PowerWater

Program Business Need Identification

Power and Water Corporation

CONTROLLED DOCUMENT

NMP9 / PRD33443

Transmission Tower Corrosion Protection Life Extension Program

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Proposed:

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Date: 15/2/2018

Approved:

Michael Thomson
Chief Executive
Power and Water Corporation
Date: 23/02/2018

Djuna Pollard
Executive General Manager
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Date: 15/2/2018

Refer to email D2018/72353

Finance Review
Date: 06/02/2018

Refer to email D2018/67178

PMO-QA
Date: 13/02/2018

1 Program Summary

Program Name:	Transmission Tower Corrosion Protection Life Extension Program		
Program No:	NMP9 / PRD33443	**SAP Ref:**	
Financial Year Commencement:	July 2019		
Business Unit:	Power Networks		
Program Owner (GM):	Djuna Pollard	**Phone No:**	08 8985 8431
Contact Officer:	Stuart Eassie	**Phone No:**	8924 5214
Date of Submission:	23/02/18	**File Ref No:**	D2017/468430
Submission Number:		**Priority Score:**	
Primary Driver:	Renewal/Replacement	**Secondary Driver:**	Commercial/ Efficiency
Program Classification:	Capital Program of Works		

2 Recommendation

MAJOR PROJECT >$1M OR PROGRAM

It is recommended that the Chief Executive note the proposed Transmission Tower Corrosion Protection Life Extension Program for an estimated budget of $2.02 million, and approve the inclusion of this program into the SCI for this amount, with a corresponding completion date of June 2024.

The forecast for this program of work extends beyond the current SCI period. The first two years of this program aligns with the last two years of the 2017-18 SCI. This program will be included in the 2019-24 Regulatory Proposal to the Australian Energy Regulator (AER).

Note that individual projects within the program will be documented in Business Case Category C to be approved by the Executive General Manager Power Networks.

3 Description of Issues

Recent investigations identified a need for investment in the life extension of Transmission Towers in the Darwin region. Transmission towers are widely used for the delivery of electricity from generation to distribution centres. Towers are historically of light steel construction, comprising complex junctions and sandwiching of angle and plate components. These designs are ideally suited for protection with hotdip galvanizing.

Many of the transmission towers in Darwin have been in service for many decades and are nearing the end of their service life in terms of the galvanized protection system. Rejuvenating these structures with a view to long term protection, comparable to that afforded by the original galvanizing, should be a priority when considering the surface preparation and coating system options. Transmission towers in the top end are subjected to extreme weather and environmental conditions which impacts asset lives and performance.

An inspection of 72 transmission towers and poles was conducted in Darwin City, Stuart Park, The Gardens and Woolner distribution areas, and the results revealed consistent degradation of galvanising, particularly on structures aged 40 years and above. The inspection sample represents 2.8% of the Darwin transmission tower and pole population, and 2.0% of the total system population. The inspection results are summarised as follows:

- 69% or 50 of the 72 towers and poles inspected were identified as requiring recoating.
- 98% of the towers aged 42 years, were identified as requiring recoating.
- All the structures identified as requiring recoating are of the 4 leg tower structure type.

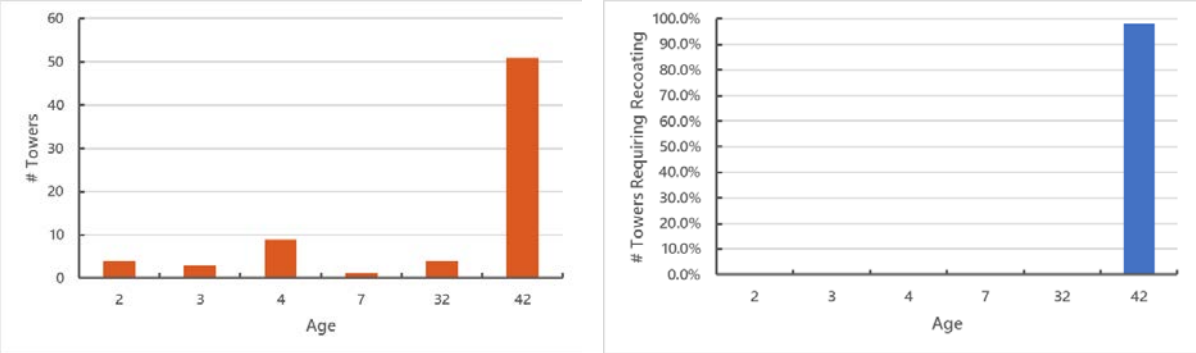

Figure 1 - Transmission towers age profile and inspection results

Up to 39% of the Darwin transmission tower and pole population is aged 40 years and older, i.e. around 1,027 towers. This is a considerable number of structures in need of investment to extend the asset life. The inspection sample was selected based on known areas of poor condition and is therefore not representative of the overall population. Further inspections are required to develop an understanding of the extent of the corrosion degradation issue.

