Case For Investment (CFI): NDW-000010 (HVW) Distribution Works Program

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Endeavour Energy

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Contents

Investment Title	**Distribution Works Program**
<< project # / code >>	NDW-000010 (HVW)
Portfolio	Augex
CFI Date	
Pre RIT-D	☐
Final CFI	☐
Other	☒

1. Executive Summary

This CFI recommends investment in the Distribution Works Program (DWP) over the FY25 – FY29 Regulatory Period. It recommends that a program value of $35 Million ($7 Million per year) be approved over the next Regulatory Period for consideration in Portfolio Investment Plan. This program is a reactive program and therefore the scope is unknown until the year preceding its expenditure.

The DWP is a program of works targeting risk areas associated with safety, capacity and flexibility of network operation of the 11kV/22kV distribution networks.

The categories of risks and constraints are listed below:

1. Distribution feeders exceeding planning design ratings
2. Conductors with insufficient fault withstand capacity
3. Conductors with insufficient continuous capacity rating
4. Network areas with excessive voltage regulation
5. Network backup protection compliance
6. Zone substation feeder cable capacity affected by proximity derating
7. Distribution network standard compliance upgrades
8. Environmental risk management
9. Western Sydney Aerotropolis enabling works

The option of 'No proactive intervention' for the majority of identified needs will lead to load at risk which will result in significant unserved energy as well as increased STPIS penalties. This option will also result in the prevention of connecting new customers to Endeavour Energy's network resulting in a violation of Endeavour Energy's obligation to connect customers as per the National Electricity Rules.

Options to address identified risks and constraints can include (but not limited to) the following network solutions:

- Augmenting and/or installing overhead and/or underground conductors
- Establishing cross feeder and zone ties
- Installing and/or replacing high voltage isolations
- Installing protection devices such as fuses
- Rearrangement of the network

In addition to network options, Endeavour Energy will investigate non-network options as the National Electricity Market transitions into the use of future technologies such as batteries.

Individual projects proposed to address risks and constraints will have economical assessments to ensure they are NPV positive prior to being included in this program.

Based on historical actuals, Endeavour Energy has had a stable expenditure in this program of $5.5 Million over the last five years. In addition, it is estimated an additional $1.5 Million is required per year for enabling works associated with the Western Sydney Aerotropolis area.

Therefore Endeavour Energy proposes $7 Million per year totalling $35 Million over the FY25 – FY29 Regulatory Period.

2. Program Proposal

2.1 Identified Need or Opportunity

The Distribution Works Program (DWP) is a program of works targeting risk areas associated with safety, capacity, resilience and flexibility of network operation of the 11kV/22kV distribution networks.

The categories of risks and constraints are listed below:

1. Distribution feeders exceeding planning design ratings
2. Conductors with insufficient fault withstand capacity
3. Conductors with insufficient continuous capacity rating
4. Network areas with excessive voltage regulation
5. Network backup protection compliance
6. Zone substation feeder cable capacity affected by proximity derating
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8. Environmental risk management
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2.2 Distribution Network Risks

2.2.1 Distribution feeders exceeding planning design ratings (overloaded feeders)

Endeavour Energy designs to a standard thermal rating of 300 Amps for its distribution network feeders. In older parts of the network the thermal ratings can be even lower due to older lower rated cables. Each feeder has switching points between adjacent feeders. This allows for each feeder to take a portion of load from an adjacent feeder during contingent conditions whilst remaining within its allowable operating conditions. To allow for the outage contingency, a threshold of 80% is applied for the normal operation of the feeders. Therefore, a network feeder is considered to be overloaded if the when the feeder load exceeds 240 Amps.

When the 240 Amp threshold is exceeded there is a risk that the electrical load on a feeder affected by an outage may not be able to be supplied from the adjacent feeders. Hence there is a risk of extended customer outages. Whilst this threshold is a trigger for investigating constraints, planning investigations begin with identifying possible solutions that do not require investment such as network switching.

