ElectraNet Transmission Network Revised Revenue Proposal

Appendix Q - Asset Refurbishment Plan for the Period 2013-2018

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Contents

1. Purpose

To outline the framework for assessing and developing the Asset Refurbishment Plan.

2. Scope

The Asset Refurbishment Plan identified for the 2013 to 2018 regulatory control period.

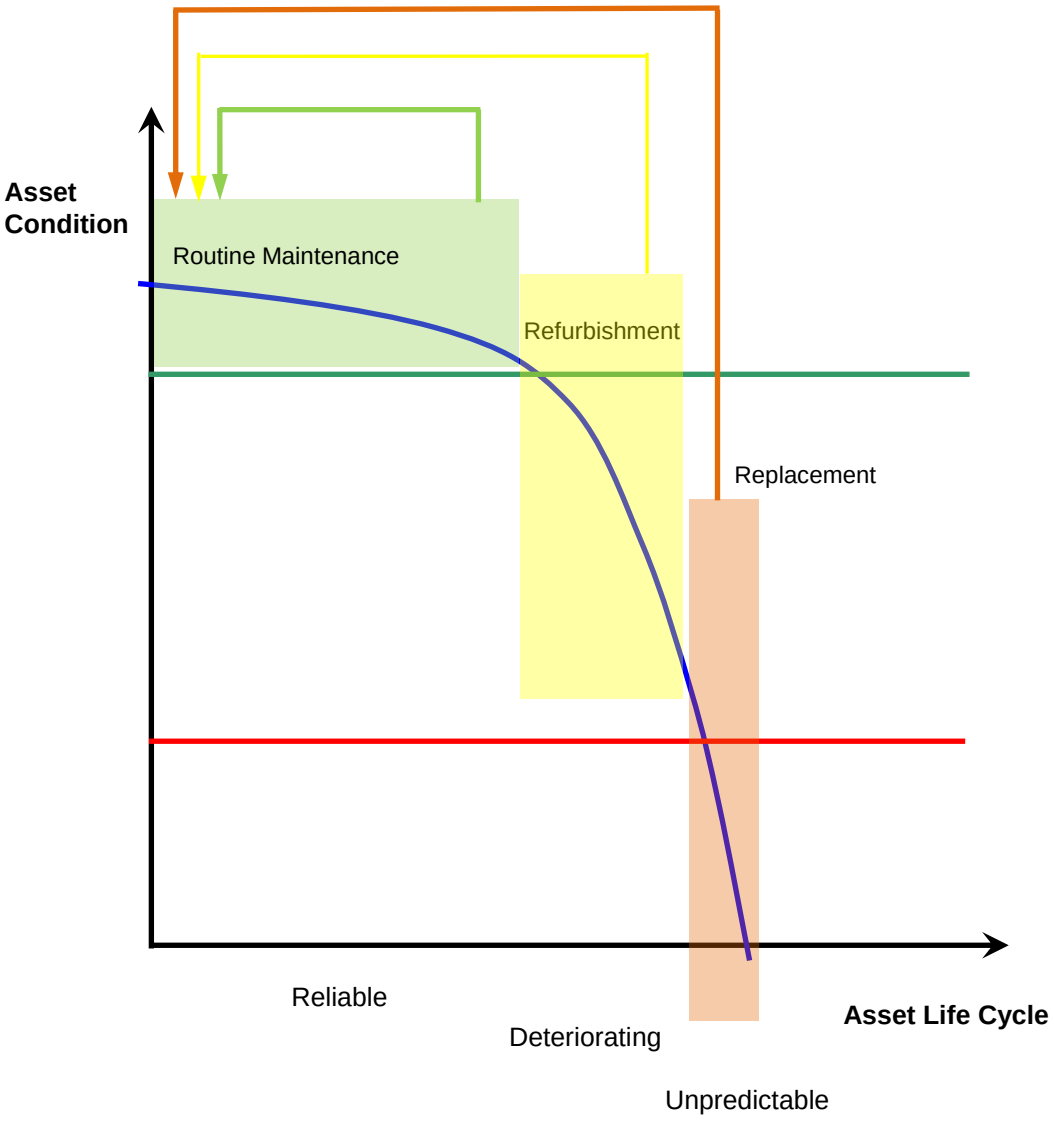
3. Definitions

Asset Refurbishment - Defined as additional planned maintenance required outside the specified routine maintenance program – generally applied to an asset in order to return it to a condition where routine maintenance will be effective (applied where routine maintenance by itself will not prevent unacceptable deterioration of safety/environment or availability/reliability).

4. Framework

As an asset moves through its lifecycle the relative effectiveness of maintenance on the asset changes. Therefore, maintenance decisions change in response to asset condition changes as represented in Figure 4-1 Asset Lifecycle Maintenance and Replacement below.

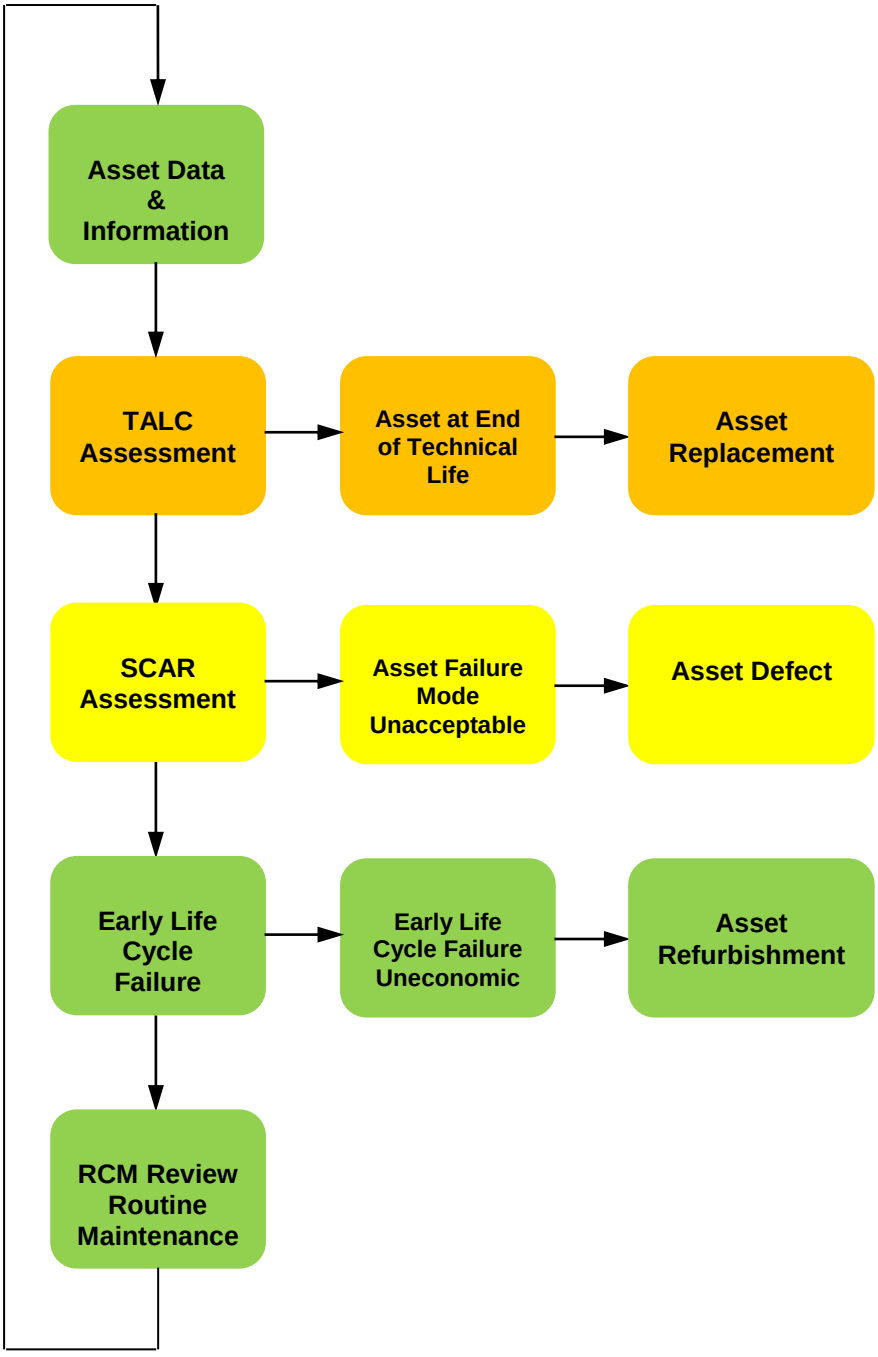
Figure 4-1 Asset Lifecycle Maintenance and Replacement



4.1 Refurbishment Plan – Decision Steps

Development of the Asset Refurbishment Plan is based on identifying those assets that have not yet reached the end of technical and economic life but exhibit active failure modes that if allowed to continue to functional failure will result in unacceptable safety, environmental, operational or asset management consequences. The decision steps are set out below.