3.1 Project Drivers

a. Compliance
A fundamental business driver for Power and Water Corporation (PWC) is compliance with the Network Technical Code and Network Planning Criteria objective of providing safe, secure, reliable, high quality power supply at a minimal cost. Targeted refurbishment of deteriorated transmission towers and poles will maintain the effective functioning of the transmission system in compliance with the business objective.
b. Customer / Commercial
Poor asset management of transmission towers will result in a high cost and potential reliability of supply impacts to customers as towers reach end-of-life. Identifying the asset management approach that provides the lowest whole of life cost is a key consideration in the establishment of a life extension program for towers, particualry given the complexity and high costs associated with replacement of towers in urban built up areas.

4 Potential Solution

Opportunities to maintain the integrity of the transmission network have been considered. These include:

Option 1 - Run to failure

Run to failure involves the reactive maintenance and repair of the transmission towers and poles. It involves routine ground-based visual inspections focused on monitoring ageing factors such as corrosion, damage, and structural degradation. Repair and refurbishment works are scheduled based on the inspection findings. PWC applies a 3 yearly ground-based visual inspection and an annual visual/aerial inspection cycle to assess the health of transmission structures.

The run to failure approach is an accepted approach for assets with a low consequence of failure. This is not considered an acceptable approach for transmission towers. If the corrosion protection is considered in isolation, measuring the health of corrosion protection such as galvanising and determining a “failure” point is complex as the structural degradation takes place across the extent of the lattice structure at different rates. The rates vary depending on exposure, thickness of the member sections and external impact damage or pollution. Regular and very detailed inspections would be required to measure all parts of the tower lattice structure, then identify individual members to replace or repair. As some members are not replaceable without significant

deconstruction of the tower, ongoing replacement or refurbishment of parts of a tower is not practical.

Option 2 - Inspection and targeted refurbishment

This approach involves the methodical inspection of transmission towers and poles selected based on factors such as age, routine inspection results, proximity to coastal salt spray or other industrial pollution, and the criticality of the network. Refurbishment or replacement requirements are determined based on the results of a structural inspection that includes an inspection and testing of the structure for bent/ over stressed components, sample measurements of galvanising thickness, other damage, and an inspection of the foundation for exposure damage, erosion, water pooling, and corrosion.

Based on the detailed structural inspection, an assessment of the overall health of the tower corrosion protection can be made and a suitable timing for refurbishment considered taking into account remaining life of the galvanising and the conditions required for optimal life of the replacement corrosion protection system/product.

Replacement of corrosion protection prior to any significant corrosion developing also reduces cost and the environmental impact of abrasive blasting. In an urban environment, controlling the pollution in terms of blast grit and noise is costly and adds significant time to the work.

The refurbishment of lattice transmission towers is considered an effective asset management approach by other Australian and overseas network utilities to maintaining the safe and reliable operation of the network in a prudent and cost efficient manner. Other utilities that apply this methodology (often referred to as Early Life Tower Painting) include Powerlink[1], Transgrid and Transpower (New Zealand).

4.2 Comparative Cost Analysis

A comparative cost analysis of the two options has been undertaken. The net present cost of each option including Opex and Capex over a 40 year period is detailed in the table below.

[1] Powerlink – Transmission Line Asset Methodology – Framework (AER website)

Option	Capital cost ($M)	Net Present Cost ($M)	Comments
1 – Run to failure	8.0	3.4	Assumed replacement of 20 towers between 2030 and 2050 (age span 55 to 70 years). Allowed for single member replacement on 14 towers over same period.
2 – Inspection and targeted refurbishment	3.8	2.3	Assumed re-application of corrosion protection in 20 years

As outlined above, option 2 has a lower net present cost than option 1.

