# Distribution Works Program

## Expenditure Forecast for the 2019-24 Regulatory Period

Prepared by Asset Strategy and Planning

REVIEW AND APPROVAL SCHEDULE

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# 1.0 PURPOSE

This document has been prepared to provide a forecast for the Distribution Works Program capital expenditure requirements for the 2019/20 to 2023/24 period.

It also gives an overview of the network needs forming the main drivers for the expenditure requirement and details of the options considered and the methodology used in the determination of the forecast expenditure.

# 2.0 INTRODUCTION

The high voltage distribution network comprises of 11kV, 12.7kV and 22kV assets and forms the link between zone substations and distribution substations feeding the majority of Endeavour Energy's customers. The distribution network provides a means of connecting customers as well as allowing for flexible switching options for the transfer of load under contingent situations between adjacent high voltage feeders.

Each year the Distribution Works Program (DWP) targets the network risks associated with the high voltage distribution network assets and infrastructure.

Constraints identified are reviewed with a risk based approach prior to developing a network augmentation project. This includes assessment of alternate options such as Do Nothing, Non-Network or operational actions (such as switching).

# 3.0 DISTRIBUTION NETWORK RISKS

## 3.1 GENERAL

The DWP addresses a number of risk areas mainly associated with the safety, capacity and capability of the distribution network. These risks are detailed below.

### 3.2 Conductor Fault Rating Exceedance

If the fault rating of a conductor is exceeded the structure of the conductor will breakdown. 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 an upstream protective device and the heat generated by the fault current is not dissipated quickly enough, failure of the conductor is likely.

Failure of any conductor will lead to an unplanned outage but more importantly may place the safety of the community at risk via exposure to falling conductors and the possible ignition of fires.

### 3.3 Conductor Overload

Under normal conditions where a conductor is known to be undersized, operations staff would need to monitor the electrical load through the section of network. This could lead to a limitation of supply to customers beyond this section of network. Alternatively, if the conductor regularly carries current in excess of its rated continuous current carrying 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 may ultimately lead to the failure of the conductor.

Similar to conductor fault rating exceedance, failure of any conductor will lead to an unplanned outage and a supply limitation, but more importantly may present a safety risk to the public either through direct contact with the falling conductor or indirectly through the possible ignition of a fire.

### 3.4 Voltage Regulation

Voltage limits supplied to customers must be maintained to the range published within the Endeavour Energy Customer Service Standards. These limits are based on Australian 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.

### 3.5 Overloaded Feeders

Endeavour Energy configures the distribution network topology so each feeder has switching points between adjacent feeders, in line with Substation Design Instruction SDI501 – Network Configuration. This allows for each feeder to take a portion of load from an adjacent feeder during outage conditions, whilst remaining within its allowable operating conditions.

Endeavour Energy designs to a standard thermal rating of 300 Amps for its 11kV distribution network feeders. To allow for the outage contingency mentioned above, a threshold of 80% of the standard thermal rating is applied for the normal operation of the feeders. Therefore a network feeder is considered to be overloaded if the normal load supplied exceeds 240 Amps.

When the 240 Amp threshold is exceeded there is a risk 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.

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 and overloaded conductors.

### 3.6 De-rated Zone Substation Feeder Cables

This category of work specifically targets distribution feeder cables exiting zone substations. Generally cables in these locations are installed within close proximity to other feeder cables. The mutual heating due to the close proximity of the cables impacts upon the overall ratings of each of the cables

The analysis for this category applies the de-rating factors associated to underground cables laid in close proximity to each other as detailed in MDI0011 - Underground distribution cables - continuous current ratings. This standard stipulates the proximity de-rating factors, due to mutual heating, to be applied to cables laid close to each other.

The de-rated rating of a particular cable is dependent on a number of factors, possibly reducing 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 11kV cables are a smaller size and have a lower maximum operating temperature than the standard cables currently used.

The risks and consequences associated with this category are similar to the overloaded conductor category where conductor failure, unplanned outages and supply limitations may result.

### 3.7 Distribution Network Standards

Projects in this category address issues relating to the non-compliance of the network configuration to Endeavour Energy's existing design philosophies and standards, for example the installation of appropriate isolation points, the creation of cross feeder ties 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.

## 3.8 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, specifically trees, whilst also enhancing the aesthetics of the area in accordance with Company policies.

Prospective projects are rated on the environmental benefit of the proposal after 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 on 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 internal environmental stakeholders in regard to the relative merits of the existing network configuration compared with the proposed configuration.

Projects undertaken in this category are generally considered low risk, as the purpose of the work is based on company reputation/community expectation and local area aesthetics rather than the rectification of network non compliances.

# 4.0 IDENTIFICATION OF NETWORK RISKS

Distribution network constraints are identified and detailed within the annual release of the Distribution Network Status Report (DNSR). The DNSR is compiled to give a 'snapshot' of the electrical state of the distribution network under peak loading conditions to identify constraints in the network associated with the risks described above. The criteria for identifying constraints are based on Endeavour Energy standards and policies pertaining to the configuration and operation of the high voltage network within acceptable parameters such as safety, capacity, steady state voltage levels, ratings and operational flexibility.

