
Top Down Adjustment

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1 PURPOSE

This document describes the top-down review that AusNet Services' has applied to forecast Capital Expenditure for the regulatory period 2022-26. The outcome of the review is a downward adjustment to total CAPEX

2 SCOPE

The scope of this document is the CAPEX forecast for the regulatory period 2022-26. It includes network and non-network components across projects and programs. This document directs readers to other documents that are relevant to the forecast such as Plant Strategies, Planning Reports and Project descriptions.

Values shown in this document are in 2018 dollars. Amounts will be converted into 2020 dollars for the submission. This document does not provide any justification of proposed expenditure.

3 ABBREVIATIONS AND DEFINITIONS –

Term	Definition
ACR	Automatic Circuit Recloser
AUGEX	Augmentation Expenditure
CAPEX	Capital Expenditure
CB	Circuit Breaker
CT	Current Transformer
CVT	Capacitive Voltage Transformer
EDPR	Electricity Distribution Price Review
HV	High Voltage
LV	Low Voltage
NED	Neutral Earth Device
NER	Neutral Earth Resistor
REFCL	Rapid Earth Fault Current Limiter
RTU	Remote Terminal Unit
VRR	Voltage Regulator Relay

4 BACKGROUND

AusNet Services has built up its CAPEX forecast using a bottom-up approach. A series of projects and programs are proposed to address various drivers. Projects address issues at specific geographical locations and may require work on a range of different asset classes. Meanwhile, programs typically address one specific asset class where the individual assets are located across multiple locations.

Each program or project identifies a driver for expenditure and estimates the volume and cost of assets required. The identification of assets for some programs is based on asset or fleet specific information and may not take into account interrelationships with other works being proposed or conducted. There is therefore the potential for overlap and synergies between programs and projects where two or more bodies of work are undertaken at the same location or propose to replace the same asset. In some cases, the

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replacement of one asset class may require the replacement of other physically or electrically connected assets. In other cases, it is economically efficient to bring forward non-essential replacements to coincide with required work.

AusNet Services has therefore conducted a top-down adjustment to its programs and projects to ensure that any interrelationship between components of the program are accounted for in the CAPEX forecast. The interrelationship between components of the program have been accounted for in two ways; by adjusting the forecast during the bottom-up build and by application of a top-down adjustment. This document identifies both of these methods and the size of each adjustment.

5 ASSET LOCATIONS

AusNet Services' Network assets can generally be classified as either "Station" or "Line". "Station" assets are located within the property boundary of a Terminal Station or Zone Substation whilst "Line" assets are located outside the property boundary. It is uncommon that replacement of an asset in one classification relies upon or necessitates the replacement of an asset in the other classification. In the majority of cases, each program or project will only involve either Station or Line assets. There are, therefore, no synergies between work in Stations and on Lines. The exceptions are the REFCL and Augmentation programs, which involve a combination of both types of assets.

Non-Network assets do not form part of the electrical system but are required in the day to day running of the business. They are required for the efficient and effective day to day operation of AusNet Services. There is therefore no overlap between Non-Network assets and Network assets.

6 STATION ASSETS

Figure 1 below shows the various categories of projects and programs related to Station assets. There are some overlaps and potential overlaps between the categories. The majority of overlaps have already been removed from CAPEX schedule during the bottom-up build.

