



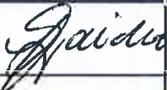
TM171 – REPLACEMENT OF CORRODED EARTH WIRES

BUSINESS CASE 2017/18 - 2018/19

Prepared by Asset Strategy and Planning

October 2017

REVIEW AND APPROVAL SCHEDULE

Responsibility	Position	Name	Signature	Date
Authored	Renewal Project Development Officer	Vasan Naidoo		9/10/17
Reviewed	Senior Renewal Project Development Engineer	Jonathan Cook		9/10/17
Endorsed	Network Investment Planning Manager	Manoraj Jayasekara		9/10/17
Endorsed	Manager Asset Strategy and Planning	Peter Langdon		10.10.17

CONTENTS

1.0 EXECUTIVE SUMMARY	4
2.0 INTRODUCTION	4
2.1 PURPOSE.....	4
2.2 BACKGROUND	5
2.3 SAMPLE IMAGES OF CORRODED EARTHWIRES	5
3.0 PROJECT NEED.....	6
4.0 OPTIONS TO ADDRESS THE RISK	7
4.1 REPLACE WITH LIKE FOR LIKE.....	8
4.2 REPLACE OHEW WITH AAAC OR ACSR.....	8
4.3 REPLACE OHEW WITH OPGW.....	8
4.4 REPLACEMENT PRIORITY	8
5.0 SCOPE OF WORK.....	10
5.1 FEEDER 934 – FROM WALLERAWANG BSP TO HAWKESBURY TS	10
5.2 FEEDERS 940/941/942/93E WALLERAWANG BSP TO PENRITH TS	11
5.3 FEEDER 223/237/23C/23F – SYDNEY WEST BSP TO ROOTY HILL ZS / BHP / DOONSIDE	12
5.4 FEEDER 93U – SYDNEY WEST BSP TO ABBOTSBURY ZS	12
5.5 FEEDER 988 – DAPTO BSP TO TEE 1 - BURRAWANG PUMPS	13
5.6 FEEDER 7510 – BOMADERRY ZS TO MEROO MEADOW TEE.....	13
5.7 FEEDER 7176 – GERRINGONG ZS TO BERRY ZS	14
5.8 FEEDER 7534 – ULLADULLA ZS TO RECLOSER A8324	14
5.9 FEEDER 7175 – GERRINGONG ZS TO JERRARA SS	15
6.0 COST ESTIMATES	15
6.1 DISPOSAL OF SCRAP METAL	16
6.2 CONTINGENCY PROVISION	16
7.0 FUNDING PROVISION	16
8.0 RECOMMENDATIONS	16
9.0 APPENDICES	17
10.0 REFERENCES.....	17

1.0 EXECUTIVE SUMMARY

The purpose of this business case is to seek approval for the funding for the next phase of the corroded steel OHEW replacement program TM171 to replace corroded overhead earthwires on sub-transmission lines across the network in the period from 2017/18 - 2018/19.

Endeavour Energy has approximately 3,200 km of overhead lines constructed to operate at 132, 66 and 33kV. 2,300 km of these lines are fitted with overhead earth wires to provide protection from lightning strikes and to provide earthing functions. Some of these earth wires (approximately 726 km) are galvanised steel which corrodes over time.

Due to age and exposure to the atmosphere, a number of these earth wires have lost their protective galvanising and are now suffering from significant corrosion damage.

Overhead earth wires which have lost their mechanical strength due to corrosion damage are at risk of failure and falling with a resultant risk of hazards to personnel, damage to property and loss of supply. A broken earth wire can strike a live phase conductor (located below) on its way to the ground and cause sparks and molten material to fall to the ground and with the risk of initiating a bushfire.

Likewise, overhead earth wires which have reduced conductivity due to corrosion damage are at risk of burning down in the event of a lightning strike or a fault occurring in a critical location with similar risks of hazards to personnel, damage to property, loss of supply and initiation of a bushfire.

