

Network Design Planning (NDP)

Regulatory Business Case (RBC) 2024-29

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1. Summary

This business case has been prepared to support the 2024-29 Regulatory Proposal. The business case demonstrates that Power and Water has undertaken appropriate analysis of the need and identified a full suite of credible options that will resolve the need, to ensure that Power and Water continues to meet the National Electricity Objectives and manage the network prudently and efficiently.

The projects under the program identified in this business case will undergo further assessment and scrutiny through Power and Waters normal governance processes prior to implementation.

This business case addresses minor network augmentation projects that are required at Power and Water's zone substation and sub-transmission substations typically to meet changes in demand.

1.1 Business need

The Network Design Planning (NDP) program is a series of minor network augmentation projects ('minor projects') that are required at Power and Water's zone substation and sub-transmission substations (collectively referred to as 'substations'), typically to address capacity constraints or to address lack of operational flexibility. These 'minor projects at substations' are individually investments of less than \$1.0 million, and usually much less than that. They are difficult to define more than one year in advance because they respond to issues arising from local changes to customers' demand.

Network augmentation projects exceeding \$1.0 million are subject to individual business cases and, accordingly, preliminary business cases have been developed for each of them for the 2024-29 regulatory control period ('the next RCP').

Minor projects at substations under the NDP program include activities such as increasing the cyclic ratings of power transformers, modifying feeder supply arrangements, increasing the ratings of substation equipment to increase utilisation of power transformer capacity, improving distribution load transfer capacity (DTC) for network maintenance and contingency events at substations.

The NDP program helps Power and Water meet the requirements outlined in the Network Technical Code and Network Planning Criteria by helping to maintain network reliability, operational flexibility, and minimising customer interruptions as the network develops to meet customer and demand growth.

1.2 Options analysis

The options considered to resolve this need are shown in Table 1.

Table 1 Summary of credible options

Option	Option Name	Description	Recommended
1	Do Nothing	No investment on projects costing less than \$1.0m in the next RCP	No
2	Develop the minor projects at substations now	Identify the minor projects at substations required in the next RCP	No

3	Continue the NDP program	Establish a budget which can be drawn down over the course of the next RCP for minor projects at substations identified each year as part of the annual planning cycle	Yes
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1.3 Recommendation

The recommended option is Option 2 - continuing the NDP program at an estimated cost of \$1.9 million (2021/22).

Table 2 shows a summary of the expenditure requirements for the next RCP.

Table 2 Annual capital and operational expenditure (\$m, real FY22)

Item	FY25	FY26	FY27	FY28	FY29	Total
Capex	0.37	0.37	0.37	0.37	0.37	1.85
Opex	-	-	-	-	-	-
Total	0.37	0.37	0.37	0.37	0.37	1.85

2. Identified need

This section provides the background and context to this business case, identifies the issues that are posing increasing risks to Power and Water and its customers, describes the current management program, highlights challenges and emerging issues, and provides a risk assessment of the inherent risk if no investment is undertaken.

2.1 Background

The NDP program includes a series of minor network augmentation investments that are required at Power and Water's zone substation and sub-transmission substations. Power and Water is obligated to arrange for the,

"management, maintenance and operation of the electricity network such that in the satisfactory operating state, electricity may be continuously transferred at a connection point up to the agreed capability".¹

Activities under the NDP program are driven by Power and Water's obligations under the Network Planning Criteria and the Network Technical Code which requires Power and Water to maintain network security, reliability, and quality of supply to network users. Network augmentation projects exceeding \$1.0 million are addressed through standalone projects and business cases.

While Power and Water conducts investigations to identify issues in the network, it is not possible to have full visibility of the issues that will emerge over the next RCP, with the end of FY29 being more than six years in the future. It is very likely that network issues will emerge over the next regulatory period that will require relatively minor network augmentation projects at zone and sub-transmission substations as this has been Power and Water's experience over time.

2.2 Historical and current programs

NDP projects are identified as a result of annual compliance reviews of network constraints (typically ratings versus loading for credible contingency scenarios) involving zone or sub-transmission substations. Typically the need for minor projects at substations arise as a result of sporadic localised load growth driven by small to medium spot loads. Minor projects at substations include:

- Improving the cyclic ratings of power transformers to avoid overload (e.g. by adding cooling fans)
- Modifying feeder supply arrangements to improve DTC to avoid the need for more significant network augmentation and/or to improve operational flexibility
- Otherwise increasing the ratings of substation equipment to allow optimal utilisation of power transformer capacities to defer larger augex projects (e.g. upgrading an under-rated circuit breaker).