Figure 4-2 Asset Refurbishment - Decision Steps



Features of the decision framework are:

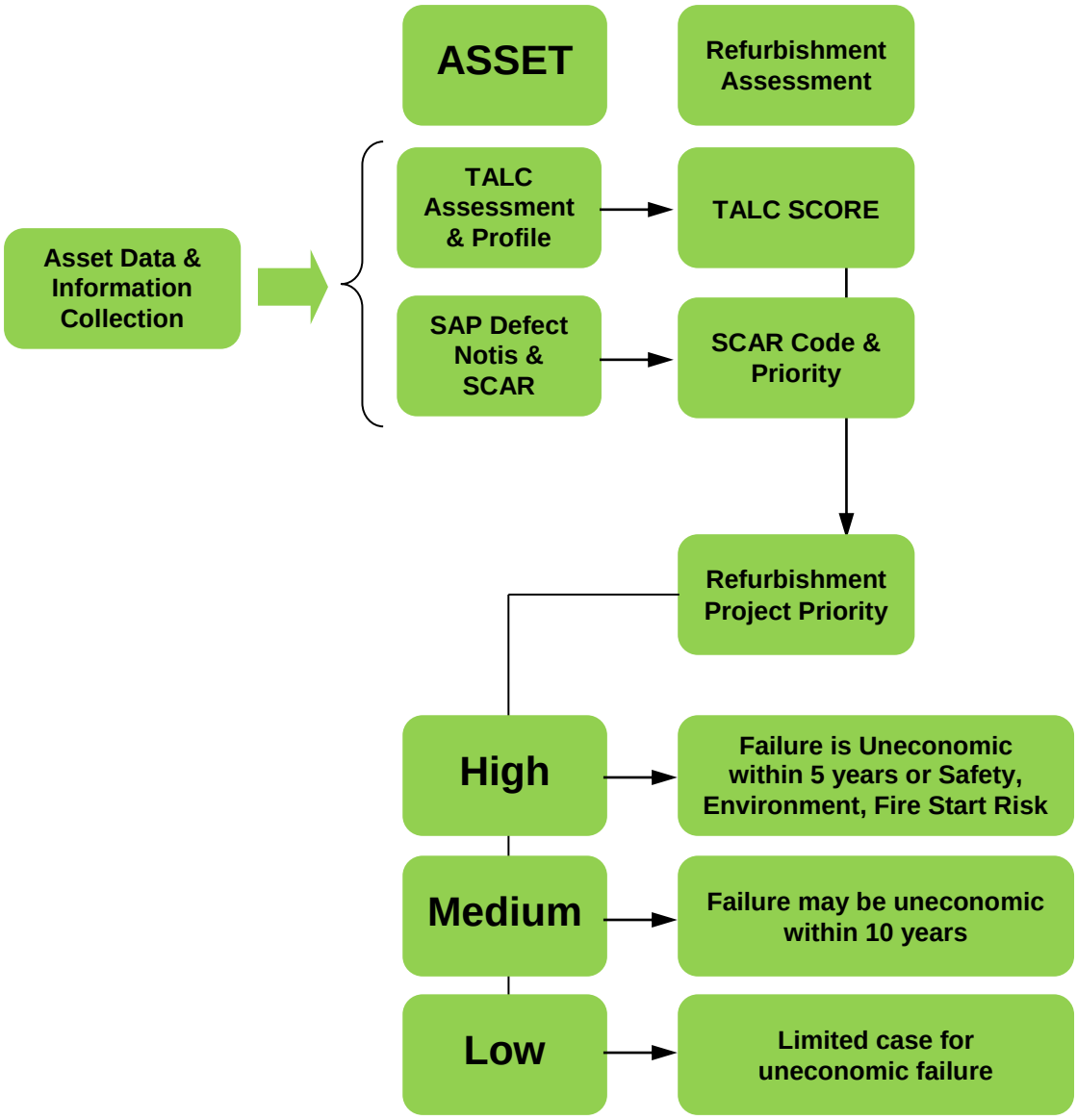
- Assets at end of technical life are not considered for refurbishment (as end of technical life indicates refurbishment is no longer economic)
- Only assets that have active failure modes with unacceptable consequences of failure are managed as defects
- Where an asset has an active failure mode that will result in early life cycle failure, it is refurbished when economic to do so

4.2 Scoring and Rating of Projects

The process for scoring and rating a potential asset refurbishment project is shown in the figure below. Projects are based on grouping common asset issues into projects specific to that issue (in order to maximise efficient maintenance delivery) and are rated High, Medium or Low as indicated in the figure.

Only projects that are likely to result in an uneconomic outcome (or may relate to the need to address safety, environmental or fire start risk) during the next 5 years, if not refurbished, are rated as High Risk. These projects form the basis of the Asset Refurbishment Plan. All projects listed in the plan are subjected to a more detailed assessment in order to confirm final inclusion.

Figure 4-3 Rating Process Refurbishment Priority



4.3 Project List Assessment

Projects identified as high priority have been categorised as follows:

Table 4-1 Project Category Description

Category	Description
Buildings	Building hardening to mitigate physical security risk
Communications – Tower	Safety compliance on communications network towers
Failure Mode	Asset condition assessment and analysis relating to transmission line asset component failure modes (particularly related to fire start risk)
Insulator	EPL insulator replacement (related to mitigation of fire start risk)
Oil Containment	Environmental compliance – Transformer bunds and associated oil treatment systems
Plant Overhaul	GIS Overhaul (Northfield, Kilburn & East Terrace) Isolator Overhaul (Approx. 420 units) TF Overhaul (Approx. 39 units)
Removal	Removal of redundant line section
Risk	Operational safety risk mitigation
Substation Civil	Fire system and major erosion remediation
Tower	Operational Safety and tower structure repairs

The basis for economic assessment is discussed in Appendix 1 – Assessment Criteria.

A summary of high priority refurbishment project assessments is shown in Appendix 3 – Summary of Economic Assessment.

5. Project List

The Asset Refurbishment Plan project list is shown below in Table 5-1. Project reference numbers refer to the specific project scope and estimate document containing the detailed scope and estimate.

