers are almost exclusively opened remotely with the switch room evacuated.

ZONE SUBSTATION TRANSFORMERS (1 of 2)

WSP identified eight zone substation transformers with elevated risk due to internal condition and component issues. The inspection, testing and maintenance of some units was incomplete. Further issues were identified in relation to environmental and fire risks.

The table, below, sets out the status of improvement initiatives that support de-risking our zone substation transformer fleet. The initiatives extend beyond the risks identified by WSP and seek to improve our overall management of this important fleet. This includes improving our condition information, asset health modelling, and implementing a range of risk mitigation measures.

STRATEGIC APPROACH	INITIATED	IN PROGRESS	COMPLETE	OVERALL STATUS	COMMENTS
Develop a transformer risk management strategy and plan	✓	✓		●	Due for completion as part of our fleet plan development. See **Note 1**
INVESTMENT PLANNING	**INITIATED**	**IN PROGRESS**	**COMPLETE**	**OVERALL STATUS**	**COMMENTS**
Develop replacement prioritisation plan	✓	✓	✓	●	Has been reflected in our AMP/CPP investment plans
OPERATIONS & MAINTENANCE	**INITIATED**	**IN PROGRESS**	**COMPLETE**	**OVERALL STATUS**	**COMMENTS**
Review maintenance procedures	✓	✓	--	●	Ongoing. Further improvements being made to gather better condition data on transformers
Review maintenance test results	✓	✓	✓	●	Maintenance and condition information has been reviewed as part of asset health model development
Ensure maintenance cycle met	✓	✓	✓	●	
DGA/TCA testing programme	✓	✓	✓	●	
Review critical spares	✓	✓		●	Underway, reviewing spares holdings, including bushings, and tap changer components

ZONE SUBSTATION TRANSFORMERS (2 of 2)

Overview of Work Programme

Below we highlight the current status and our progress on some key projects addressing risk related to our zone substation transformers.

ASSET / SITE	INITIATED	SCOPING/DESIGN	CONSTRUCTION	COMPLETE	COMMENTS
Tap changer maintenance	✓	--	--	✓	
Andersons Bay T1/T2 replacement	✓	✓			Scheduled for completion in RY22
Arrowtown T1/T2 replacement					Scheduled for completion in RY24/25
Cromwell T1/T2 replacement	✓	✓	✓		Expected to be completed in RY21. Growth driver
Green Island T1/T2 replacement	✓	✓			Expected to be completed in RY23/24
Port Chalmers T1/T2 replacement					Scheduled for completion in RY24/25

NOTES	
Note 1	Our strategic approach to managing zone substation transformer risks includes a mixture of transformer replacement, improved network back-up, use of mobile substation, and critical spares. Our risk management plan will identify the combination of mitigations to apply for each site and will inform our replacement prioritisation plan.

SUPPORT STRUCTURES (1 of 3)

WSP found that while pole-related risk remains elevated it has been steadily reduced though the accelerated pole-replacement programme. They identified emerging issues with the crossarms fleet and its large portion of ageing assets.

The table below sets out the status of improvement initiatives that support de-risking our support structures fleets. Most of the improvement initiatives have been completed or have moved to an on-going business as usual function. Some testing initiatives have been delayed by restrictions due to the COVID-19 pandemic.

STRATEGIC APPROACH	INITIATED	IN PROGRESS	COMPLETE	OVERALL STATUS	COMMENTS
Refine and document our fleet strategy/plan	✓	✓	✓		Reflected in our expanded AMP material
Wood pole testing review/trial	✓	✓			Review of testing methodologies and previous results to determine a preferred long-term approach. See **Note 1**
Concrete pole strength determination	✓	✓			Investigate design strength of concrete poles and utilise destructive testing to validate, as required. See **Note 1**
Develop a pole design standard	✓	✓	✓		Standard created, will ensure consistency of approach and support an outsourced design approach
Review triggers for pole replacement	✓	✓			Review ongoing
Develop an asset register for crossarms	✓	✓			Ongoing, see **Note 2**
Wood pole forensic analysis	✓	✓			Specialist analysis to assess drivers of pole decay/rot, to help refine lifecycle management in specific areas. See **Note 1**

SUPPORT STRUCTURES (2 of 3)