Further benefits are realised in maintaining feeder loads below the 240 Amp threshold as it assists in the management of the feeder voltage regulation profile.

2.2.2 Insufficient conductor fault withstand capacity (fault exceeded conductors)

If the fault rating of a conductor is exceeded, the structure of the conductor will breakdown when it experiences a fault. The flow of current under fault conditions is greater than the normal load currents hence the energy throughput is large and there is a rapid rise in conductor temperature to damaging levels. If the fault is not isolated by upstream protection and the heat generated by the fault current is not dissipated quickly enough, failure of the conductor is probable.

The risks this may present are:

- increased conductor sag, resulting in possible encroachments on clearances between other circuits or the ground/structures below the overhead feeder, or
- conductor failure/breakage.

Both scenarios have the possibility of risking the safety of the community via falling conductors, possible ignition of fires, equipment exposure to circuit intermixes and unplanned feeder outages.

2.2.3 Conductors with insufficient continuous capacity rating (conductor overloads)

Under normal conditions where a conductor is known to be undersized, operations staff would need to monitor the electrical load through that section of the network. This could lead to a limitation of supply to customers beyond this section of the network. If, however, the conductor regularly carries current in excess of its rated continuous current capacity, the structure of the conductor will begin to breakdown.

There are many factors to be considered when analysing overloaded conductors. However, over time, continual overloading of the conductor will ultimately lead to the failure of the conductor.

Similar to conductor fault rating exceedances, failure of any conductor will lead to the possibility of risking the safety of the community via falling conductors, possible ignition of fires, equipment exposure to circuit intermixes and unplanned feeder outages.

2.2.4 Network areas with excessive voltage regulation

Voltage limits supplied to customers must be maintained to the voltage standards published within the Endeavour Energy Customer Service Standards. If an area within the high voltage network is identified as having excessive voltage regulation and is not addressed accordingly, it may manifest in customer complaints. These complaints generally follow on from possible noticeable events or appliance damage resulting in possible claims against Endeavour Energy.

The customer may escalate the complaint to the Electricity & Water Ombudsman of NSW (EWON) possibly leading to Endeavour Energy incurring further costs.

2.2.5 Network backup protection compliance

The National Electricity Rules require network service providers to provide protection systems and backup protection systems to ensure a fault of any type is disconnected. This category of work targets locations where there is a contingent protection deficiency. This results in a reliance on the upstream protection to see and clear the fault. Works in this category can either be the installation of an additional auto recloser, drop out fuses or the augmentation of HV conductor to improve the existing protection reach.

Although this category of work is designed as a contingent/backup protection strategy, the risks are similar to conductor fault rating exceedance. That is, there is a possibility of conductor failure which may lead to the possibility of risking the safety of the community via falling conductors, possible ignition of fires, equipment exposure to circuit intermixes and unplanned feeder outages. Furthermore, backup protection deficiency may lead to a penalty for the breach of the National Electricity Rules.

2.2.6 Zone substation feeder cable capacity affected by proximity derating

This category is similar to the overloaded conductor category in regard to the risks and consequences involved. However, the analysis for this category applies the derating factors associated to underground cables laid in close proximity to each other. The derating of underground cables is assessed either using Endeavour Energy standards or CYMCAP software.

The derating of a particular cable is dependent on a number of factors and can reduce its rating to a level below the minimum rating required for the feeder cable under normal and contingent operating situations. The problem is exacerbated in older zone substations where the cables are a smaller size and have a lower maximum operating temperature than the standard cables currently used. This can lead to conductor failure, unplanned outages and supply limitations.

2.2.7 Distribution network standard compliance upgrades

Projects in this category address issues relating to the non-compliance of the network configuration to Endeavour Energy design philosophies and standards. The types of projects in this category include: the creation of cross feeder ties, the location of HV isolation points and rectification of safety clearance issues.