An annual average of \$0.35 million has been invested in the first three years of the 2019-2024 regulatory control period ('the current RCP') to address minor substation projects. Based on the average expenditure over the last five years, the expected expenditure for the remainder of the current RCP is \$0.64 million. Therefore the total capex on NDP works is expected to be \$1.69 million for the current RCP.

This continues a pattern of minor projects at substations from preceding years.

¹ Pg. 7, Network Technical Code and Planning Criteria v4 ([Link](#))

In the current RCP, minor projects at substations were initially incorporated into the Overloaded Feeders / Distribution Augmentation Program ('NFO program'). Since then, the NFO program has been split into two separate programs to provide more transparency of the two types of work (i.e. feeder augmentation versus substation augmentation):

- Network Design Planning Program (NDP) – for augmentations required at substations, and
- Network Overloaded Feeders (NOL) program– for increasing the capacity of overloaded distribution feeders.²

2.3 Consequence of failure

The primary consequence areas related to insufficient investment in the minor augmentation of the substations are:

- Reliability and service delivery
- Compliance.

These consequences areas align with the Risk Quantification Procedure and 'typical consequence areas' identified by the AER.³

2.3.1 Reliability and service delivery

Reliability and service delivery is a key obligation for Power and Water as the network operator. As outlined in the Network Technical Code, Power and Water is obligated to arrange for the,

"(2) management, maintenance and operation of its network to minimise the number of interruptions to agreed capability at a connection point on or with that network by using good electricity industry practice; and

*(3) restoration of the agreed capability as soon as reasonably practical following any interruption at a connection point on or with its network."*⁴

Investment under the NDP program supports Power and Water to achieve this obligation. The failure of equipment or the lack of sufficient supply capacity at substations following credible contingency events will potentially impact supply to several thousand customers.

2.3.2 Compliance

Power and Water is obligated to comply with its requirements as under the Network Technical Code and Planning Criteria:

*"The Network Operator shall comply with the power system performance and quality of supply standards described in this Code;"*⁵

The NDP Program supports compliance with this obligation by providing sufficient budget to invest in minor projects at substations to address operational constraints and non-compliance with applicable standards.

² The NOL program is the subject of a separate business case

³ Industry practice application note: Asset replacement planning 2019, Australian Energy Regulator.

⁴ Pg. 7, Network Technical Code and Planning Criteria v4 ([Link](#))

⁵ Obligations of the Network Operator (Page 7), Network Technical Code and Planning Criteria v4 ([Link](#))

For example, PWC has completed an upgrade of the power transformers at Tennant Creek Zone Substation in the current regulatory period. The transformers only had radiators with an ONAN rating of 7.5MVA each. To service an increase in demand due to a new customer connection, the rating of the transformers was increased to 10MVA (ONAF) with the installation of radiator fans. This avoided the need to install a third transformer and associated works that would have cost significantly more than the completed project.

Another project was increasing the cyclic ratings for the power transformers at Strangways Zone Substation. The transformer ratings were reduced from its nameplate due to protection settings and secondary wiring to the current transformers. Modifications resulted in an increase of the cyclic ratings, allowing new customers to be supplied without significant capital investment at the zone substation. It also improved distribution transfer capacity between Strangways and surrounding zone substations.

2.4 Risk assessment

The magnitude of the benefits and risk reduction from undertaking the NDP program is dependent on the projects conducted under the program. The projects are developed depending on the issues identified during the course of the next RCP, so the overall risk reduction or benefit from the program cannot be quantified at this early stage.

A cost-benefit analysis will be conducted on each project before work/expenditure is approved for that project, providing the appropriate governance over the investment. For example, in the current RCP old paper lead circuit breaker cables on four 11kV feeder circuits at Lovegrove substation were constraining utilisation of the step-down transformers. The cables were upgraded by 21% which addressed the transformer utilisation issue and improved the DTC capacity. The benefit of the investment exceeded the cost by 50% after one year of operation.⁶

2.5 Summary

While network augmentation projects exceeding \$1.0 million are addressed through standalone projects and business cases, the NDP program underway in the current RCP addresses minor substation constraints or non-compliance with investments of less than \$1.0 million per project.