INVESTMENT PLANNING	INITIATED	IN PROGRESS	COMPLETE	OVERALL STATUS	COMMENTS
Develop three month rolling plan.	✓	✓		●	Ongoing, noting that 90-day red tag pole compliance requires some reactionary work
Review of pole remediation process	✓	✓		●	See **Note 1**
Works coordination	✓	✓		●	Work is ongoing
Adapt plan to new fleet strategy/plan	✓	✓	✓	●	Has been reflected in our AMP/CPP investment plans

OPERATIONS & MAINTENANCE	INITIATED	IN PROGRESS	COMPLETE	OVERALL STATUS	COMMENTS
Development of risk-based pole testing	✓	✓	✓	●	Public safety criticality zones have been used to prioritise testing
Implement Rapid Response programme	✓	✓	✓	●	The programme has been introduced and enables poles at immediate risk of failure to have accelerated replacement
Pole reinforcement/nailing programme	✓	✓	✓	●	Programme has been completed
Deuar pole test training	✓	✓	--	●	Ongoing refresher training
Pole safety awareness	✓	✓	--	●	This is an ongoing initiative
Development of defects application	✓	✓	✓	●	A mobile application for recording defects has been developed and deployed
New field service agreements	✓	✓	✓	●	
Implement crossarm inspection programme	✓	✓	✓	●	New programme has been introduced

SUPPORT STRUCTURES (3 of 3)

Overview of Work Programme

Below we highlight the main aspects of the support structures work programme. These works address both poles and crossarm assets.

PROGRAMME	COMPLETE	STATUS	COMMENTS
High criticality (zone 1) wood pole testing	✓	●	
Zone 1 wood pole remediation	Ongoing	●	The initial Action Plan remediation programme has effectively been completed. See **Note 3**
All wood poles within current test regime		●	Some minor delays due to COVID-19. See **Note 4**
All poles within five year test cycle		●	Concrete testing will recommence following the completion of related testing.
Pole (legacy) backlog addressed	✓	●	The initial Action Plan remediation programme has effectively been completed. See **Note 3**
Zone 1 crossarm inspections	✓	●	
Zone 1 crossarm remediations	Ongoing	●	Crossarm remediations run in parallel with the testing programme, allowing poor condition units to be addressed via rapid response or coordinated with other works

NOTES	
Note 1	Aspects of our support structures review and forensic testing have been delayed due to COVID-19. These are scheduled to restart in September 2020.
Note 2	The introduction of an asset register for crossarms will enable us to better track asset attributes, age and condition. This is an intermediate step, while we implement a dedicated asset management information system.
Note 3	Initial work volumes have been addressed. Discovery of new red/orange tag poles has continued as we undertake our inspection programmes. From August 2020 we expect to replace all new discovery red tag poles within the 90-day compliance period. We expect to have addressed the orange tag pole backlog by March 2021.
Note 4	Essentially complete in Dunedin. Central should be complete by end RY21. Note, status does not include 'unable to test' poles that require special treatment or consumer-owned poles.

OVERHEAD CONDUCTORS (1 of 2)

WSP identified aged, light copper, conductor as being high-risk. In addition, we included some aged steel conductor located in high criticality areas and prioritised this within our Action Plan. The initiatives below extend beyond the risks identified by WSP and seek to improve our overall management of this fleet.

STRATEGIC APPROACH	INITIATED	IN PROGRESS	COMPLETE	OVERALL STATUS	COMMENTS
Refine and document our fleet strategy/plan	✓	✓	✓	●	Reflected in our expanded AMP material
Conductor forensic testing and analysis	✓	✓		●	Progressing well, with the second tranche of testing ongoing
Research and trial aerial inspection technologies	✓	✓	✓	●	Aerial inspections trial has been completed
Develop a procedure for conductor inspections	✓	✓		●	Currently being developed into a mobile app. An overhead inspection procedure is planned for development
Refine our fault data capture process	✓	✓		●	Underway as a part of the reliability management initiatives
Confirm engineering validation of the Wanaka lines	✓	✓	✓	●	Study complete
INVESTMENT PLANNING	**INITIATED**	**IN PROGRESS**	**COMPLETE**	**OVERALL STATUS**	**COMMENTS**
Develop short term replacement prioritisation plan	✓	✓	✓	●	Was utilised for RY21 work plan
Improve replacement project scoping and tracking	✓	✓		●	Ongoing initiative to implement new processes and systems to track projects through to completion
Adapt plan to new fleet strategy/plan	✓	✓	✓	●	Reflected in our expanded AMP/CPP work plans
OPERATIONS & MAINTENANCE	**INITIATED**	**IN PROGRESS**	**COMPLETE**	**OVERALL STATUS**	**COMMENTS**
Implement our conductor inspection programme	✓	✓		●	
Summer – auto-reclose blocking	✓	✓	--	●	This is an ongoing initiative

OVERHEAD CONDUCTORS (2 of 2)

Overview of Work Programme

Below we highlight the main aspects of the overhead conductor work programme that was included in the Action Plan.