A high-level risk assessment is carried out for proposed projects in this category to determine the degree of non-compliance to the relevant Endeavour Energy policies, the capital cost of the project and the network benefits achieved by undertaking the proposed works. Additional input is gained from the Network Operations group in regard to the anticipated operational benefits achieved.

2.2.8 Environmental risk management

Works in the Environmental Risk Management section of the program are designed to address environmental risks associated with the impact of Endeavour Energy's distribution network on the local environment.

Prospective projects are assessed on the environmental risk posed by the presence of the network in the proposed area. Consideration is given to type, number, condition and growth patterns of street trees and whether the proposal is in a high use area in regard to the level of accessibility to the general public. An assessment as to how the trees will respond to further trimming is also undertaken i.e., whether the trees are capable of regrowing or if further annual trimming will result in permanent damage/disfigurement of the trees.

Each project is assessed for inclusion in the program based the cost effectiveness of the expenditure. This is determined by assessing the capital cost of the project versus the reduction in the operating costs required to maintain suitable clearances between Endeavour Energy's network and the trees in question. Additional input is taken from the environmental group in regard to the impact the existing network configuration has versus what the proposed configuration will have.

2.2.9 Western Sydney Aerotropolis voltage conversion

Endeavour Energy's Special Report 787 – 22kV Distribution within the Western Sydney Aerotropolis Area [1] outlines its strategy of establishing a 22kV distribution network for the Western Sydney Aerotropolis Area instead of its traditional 11kV network. The report demonstrates that over the development of this area, adopting a 22kV network will provide financial and network benefits over an 11kV network. As a result, in addition to the base expenditure proposal.

Projects have commenced from the FY22 DWP to start this conversion. Endeavour Energy aims to complete this conversion by the end of the FY25 – FY29 Regulatory Period.

2.3 Summary of Options

2.3.1 Consequence of 'no proactive intervention'

The option of 'No proactive intervention' for the majority of identified needs will lead to load at risk which will result in significant unserved energy as well as increased STPIS penalties. The majority of needs in the DWP address overloading of assets above their ratings.

In additional to the risk of unserved energy to existing customers, the option of 'No proactive intervention' will also result in the prevention of connecting new customers to Endeavour Energy's network. This would be in violation of Endeavour Energy's obligation to connect customers as per the National Electricity Rules.

2.3.2 Network options

In order to address the different needs a number of network options will be investigated. The options are typically assessed to determine the most cost effective solution. Such options include (but are not limited to):

- Augmenting and/or installing overhead and/or underground conductors
- Establishing cross feeder and zone ties
- Installing and/or replacing high voltage isolations

- Installing protection devices such as fuses
- Rearrangement of the network

2.3.3 Grid transformation

There is broader transition in the NEM towards both large scale and distributed renewable energy. This has created an overall market need for energy storage to facilitate this transition. When considering the needs identified in this program, energy storage options will be considered. Endeavour Energy will investigate, assess and compare the feasibility of energy storage as well as other potential non network options against identified network options.

2.4 Proposed Investment Timing

The DWP is a reactive annual program and therefore the scope of the program is determined in the year preceding the publication of each year's DWP. This annual release contains the bulk of the program however additional scope can be identified throughout the year which can be added into the program via change controls.

3. Program costs

Historically Endeavour Energy had a high expenditure in the Distribution Works Program which was largely attributed to older Licence Conditions. Since the change in those requirements, the expenditure in this program has reduced and stabilised over the last five years as shown in Figure 1 below.