4.3 Non-cost attributes

An analysis of the non-cost attributes for each option has been completed using the multi-criteria analysis method. The attributes are selected considering major risks and priorities to achieve the Project Objectives. A weighting is allocated to each, totalling 100%. Each attribute is given a score out of 5 (from 1 – Fails to satisfy, to 5 – exceeds requirements); the score is then multiplied by the relevant weighting to give the weighted score that is summarised in the table below.

	Technical & System Risk	Stakeholder Risk	Env. Risk	Commercial	
Criteria	**System Security**	**Community Impact**	**Paint Contamination**	**NPC**	**Weighted Scores**
Weighting (%)	30	10	10	50	
Option 1	0.3	0.2	0.5	1.5	**2.5**
Option 2	1.2	0.3	0.2	2.0	**3.7**

4.4 Preferred Option

Option 2 is the preferred option. A risk based approach has been used to establish a targeted refurbishment program that involves the recoating of transmission tower and pole structures to restore corrosion protection to structures in Darwin. Previous structural inspections and predictions of remaining like have been used to inform this approach[2]. The program will recoat 50 transmission towers in the next regulatory period, 2019/20 to 2023/24, the focus will be on the highest risk installations, and systematically inspect a further 350 towers and poles to inform the refurbishment program going forward. It is worth noting the most critical areas of transmission tower corrosion degradation identified

[2] D2009/186410 Final report Structural Assessment of Lattice Towers Darwin City lines and D2014/606282Channel Island Transmission Towers Corrosion Report

in previous structural reports have already been addressed in the current and previous regulatory period.

It is expected to cost $2.02 million over the 5 year period. This strategy will result in the recoating of all known high risk tower structures during the regulatory period. Allowance has also been made for ongoing targeted corrosion assessments associated with emerging refurbishment requirements. The strategy refurbishes 1.4% of the transmission tower and pole population over the 5 year period, and inspects 9.8% of the system population.

Year	2019-20	2020-21	2021-22	2022-23	2023-24	Total
	Qty	Qty	Qty	Qty	Qty	Qty
Refurbishment volumes	10	10	10	10	10	**50**
Corrosion Assessment	70	70	70	70	70	**350**
Total	**80**	**80**	**80**	**80**	**80**	**400**

4.5 Non Network alternatives

No viable non-network alternatives were identified that would mitigate the need for the refurbishing the transmission tower corrosion protection.

4.6 Capex/Opex substitution

The proposed transmission tower and pole refurbishment program addresses an asset degradation issue that cannot be solved through operations and maintenance activities.

4.7 Contingent Project

The expenditure does not meet the criteria for a contingent project - National Electricity Rules, section 6.6A.1(b)(2).

5 Strategic Alignment

This program aligns with the Asset Objectives defined in the Strategic Asset Management Plan (SAMP) and Asset (Class) Management Plans (AMP). The capital investment into transmission towers outlined in this program will contribute to the Corporation achieving the goals defined in the boards Strategic Directions and SCI Key Result Areas of Health and Safety and Compliance.

6 Timing Constraints

It is essential that this project commences as proposed to manage the continued safe and reliable operation of the network. The transmission towers identified with corrosion need to be proactively refurbished to extend the asset life.

Identifying the right time to carry out maintenance is critical to a successful intervention. Replacement of corrosion protection is best carried out whilst the structure and galvanizing are relatively sound. Through use of appropriate protection products, this reinstates a level of galvanic protection to the steel with far better performance than typical paint products which are far more susceptible to cracking and impact damage. Below is a simple representation of improved outcomes of galvanic protection systems.

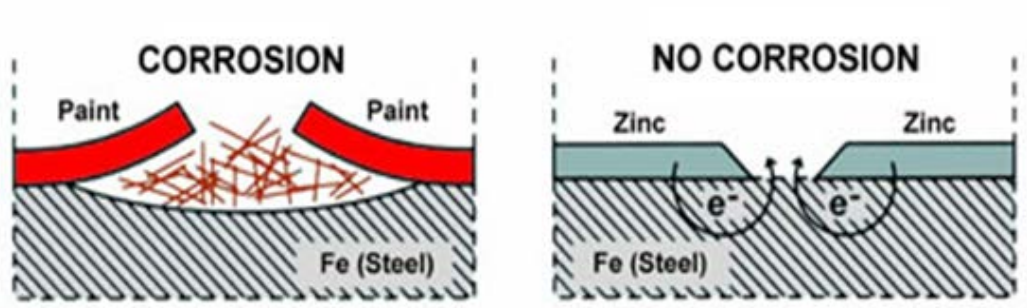

Figure 2 Typical Paint System versus Galvanic (Zinc based) Protection System[3]

Allowing the corrosion protection to deteriorate further will increase the cost of refurbishment or result in loss of section for structural members. Further details on the considerations for timing of intervention and suitable corrosion replacement products are described in the Asset Class Management Plan for Poles and Towers.