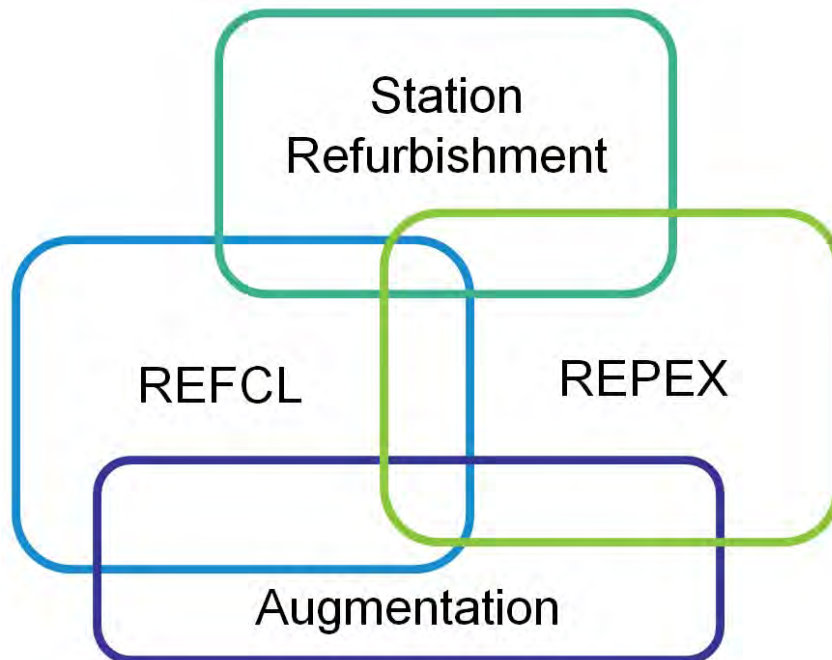


Figure 1 Station related CAPEX programs and projects

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6.1 REFCL

REFCL's have been mandated to be installed in 22 Zone Substations around AusNet Services' network. In the 2022-26 regulatory period work will be carried out at 5 stations, designated as Tranche 3 of the program with Tranches 1 and 2 largely being completed within the 2016-2020 regulatory period. The Station asset components of REFCL projects consist of replacement of various assets within the 22kV switchyards including transformers. Each Zone Substation is distinct from each other so there is no overlap within this program. The Zone Substations affected by this program are:

Zone Substation	Document
LLG – Lang Lang	
SLE – Sale	
MSD – Mansfield	
BN – Benalla	
KLO – Kalkallo	

6.2 STATION REFURBISHMENT

When large amounts of deteriorated assets are identified within the same zone substation, a station refurbishment project is proposed to replace multiple asset classes at once. This achieves delivery efficiencies as resources can be engaged to replace multiple assets without needing to remobilise. This approach also improves customer outcomes as the unavailability of zone substations is reduced when multiple assets are replaced during the same outage. As with the REFCL program, all zone substations involved in this program of works are distinct from each other so there is no overlap within this program. The zone substations affected by this program are:

Zone Substation	Document
BN – Benalla	AMS 20-260
BWR – Bayswater	AMS 20-261
MFA – Maffra	AMS 20-250
NLA – Newmerella	AMS 20-262
TGN – Traralgon	AMS 20-263
TT – Thomastown	AMS 20-252
WGL – Warragul	AMS 20-264
WT – Watsonia	AMS 20-257

There is one station, Benalla, which falls into both the station refurbishment and REFCL programs. As the 22kV switchyard will undergo replacement as part of the REFCL program, a portion of the Benalla refurbishment project should be removed from the CAPEX forecast as part of a top down adjustment. The 22kV switchyard component comprises approximately 50% of the Benalla refurbishment project equating to \$4.485M. This amount has been listed as part of the top down adjustment in Section 9.

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6.3 STATION CAPACITY AUGMENTATION

Augmentation of a station is required when operational requirements have changed over time. This is a different driver to the regulatory or risk-based drivers of the previous two programs described in sections 6.1 and 6.2. There are three main drivers of augmentation programs in the 2022-26 EDPR proposal, all stemming from demand growth; station capacity, capacitive current levels, and voltage reliability.

AusNet Services regularly monitors demand growth across its network. From time to time, augmentation projects are required to increase Zone Substation capacity, mitigating the supply risks caused by growing demand. For the 2022-26 period, only one such project is proposed at Clyde North Zone Substation. This station is not proposed for refurbishment during 2022-26 and will not have a REFCL fitted and hence there is no overlap with the Station Refurbishment and REFCL programs.

6.4 REPEX

For each asset class of Station assets, a volume is forecasted for replacement during the regulatory period using an appropriate forecasting model. Generally, Stations assets are low volume, which allows for an assessment of each individual asset to be carried out before being nominated for replacement. It is therefore possible to identify when a specific asset identified by a forecast model for replacement, overlaps with a REFCL, Station Refurbishment or Capacity Augmentation project or program where the corresponding scope is known. For each asset class, the volume proposed for replacement as part of a REPEX program has been reduced where an overlap was identified. The volumes and values removed from the forecast are listed in Section 9.