Table 5-1 Asset Refurbishment Project List

Project	Project Ref	Category	SAE ($11/12)
Substation Building Security Hardening & Refurb	Blds047	Buildings	$ 1,715,000
Communications Building Security Hardening & Refurb	Blds048	Buildings	$ 58,750
T399 Berri BUILDING - BRICK (BD01) Refurb - Major	Blds049	Buildings	$ 88,700
Comms Tower CA	Comms001	Comms Tower	$ 590,000
Comms Towers Fall Arrestor Replace	Comms002	Comms Tower	$ 314,914
F1836/1837/1833 conductor CA	Lines002	Failure Mode	$ 1,183,525
CA Analysis (Eng support)	Lines007	Failure Mode	$ 2,100,000
Tx Line Mid-Span Joint Testing Baseline	Lines009	Failure Mode	$ 4,140,126
Tower earthing & assessment	Lines010	Failure Mode	$ 1,450,000
Line component testing (conductor & joints)	Lines011	Failure Mode	$ 1,052,222
Tx line thermography 3yr cycle	Lines012	Failure Mode	$ 1,811,325
Tx line corona 3yr cycle	Lines013	Failure Mode	$ 660,900
Insulator Testing for Z-Code Replacement	Lines051	Failure Mode	$ 922,584
NDT Foundation CA	Lines056	Failure Mode	$ 126,000
Veg ID & Mngt Tool Investigation	R&D06	Failure Mode	$ 400,000
EPL insulator replace	Lines030	Insulator	$ 4,105,843
TF Bunds Refurb - Plate Separators Replacement	Subs024	Oil Containment	$ 407,590
TF Bunds Refurb - Design/Construct	Subs025	Oil Containment	$ 1,310,990
TF Bunds Refurb - U/G Oil/Water Separation Tank Sample Point Install	Subs026	Oil Containment	$ 131,375
TF Bunds Refurb - Oil Blocking System Replace	Subs038	Oil Containment	$ 666,825
TF Bunds Refurb - Oil Separator Install	Subs039	Oil Containment	$ 803,120
Subs Plant Isolator Refurb	Subs001	Plant OH	$ 9,142,263
GIS Refurbishment	Subs003	Plant OH	$ 4,698,000
Structure and Footing Repair	Subs004	Plant OH	$ 511,029
Sub Plant TF Minor Refurb	Subs005	Plant OH	$ 4,778,941
Battery Charger Upgrades - Pri 1	Subs033	Plant OH	$ 4,526,900
Substation Computer Based Local Control Facilities (HMI) Replacement	SecSys15	Plant OH	$ 970,000
T140 Keith Earthing Remedial Works	Subs044	Plant OH	$ 508,366
T292 Kincraig Earthing Remedial Works	Subs045	Plant OH	$ 387,320
F1830 removal	Lines026	Removal	$ 521,711
TIPS De-Energised 66kV U/G Oil-filled Cable Removal	Lines059	Removal	$ 1,740,000
Aerial Hazard ID [over/under line xing markers]	Lines021	Risk	$ 3,825,600
ERS - training	Lines023	Risk	$ 268,862
H209 Site Drainage Refurb & Asphalt Hardstand	Subs016	Sub Civil	$ 1,969,700
H403 Site Drainage Refurb & Asphalt Hardstand	Subs023	Sub Civil	$ 456,000
H209 Fire Hydrant Refurbishment	Subs030	Sub Civil	$ 183,000
Fire water Tank & Pump Replacement	Subs031	Sub Civil	$ 49,800
F1812/57 footing fix pri 1	Lines025	Tower	$ 1,196,545
Twr Rusty Nut & Bolt Refurb	Lines034	Tower	$ 985,000
High Crossing Twr Climbing Inspection	Lines050	Tower	$ 359,700
link box refurb	Cable003	U/G Cables	$ 435,827
Aux plant refurb/upgrade	Cable004	U/G Cables	$ 175,000

6. Appendices

- Appendix 1 – Assessment Criteria
- Appendix 2 – Project Economic Assessment
- Appendix 3 – Summary of Economic Assessment

6.1 Appendix 1 – Assessment Criteria

Projects listed in the Asset Refurbishment Plan fall into three main types, these are set out in the table below showing the assessment strategy applied.

Project Type	Assessment Strategy
Projects specifically defined to mitigate risk associated with operational or public safety or environmental obligations set out in legislation.	Projects in this category generally fall under the requirements of Workplace Health and Safety Legislation or State Environmental Legislation. Where the project is specifically to meet safety or environmental obligations and is related to a single option, no economic assessment is conducted.
Projects associated with the management of transmission line fire start risk.	These projects are for condition assessment and analysis of transmission line component modes. As development of a full understanding of all component failure modes and associated component condition is directly associated with mitigation of fire start risk (as indicated by the Victorian Royal Commission), no economic assessment is conducted.
Projects to mitigate early asset end of technical life where it is economically efficient to do so.	All projects designed to mitigate early asset end of technical life are subject to an economic assessment based on comparing the cost of undertaking the project compared with costs associated with doing nothing. Details specific to each project assessment are shown in the following section.

6.2 Appendix 2 – Project Economic Assessment

Project: Substation Building Security Hardening & Refurbishment

Project Need

A number of ElectraNet substation buildings are vulnerable to unauthorised, unlawful access because of inadequate building security. Also, many have no fire-stopping barriers to prevent building fires spreading to adjacent rooms, and many have no emergency evacuation lighting systems installed in accordance with the 'Building Code of Australia'.

Options Considered

Table 6-1 Substation Building Security Options

Option	Response
Do Nothing	Site remains susceptible to unauthorised entry, possible damage to equipment and interruption of supply due to protection equipment damage – see estimate of value at risk below
Defer for Asset Replacement	No building asset replacement project identified
Defer for Site Replacement	No site asset replacement project identified
Asset Refurbishment Project	Building Security Hardening – see project scope below

Estimate of Value at Risk

Table 6-2 Estimate of Value at Risk (Substation Building Security)

Item	Risk	Value
Protection Equipment	Minor damage requiring replacement	$50k
Network Outage	Interruption of supply due to protection equipment damage/failure – outage (10MW for 6 hours where Value of Lost Load is $44,300/MWh)	$2,658k
Adverse Event	Assumed to be a one in 10 year event (based on location of site and history of unauthorised activity)	
Value at Risk		**$2,708k**

Project Scope

The project scope is to upgrade the physical building security hardening, install fire-stopping barriers and install emergency evacuation lighting systems in substation buildings where needed, and in accordance with the 'Building Code of Australia (BCA)'. This project will also address any building Work Health and Safety (WHS) compliance shortcomings. The estimated cost of this project is $1,715k.

Cost Benefit Analysis

Table 6-3 Cost Benefit (Substation Building Security)

Risk Category	Risk	Mitigation Cost	Risk Cost	Benefit	Notes
Physical Security	High probability of damage to substation protection systems	$1,715k	$2,708k	$993k	Assume 1 incident in 10 years where damage to equipment results in replacement 1 unit of property ($50k per unit) and lost load of 10MW for 6 hours @ $44.3k/MWh

Based on the cost benefit showing a positive benefit the substation building security project is recommended as the least whole of life cost option.

Project: Communications Building Security Hardening and Refurbishment

Project Need

A number of ElectraNet telecommunication buildings are vulnerable to unauthorised, unlawful access because of inadequate building security. Also, many have no fire-stopping barriers to prevent building fires spreading to adjacent rooms, and many have no emergency evacuation lighting systems installed in accordance with the 'Building Code of Australia'.

Options Considered

Table 6-4 Communications Building Security Options

Option	Response
Do Nothing	Site remains susceptible to unauthorised entry, possible damage to equipment and short interruption of supply due to protection signalling interruption – see estimate of value at risk below
Defer for Asset Replacement	No building asset replacement project identified
Defer for Site Replacement	No site asset replacement project identified
Asset Refurbishment Project	Building Security Hardening – see project scope below

Estimate of Risk

Table 6-5 Estimate of Risk (Communications Building Security)

Item	Risk	Value
Communications Equipment	Minor damage requiring replacement	$50k
Network Outage	Interruption of protection signalling – minor outage (5MW for 1 hour where Value of Lost Load is $44,300/MWh)	$221.5k
Adverse Event	Assumed to be a one in 10 year event (based on location of site and history of unauthorised activity)	
Risk		**$271.5k**

Project Scope

The project scope is to upgrade the physical building security hardening, install fire-stopping barriers and install emergency evacuation lighting systems in substation buildings where needed, and in accordance with the 'Building Code of Australia (BCA)'. This project will also address any building Work Health and Safety (WHS) compliance shortcomings. Estimated cost of project is $58.75k.

Cost Benefit Analysis

Table 6-6 Cost Benefit (Communications Building Security)

Risk Category	Risk	Mitigation Cost	Risk Cost	Benefit	Notes
Physical Security	High probability of damage to substation communication systems	$58.75k	$271.5k	$212.7k	Assume 1 incident in 10 years where damage to equipment results in replacement 1 unit of property ($50k per unit) and lost load of 5MW for 1 hour @ $44.3k/MWh

Based on the cost benefit showing a positive benefit the communications building security project is recommended as the least whole of life cost option.

Project: T339 Berri Building Brick(BD01) Refurbishment (Major)

Project Need

T399 Berri substation control building has suffered footing failure on the northern side resulting in footing subsidence. This, in turn, has dragged the roof structure across all the parallel walls throughout the building resulting in significant cracking to these walls. The southern wall in particular has suffered severe movement. Various 'Work Health and Safety' (WHS) compliance shortcomings now apply and the building is near to being classified as unsafe.

Options Considered

Table 6-7 T339 Berri Building Structure Options

Option	Response
Do Nothing	Deterioration of the building continues with no controls applied, it is likely that the building will become unsafe.
Defer for Asset Replacement	No building asset replacement project identified
Defer for Site Replacement	No site asset replacement project identified
Asset Refurbishment Project	Building Remediation Project – see project scope below

Estimate of Risk

Table 6-8 Estimate of Risk (T339 Berri Building Structure)

Item	Risk	Value
Building Structure	Building structure is declared unsafe, restricted access to control equipment is unacceptable therefore emergency remediation would be required – due to the emergency/unplanned response required the estimate is $150k (based on cost of planned response + escalation)	$150k
Adverse Event	Estimated to be almost certain during the next 5 to 10 years based on condition and history of the building	
Risk		**$150k**

Project Scope

Berri substation control building is earmarked for replacement in the medium term. Therefore, the project scope is to attend to all WHS shortcomings and implement measures to increase the structural integrity of this building to ensure the building will be safe for use for a further ten year period. Estimated cost of project is $88.7k.