The deficiencies highlighted within the DNSR are subject to further investigation and may culminate into projects to be included within the HV Development section of the DWP.

The DNSR documents the distribution network constraint items 1-4 detailed in Table 1 below. Items 5 to 7 are assessed as per sections 4.2, 4.3 and 4.4.

| Network Constraint Item | Risk | Investigation criteria |
|---|---|---|
| 1 | Conductor Fault Exceedance | Conductor fault rating exceedance based on actual network protection clearance times |
| 2 | Conductor Overload | Conductor section load exceeds 100% of the conductor continuous rating |
| 3 | Voltage Regulation | Network voltage regulation exceeds 6% |
| 4 | Overloaded Feeder | Distribution feeder load in excess of 240 Amps |
| 5 | De-rated ZS feeder cables | ZS feeder cable section load exceeds the calculated de-rated rating |
| 6 | Distribution network standards | Compliance to endeavour Energy's policies & standards |
| 7 | Environmental risks | Benefit gained by reducing the impact of the network on the environment. |

**Table 1 – Distribution Network Risk Factors and Identification Criteria**

## 4.1 DNSR Methodology

Analysis of voltage regulation, overloaded conductors and fault level exceeded conductors for the DNSR is undertaken utilising the DigSilent PowerFactory Application Programming Interface (API). This software allows for the batch analysis of the PowerFactory zone substation network models.

The API carries out a network load flow and fault analysis for each zone substation then scans each network model for the above mentioned non-compliances and outputs them into a tabulated Excel spreadsheet format for each of the categories. The individual results are then collated and a table of non-compliances with respect to each high voltage feeder in each zone substation is produced.

The fault level results are forwarded to the Endeavour Energy protection group for further assessment and checking against the results of an ongoing network wide protection study of all zone substation feeders. This ensures only sections of the network with inadequate protection are targeted for future works.

The process to determine the overloaded feeders begins with the extraction of the SCADA distribution feeder load data from Historian for Summer (31 October to 1 April) and Winter (31 May to 1 September) periods. The maximum loads for each feeder are filtered, via the script, to remove abnormal readings cause by short term load transfers. A further manual verification process is undertaken to determine the filtered maximum loads and the list of overloaded feeders is finalised and documented.

### 4.1.1 2016 DNSR Results and Risk Based Assessment

The 2016 review of the distribution is presented as an example to illustrate the annual risk based planning process.

The 2016 DNSR identified;

- 2119 - fault level exceeded conductor sections
- 222 - overloaded conductor sections
- 3390 - network nodes where the voltage regulation exceeded 6%, and
- 97 - feeders with loads in excess of 240 Amps.

The forecast expenditure detailed within this document has been based on the most recent view of volume of network constraints and historical investment levels required in each category during the current regulatory period.

A rigorous risk based engineering assessment is applied to all identified constraints to ensure prudent network investment. This process results the majority of identified constraints not requiring network augmentation.

## 4.2 De-rated ZS Feeder Cables

The assessment of zone substation de-rated feeder cables follows a selection criteria process designed to target the most onerous cable installations in terms of proximity de-rating. The preliminary stage of this assessment filters the number of feeders to a manageable number based on the following criteria and a calculation based on MDI0011.

- Does the ZS have more than 8 feeders?
- Are the feeder cables grouped in duct banks more than 4?
- Are existing cables a smaller size than 240mm Cu XLPE?
- Is the filtered max loading more than the calculated cable rating based on MDI0011?

Feeders meeting these criteria become the subject of a three tiered investigation designed to assess the risk these cable installations pose to the safe and reliable operation of network. Using the CYMCAP software, models are configured to simulate the cable types, cable loads, duct bank configurations and the ground conditions the feeders are in. Up to three separate tests, as detailed below, are undertaken;

1. <u>Maximum cable current allowable before maximum cable temp is reached</u>. This test applies the maximum operating temperature (MOT) to each of the cables in the duct bank and calculates the maximum current for each cable without breaching the cables MOT. If the test indicates the filtered maximum load is in excess of the calculated maximum current, step 2 is undertaken.
2. <u>Temperature reached with the undiversified filtered max load.</u> This test applies the filtered maximum feeder loads to the respective cables in the duct bank and calculates the cable temperature. If the MOT is breached, step 3 is undertaken.
3. <u>Temperature reached with diversified filtered maximum load</u>. This test is run over a number of iterations and selects the filtered maximum load on one cable and the corresponding loads on the other cables at the same date and time as the first cable. It then calculates the cable operating temperature for this scenario.

If after this final test any cable breaches its MOT, rectification works are proposed, either via network switching to relieve load on the cables within the duct bank or via the installation of additional network assets in order to relief the load.

## 4.3 Distribution Network Standards

The high voltage distribution network is configured in accordance with company policies and standards. Recently constructed network is designed in accordance with these standards, however in older network areas the configuration may not meet the current standards. Additionally, as changes are made to the network, extra works may be required to maintain compliance of the network to these standards.