Station assets forming part of various REPEX programs are:

Station assets	Document
Roofs, Doors and Windows	AMS 20-55
Power Transformers and Fall Arrest Systems	AMS 20-71
Circuit Breakers	AMS 20-54
Switchboards	AMS 20-56
CT's	AMS 20-63
CVT's	AMS 20-63
Capacitor Banks & Reactors	AMS 20-53
NER's & NED's	AMS 20-79
Station Surge Arresters	AMS 20-77
HV Switches, Earth Switches and Isolators	AMS 20-62
Buildings	AMS 20-55
Battery Rooms	AMS 20-55
Oil Control	AMS 20-55
Zone Substation Lighting	AMS 20-14
Mechanical Locks and Keys	AMS 20-14
Protection Relays	AMS 20-72
RTU's	DD-0002699

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Station assets	Document
Auxiliary Systems	AMS 20-80
Station VRR's	AMS 20-72
Communications Equipment	AMS 20-81

6.5 CAPACITIVE CURRENT AUGMENTATION

As new sections of network are added, particularly with insulated cable, the capacitive current on each feeder increases. Where a REFCL is installed at a Zone Substation, there is a need to maintain total capacitive current seen by the station below certain thresholds in order for arc suppression coils to operate correctly. Prior to 2025, it is estimated that 10 Zone Substations will be affected by high levels of capacitive current and therefore require augmentation projects to ensure the ongoing operational compliance of their REFCL's. These stations will have a REFCL installed in Tranches 1 and 2 of the REFCL program during the current regulatory period and have no expenditure forecast in the REFCL program component of the CAPEX forecast. They also do not overlap with the Station Refurbishment projects or the Station Capacity Augmentation project at Clyde North. The zone substations affected by these projects are:

Zone Substation	Scope of Works	Assets replaced
WYK – Woori Yallock	Install 2 isolation transformers with underground works in Myers Creek	
KLK – Kinglake		
KMS – Kilmore South	Upsize Arc Suppression Coil	
WGI – Wonthaggi	Install additional GFN	Power Transformer
RWN – Ringwood North	Install additional GFN	
BGE – Belgrave	Load transfers and network augmentation	Conductor
WOTS – Wodonga Terminal Station	New Zone Substation, install GFN and line extension	
ELM – Eltham	New Zone Substation, install GFN and line extension and 22kV augmentation	Conductor
LDL – Lilydale	Install 1 isolation transformer with underground works in Mt Dandenong	
BDL – Bairnsdale	New Zone Substation, install GFN	

The construction of new Zone substations, additional GFN's, isolation transformers, Arc Suppression Coils and line extensions, will not overlap with the previously mentioned replacement programs. Furthermore, none of these stations overlap with the Station refurbishment or Tranche 3 REFCL sites. The only proposed asset replacements are the power transformer at Wonthaggi and conductors on Belgrave and Eltham. The Wonthaggi transformer does not appear in the list of transformer replacements and hence there is no overlap.

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It is estimated that \$1.29m of the forecasted REFCL Augmentation expenditure, will be applied to the replacement of bare conductor emanating from the Belgrave zone substation. Since 4% of Belgrave conductor is expected to be replaced as part of the REPEX program, an estimated overlap between these two volumes of work is $4\% \times \$1.29\text{m} = \0.052m . This amount has been included in Section 9 as part of the top down adjustment.

It is estimated that \$11.12m of the forecasted REFCL Augmentation expenditure, will be applied to the replacement of bare conductor emanating from the Eltham zone substation. Since 5% of Eltham conductor is expected to be replaced as part of the REPEX program, an estimated overlap between these two volumes of work is $5\% \times \$11.12\text{m} = \0.556m . This amount has been included in Section 9 as part of the top down adjustment.

6.6 VOLTAGE RELIABILITY AUGMENTATION

The third driver of Augmentation projects is the increasing Voltage reliability issues being experienced by customers. Upgrades to some Station assets will be required to address these under various Augmentation programs. Augmentation programs addressing Voltage issues are:

Augmentation Programs	Document
Power Quality Monitoring	AMS 20-12
Voltage Compliance Program	AMS 20-12
Hosting Capacity Development	AMS 20-12

The Power Quality Monitoring project involves the installation of new EDM1 meters to monitor power quality of the network. These items will increase monitoring capability but are not used in the operation of the network and therefore fall outside the scope of the REFCL and Station refurbishment programs. Hence there is no overlap with the previously discussed programs.

The exact scopes of the Voltage Compliance Program and Hosting Capacity Development projects have yet to be fully defined. Parts of these projects are reactive and hence a forecast model has been developed to predict the volume of expenditure required. It is estimated that \$12.3m of the \$38.1m forecast expenditure for these programs can be attributed to replace VRR's in Zone Substations. Since 10% (13 out of 130) VRR's are expected to be replaced as part of the REPEX program, an estimate of the overlap between these two volumes of work is $10\% \times \$12.3\text{m} = \1.23m . This amount has been included in Section 9 as part of the top down adjustment.