Cost Benefit Analysis

Table 6-9 Cost Benefit (T339 Berri Building Structure)

Risk Category	Risk	Mitigation Cost	Risk Cost	Benefit	Notes
Functional Failure	Building structure is unsafe	$88.7k	$150k	$61.3k	Emergency remedial work on building is required, assume $150k

Based on the cost benefit showing a positive benefit the substation building remediation project is recommended as the least whole of life cost option.

Project: Substation Isolator Refurbishment

Project Need

ElectraNet has approximately 1216 high voltage isolators in the transmission network, 47 per cent of these units have been in service for more than 30 years.

Until 2008, ElectraNet isolators had not been maintained under a routine maintenance plan for approximately ten years. This has resulted in a large backlog of routine maintenance and defects. Although a routine maintenance plan has now been implemented, the routine maintenance task is not designed to deal with the large backlog.

Options Considered

Table 6-10 Substation Isolator Refurbishment

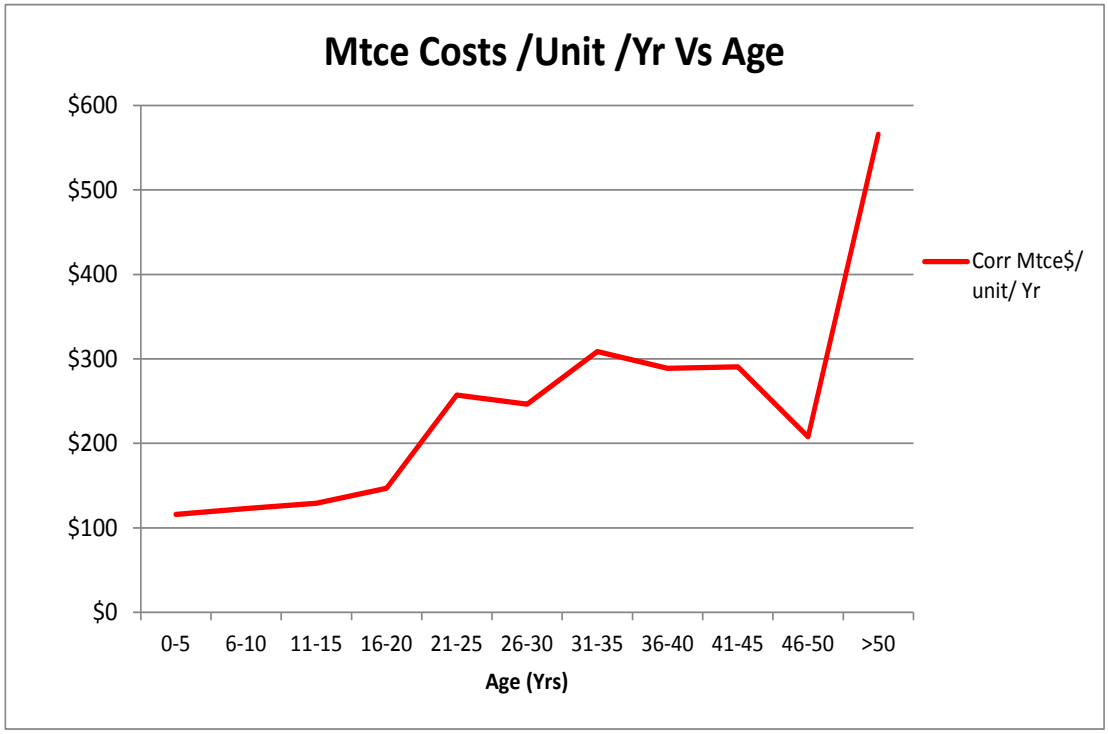
Option	Response
Do Nothing	Continue operating the network with 441 isolator units associated with 27 substation locations with defects that relate to a range of significant operating and asset condition issues. Long run outcomes are: • The network continues to be operated in a sub-optimal condition as out of service functions increase response time and cost of fault and maintenance isolation/restoration. • Network reliability and availability impacts • A high corrective maintenance response is maintained (the least efficient allocation of resources).
Defer for Asset Replacement	Replace Later – 60 per cent of units over the following two regulatory periods
Defer for Site Replacement	No site asset replacement project identified
Asset Refurbishment Project	Isolator refurbishment project – see project scope below

Estimate of Risk

Table 6-11 Estimate of Risk (Substation Isolator Refurbishment)

Item	Risk	Value
Isolator Condition	During the next five years isolator condition deteriorates (operational safety and network reliability) – 60% of defected isolators (220 units) require change out in each of the next two regulatory periods.	Change-out cost is based on $70k per unit
Isolator corrective maintenance cost	On average the additional corrective maintenance cost per unit is $200/year/unit (see isolator age/cost profile below) – over a five year period this equals an additional $1k/unit/period	Additional corrective maintenance cost of $1k/unit/period
Isolator Operability	Due to additional time taken to operate network, incremental increases in outage times increase lost load	VOLL = $44,300 MWh, load lost = 5MW for 5 events/year of 1 hour each
Risk (NPV 20 Years)	**Replace Later** **Refurbish**	**$16,540k** **$10,452k**

Figure 6-1 Isolator Corrective Maintenance Cost as a function of Age



Project Scope

The scope of this project is to address the backlog of maintenance and defect items relating to 441 identified isolators spread through 28 different substations. This primarily involves assignment of resources to previously identified issues on each of the stipulated isolators according to field studies recently conducted.

The field studies have quantified the extent of the corrective work needed for each isolator through 'hands-off' 'ground-level' inspections recently undertaken. The basis of these inspections was aligned to the ElectraNet standard for 6-yearly maintenance of isolator plant. The estimated cost for this project is $9.142k.

Cost Benefit Analysis

Table 6-12 Cost Benefit (Substation Isolator Refurbishment)

Risk Category	Risk	Refurbishment Cost (NPV)	Replace Later (NPV)	Benefit (NPV)	Notes
Functional Failure	Poor condition and performance	$10,425k	$16,540k	$6,115k	Refurbish now compared with replace 60 per cent over two regulatory periods later.

Based on the cost benefit showing a positive benefit the isolator refurbishment project is recommended as the least whole of life cost option.

Project: Gas Insulated Switchgear Refurbishment

Project Need

ElectraNet has 275kV Gas Insulated Switchgear (GIS) at Northfield, Kilburn and East Terrace substations that was installed in the 1980's. This GIS equipment is located in the open and ElectraNet inspections have identified evidence of physical deterioration.

Options Considered

Table 6-13 Substation GIS Refurbishment

Option	Response
Do Nothing	The GIS equipment installed at Northfield, Kilburn and East Terrace is designed for indoor installation, however has been installed outside. Additional protective coatings have been applied to all GIS pipework flanges. This equipment is currently at mid-life. As equipment protective coatings and seals continue to deteriorate the following risks have been identified: • Integrity of flanges on GIS pipework is compromised resulting in SF6 leaks – Likelihood has been assessed as almost certain during next 10 years • Major component replacement/repair required as emergency corrective maintenance - Likelihood has been assessed as almost certain during next 10 years • GIS contacts associated with isolators and circuit breakers condition remains unknown (manufacturer recommends inspection in order to identify if corrective actions are required) – Likelihood of condition assessment not undertaken is 100 per cent
Defer for Asset Replacement	GIS asset replacement is not scheduled for these sites
Defer for Site Replacement	Site replacement is not scheduled
Asset Refurbishment Project	Planned maintenance tasks: • Refurbish equipment protective coatings and flange seals • Undertake condition refurbishment of air systems • Circuit breaker and isolator units condition inspection (in accordance with manufacturers recommendation)

Estimate of Risk

Table 6-14 Estimate of Risk (Substation GIS Refurbishment)