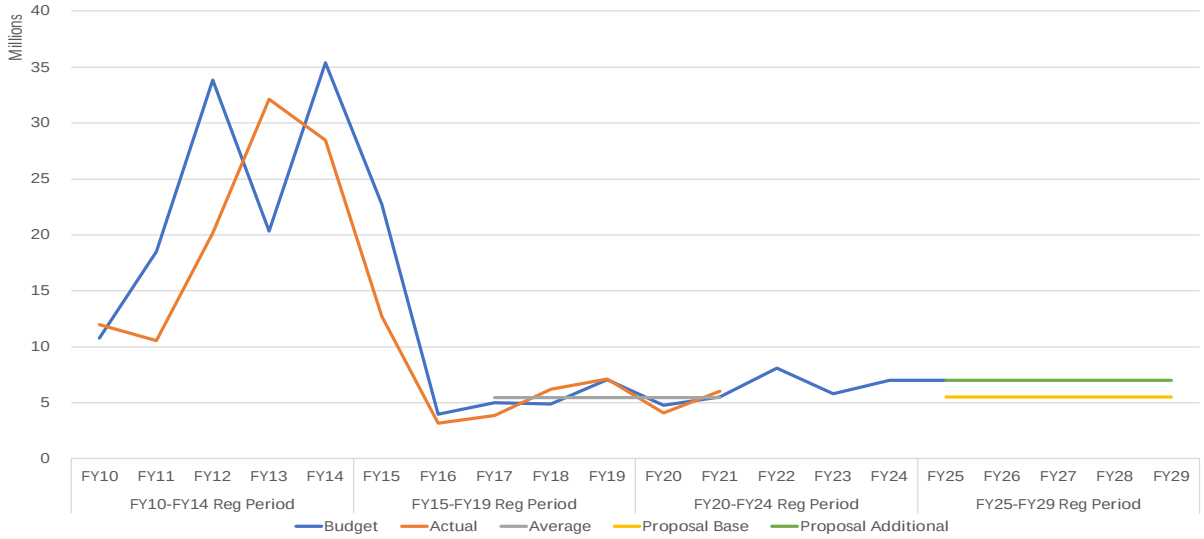

Figure 1 – Distribution Works Program Historical & Forecast Expenditure

*FY22 & FY23 budgets are based on released DWPs

*FY24 budget is based on the Portfolio Investment Plan

Based on the actuals in the last five years, Endeavour Energy spent an average of $5.5 Million each year in this program. This average forms the base expenditure forecasted for the FY25 – FY29 Regulatory Period.

Endeavour Energy also proposes an additional funding for works to service customers in the Western Sydney Aerotropolis Growth area. This estimate is based on the estimate of $12 Million for the 11kV to 22kV conversion outlined in Special Report 787 [1]. These conversion works have commenced in FY22 and is estimated to be completed by the end of the FY25 – FY29 Regulatory Period thus giving an additional estimated annual expenditure of $1.5 Million per year.

In total, Endeavour Energy proposes $7 Million per year for the Distribution Works Program totalling $35 Million over the FY25 – FY29 Regulatory Period.

3.1 Economic Justification

Since FY22, economic evaluations have been carried out for the individual projects in the Distribution Works Program [2,3] to ensure they are NPV positive as summarised in the table below.

	Program Estimate ($)	NPV ($)
FY22 DWP	8,077,000	437,213,000
FY23 DWP	5,805,000	175,955,000

Table 1 – Previous DWP estimates & NPV

Due to the nature of the DWP program being reactive based, the scope of the future program is unknown. As a result, the program as a whole has had any economic evaluation carried out. However, in continuance with current practice, all future identified projects will undergo individual economic evaluations to ensure they are justified.

4. Recommendation

It is recommended that the High Voltage Distribution Works Program for the FY25 – FY29 Regulatory Period with a total capital investment of $35 Million (with an average of $7 Million per year) be approved.

Appendices

A. Referenced documents and appendices

[1] Capacity Planning, Special Report 787 – 22kV Distribution within the Western Sydney Aerotropolis Area. Endeavour Energy: 2019.

[2] Capacity Planning, Distribution Works Program 2021/22 Case for Investment. Endeavour Energy: 2021.

[3] Capacity Planning, Distribution Works Program 2022/23 Case for Investment. Endeavour Energy: 2021.

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