The projects are identified and developed annually as part of the planning cycle following review of the latest peak load data and after adjusting the forecast peak demand at each substation, taking into account committed spot loads. This means that a definitive list of minor substation augmentation projects for the 2024-29 regulatory period is not able to be determined with any confidence.

The risk of not continuing with the NDP program in the next RCP is increased reliability and compliance risk. Alternatively increased risk can be avoided by investing in project costing more than \$1.0 million, which would not be economically prudent.

⁶ PRA34561 - 11LG06 (Bradshaw), 11LG07 (Araluen), 11LG15 (Larapinta) and 11LG16 (Braitling) Feeder Augmentation

3. Options analysis

This section describes the various options that were analysed to address the increasing risk to identify the recommended option. The options are analysed based on ability to address the identified needs, prudence and efficiency, commercial and technical feasibility, deliverability, benefits and an optimal balance between long term asset risk and short-term asset performance.

3.1 Comparison of credible options

Credible options are identified that address the identified need, are technically feasible and can be implemented within the required timeframe. The following options have been identified:

- Option 1 – Do Nothing. This option is premised on not undertaking minor works at substations for the duration of the next RCP.
- Option 2 - Develop the minor projects now. This option is premised on identifying the five year program of individual minor projects at substations now for the 2024-2029 regulatory period and securing expenditure approval via the usual business governance process.
- Option 3 - Continue NDP program. This option is based on providing an approved amount of capex to be drawn upon to address minor projects at substations as they are identified as part of the annual planning cycle, as undertaken under the current NDP program.

A comparison of the three identified credible options and the issues they address in the identified need is depicted in the table below. A detailed discussion of each option is provided below.

Table 3: Summary of options analysis

Assessment metrics	Option 1	Option 2	Option 3
NPV (\$m, real 2022)	0.00	Not available	-1.62
Capex (\$m, real 2022)	0.00	Not available	1.85
Opex (\$m, real 2022)	0.00	0.00	0.00
Meets customer expectations	○	○	●
Aligns with Asset Objectives	○	○	●
Technical Viability	○	○	●
Deliverability	Not applicable	Not available	●
Preferred	✗	✗	✓

- Fully addresses the issue
 ● Adequately addresses the issue
 ○ Partially addresses the issue
 ○ Does not address the issue

Notes: the NPV and capex was calculated over the 5 year period.

3.1.1 Option 1 – Do Nothing (Base Case) – Do not continue the NDP Program past 2024

This option is based on not undertaking any investment in mitigating identified constraints in substations in the next RCP if the projects are classified as minor (i.e. individually cost less than \$1.0 million). Whilst this option incurs no direct capital cost, it has two key disadvantages:

- incurring more reliability or safety risk than is prudent over the course of the next RCP (e.g. due to localised demand growth and/or operational constraints hampering maintenance), or
- advancement of more expensive options that could otherwise be deferred by the minor projects at substations, leading to an uneconomic outcome.

Based on historical experience, network constraints and compliance issues will be identified as part of the annual planning cycle during the course of the next RCP. Not addressing these via minor projects at substations will either lead to exposure to imprudent levels of risk or uneconomic technical solutions (i.e. by advancing projects costing more than \$1.0 million).

This option would not meet the reasonable expectations of our customers and stakeholders to maintain a safe and reliable network through prudent and efficient investments. Similarly, deliberately ignoring prudent and efficient investment options to manage reliability and compliance risk does not align with Power and Water's network management objectives or principles.

The Do Nothing option is not recommended.

3.1.2 Option 2 – Develop the minor projects now

This option is premised on identifying all of the individual minor projects at substations for the next RCP now and securing expenditure approval via the usual business governance process. However, is not possible to identify the minor projects at substations up to 6 years in advance because they typically respond to localised changes in demand which are difficult to determine more than one year in advance. Therefore, this approach is likely to only provide justifiable projects for the next one-to-two years at most and adsorb considerable scarce planning resources which would be better directed at larger augmentation projects.

This option would in practical terms only provide justifiable projects for the next one-to-two years at most and absorb considerable scarce planning resources that would be better directed to higher priority (major) project development. The preferred option 3 by contrast, concentrates the planning effort on updated annual data, which is more time and cost efficient for minor projects.

Option 2 would be unlikely to represent an efficient level of expenditure and would therefore not meet the reasonable expectations of our customers nor align with our network management objectives and principles.

Option 2 is not recommended.