Item	Risk	Value
GIS Pipework Condition/Integrity	Flange condition deteriorates resulting in SF6 leak (as flange surface is corroded behind "O" ring). Dismantling and replacement/repair of main GIS pipework required.	Emergency response base on refurbishment estimate with 50 per cent escalation
Air System reliability	Air system components and controls in poor condition leads to decreasing reliability/availability	Increased corrective maintenance cost
Switching Devices	Internal condition issues are not identified leading to operating fault	Emergency response base on refurbishment estimate with 50 per cent escalation
Lost Load	Unreliable operation or development of SF6 leaks may result in some load being lost due to prolonged periods of equipment outage with increased exposure to next contingency events.	50MW for 1 Hour
Risk (NPV 20 Years)	**Do Nothing** **Refurbish**	**$6,245k** **$4,077k**

Project Scope

The scope of this project is for the refurbishment of the 275kV GIS equipment located at Northfield, Kilburn and East Terrace substations:

- Refurbish equipment protective coatings and flange seals
- Undertake condition refurbishment of air systems
- Circuit breaker and isolator units condition inspection (in accordance with manufacturers recommendation)

Cost Benefit Analysis

Table 6-15 Cost Benefit (Substation GIS Refurbishment)

Risk Category	Risk	Refurbishment Cost (NPV)	Do Nothing (NPV)	Benefit (NPV)	Notes
Functional Failure	Poor condition and performance	$4,077k	$6,245k	$2,168k	Refurbish now compared with doing nothing (resulting in emergency corrective maintenance in the following regulatory period)

Based on the cost benefit showing a positive benefit the Substation GIS Refurbishment project is recommended as the least whole of life cost option.

Project: Substation Plant Transformer Minor Refurbishment

Project Need

ElectraNet has approximately 158 power transformers in the transmission network, 46 per cent of these units have been in service for more than 30 years.

Until 2008, ElectraNet major overhaul of power transformers has not been routinely undertaken. This has resulted in a large backlog of routine maintenance and defects. Although a routine maintenance plan has now been implemented, the routine maintenance task is not designed to deal with the large backlog.

Options Considered

Table 6-16 Substation Transformer Refurbishment

Option	Response
Do Nothing	There are 36 system transformers that have been identified with significant defects that are beyond the scope of routine maintenance. If left unattended it is likely that: • Further deterioration in condition will arise • Issues of safety and environmental risk will increase, in particular oil leaks and bushing condition • The overall life of the transformer asset is compromised due to the loss of integrity of the transformer oil insulation (due to significant leaks introducing an air/oil interface and resulting path for increasing moisture levels in the oil)
Defer for Asset Replacement	Asset replacement is not scheduled for these sites
Defer for Site Replacement	Site replacement is not scheduled
Asset Refurbishment Project	Planned maintenance tasks: • Refurbish joints and seals • Refurbish auxiliary equipment • Replace bushings were required • Clean and paint components

Estimate of Risk

Table 6-17 Estimate of Risk (Substation Transformer Refurbishment)

Item	Risk	Value
Condition of Insulation	Continued oil leaks lead to high moisture levels in insulating oil – likely to reduce the life of the transformer	Early replacement required for some units
Oil leaks	Site safety is compromised due to oil leaks into bund area with associated hazards Risk of release of oil to environment due to large volumes of oil in bunds	Increased corrective maintenance cost
Auxiliary Devices and General Condition	Poor condition of auxiliaries and protective coating degradation – increased corrective maintenance and forced outage time	Risk of lost load
Risk (NPV 20 Years)	**Do Nothing** **Refurbish**	**$5,478k** **$3,873k**

Project Scope

The scope of this project is to address the backlog of maintenance and defect items relating to 36 identified power transformers spread through 22 different substations. This primarily involves assignment of resources to previously identified issues on each of the stipulated transformers according to field studies recently conducted. The project estimated cost is $4,778k.

Table 6-18 Cost Benefit (Substation Transformer Refurbishment)

Risk Category	Risk	Refurbishment Cost (NPV)	Do Nothing (NPV)	Benefit (NPV)	Notes
Functional Failure	Oil leaks lead to life cycle degradation - early end of life	$3,873k	$5,478k	$1,605k	Assume replacement of 2 TF required within 20 years and 2 lost load events of 50MW for 1 hour

Based on the cost benefit showing a positive benefit the Substation Transformer Refurbishment project is recommended as the least whole of life cost option.

Project: Battery Charger Upgrades – Priority 1

Project Need

ElectraNet substations currently employ a number of various battery charger units of various ages/manufacturers and technologies. A number of these units have reached the end of their practical life.

Options Considered

Table 6-19 Substation Battery Charger Replacement

Option	Response
Do Nothing	Battery chargers (69 units now obsolete) will required significant additional corrective maintenance effort Emergency replacement of some units may be necessary
Defer for Asset Replacement	Asset replacement is not scheduled for these sites
Defer for Site Replacement	Site replacement is not scheduled
Asset Refurbishment Project	Replace units with current standard equipment

Estimate of Risk

Table 6-20 Estimate of Risk (Battery Charger Replacement)

Item	Risk	Value
Corrective maintenance	Additional corrective maintenance effort required to keep units in service	Estimated at $20k per unit
Emergency replacement	Emergency replacement of some units required as equipment repair is not possible (5 units replaced per year)	Emergency replacement based on replacement cost with 50 per cent escalation
Risk (NPV 10 Years)	**Do Nothing** **Refurbish**	**$4,240k** **$3,669k**

Project Scope

ElectraNet battery charger units have been separated into two separate categories; Priority 1 and Priority 2, based on condition assessment findings. The scope of works is for the removal of the existing site battery charger unit and replacement with a conventional ElectraNet approved modern unit. The estimated cost of this project is $4,526k.

Cost Benefit Analysis

Table 6-21 Cost Benefit (Battery Charger Replacement)

Risk Category	Risk	Refurbishment Cost (NPV)	Do Nothing (NPV)	Benefit (NPV)	Notes
Functional Failure	Substation DC system performance is unreliable due to end of technical life component (DC Chargers)	$3,669k	$4,240k	$571k	Defect maintenance costs incurred are ongoing - estimated to be 4k per unit per annum for a total of 69 units. Emergency replacement of 5 units per year

Based on the cost benefit showing a positive benefit the Substation Battery Replacement project is recommended as the least whole of life cost option.

Project: Substation Computer Based Local Control Facilities (HMI)

Project Need

ElectraNet substations currently employ technology that enables users to view the status of components of plant within the substation through what has become to be known as a 'Human Machine Interface' or HMI. A number of these screen-based systems are now at their end-of-life phase and do not possess facility for spares and technical support. The HMI's in question are Areva 'E-Terra' units. The fault trend with this unit is currently increasing to the point where a replacement with current technology is now warranted.

Options Considered

Table 6-22 Substation LCF HMI Replacement

Option	Response
Do Nothing	HMI devices (10 units now obsolete) will required significant additional corrective maintenance effort Emergency replacement of some units may be necessary
Defer for Asset Replacement	Asset replacement is not scheduled for these sites
Defer for Site Replacement	Site replacement is not scheduled
Asset Refurbishment Project	Replace units with current standard equipment

Estimate of Risk

Table 6-23 Estimate of Risk (LCF HMI Replacement)

Item	Risk	Value
Corrective maintenance	Additional corrective maintenance effort required to keep units in service	Estimated at $30k per unit
Emergency replacement	Emergency replacement of some units required as equipment repair is not possible	Emergency replacement based on replacement cost with 50 per cent escalation
Risk (NPV 10 Years)	**Do Nothing** **Refurbish**	**$1,062k** **$786k**

Project Scope

The existing Areva E-Terra HMI system is recommended for replacement at ten (10) identified substation sites. This will involve a partial control system upgrade, only.

Each Areva E-Terra HMI system identified is to be replaced with a Siemens SiCAM PAS CC hardware platform in line with soon-to-be-released ElectraNet SDM V9 design templates. All existing hardware is to be removed from site.

In addition to the hardware required, the necessary SiCAM software and licenses are to be procured. Software configuration and engineering design must be performed, as well as factory testing and site commissioning of all substation Inputs/Outputs for each site in question. The estimated cost of this project is $970k.

Cost Benefit Analysis

Table 6-24 Cost Benefit (LCF HMI Replacement)

Risk Category	Risk	Refurbishment Cost (NPV)	Do Nothing (NPV)	Benefit (NPV)	Notes
Functional Failure	Substation Local Control performance unreliable due to end of technical life of component	$786k	$1,062k	$276k	Defect maintenance costs incurred are ongoing - estimated to be 30k per unit per annum Emergency replacement of units over 2 regulatory period based on replacement cost with escalation of 50 per cent

Based on the cost benefit showing a positive benefit the Substation LCF HMI project is recommended as the least whole of life cost option.