There is no overlap between the Capacitive Current Augmentation projects described in section 6.5 and the Voltage Reliability Augmentation.

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7 LINE ASSETS

Figure 2 below shows the various categories of projects and programs related to Line assets. There are some overlaps and potential overlaps between the categories. The majority of overlaps have already been removed from CAPEX schedule in the bottom up development of the forecast.

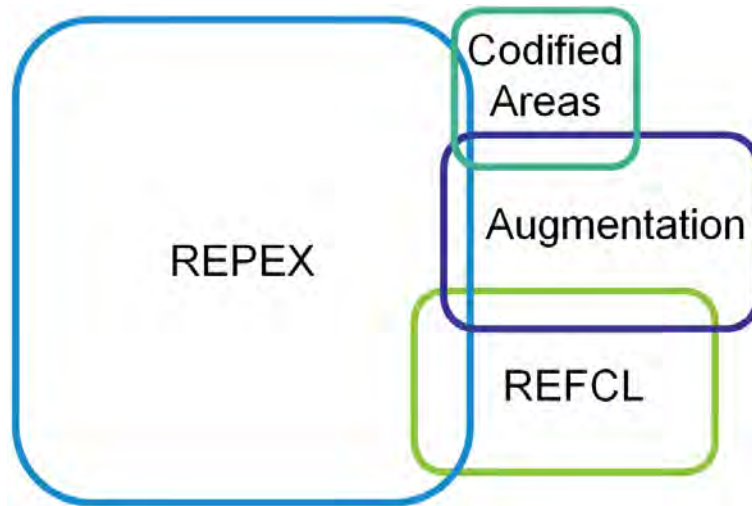


Figure 2 Line related CAPEX programs and projects

7.1 REFCL

REFCL's have been mandated to be installed in 22 Zone Substations around AusNet Services' network. In the 2022-26 regulatory period work will be carried out 5 stations, designated as Tranche 3 of the program with Tranches 1 and 2 being completed within the 2016-2020 regulatory period. The Line asset components of REFCL projects consist of replacement of various Line assets within the HV multiphase network supplied by these 5 stations. Each Zone Substation is distinct from each other so there is no overlap within this program. The Zone Substations affected by this program are:

Zone Substation	Document
LLG – Lang Lang	
SLE – Sale	
MSD – Mansfield	
BN – Benalla	
KLO – Kalkallo	

7.2 CODIFIED AREAS

The Codified Area program involves the replacement of approximately 100km of SWER bare conductor in Codified Areas with insulated overhead or underground cables. REFCL's do not detect faults on the SWER network. Hence, the 100km of SWER replacement will not overlap with any REFCL related construction.

The Codified Area program is limited to feeders emanating from the KMS, KKK and SMR Zone Substations.

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7.3 REPEX

For each asset class of Line assets, a volume is forecasted for replacement during the regulatory period using an appropriate forecasting model. Whilst Line assets usually see high volumes of replacement, it is still possible to identify when a specific asset identified by a forecast model for replacement, overlaps with a previously mentioned project or program where the corresponding scope is known. For each asset class, the volume proposed for replacement as part of a REPEX program has been reduced if an overlap was identified. The volumes and values removed from the forecast are listed in Section 9.

Line assets forming part of various REPEX programs are:

Line assets	Document
Poles	AMS 20-70
Crossarms	AMS 20-57
Conductors	AMS 20-52
Cables	AMS 20-65
Distribution Substations	AMS 20-58
Services	AMS 20-76
Control Boxes and ACR's	AMS 20-60
MV Switches	AMS 20-60
Fuses	AMS 20-61
Line Surge Arresters	AMS 20-67
Line Voltage Regulators	AMS 20-68
Pole Top Capacitors	AMS 20-69
Insulators	AMS 20-66
Electrical Earths	AMS 20-59
Line Voltage Regulator Fences	AMS 20-14
Ground Type Substation Fences	AMS 20-14

7.4 AUGMENTATION PROGRAMS AND PROJECTS

As with station augmentation projects, the full scope of Line augmentation projects is not known until specific areas are assessed and a specific solution selected.