PROGRAMME	COMPLETE	STATUS	COMMENTS
RY20 conductor replacement programme	✓	●	RY20 work programme included 23.2 km of replacement works
High risk light copper conductor replacement	✓	●	Cape Saunders project was completed, further small copper scheduled for replacement in RY21 (majority near the coast).
High risk steel conductor replacement	Ongoing	●	RY20 works completed. Further No. 8 steel identified for replacement in RY21, with the majority in design (at time of writing)
End of life copper conductor replacement	Ongoing	●	Initial focus on higher risk assets, this will gradually shift towards less critical end-of-life assets
End of life steel conductor replacement	Ongoing	●	Initial focus on higher risk assets, this will gradually shift towards less critical end-of-life assets

UNDERGROUND CABLES – (CAST-IRON POTHEADS)

Our underground cables fleet includes terminations known as ‘cast-iron potheads’. WSP identified moderate failure risks associated with the underground cables themselves, however cast-iron potheads were identified as having high public safety risk. Our Action Plan included addressing the cast-iron pothead components of the underground cable fleet.

Some remaining cast-iron potheads are located in high criticality areas (zone 1) and pose an elevated public-safety risk due to their location. These assets require more immediate intervention, and we plan to have these removed from the network by the end of RY21. These will be carried out through a combination of targeted, standalone work packages where the existing support structure allows the replacement to be performed safely and in conjunction with pole replacements in all other cases. To ensure the programme can be delivered to plan we have engaged specialist resources from other regions of New Zealand.

Cast-iron potheads are known to present an elevated risk of failure (explosive hazard) when re-energising. We plan to also mitigate this risk by implementing operational changes to help ensure that the public are not in the vicinity of potheads when re-energising the circuit.

Our work programme to address at-risk cast-iron potheads is ongoing and making good progress. It will remain in place until RY25.

DISTRIBUTION TRANSFORMERS

Distribution transformers is a volumetric fleet. The future work programme is not specified in the same detail as the work programmes specified earlier in the report (e.g. zone substations projects).

WSP identified, elevated risks associated with 59 transformers, and moderate risk associated with 328 distribution transformers (about 5% of the fleet). Individual units requiring intervention are typically identified through our scheduled inspection programme.

Our distribution transformers work programme will continue to address the at-risk assets identified by WSP, through the:

- proactive replacement of large, aged pole mounted units (which present a specific public and worker safety risk) with ground mounted units
- condition-based replacement of other pole mounted transformers
- continue replacement/relocation of underground distribution transformers in the Dunedin CBD to remove the risk of working in confined spaces.

Our work programme to address at-risk distribution transformers is ongoing and we continue to address the issues identified by WSP.

DISTRIBUTION SWITCHGEAR

Distribution switchgear is a volumetric fleet. The future work programme is not specified in the same detail as zone substations or other identified works.

Our distribution switchgear work programme will continue to address the risks identified by WSP, through:

- increased ground mounted switchgear renewal to address switchgear in poor condition or with type issues
- addressing inoperable switchgear by undertaking corrective maintenance (supported by new maintenance standards).

Our planned remediations will continue until higher-risk models identified by WSP have been addressed, including Statter, Reyrolle, and Andelect.

We are progressing our inspection, maintenance and wider replacement programme, focusing on:

- maintaining RMUs and remediating ‘do not operate’ (DNO) tilt issues
- replacing and/or maintaining DNO ABSs
- inspecting other ABSs
- continuing to inspect the LV enclosure fleet and remediating installations that present a public safety hazard.

Our work programme to address at-risk distribution switchgear is ongoing and we continue to address the issues identified by WSP.

Further Information

For further information on our work programmes, please consult the following:

- 2020 Asset Management Plan
- CPP Application
- Our CPP website