Project: H209 Site Drainage Refurbishment and Asphalt Hardstand

Project Need

At Happy Valley substation, the present drainage system has deteriorated to the point where it is causing damage to some areas of the site and is affecting the operations on the site. It will continue to deteriorate and will require continual maintenance unless significant remedial work is undertaken.

There is significant visual evidence of failure of the drainage system and it requires rectification as recommended in two independent engineering reports that identify root causes for the failures and methods of remediation.

Options Considered

Table 6-25 Substation H209 Site Drainage Refurbishment

Option	Response
Do Nothing	Continued erosion of site civil structure (substation bench)
Defer for Asset Replacement	Asset replacement is not scheduled for these sites
Defer for Site Replacement	Site replacement is not scheduled
Asset Refurbishment Project	Undertake refurbishment of site drainage and repair bench.

Estimate of Risk

Table 6-26 Estimate of Risk (H209 Site Drainage Refurbishment)

Item	Risk	Value
Corrective maintenance	Additional corrective maintenance effort required to repair damage due to erosion	Emergency repair based on replacement cost with 50 per cent escalation
Emergency repair	Volume of erosion increases linearly with time – emergency repair will be required	

Project Scope

The scope of this project is to refurbish the failing drainage system within the ElectraNet land of Happy Valley substation by implementing most of the recommendations contained within the independent drainage review reports.

The estimate for this project is $1,969k.

Cost Benefit Analysis

Table 6-27 Cost Benefit (H209 Site Drainage Refurbishment)

Risk Category	Risk	Refurbishment Cost	Do Nothing	Benefit	Notes
Functional Failure	Site failure is much larger due to contained erosion/collapse	$1,969k	$2,461k	$492k	Cost increases linearly with time assuming constant rate of deterioration

Based on the cost benefit showing a positive benefit the H209 Site Drainage project is recommended as the least whole of life cost option.

Project: H403 Site Drainage Refurbishment and Asphalt Hardstand

Project Need

The present drainage system at Northfield substation has deteriorated to the point where it is causing damage to some areas of the site and is affecting the operational conditions of the site. It will continue to deteriorate and will require continual maintenance unless significant remedial work is undertaken.

The integrity of the storm water management system requires rectification due to issues of water pooling, boggy trafficable areas, deterioration of gravelled areas and erosion and silting of drainage areas under perimeter security beams.

Options Considered

Table 6-28 Substation H403 Site Drainage Refurbishment

Option	Response
Do Nothing	Continued erosion of site civil structure (substation bench)
Defer for Asset Replacement	Asset replacement is not scheduled for these sites
Defer for Site Replacement	Site replacement is not scheduled
Asset Refurbishment Project	Undertake refurbishment of site drainage and repair bench.

Estimate of Risk

Table 6-29 Estimate of Risk (H403 Site Drainage Refurbishment)

Item	Risk	Value
Corrective maintenance	Additional corrective maintenance effort required to repair damage due to erosion	Emergency repair based on replacement cost with 50 per cent escalation
Emergency repair	Volume of erosion increases linearly with time – emergency repair will be required	

Project Scope

The project scope is to rectify the failing storm water management system within the ElectraNet owned and controlled property of Northfield substation, by installing:

- Asphalt to existing and proposed internal roadways;
- Trafficable concrete gutters to some internal roadways;
- Installation of spoon drains; and
- Shaping of ground terrain to redirect storm water to the discharge system.

The estimated cost of this project is $456k.

Cost Benefit Analysis

Table 6-30 Cost Benefit (H403 Site Drainage Refurbishment)

Risk Category	Risk	Refurbishment Cost	Do Nothing	Benefit	Notes
Functional Failure	Site failure is much larger due to contained erosion / collapse	$456k	$684k	$228k	Cost increases linearly with time assuming constant rate of deterioration

Based on the cost benefit showing a positive benefit the H403 Site Drainage project is recommended as the least whole of life cost option.

Project: F1812/57 Footing Fix Priority 1

Project Need

In 2005, Groundline Pty Ltd was commissioned to investigate the pile integrity of 1800 foundations using non-destructive testing techniques and Below Ground Corrosion Meter testing. This investigation identified forty three foundations requiring attention as the measured lengths or shaft integrity issues showed significant deviations from the norm or predicted values. Foundation reinforcement bars and stubs are exhibiting significant degradation due to corrosion and in some cases are completely missing.

Options Considered

Table 6-31 F1812/57 Footing Repair

Option	Response
Do Nothing	Increased likelihood of tower collapse (within design wind loading conditions)
Defer for Asset Replacement	Asset replacement is not scheduled for this feeder
Defer for Feeder Replacement	Feeder replacement is not scheduled
Asset Refurbishment Project	Undertake refurbishment and reinstatement of footings

Estimate of Risk

Table 6-32 Estimate of Risk (F1812/57 Footing Repair)

Item	Risk	Value
Emergency repair	Tower collapse under design conditions due to wind loading on tower resulting in footing failure and tower collapse	Assume typical failure of four towers with associated emergency replacement

Project Scope

The project scope covers three phases that prioritises the work to refurbish the most critical or serious footings first, with each phase to be performed in each successive year. The estimated cost for this project is $1,196k.

The scope of work will include the following works (for each of the fourteen towers):

- Geotechnical investigation & soil resistivity tests.
- Detailed structural design and drafting of grout anchor foundations.
- Mobilisation.
- Construction of grout anchor foundations.
- Demobilization and site reinstatement.

Cost Benefit Analysis

Table 6-33 Cost Benefit (F1812/57 Footing Repair)

Risk Category	Risk	Refurbishment Cost	Do Nothing	Benefit	Notes
Functional Failure	Tower collapse and associated emergency response measures	$1,196k	$9,400k	$8,204k	Replacement of four towers (adjacent) at a cost of $100k per tower and estimate of VOLL is 5MW for 72 hours @ $25k/MWh

Based on the cost benefit showing a positive benefit the F1812/57 Footing Repair project is recommended as the least whole of life cost option.

Project: High Crossing Tower Climbing Inspection

Project Need

Structure member, structure fastener, and Ground line interface corrosion are the main factors in determining the structural integrity of transmission line structures.

ElectraNet have identified High Crossing 'Special Structures' which exhibit additional risk concerns. These structures are generally extremely tall lattice towers that cross salt-water bodies. They are also near industrial pollutants. These factors mean that they are difficult to access and are potentially exposed to excessive pollution.

Based on these factors, ElectraNet want to get a thorough understanding of current condition and likely remaining life of these towers through detailed inspections and condition assessment. It is also crucial for ElectraNet to understand the scope and cost of any future refurbishment work required to develop the secure adequate funding for the next 5 year regulatory period.

Options Considered

Table 6-34 High Crossing Tower Inspection

Option	Response
Do Nothing	Increased likelihood of tower condition deteriorating to the point where replacement is required
Defer for Asset Replacement	Asset replacement is not scheduled for this feeder
Defer for Feeder Replacement	Feeder replacement is not scheduled
Asset Refurbishment Project	Undertake inspection and condition assessment of towers in order to determine the appropriate long term remedial action.

Estimate of Risk

Table 6-35 Estimate of Risk (High Crossing Tower Inspection)

Item	Risk	Value
Tower condition deterioration	Tower condition deteriorates to a point where remediation is no longer cost effective – tower replacement will become the only option	Probability of occurring within 10 years is 0.2

Project Scope

To carry out detailed condition assessment on identified sixteen (16) High Crossing 'Special Structures' to the following criteria:

Tower condition assessments to be conducted in accordance with:

- 1-03-P06 Procedure A&O Transmission Line Maintenance Tower Inspection;
- 1-03-T06 Task list A&O Transmission Line Maintenance Tower Inspection; and
- 1-03-C06 Checklist A&O Transmission Line Maintenance Tower Inspection.

The estimated cost of this project is $359k.

Cost Benefit Analysis

Table 6-36 Cost Benefit (High Crossing Tower Inspection)

Risk Category	Risk	Refurbishment Cost	Do Nothing	Benefit	Notes
Functional Failure	Tower condition deteriorates to the point where remediation is not possible	$375k	$1,000k	$625k	Replacement cost of towers $2.5 million - assume probability of 0.2 in next 10 year period

Based on the cost benefit showing a positive benefit the High Crossing Tower Inspection project is recommended as the least whole of life cost option.