Projects in this category are either identified during the network review undertaken as part of the compilation of the DNSR or they are referred to Asset Strategy & Planning for consideration by the operations group. They are proposed to rectify any configuration issues in the HV network such as;

- operational flexibility
- customer reliability during planned and unplanned outages
- load transfer capability for feeder load balancing
- prevention works to mitigate adjacent feeder outages and
- safety clearances

Some examples of the type of work undertaken within this category are;

- construction of strategic network links
- the installation of HV isolation points
- the tenure of land in areas where it is known future strategic links will be required

These works are assessed on both a network risk and a cost versus benefits basis.

## 4.4 Environmental Enhancement Works

Proposed projects in the Environmental Works category address issues relating to the impact the network has on the immediate environment. At present they are put forward either by the environmental group, the vegetation management group or by customers/community groups.

Projects put forward for this program address;

- Local environment aesthetics
- Risk of negative public/media attention and
- Areas where tree management causes conflict with customers

# 5.0 EXPENDITURE FORECAST

## 5.1 DNSR/DWP TIMELINE

The release of the DNSR and DWP follows the annual timeline detailed below.

- First week of September - The Summer & Winter distribution feeder filtered maximum loads are extracted and verified.
- Mid-September – Zone substation PowerFactory files set up in readiness for the API batch.
- Mid to late October – DNSR results are released, work begins on analysing the results and development of rectification works for inclusion into the draft DWP.
- Last week of December – release of the draft DWP.
- March – release of final DWP.

## 5.2 Portfolio Investment Plan Expenditure Forecast

The proposed Portfolio Investment Expenditure forecast for the 2019 – 2024 period appearing in Table 2 below has been formulated from the assessment of the network risks as detailed in Section 5.3 of this document.

| Description | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|
| HV Development Works ($M) | $6.8 | $7.1 | $6.6 | $6.3 | $5.9 |

**Table 2 - PIP expenditure forecast currently in the SAMP**

## 5.3 Proposed Expenditure Forecast

An expenditure forecast has been prepared for the different categories of work within the DWP with consideration being given to the degree of non-compliance and the mitigation of the network risks to an acceptable level.

The following sections detail the methodology used to prepare this expenditure forecast.

### 5.3.1 Fault Withstand Expenditure Forecast

Previously, the DSNR conductor fault withstand review was carried out by placing a fault at each node and comparing the resulting network fault level against a figure equating to 120% of the conductor fault rating. The output from this process was reviewed by the protection group to determine if the network protection settings were adequate to protect the conductor, or if works were required.

With the introduction of the PowerFactory software, the fault withstand assessment utilises the actual protection settings of all protective devices within the network and assesses the conductor fault withstand ability based on the network protection clearances times.

The Endeavour Energy protection group analyse the PowerFactory fault withstand results and identify any at risk conductor sections which require addressing. This may not necessarily manifest into build options as in some cases the adjustment of upstream protection device settings may be sufficient to alleviate the issue. Diagram 1 below indicates the breakdown of the 2016/17 DNSR fault withstand results and the overall number of conductor sections identified as requiring work.

A new category of work has been included in this forecast to address non – compliances to the current National Electricity Rules (S5.1.9) regarding protection systems and fault clearance times. The budget allowance in the DWP forecast specifically targets the backup protection issues associated with the failure of auto reclosers.