Augmentation projects typically address issues regarding load growth and upgrading parts of the network which cannot carry increased loads. As the customer density in SWER areas is approximately 1/16 that of multiphase areas and there is very little forecast growth in rural areas, there is a substantially lower probability that they will exceed their design capacity. It is therefore assumed that there is negligible overlap between the Augmentation projects and the Codified Area program.

The Augmentation programs are created predominantly as reactive programs where other large projects are not already addressing issues. Their forecasts are estimated based on historical expenditure and assume ongoing programs of work. The forecast therefore already account for ongoing REFCL projects which have already commenced in the current regulatory period. Hence, it is assumed that REFCL projects will consider

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load growth issues in their design and address them appropriately, but this should not necessitate a top down adjustment for overlaps between these two programs.

Augmentation programs addressing Line issues are:

Project	Document
Power Quality Monitoring	AMS 20-12
Flexible DER Sensing Devices	DER – Program Brief v 2.1
Voltage Compliance Program	AMS 20-12
Hosting Capacity Development	AMS 20-12
East Region Feeders	AMS 20-12
Central Region Feeders	AMS 20-12
North Region Feeders	AMS 20-12
Summer Network Readiness	AMS 20-12
Customer Supply Compliance Program	AMS 20-12
Eliminating Network Operational Deficiencies	AMS 20-12
LV Network Capacity	AMS 20-12

7.4.1 POWER QUALITY AND DER SENSING

As per the stations component of the Power Quality Monitoring project, the lines component involves the installation of new assets with new capabilities and hence are unlikely to overlap with the REFCL, Codified Area or REPEX programs. Similarly, the Flexible DER Sensing Devices project is also unlikely to overlap with these programs.

7.4.2 VOLTAGE COMPLIANCE AND HOSTING CAPACITY

The exact scopes of the Voltage Compliance Program and Hosting Capacity Development projects have yet to be fully defined. Parts of these projects are reactive and hence a forecast model has been developed to predict the volume of expenditure required.

It is estimated that \$2.25m of the \$38.1m forecast expenditure for these programs can be attributed to replacing Line Voltage Regulators. Since 17% (15 out of 89) LVR's are expected to be replaced as part of the REPEX program, an estimate of the overlap between these two volumes of work is $17\% \times \$2.25\text{m} = \0.379m . This amount has been included in Section 9 as part of the top down adjustment.

It is estimated that \$11.7m of the \$38.1m forecast expenditure for these programs relates to replacing bare conductor. Since 3.5% (1339km out of 38,000km) of conductor is expected to be replaced as part of the REPEX program, an estimate of the overlap between these two volumes of work is $3.5\% \times \$11.8\text{m} = \0.412m . This amount has been included in Section 9 as part of the top down adjustment.

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7.4.3 FEEDER AUGMENTATION

Feeder Augmentation is proposed on feeders emanating from the following Zone Substations:

- CRE
- OFR
- PHM
- DRN
- KLO
- MOE
- WOTS

None of these are listed in the section 7.2 and hence there is no overlap between Feeder Augmentation projects and the Codified Area program.

The Feeder Augmentation projects encompass a variety of solutions to address feeder capacity. The most common proposed solutions involve network reconfigurations, demand management and installation of batteries and generators. These solutions do not require replacement of existing equipment and therefore will not overlap with REPEX programs. However, the most likely solution for the KLO14 and MOE 13 feeders is a feeder upgrade, involving replacement of bare conductor. The section of KLO14 proposed for replacement does not fall into the scope of works of the Conductor REPEX program. However, the section of MOE13 proposed for upgrade does. Therefore, \$0.3m has been included in Section 9 as part of the top down adjustment.

7.4.4 OTHER AUGMENTATION

The remaining augmentation programs will involve a variety of work including replacement of existing assets, relocation or rearrangement of existing assets and construction or installation of new assets. The exact split of expenditure between difference asset classes is difficult to estimate as the specific solution for each site will depend on a site by site assessment. The following asset classes are most likely to be involved in replacement work for Augmentation programs. The corresponding calculations indicate the proportion of each fleet being replaced through REPEX programs.

- Conductor ($1338\text{km} / 38,000\text{km} = 3.5\%$)
- Distribution Transformers ($600 / 54,516 = 1.1\%$)
- MV Switches ($819 / 15,500 = 5.3\%$)
- Fuses ($9180 / 150,500 = 6.1\%$)

On average, 4% of these asset classes will be replaced through REPEX. Therefore, the likely overlap between the \$19.8m Augmentation programs and REPEX programs is $\$19.8\text{m} \times 4\% = \0.792m . This amount has been included in Section 9 as part of the top down adjustment.