Project: Link Box Refurbishment

Project Need

The Magill to East Terrace 275kV underground cable has its cable sheath connections bonded at each cable joint through a link box which is located in an underground pit adjacent to the cable joint pit. Routine maintenance inspections have indicated the condition of the link boxes has deteriorated to the point that replacement of the link boxes is required.

Options Considered

Table 6-37 Link Box Replacement

Option	Response
Do Nothing	Continued deterioration of cable link boxes and associated increasing corrective maintenance cost.
Defer for Asset Replacement	Asset replacement is not scheduled for this feeder
Defer for Feeder Replacement	Feeder replacement is not scheduled
Asset Refurbishment Project	Replace link box with new unit and re-terminate all cables

Estimate of Risk

Table 6-38 Estimate of Risk (Link Box Replacement)

Item	Risk	Value
Deterioration and poor condition of link boxes	Increasing corrective maintenance costs with possible emergency replacement of units over next regulatory period Increased corrective maintenance of $1k per unit annually.	Emergency replacement based on replacement estimate with 50 per cent escalation

Project Scope

The scope of this project is to replace of all the link boxes with new link box units in the existing underground pits. There are 19 boxes in total that are in need of replacement. This remediation work is based primarily on the following elements:

- Design and manufacture of new link boxes.
- Changeover of the link boxes using a predetermined work methods.
- Outage planning, support and administrative activities.

The estimated cost of this project is $436k.

Cost Benefit Analysis

Table 6-39 Cost Benefit (Link Box Replacement)

Risk Category	Risk	Refurbishment Cost (NPV)	Do Nothing (NPV)	Benefit (NPV)	Notes
Functional Failure	Link boxes require corrective maintenance regularly & emergency replacement over following regulatory period	$353k	$414k	$61k	Ongoing average annual defect maintenance cost $1k per unit (19 units) Emergency replacement over following regulatory period

Based on the cost benefit showing a positive benefit the Link Box Replacement project is recommended as the least whole of life cost option.

Project: Auxiliary Plant Refurbishment

Project Need

The Magill-East Terrace 275kV fluid-filled underground cable is one of two transmission lines supplying the Adelaide CBD. Auxiliary plant held to support maintenance and emergency restoration of this cable includes plant to process and de-gas the fluid, fluid pressure tanks, spare fluid and various connection accessories.

The cable and auxiliary plant were installed in 1983.

The paper insulation of oil filled cables such as this relies heavily on the complete impregnation of the paper with oil and also that the oil is free of gas and moisture. Failure to meet and maintain these requirements will result in internal cable or accessory failure. Repair will be time consuming and expensive.

Defects in the auxiliary plant due to age, wear and use, and the loss of knowledge / capability due to loss of key resources, have reduced the serviceability of the auxiliary plant and could cause it to fail during operation. The de-gasification plant operating instructions have not been updated to reflect changes made to the plant and only provide basic operating instructions, which do not address all operational modes.

Work in this area will be needed to eliminate potential delays to ElectraNet's capability to respond to a fluid filled cable emergency.

Options Considered

Table 6-40 Cable Auxiliary Plant Overhaul

Option	Response
Do Nothing	Cable oil facility remains out of service
Asset Refurbishment Project	Overhaul unit and return to service

Estimate of Risk

Table 6-41 Estimate of Risk (Cable Auxiliary Plant Overhaul)

Item	Risk	Value
Management of HV Cable Oil	Clean dry cable oil is required for on-going maintenance of the 275kV Oil Insulated Cable (supplying the CBD). With the cable oil facility out of service oil must be sourced from others. Additional controls and tests are then required to manage this process	Annual cost – additional management, transport, test and storage process

Project Scope

The project will require the following high-level items to be completed:

1. De-gasification plant repairs;
2. Working Pressure Tank (WPT) repairs/refurbishment;
3. Procurement of specialised accessories required for operation of plant and maintenance processes;
4. Update of de-gasification plant operating instructions/manual;
5. Update of Magill-East Terrace cable maintenance manual;
6. Establishment of auxiliary plant SAP records for ongoing auxiliary plant maintenance management;
7. Establishment of the ongoing recording of WPT and spare fluid-processing history records;
8. Establishment of cable fluid sample records requirements; and
9. Training appropriate for the ongoing operation and maintenance of the auxiliary oil plant.

The estimated cost of this project is $175k.

Cost Benefit Analysis

Table 6-42 Cost Benefit (Cable Auxiliary Plant Overhaul)

Risk Category	Risk	Refurbishment Cost	Do Nothing	Benefit	Notes
Functional Failure	Integrity of cable oil is compromised	$175k	$200k	$25k	Additional costs incurred for procurement and management of clean, dry cable oil, annual estimate $40k

Based on the cost benefit showing a positive benefit the Cable Auxiliary Plant Overhaul project is recommended as the least whole of life cost option.