The steel OHEW replacement program began in 2013/14 under project TM01701 – *Replacement of overhead earth wires due to corrosion damage*. TM01701 noted that the above works were the first stage of an overall earth wire replacement program and further lines will be addressed in forthcoming years as required by their condition.

In 2015 a scoping study to assess the condition of the remaining steel OHEW in the network was conducted. This study surveyed the remaining steel OHEW and prioritised their condition in accordance with technical bulletin TB-0194.

TB-0194 requires that category 5 steel overhead earthwires be replaced as soon as possible and as a result program TM171 includes the replacement of category 5 earthwires in the short term followed by the replacement of category 4 and category 3 in later stages of the program.

This business case seeks to replace the remaining 222km of Category 5 and Category 4 corroded OHEW in the network. The cost estimate for these works is \$7.6 million (in real 2017/18 terms) and it is proposed that the works be carried out in the two year period from 2017/18 to 2018/19.

PIP V 8.5 includes a funding provision of \$10.6 million for the replacement of corroded OHEW in this period which is sufficient for this project.

A contingency allowance of \$0.4 million is proposed to allow for additional fittings needing replacement which may be discovered during the replacement works.

Accordingly, it is recommended that:

- A capital expenditure of \$7.7 million for TM171 – Replacement of corroded earth wires as outlined in this business case during 2017/18 – 2018/19 be approved; and
- A contingency sum of \$0.4 million, representing approximately 5% of the estimated cost of the project to cover the replacement of additional fittings that may be discovered during the replacement works.

The total project estimate, including the base cost and contingency allowance totals \$8.1 million.

2.0 INTRODUCTION

2.1 PURPOSE

The purpose of this business case is to obtain approval for the funding for replacement of corroded category 5 and category 4 OHEWs in the financial years FY18 and FY19.

2.2 BACKGROUND

Endeavour Energy has approximately 3,200 km of overhead lines constructed to operate at 132, 66 and 33kV. 2,300 km of these lines are fitted with overhead earth wires and of these approximately 726 km are galvanised steel (excluding Hardex pilot wires and ACSR).

The steel OHEW replacement program began in 2013/14 under TM01701 and was later progressed under TM171.

In 2015 a scoping study to assess the condition of the remaining steel OHEW in the network was approved. Refer TM171 – *Replacement of corroded earth wires, Business Case for 2015/16 Scoping Study* for further details about the scoping study.

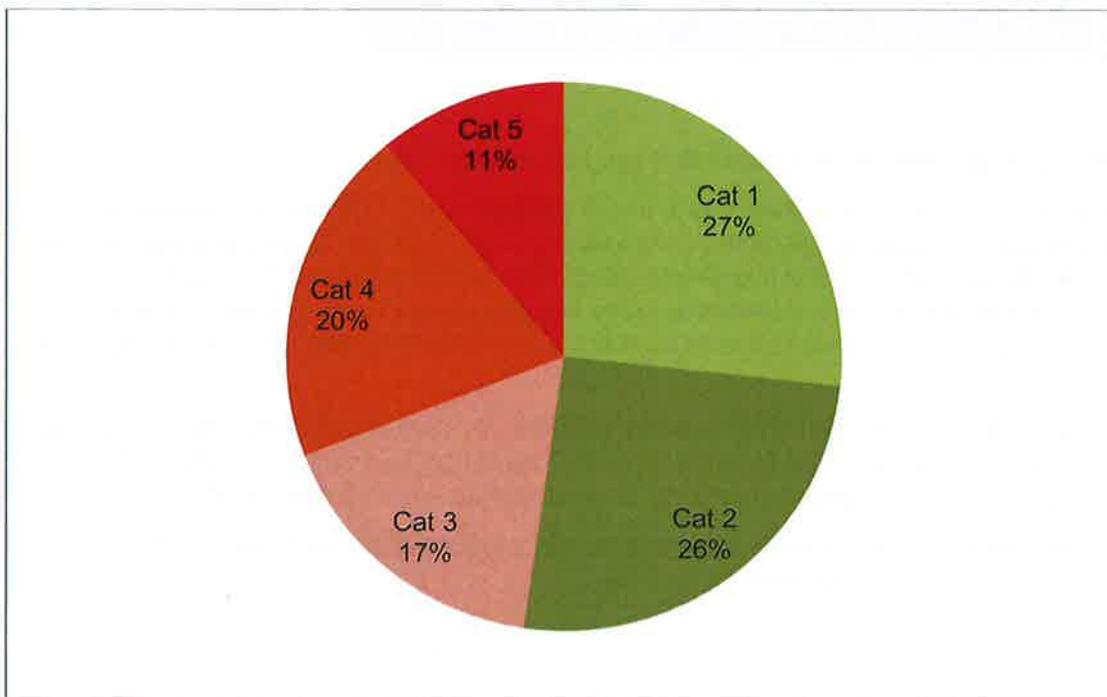
TABLE 1 below shows a distribution of the condition of the remaining OHEWs where category 1 is as new and category 5 is corroded to such an extent that replacement is required as soon as practicable. The categories are as provided by Technical Bulletin, “TB-0194 *Assessment Criteria for Overhead Steel Conductors*” published in July 2015. TB-0194 further states that the location and criticality of the feeder may also influence the replacement priority. Refer Appendix A for further detail of TB-0194.