7 Expected Benefits

Driver	Benefit	Measure
Asset Renewal	Compliance with Network Technical Code and Network Planning Criteria objective	Functional Assets. No failures
Compliance	Safe, secure, reliable, high quality power supply at a minimal cost	Technical Code Compliance
Service Improvement	Eliminate future extended outages for tower replacement	SAIDI / SAIFI impact of transmission outages
Commercial / Efficiency	Lower whole of life costs for transmission towers	Direct expenditure on transmission towers

[3] A Film Galvanising System with Cathodic Protection, royalmarinegroup.com

Driver	Benefit	Measure
Social / Environmental	Early life tower painting requires less aggressive blasting in urban areas.	Environmental incidents Customer complaints

8 Milestones (mm/yyyy)

Investment Planning	Project Development	Project Commitment	Project Delivery	Review
01/2018	06/2018	07/2019	06/2024	09/2024

The program delivery is scheduled to run over 5 years from July 2019 to June 2024. A program review will be held at the end of the 5 year program as well as interim reviews at the end of each Financial Year.

9 Key Stakeholders

Stakeholder	Responsibility
Internal governance stakeholders	Executive General Manager Power Networks
	Group Manager Service Delivery
	Chief Engineer
Internal design stakeholders	Senior Manager Network Development and Planning
	Senior Manager Contracts and Projects
	Senior Manager Asset Management
	Manager Test & Protection Services
	General Manager System Control
	Manager SCADA and Communication Services
External – Government, Unions and public	Local Residents
	ETU
	Ministers
External regulators	Utilities Commission

Stakeholder	Responsibility
	Australian Energy Regulator

10 Resource Requirements

Resourcing requirements for this program are considered Business as Usual and will be incorporated into the development of Category C Business Case's for each batch of replacements. This will include external engineering support for structural assessments of towers not already assessed.

11 Delivery Risk

Consequential, site specific costs may result from works being undertaken on existing installations in existing built up environments. The expenditure estimates have been based on similar brown field works undertaken in recent years.

Work on towers in residential areas will require community consultation to mitigate reputational risk associated with this type of work as it can produce noise and air pollution. Control measures will be implemented to limit noise and air pollution as far as practical.

12 Financial Impacts

12.1 Expenditure Forecasting Method

The expenditure forecast has been based on a programmed approach. The forecast volumes have been determined based on a targeted systematic inspection and prioritisation of assets focusing on the refurbishment of the highest risk installations.

The asset refurbishment investment program is internally driven and no customer contributions are expected.

12.2 Historical and Forecast Expenditure

Transmission tower and pole refurbishment has historically been performed on an ad hoc basis when identified as being corroded or damaged.

An allowance of $245 thousand has been included in the 2019/20 to 2023/24 regulatory period for methodical transmission structure assessments to determine asset condition across the transmission network, and verify ongoing refurbishment requirements into the following regulatory period.

The annual forecast refurbishment expenditure for the 2019/20 to 2023/24 regulatory period is provided in Section 12.4.

12.3 Validation

The transmission tower and pole refurbishment expenditure forecast has been based on a bottom up estimate of labour, material, and contractor costs and involves the corrosion resistance coating of transmission structures.

The cost estimate has been based on similar works undertaken by PWC in recent years.

12.4 Capex Profile

The capex in the table below is in $2017-18, and is excluding capitalised overheads and cost escalation

Phase	2019-20 ($'000)	2020-21 ($'000)	2021-22 ($'000)	2022-23 ($'000)	2023-24 ($'000)	Total ($'000)
Investment Planning						
Project Development						
Project Commitment						
Project Delivery	404	404	404	404	404	2,020
Review						
Total	**404**	**404**	**404**	**404**	**404**	**2,020**

12.5 Opex Implications

No step change in operating cost is forecast for the next regulatory period as result of investing in the refurbishment of the transmission towers and poles.

12.6 Variance

The forecast for this program of work extends beyond the current SCI period. The first two years of this program aligns with the last two years of the 2017-18 SCI.