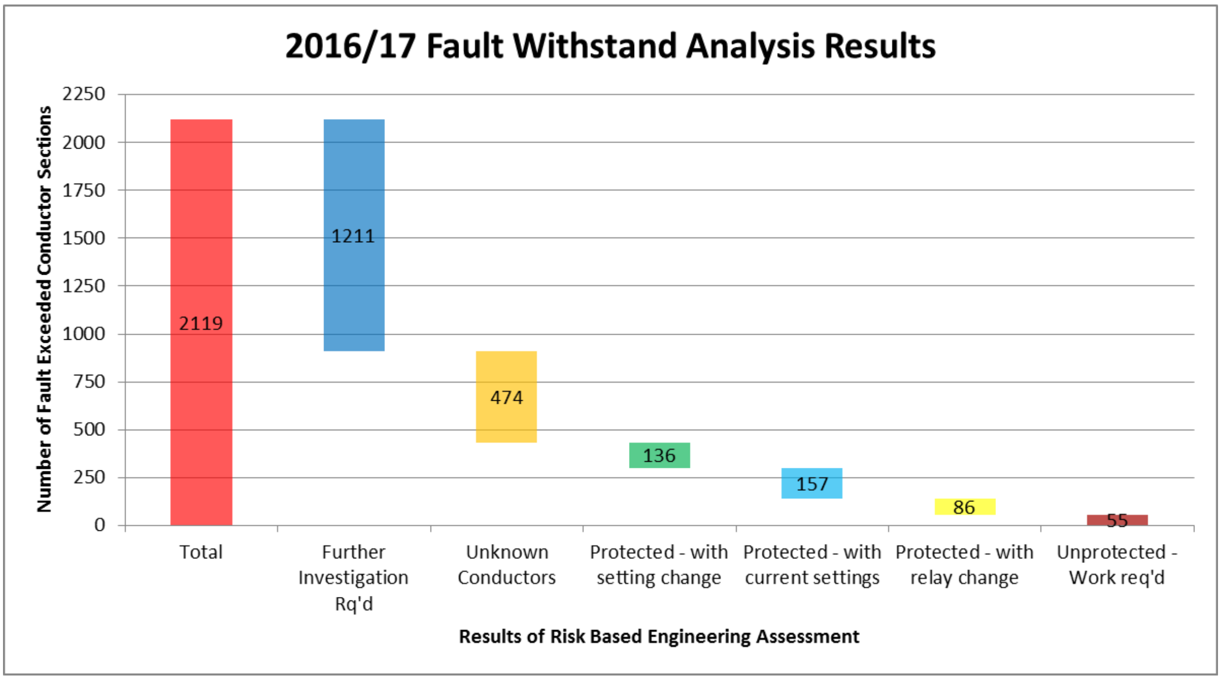


**Diagram 1– Breakdown of the Fault Withstand Non- Compliances identified in the 2016 Distribution Network Status Report.**

Diagram 2 below indicates the number of projects undertaken each year to address identified conductor fault withstand exceedances.

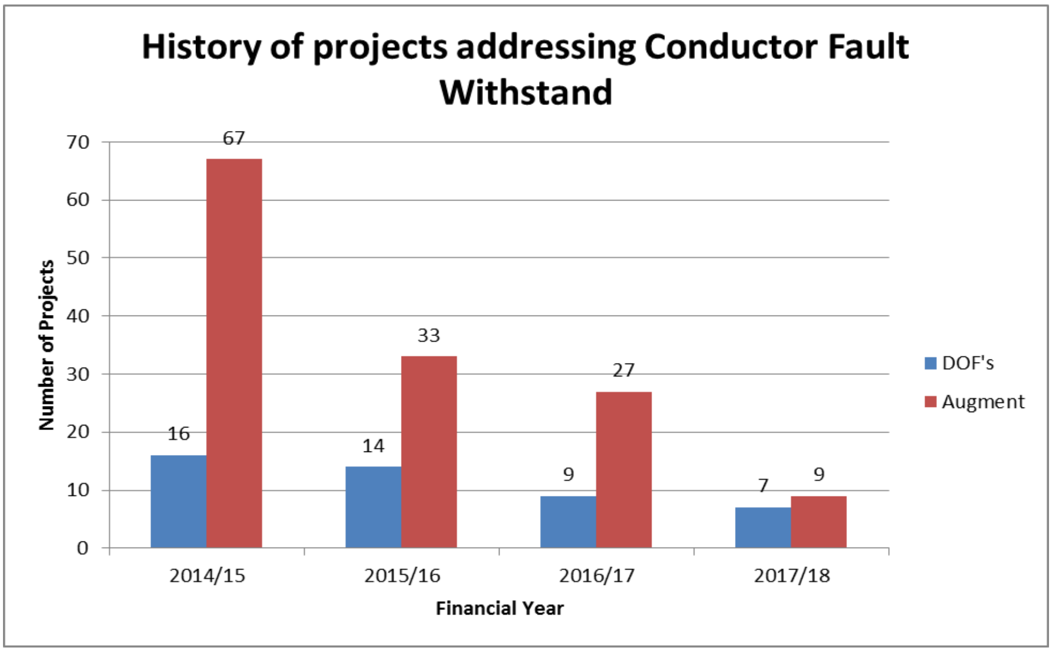


**Diagram 2 – Number of projects addressing Conductor Fault Withstand during the 2014/19 regulatory period.**

The forecast expenditure shown in Table 3 has been derived from the following inputs;

- Auto recloser backup program – Investigation into the back up protection requirements is underway. It is proposed to address 26 high risk AR's in 2018/19 the remainder will be addressed over the 2019/2024 period.
- Power Factory DNSR results – this category is split into the installation of DOF's and the augmentation of HV conductor to address conductor sections where the protection is not sufficient and there is a risk of conductor failure. A forecast has been derived based on the average cost and the number of projects carried out during the 2014/15 to 2017/18 period in each category shown in

Diagram 2. It is forecast to undertake10 DOF projects in 2019 decreasing to 7 in 2023, while 31 HV augmentation projects are proposed in 2019 and decreasing to 20 in 2023.

- Unknown conductors - Currently the GIS database contains approximately 474 conductor sections totalling 86km of unknown conductor within the HV distribution network. A project has been initiated to capture the conductor details of the unknown conductors and have the details placed into GIS.
  It is anticipated a percentage of these conductors will not be sufficiently protected and will require works to ensure adequate protection is afforded to them. A forecast based on 20% of the 86km total has been calculated and included in the forecast.

| Fault Withstand Program | | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|---|
| AR Backup | No. of AR's | 30 | 29 | 28 | 28 | 28 |
| | Cost | $1.22 | $1.36 | $1.31 | $1.31 | $1.31 |
| Conductor Fault level exceedance- DOF's | No. of DOF's | 10 | 9 | 8 | 8 | 7 |
| | Cost | $0.35 | $0.35 | $0.31 | $0.28 | $0.25 |
| Conductor Fault level exceedance- Augments | No. of Projects | 31 | 28 | 25 | 22 | 20 |
| | Cost | $2.04 | $2.04 | $1.84 | $1.65 | $1.49 |
| Unknown Conductor - DOF's | No. of DOF's | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| | Cost | $0.14 | $0.16 | $0.16 | $0.16 | $0.16 |
| Unknown Conductor - Augments | Length (km) | 0.57 | 0.57 | 0.57 | 0.57 | 0.57 |
| | Cost | $0.13 | $0.15 | $0.15 | $0.15 | $0.15 |
| | Total ($M) | **$3.8** | **$4.06** | **$3.77** | **$3.55** | **$3.36** |