Details of the feeders and the survey categories identified by the scoping study are provided in Appendix B.

TABLE 1 : CLASSIFICATION OF STEEL OHEWs

Location	Categories					Total
	1	2	3	4	5	
Number of feeders in category	13	13	14	10	1	51
Total route length in km of the category	195	186	122	142	81	726
category percentage of total OHEW	27%	26%	17%	20%	11%	100%

FIGURE 1: DISTRIBUTION OF CONDITION OF STEEL OHEW



2.3 SAMPLE IMAGES OF CORRODED EARTHWIRES

The survey provided the following images of category 5 and category 4 earthwires.

FIGURE 2 : FEEDER 934 – EARTHWIRE IN CATEGORY 5 CONDITION



FIGURE 3 : FEEDER 941 – EARTHWIRE IN CATEGORY 4 CONDITION



3.0 PROJECT NEED

This project addresses corroded steel OHEW that are in poor condition.

Overhead earth wires which have lost their mechanical strength due to corrosion damage are at risk of failure and falling with a resultant risk of hazards to personnel, damage to property and loss of supply. A broken earth wire can strike a live phase conductor (located below) on its way to the ground and cause sparks and molten material to fall to the ground and with the risk of initiating a bushfire. As most of the targeted feeders are in bushfire prone locations this threat is highly likely to occur.

Likewise, overhead earth wires which have reduced conductivity due to corrosion damage are at risk of burning down in the event of a lightning strike or a fault occurring in a critical location with similar risks of hazards to personnel, damage to property, loss of supply and initiation of a bushfire.

Table 2 below assesses the principal risks associated with a failure of an earth wire and the proposed treatment to reduce the risk level to ALARP.

TABLE 2: RISK ASSESSMENT

Asset	Event	Likelihood	Consequence	Risk rating	Consequence and comments	Proposed treatment	Expected risk after treatment
Earth wire	Earth wire falls onto conductor and ground.	Possible (C)	Major (4)	High (C4)	Mechanical failure causing earth wire to contact live conductor and ground. May result in serious injury to personnel, damage to surrounding equipment, loss of supply, high incident recovery costs.	Replace earth wire and fittings.	Medium (E4)
	Earth wire falls on major road.	Possible (C)	Major (4)	High (C4)	Earth wire falling across a major road can cause significant safety implications for the road users. Consequences may also include significant damage to the brand.	Replace earth wire and fittings.	Medium (E4)
	Earth wire fails during a fault.	Possible (C)	Major (4)	High (C4)	During system fault conditions the earth wire fails due to overcurrent which will then allow more current to flow in the ground and can result in Earth Potential Rise (EPR) which may result in serious injury to the public in the vicinity.	Replace earth wire and fittings.	Medium (E4)
	Earth wire falls onto live conductor causing sparks and molten material falling to the ground	Possible (C)	Major (4)	High (C4)	Corroded OHEW may fall onto live conductors and thereby causing arcs and sparks which may result in molten material falling to the ground and initiating a bushfire. As most of the OHEW are in bushfire prone locations, this is likely to occur. Bushfires can result in the loss of properties in the area.	Replace earth wire and fittings.	Medium (E4)
	Earth wire burns down during a lightning strike	Possible (C)	Major (4)	High (C4)	Corrosion damage may result in reduced electrical conductivity which can result in the OHEW burning down in the event of a lightning strike or a fault occurring in a critical location.	Replace earth wire and fittings.	Medium (E4)