3.1.3 Option 3 – Continue the NDP program

This option is based on providing an approved amount of capex to be drawn upon to address minor projects at substations as they are identified as part of the annual planning cycle. This option proposes to continue the NDP program to undertake minor substation augmentation projects as the issues at the

substations are identified. These projects will be driven by changes in demand and include activities such as:

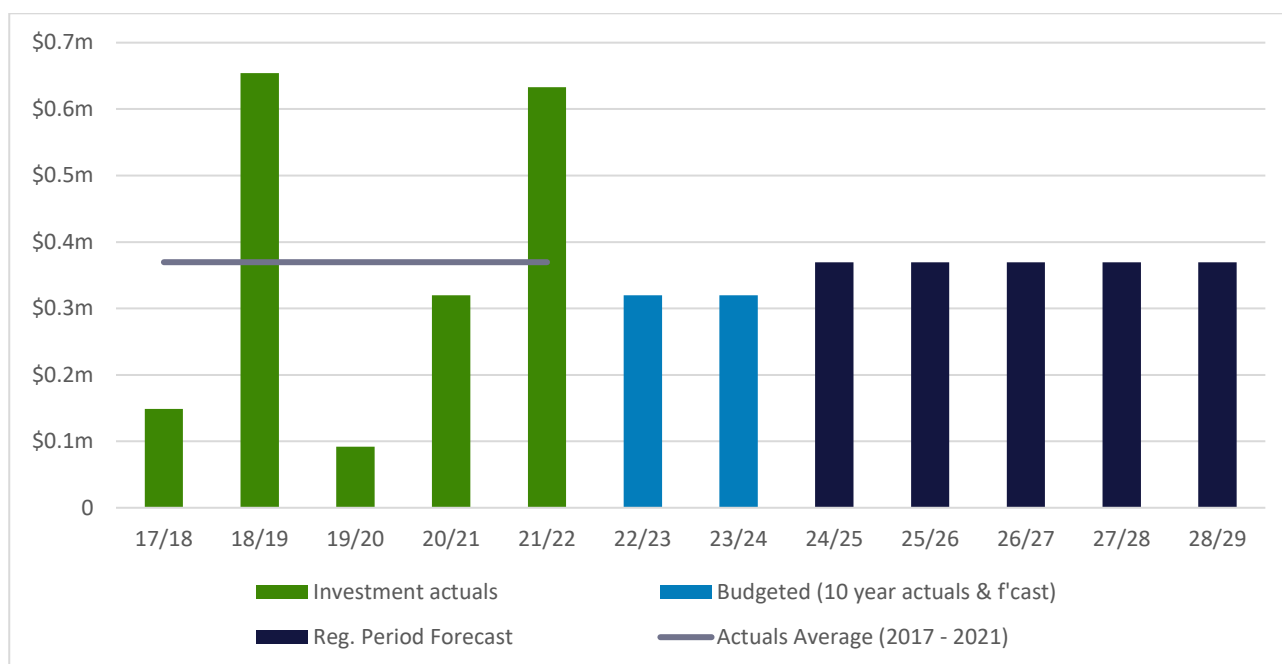
- Upgrading or installing new substation equipment such as CTs, conductors and cables to remove circuit constraints on utilising the full power transformer capacity
- Minor modifications to existing substation arrangements e.g. modifications to feeder circuit breaker arrangements to allow for connection of new developments to the substation.

It is not possible to have full visibility of the issues that will emerge over the next regulatory period at substations and that are likely to be resolvable by minor projects. Instead, the NDP program provides for prudent and efficient investments to address minor zone and sub-transmission substation augmentation projects if and when required in the next RCP.

The expenditure forecast is based on the average historical spending on the NDP program from 2017/18 to 2021/22. This approach has proven to be a prudent and efficient means of undertaking projects if and when justified based on analysis of localised operational risks.

The expenditure profile of the existing and proposed NDP program is shown in the figure below.

Figure 1: NDP program investment profile



The availability of resources resulted in the large variance in the historical expenditure profiles. Additionally, varying priorities for Power and Water during different years have contributed to the large variance in the expenditure profile.

The expenditure for 18/19 year was higher as usual as there were a number of feeder upgrades completed that year. There was an underspend in 2019/20 due to structural changes within PWC works management, covid disruptions to works program and due to asbestos effecting works at Palmerston ZSS. As these disruptions resolved, the delayed works were resumed leading to an increase in spending in 2020/21 and 2021/22.