**Table 3 - Forecast Conductor Fault Withstand Expenditure ($M)**

### 5.3.2 Overloaded Conductor Expenditure Forecast

There has been no change in the methodology used in identifying overloaded conductors between the new PowerFactory assessment and the DINIS API. The PowerFactory script carries out a load flow on the network and checks the load on the individual conductor sections versus the rating of the conductors. A report is generated giving details of any conductor with a load in excess of its rating.

During the 2014-19 regulatory period it was typically found only a small percentage of the conductors identified required remediation works. Diagram 3 below shows the breakdown of the 2016/17 Distribution Network Status Report results and illustrates the small number of overloaded conductor sections requiring work as compared to the total identified.

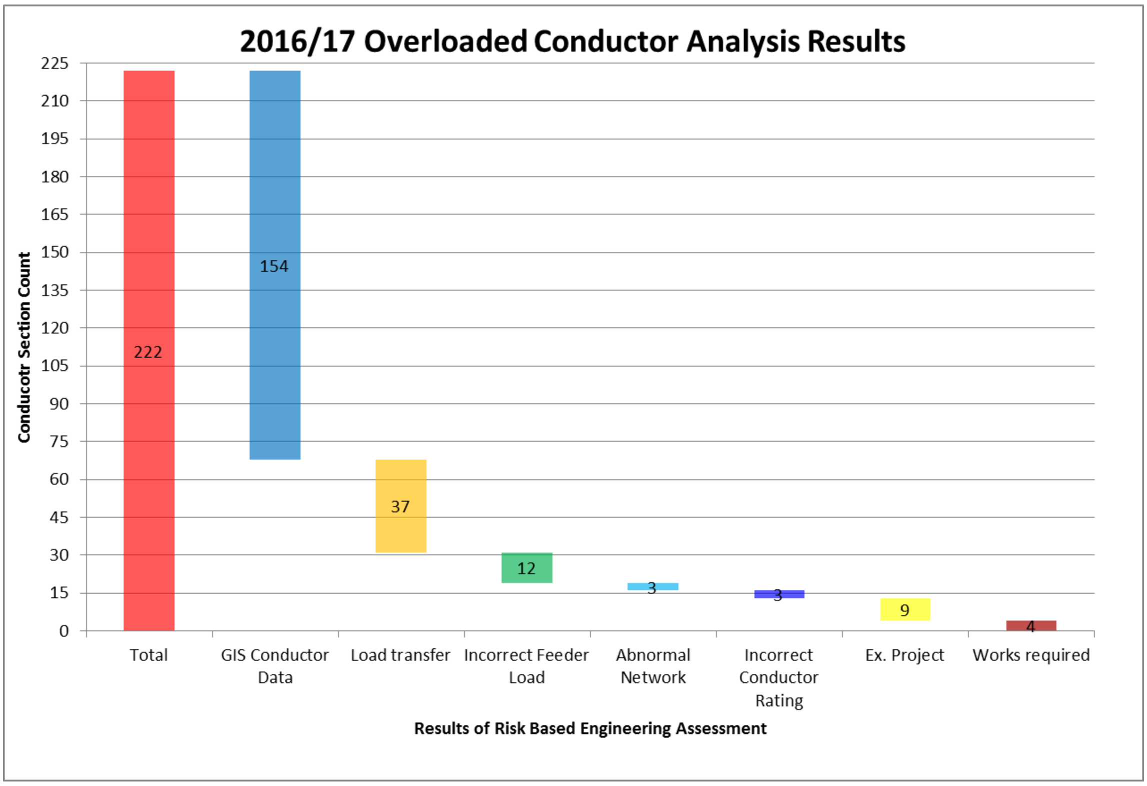


**Diagram 3 - Breakdown of the Overloaded Conductor Non – Compliances identified in the 2016/17 Distribution Network Status Report.**

The expenditure forecast in Table 4 below has been based on this experience and the expectation the number of overloaded conductor sections will continue to decrease.

| Overloaded Conductors | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|
| Expenditure ($M) | $0.304 | $0.319 | $0.294 | $0.269 | $0.252 |

**Table 4 – Forecast Overloaded Conductor Expenditure ($M).**

### 5.3.3 Voltage Regulation Expenditure Forecast

Similar to the overloaded conductor category, the DNSR results for voltage regulation from previous years identify a high number of network nodes with a voltage regulation in excess of 6%. However the number of projects and the expenditure in this category has been relatively low. This is due the introduction of a verification process prior to the 2015-2019 regulatory period. This process involves the installation of voltage monitors at sites where further investigation is deemed warranted. This is illustrated in Diagram 4 below, which indicates the number of network nodes identified as requiring investigation via the installation of LV monitors as compared to the total number of network nodes identified as having a voltage regulation above 6%.