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8 NON-NETWORK ASSETS

Non-Network capex comprises the following categories:

- Property
- Motor Vehicles and Fleet
- Tools and Test Equipment
- General Equipment
- ICT

The assets purchased or replaced as part of these Non-Network programs do not overlap with each other. Similarly they do not overlap with any of the Network assets.

9 TOP DOWN ADJUSTMENTS

The following amounts have been removed from the CAPEX forecast during the bottom up build to account for overlaps between projects and programs.

Document	Asset Class	Overlap with	Units removed	Cost removed (\$M)
AMS 20-14	ZSS Fencing and Locks	ZSS Refurbishments	[C.I.C]	0.915
AMS 20-14	ZSS Lighting	ZSS Refurbishments		0.450
AMS 20-14	Switchyard Upgrades	ZSS Refurbishments		0.515
AMS 20-52	Conductor	Codified Area program		2.395
AMS 20-53	Cap Banks	REFCL		3.300
AMS 20-53	Cap Banks	REFCL		1.200
AMS 20-54	CB's	REFCL		3.097
AMS 20-54	CB's	ZSS Refurbishments		10.685
AMS 20-55	Oil Spill Control	ZSS Refurbishments		0.150
AMS 20-55	Aesbestos	ZSS Refurbishments		0.400
AMS 20-55	Roofs Windows and Doors	ZSS Refurbishments		0.000
AMS 20-57	Crossarms	Poles		11.425
AMS 20-60	MV Switches and ACR's	REFCL		3.720
AMS 20-61	Isolators and Switches	REFCL		3.280
AMS 20-61	Fuses	REFCL		0.017
AMS 20-61	Fuses	Poles and Crossarms		3.461
AMS 20-63	CT's	REFCL		3.104
AMS 20-63	CT's	ZSS Refurbishments		1.940
AMS 20-63	CVT's	REFCL		1.408
AMS 20-63	CVT's	ZSS Refurbishments		2.640
AMS 20-65	Cable	REFCL		11.200
AMS 20-66	Insulators	Poles and Crossarms		0.648
AMS 20-67	Line Surge Arrestors	REFCL		1.010
AMS 20-67	Line Surge Arrestors	Poles and Crossarms		0.293
AMS 20-71	VRR Secondary assets	ZSS Refurbishments		5.348
AMS 20-71	VRR Secondary assets	REFCL		0.787
AMS 20-72	Protection assets	REFCL and ZSS Refurbishments		43.005
AMS 20-76	Services	Poles and Crossarms		4.358
AMS 20-77	Station Surge Arrestors	REFCL		3.138
AMS 20-79	NER's	REFCL		0.332
AMS 20-80	AC Supply	REFCL		0.000
AMS 20-80	AC Supply	ZSS Refurbishments		0.800
AMS 20-80	DC Supply	REFCL		1.077
AMS 20-80	DC Supply	ZSS Refurbishments		1.615
LV Network Capacity		Voltage Compliance		13.710
Customer Supply Compliance		Voltage Compliance		1.420
Total				142.841

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The following top down adjustments have been made at a portfolio level in the CAPEX forecast. As is common with a top down adjustment, the amount has been applied across a portfolio of projects, rather than specific projects. Adjustments have been applied to both AUGEX and REPEX programs.

Document	Asset Class	Overlap with	Overlap	Cost removed (\$M)
AMS 20-260	Benalla Refurbishment	REFCL	22kV Switchyard	4.485
REFCL AUGEX	Belgrave Conductor	REPEX	4%	0.052
REFCL AUGEX	Eltham Conductor	REPEX	5%	0.556
Voltage Compliance	Station VRR	REPEX	10%	1.230
Voltage Compliance	Line VR	REPEX	17%	0.379
Voltage Compliance	Conductor	REPEX	3.5%	0.412
Feeder Augmentation	Conductor	REPEX	100.0%	0.300
Other Augmentation	Various	REPEX	4%	0.792
Total				8.206

10 SCHEDULE OF REVISIONS

Issue	Date	Author	Details of Change
1	30/04/2019	Jensen Lai	Initial document
2	29/07/2019	Jensen Lai	REFCL Augmentation amendments