For the next regulatory period, it is proposed that an annual expenditure of \$0.37 million is allocated for the NDP program, a total of capex cost of \$1.85 million (real 2021/22).

The benefits from the minor substation augmentation works undertaken under the NDP Program are identified in the table below.

Table 4 Summary of benefits

Option	Option Name
Optionality	<p>The future operational environment is characterised by uncertainty from the impacts of renewables (distributed and large scale), electric vehicles, economic growth levels, major new loads, network and system management innovations,⁷ and changes in customer behaviours (e.g. in response to tariff structure and price changes).</p> <p>Uncertainty is best dealt with in a network investment context by preserving optionality as these uncertainties are likely to be progressively resolved over time, and the prudent and efficient investment will become apparent. NDP projects, such as uprating power transformers, provide a low-cost alternative to investment in large, permanent infrastructure such as new transformers or zone substations. The quantum of these benefits cannot be quantified at this stage.</p>
Improved reliability and operational flexibility	<p>The minor projects at substations typically increase (i) the N-1 capacity of the substations, reducing or eliminating load shedding following a credible contingency event, or (ii) the DTC to contiguous substations, allowing supply to more customers to be restored following a credible contingency event (i.e. with network reconfiguration). Increasing available DTC has a complementary benefit when implementing planned outages (e.g. for maintenance).</p> <p>This option is deliverable and technically feasible. This option offers multiple benefits:</p> <ul style="list-style-type: none"> • It will contribute towards achieving the Asset Objectives of maintaining reliability and safety of the network • It ensures that Power and Water can address issues in a timely manner as they are identified.

3.2 Non-Credible Options

Our analysis also identified options found to be non-credible. These options are described below and were not taken through to detailed analysis for the reasons provided.

⁷ such as Power and water's proposed dynamic operating envelope (DOE) project – refer to the business case for more detail

3.2.1 Non-network solutions

While non-network alternatives are possible at a project level in response to specific identified issues, they are not considered a feasible strategy at the program level. When a specific issue is identified at the substation, non-network alternatives, which may involve a capex-opex trade-off, will be included in the assessment of the best option for resolving the issue.

4. Recommendation

The recommended option is Option 3 – Continue the NDP program to be most prudent and cost effective to meet the identified need. This option represents a continuation of the current NDP program, at an estimated cost of. The estimated cost is \$1.9 million (real 2021/22) for the next RCP.

The proposed program is consistent with the National Electricity Rules Capital Expenditure Objectives as the expenditure is required to maintain the quality, reliability, and security of supply of standard control services and maintain the safety of the distribution system.

4.1 Strategic alignment

The “Power and Water Corporation Strategic Direction” is to meet the changing needs of the business, our customers and is aligned with the market and future economic conditions of the Northern Territory projected out to 2030.

This proposal aligns with Asset Management System Policies, Strategies and Plans that contributes to the D2021/260606 “Power and Water Strategic Direction” as indicated in the table below.

Table 5 Alignment with corporate strategic focus areas

No.	Strategic Direction Focus Area	Strategic Direction Priority
1	Living within our means	Cost Prudence
2	Customer and the community at the centre	Enhance Customer Experience and Engagement
3	Customer and the community at the centre	Trusted Partner

4.2 Dependencies

There are no known projects or other network issues that are dependent on this program.

4.3 Deliverability

The proposed works are equivalent to the similar activities to be completed in the current RCP. No delivery risks have been identified.

4.4 Customer considerations

Power and Water’s customers expect us to invest prudently and efficiently in network augmentation to maintain reliability and safety. The NDP program provides necessary budget allocation to help ensure risks identified at zone or sub-transmission substations during the next RCP are able to be addressed. The expenditure governance process will ensure that each investment is subject to the appropriate approval process.

4.5 Expenditure profile

The table below shows the estimated annual expenditure for the next RCP.

Table 6 Annual capital and operational expenditure (\$m, real FY22)

Item	FY25	FY26	FY27	FY28	FY29	Total
Capex	0.37	0.37	0.37	0.37	0.37	1.85
Opex	-	-	-	-	-	-
Total	0.37	0.37	0.37	0.37	0.37	1.85

4.6 High-level scope

The scope of this program involves the continuation of the past NDP program. The work will be carried out on an ad-hoc basis as issues are identified over the next RCP (2024-2029).

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