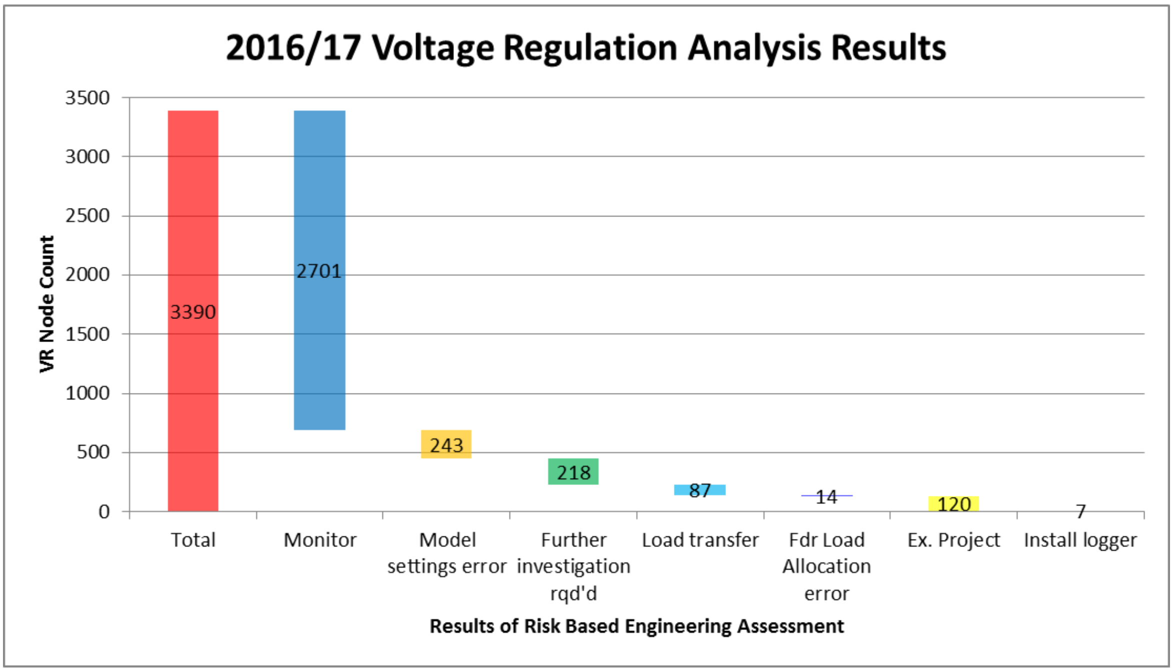


**Diagram 4 - Breakdown of the Voltage Regulation Non – Compliances identified in the 2016/17 Distribution Network Status Report.**

The verification process has revealed the DNSR analysis results are generally conservative, meaning the voltage regulation was not as low as was modelled. This has also been supported up by the;

1. National power quality survey. This survey records the supply voltage from numerous Australian DNSP's including Endeavour Energy. To date the survey has generally shown the supply voltage to be in the upper band of volts, and
2. Complaints received from solar in feed customers. Endeavour Energy regularly receives enquiries/complaints from customers with solar panels. The complaints generally regard the tripping of the solar inverter due to high system volts. This impacts upon the customers revenue returns.

The number of projects undertaken in this category each year during the 2014/19 regulatory period is shown in table 5 below.

| Financial Year | 2014/15 | 2015/16 | 2016/17 | 2017/18 |
|---|---|---|---|---|
| Number of Projects targeting Voltage regulation | 0 | 2 | 2 | 1 |

**Table 5 – Number of projects addressing Voltage regulation during the 2014/19 regulatory period.**

Based on the above information, the forecast expenditure for the 2019- 2023 period, shown in Table 6 below, has been calculated on the average number of projects and expenditure in this category in the 2015 to 2018 period.

| Voltage Regulation | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|
| Expenditure ($M) | $0.188 | $0.207 | $0.207 | $0.207 | $0.207 |

**Table 6 – Forecast Voltage Regulation Expenditure ($M)**

### 5.3.4 Overloaded Feeder Expenditure Forecast

As shown in the 2016 DNSR results, 97 distribution feeders were identified as having loads in excess of 240Amps, following the verification of the feeder loads. Diagram 5 below shows the breakdown of how the 97 feeders were addressed following a risk based approach.