6.3 Appendix 3 – Summary of Economic Assessment

Table 6-43 Project Economic Assessment

Project	Category	SAE	Life Cycle Failure	Consequence	Estimate	Risk Cost	Cost Benefit	Assumptions
Subs Plant Isolator Refurb	Plant OH	$ 9,142,263	Functional Failure	Later replacement required of 60% of units due to unserviceability	$10,425k (NPV)	$16,540K (NPV)	$6,115K (NPV)	Refurbish now compared with replace 60% over two regulatory periods later.
GIS Refurbishment	Plant OH	$ 4,698,000	Functional Failure	Failure of GIS Sections to the poiint where dismantle/repair is required	$4,077k (NPV)	$6,245K (NPV)	$2,168K (NPV)	Refurbish now compared with doing nothing (resulting in emergency corrective maintenance in the following regulatory period)
Structure and Footing Repair	Plant OH	$ 511,029	Safety	Structure is unstable/unsafe	NA	NA	NA	As this issue relates to safety an economic trigger is not considered
Sub Plant TF Minor Refurb	Plant OH	$ 4,778,941	Functional Failure	Oil leaks lead to life cycle degredation - early end of life	$3,873k (NPV)	$5,478K (NPV)	$1,605K (NPV)	Assume replacement of 2 TF required within 20 years and 2 lost load events of 50MW for 1 hour
H209 Site Drainage Refurb & Asphalt Hardstand	Sub Civil	$ 1,969,700	Functional Failure	Site erosion continues and affects substation bench	$ 1,969,700	$2,461k	$492k	Cost increases linearly with time assuming constant rate of deterioration
H403 Site Drainage Refurb & Asphalt Hardstand	Sub Civil	$ 456,000	Functional Failure	Site erosion continues and affects substation bench	$ 456,000	$ 684	$228K	Cost increases linearly with time assuming constant rate of deterioration
TF Bunds Refurb - Plate Separators Replacement	Oil Containment	$ 407,590	Environmental	Non compliance with EPA regulations - Environmental oil pollution and resulting cleanup	NA	NA	NA	As this is related to compliance with environmenatl legislation and requlations an economic trigger is not considered.
TF Bunds Refurb - Design/Construct	Oil Containment	$ 1,310,990	Environmental	Non compliance with EPA regulations - Environmental oil pollution and resulting cleanup	NA	NA	NA	As this is related to compliance with environmenatl legislation and requlations an economic trigger is not considered.
TF Bunds Refurb - U/G Oil/Water Separation Tank Sample Point Install	Oil Containment	$ 131,375	Environmental	Non compliance with EPA regulations - Environmental oil pollution and resulting cleanup	NA	NA	NA	As this is related to compliance with environmenatl legislation and requlations an economic trigger is not considered.
H209 Fire Hydrant Refurbishment	Sub Civil	$ 183,000	Fire Safety	Subsation fire fighting system failure	NA	NA	NA	As this is related to fire safety an economic trigger is not considered
Fire water Tank & Pump Replacement	Sub Civil	$ 49,800	Fire Safety	Subsation fire fighting system failure	NA	NA	NA	As this is related to fire safety an economic trigger is not considered
Battery Charger Upgrades - Pri 1	Plant OH	$ 4,526,900	Functional Failure	Substation DC system performance is unreliable due to end of technical life component (DC Chargers)	$3,669k (NPV)	$4,240K (NPV)	$571K (NPV)	Defect maintenance costs incurred are ongoing - estimated to be 4k per unit per annum for a total of 69 units. Emergency replacement of 5 units per year
TF Bunds Refurb - Oil Blocking System Replace	Oil Containment	$ 666,825	Environmental	Non compliance with EPA regulations - Environmental oil pollution and resulting cleanup	NA	NA	NA	As this is related to compliance with environmenatl legislation and requlations an economic trigger is not considered.
TF Bunds Refurb - Oil Separator Install	Oil Containment	$ 803,120	Environmental	Non compliance with EPA regulations - Environmental oil pollution and resulting cleanup	NA	NA	NA	As this is related to compliance with environmenatl legislation and requlations an economic trigger is not considered.
Substation Computer Based Local Control Facilities (HMI) Replacement	Plant OH	$ 970,000	Functional Failure	Substation Local Control perfromance unreliable due to end of technical life of component	$786k (NPV)	$1,062K (NPV)	$276K (NPV)	Defect maintenance costs incurred are ongoing - estimated to be 30k per unit per annum Emergency replacement of units over 2 regulatory period based on replacement cost with escalation of 50%
F1836/1837/1833 conductor CA	Failure Mode	$ 1,183,525	Functional Failure	Conductor failure modes are not understood - unexpected failure occurs of conductor	NA	NA	NA	As this is related to mitigation of fire start risk (the asset owner must understand asset failure modes and how asset condition relates to unacceptable failure modes) - an economic trigger is not considered.
CA Analysis (Eng support)	Failure Mode	$ 2,100,000	Functional Failure	Transmission Line failure modes are not understood - unexpected failure occurs as information analysis not available	NA	NA	NA	As this is related to mitigation of fire start risk (the asset owner must understand asset failure modes and how asset condition relates to unacceptable failure modes) - an economic trigger is not considered.
Tx Line Mid-Span Joint Testing Baseline	Failure Mode	$ 4,140,126	Functional Failure	Conductor failure modes are not understood - unexpected failure occurs due to midspan joint failure	NA	NA	NA	As this is related to mitigation of fire start risk (the asset owner must understand asset failure modes and how asset condition relates to unacceptable failure modes) - an economic trigger is not considered.
Tower earthing & assessment	Failure Mode	$ 1,450,000	Functional Failure	Tower earthing and associated EPR failure modes are not understood - unexpected failure occurs (electrocution hazard or back flashover)	NA	NA	NA	As this is related to mitigation of fire start risk (the asset owner must understand asset failure modes and how asset condition relates to unacceptable failure modes) - an economic trigger is not considered.
Line component testing (conductor & joints)	Failure Mode	$ 1,052,222	Functional Failure	Conductor failure modes are not understood - unexpected failure occurs of line component	NA	NA	NA	As this is related to mitigation of fire start risk (the asset owner must understand asset failure modes and how asset condition relates to unacceptable failure modes) - an economic trigger is not considered.
Tx line thermography 3yr cycle	Failure Mode	$ 1,811,325	Functional Failure	Conductor failure modes are not understood - unexpected failure occurs of hot joint	NA	NA	NA	As this is related to mitigation of fire start risk (the asset owner must understand asset failure modes and how asset condition relates to unacceptable failure modes) - an economic trigger is not considered.
Tx line corona 3yr cycle	Failure Mode	$ 660,900	Functional Failure	Conductor failure modes are not understood - unexpected failure occurs of line insulation	NA	NA	NA	As this is related to mitigation of fire start risk (the asset owner must understand asset failure modes and how asset condition relates to unacceptable failure modes) - an economic trigger is not considered.
Line Remediation & Risk Mitigation (following ALS)	NORM	$ 9,575,000	Public Safety	Discovery of line clearance likely to result in a flashover or accidental contact	NA	NA	NA	As this is related to public safety an economic trigger is not considered
Aerial Hazard ID [over/under line xing markers]	Risk	$ 3,825,600	Operational Safety	Visual warning/indication of line crossings not in accordance with Australian Standard (no indication in place)	NA	NA	NA	As this is related to operational safety an economic trigger is not considered
ERS - training	Risk	$ 268,862	Operational Safety	Trained staff are required for ERS deployment	NA	NA	NA	As this is related to operational safety an economic trigger is not considered
F1812/57 footing fix pri 1	Tower	$ 1,196,545	Functional Failure	Tower collapse and associated emergency response measures	$ 1,196,545	$9,400k	$8,240k	Replacement of four towers (adjacent) at a cost of $100k per tower and estimate of VOLL is 5MW for 72 hours @ $25k/MWh
F1830 removal	Removal	$ 521,711	Public Safety	Mechanical failure of redundant asset	NA	NA	NA	As this is related to public safety an economic trigger is not considered
EPL insulator replace	Insulator	$ 4,105,843	Functional Failure	Transmission line known failure mode and fire start risk	NA	NA	NA	As this is related to fire start risk an economic trigger is not considered
Twr Rusty Nut & Bolt Refurb	Tower	$ 985,000	Operational Safety	Tower collapse - unsafe to climb	NA	NA	NA	As this is related to operational safety an economic trigger is not considered
High Crossing Twr Climbing Inspection	Tower	$ 359,700	Functional Failure	Tower condition deteriorates to the point where remediation is not possible	$ 359,700	$1,000k	$625k	Replacement cost of towers $2.5M - assume probability of 0.2 in next 10 year period
Insulator Testing for Z-Code Replacement	Failure Mode	$ 922,584	Functional Failure	Transmission line known failure mode and fire start risk	NA	NA	NA	As this is related to fire start risk an economic trigger is not considered
NDT Foundation CA	Failure Mode	$ 126,000	Functional Failure	Conductor failure modes are not understood - unexpected failure occurs when footing fails	NA	NA	NA	As this is related to mitigation of fire start risk (the asset owner must understand asset failure modes and how asset condition relates to unacceptable failure modes) - an economic trigger is not considered.
TIPS De-Energised 66kV U/G Oil-filled Cable Removal	Removal	$ 1,740,000	Environmental	Non compliance with EPA regulations - Environmental oil pollution and resulting cleanup	NA	NA	NA	As this is related to compliance with environmenatl legislation and requlations an economic trigger is not considered.
Comms Tower CA	Comms Tower	$ 590,000	Operational Safety	Condition assessment in accordance with Australian Standards	NA	NA	NA	As this is related to operational safety an economic trigger is not considered
Comms Towers Fall Arrestor Replace	Comms Tower	$ 314,914	Operational Safety	Replacement in accordance with Australian Standards	NA	NA	NA	As this is related to operational safety an economic trigger is not considered
Substation Building Security Hardening & Refurb	Buildings	$ 1,715,000	Physical Security	High probability of damage to substation control systems and associated loss of load	$ 1,715,000	$2708K	$993k	Assume 1 incident in 10 years where damage to equipment results in replacement ($100k per unit) of 5 protection panels and lost load of 5MW for 24 hours @ $25k/MWh
Communications Building Security Hardening & Refurb	Buildings	$ 58,750	Physical Security	High probability of damage to substation communication systems and possible short interuption of supply	$ 58,750	$271.5k	$212.7k	Assume 1 incident in 10 years where damage to equipment results in replacement 1 unit of property ($50k per unit) and lost load of 5MW for 1 hour @ $25k/MWh
T399 Berri BUILDING - BRICK (BD01) Refurb - Major	Buildings	$ 88,700	Functional Failure	Building structure is unsafe - emergency repair required	$ 88,700	$150k	$61.3k	Emergency remedial work on building is required, assume $150k
link box refurb	U/G Cables	$ 435,827	Functional Failure	Link boxes require corrective maintenance regularly	$353k (NPV)	$414k (NPV)	$61k (NPV)	Ongoing average annual defect maintenance cost $1k per unit (19 units) Emergency replacement over following regulatory period
Aux plant refurb/upgrade	U/G Cables	$ 175,000	Functional Failure	Integrity of cable oil is compromised	$ 175,000	$200k	$25k	Additional costs incurred for procurement and management of clean, dry cable oil, annual estimate $40k
Veg ID & Mngt Tool Investigation	Failure Mode	$ 400,000	Functional Failure	Vegetation cutting validation and optimisation is limited	NA	NA	NA	As this is related to mitigation of fire start risk (the asset owner must understand asset failure modes and how asset condition relates to unacceptable failure modes) - an economic trigger is not considered.
T140 Keith Earthing Remedial Works	Plant OH	$ 508,366	Functional Failure	Early Replacement	NA	NA	NA	Required due to delay of Asset Replacement Project
T292 Kincraig Earthing Remedial Works	Plant OH	$ 387,320	Functional Failure	Early Replacement	NA	NA	NA	Required due to delay of Asset Replacement Project