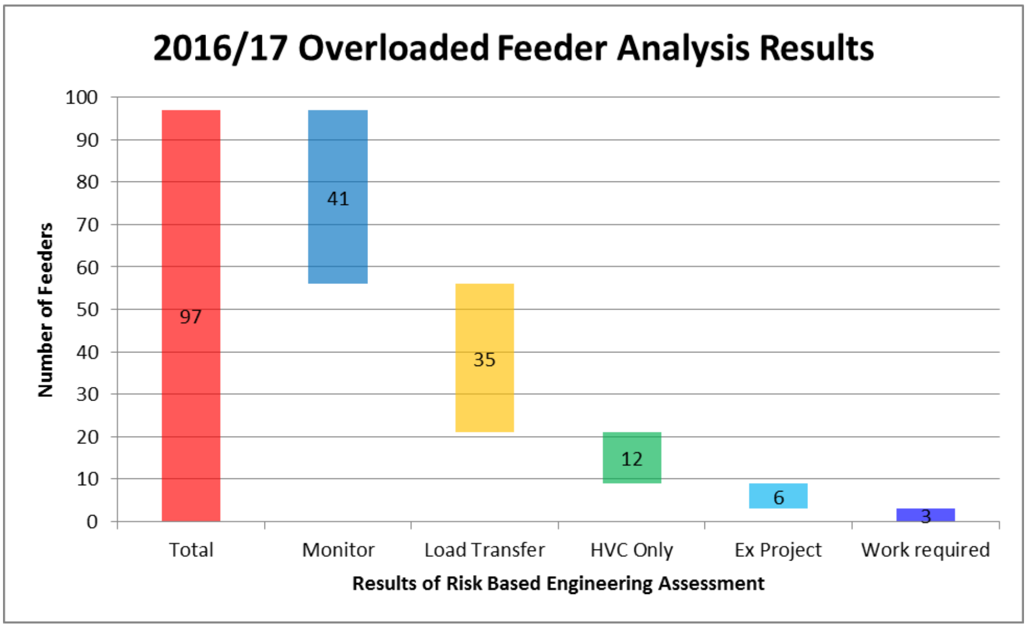


**Diagram 5 - Breakdown of the Overloaded Feeder results from the 2016/17 Distribution Network Status Report.**

As can be seen in diagram 5, only 3 feeders required works to be carried out, while the remainder were assessed as per the following;

1. Monitoring – A determination is made regarding the adherence to the 240 Amp threshold, based on the knowledge of development occurring in a given area and whether any detrimental effects will occur if the threshold is exceeded.
2. Load transfers – Investigation is undertaken to determine if load can be transferred to adjacent lightly loaded feeders to alleviate the overload
3. Existing projects – If the overload is addressed as part of other works being undertaken.
4. Load growth trending - Feeder and zone substation load growths are investigated to determine the load trend of the feeder. No work is proposed if the load appear to be decreasing or levelling.

The number of projects undertaken to address overloaded feeders to date in the 2014/19 regulatory period is illustrated in Diagram 6 below. This shows there is a significant difference between the number of feeders identified with loads above 240Amps as compared to the number of projects undertaken.

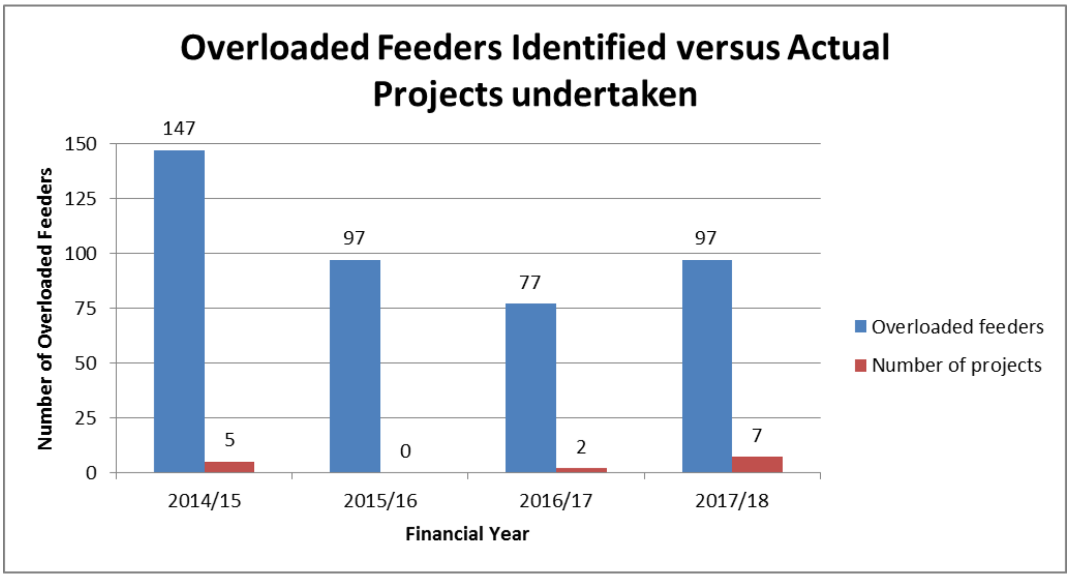


**Diagram 6 – Comparison of the identified overloaded feeders and the number of projects undertaken during the 2014/19 regulatory period.**

Based on the above information, the forecast expenditure for the 2019- 2024 period, shown in Table 7 below, has been calculated on the average number of projects and expenditure in this category in the 2014 to 2018 period.

| Overloaded Feeder Works | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|
| Expenditure ($M) | $0.59 | $0.65 | $0.65 | $0.65 | $0.65 |

**Table 7 – Proposed Overloaded Feeder Expenditure 2019/2023**

### 5.3.5 Zone Substation Cable Rating Expenditure Forecast

As detailed in section 4.2 an initial assessment is carried out based on MDI0011. This is followed by an intensive study using the CYMCAP software.

To date only a small number of zone substation cables required works to be carried out as a result of de-rating during the 2014/19 regulatory period. The expenditure forecast in Table 8 has an allowance of 1 rectification project per year for the 2019/23 period. This is based on the number of projects undertaken in the 2014/19 period and also the knowledge, many of the older zone substations used smaller sized paper insulated cables in cement fibre conduits and de-rating was not considered to be an issue at the time of installation. In addition to this, over time, other feeder cables have been added to the duct banks with still no de-rating assessments being carried out

| ZS cable de-rating | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|
| Expenditure ($M) | $0.089 | $0.099 | $0.099 | $0.099 | $0.099 |

**Table 8 – Forecast ZS De-rated Cable Expenditure ($M)**

### 5.3.6 Distribution Network Standards Expenditure Forecast

This category of work has been part of the DWP since its inception. The project scopes are driven by compliance to the current policies and standards pertaining to the development and operation of the distribution network. The main focus areas are;

- Correct positioning of HV isolations
- Development of appropriate cross feeder and cross zone ties, and
- Suitable conductor size for network location.

Additionally, it is proposed to begin including works associated with the connection of customers. The type of work proposed for inclusion are works not necessary for the direct connection of the customer but those required to maintain the compliance of the network to the policies and standards. It should be noted works critical to the connection or works carried out in conjunction with road construction must still be carried out as part of the network connections process. This type of work has normally not been included into the DWP. The change from past practice will allow for the prioritisation of works into the DWP and optimisation of the investment plan, rather than reactively authorising and constructing individual scopes as they arise.

The expenditure for this type of work has been estimated $800,000 per year. The forecast expenditure for the Distribution Standards category has been modified to include this amount and is shown in Table 9 below.

| Distribution Network Standards | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|
| Expenditure ($M) | $1.554 | $1.554 | $1.399 | $1.259 | $1.133 |

**Table 9 – Forecast Distribution Network Standards Expenditure ($M)**

### 5.3.7 Environmental Enhancement Works

Projects undertaken within the Environmental Enhancement Works category address risks associated with;

- Environmental obligations with respect to sensitive flora near overhead electricity assets, including consideration of any clashes with heritage listings or endangered species/habitats.
- Safety clearance obligations where it has not been practical to achieve clearances with normal trimming practices or where there are unusually high costs with trimming vegetation at a particular location.

Endeavour Energy has licence condition requirements to comply with the ISO14000 series of Environmental Management standards

The forecast expenditure in this category has been based on the average costs incurred carrying out the projects undertaken in the 2014 to 2017 period and is shown in Table 10 below.

| Environmental Enhancement | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|
| Expenditure ($M) | $0.20 | $0.22 | $0.22 | $0.22 | $0.22 |

**Table 10 – Forecast Environmental Enhancement Works Expenditure ($M)**

### 5.4 Distribution Works Program Expenditure Forecast

Table 11 below shows the total expenditure forecast for the Distribution Works Program for the 2019-2024 regulatory period, based upon rectification of anticipated non compliances within the Distribution Network. No allowance has been made for any carry over amounts from 2017/18.

| Work Category | PIP category | 2019/20 | 2020/21 | 2021/22 | 2022/23 | 2023/24 |
|---|---|---|---|---|---|---|
| Overloaded Feeder | HVW | $0.59 | $0.66 | $0.66 | $0.66 | $0.66 |
| AR Backup | HVW | $1.22 | $1.36 | $1.31 | $1.31 | $1.31 |
| Conductor Fault level exceedance- DOF's | HVW | $0.35 | $0.35 | $0.31 | $0.28 | $0.25 |
| Conductor Fault level exceedance- Augments | HVW | $2.04 | $2.04 | $1.84 | $1.65 | $1.49 |
| Unknown Conductor - DOF's | HVW | $0.14 | $0.16 | $0.16 | $0.16 | $0.16 |
| Unknown Conductor - Augments | HVW | $0.13 | $0.15 | $0.15 | $0.15 | $0.15 |
| Voltage regulation | HVW | $0.19 | $0.21 | $0.21 | $0.21 | $0.21 |
| Overloaded Conductor | HVW | $0.30 | $0.32 | $0.29 | $0.27 | $0.25 |
| ZS derated Cable | HVW | $0.09 | $0.1 | $0.1 | $0.1 | $0.1 |
| Distribution Network Standards | HVW | $1.55 | $1.55 | $1.39 | $1.26 | $1.13 |
| Environmental Enhancement | HVW | $0.20 | $0.22 | $0.22 | $0.22 | $0.22 |
| **Totals $(M)** | | $6.79 | $7.11 | $6.65 | $6.27 | $5.95 |

**Table 11 – Calculated Distribution Works Program Forecast ($M).**

## 6.0 CONCLUSION AND RECOMMENDATION

In conclusion the development of the Distribution Works Program is based on a robust, evidence based identification of constraints. Furthermore, a risk based assessment of constraints and non-compliances results ensures a prudent level of investment is proposed.

It is recommended the proposed Distribution Works Program expenditure detailed in this document for the 2019-24 regulatory period of $32.7M be endorsed and included in the PIP.