4.0 OPTIONS TO ADDRESS THE RISK

Whilst the obvious remedy is the like for like replacement of corroded OHEW's, there are a number of other factors which need to be considered including:

1. The existing galvanised steel earthwires are no longer EE approved earthwires;
2. Increases in fault levels in sections of the network, due to augmentation works, requiring higher fault rated earthwires than the current OHEW. This is especially true for line to ground faults close to some substations;
3. Correctly fault rated approved earthwires such as ACSR and AAAC usually require significant upgrades to elements of the line (such as poles and tower peaks) due to increased loading and tension requirements;
4. A requirement in the overhead line standard, AS/NZS AS7001:2016 which states that if any part of the line is to be upgraded then the line must comply with this standard. This standard however is not intended to apply retrospectively to installations that were designed to older standards and where no part of the line is modified;
5. The growing need for protection communication links between sections of the network due to the ageing copper based pilot wire systems; and
6. The developing need for communication links to support other network data requirements such as VOIP (voice over internet protocol), power quality monitoring and substation security system.

Consequently, the following options to reduce the risks posed by corroded OHEW were considered:

1. Like for like replacement with steel (SC/GZ) earthwire;
2. Replace with AAAC or ACSR; and
3. Replace with OPGW.

4.1 REPLACE WITH LIKE FOR LIKE

The benefit of a like for like replacement is that it allows for the existing structures and fittings to be reused which has significant cost benefits compared to the replacement with an aluminium earthwire. If the earthwire is replaced with one of the standard ACSR, AAAC or OPGW earthwires then that section of the feeder has to be redesigned to AS/NZS AS7001:2016.

Table 3 below is an example of the cost comparison between the various OHEW earthwire replacement options and shows the incremental cost increases from SC/GZ to ACSR (or AAAC) and the increase from ACSR (or AAAC) to OPGW.

TABLE 3: EXAMPLE COST COMPARISON OF OPTIONS

FDR no.	Description	Length (KM)	Cost per km in \$			Total cost in \$		
			SC/GZ	ACSR/	OPGW	SC/GZ	ACSR/	OPGW
7120	Dapto ZS to Unanderra ZS	8	120,800	150,200	163,500	970,000	1,201,600	1,308,000
Cost increase from SC/GZ				29,400	42,700		231,600	338,000
% Cost increase from SC/GZ							24%	35%

The cost increase from SC/GZ to ACSR is due to allowance for 50% of existing structures and accessories to be replaced due to the larger earth wires and to comply with the current standards. The cost increase from ACSR to OPGW is due to the optical fibre cost differential (over ACSR), jointing and some additional structure replacements that may be necessary. An added benefit of like for like replacement is the potentially shorter project delivery as the older overhead line designs can be re-used and no structure replacements are necessary.

At a project stakeholder meeting it was agreed that unless there was an earthing risk or a foreseeable protection or communication requirement, the existing OHEW should be replaced on a like for like basis, which is the lowest cost approach.

It should be noted that the existing OHEW types 7/0.128 SC/GZ or SC/GZ 7/0.144 are not approved earthwires for use on EE's network. If this earthwire is to be installed then a special dispensation from Manager Asset Standards and Design will be required to allow this earthwire to be fitted in the network. Manager Asset Standards and Design has agreed to provide this dispensation when required.

4.2 REPLACE OHEW WITH AAAC OR ACSR

If an upgrade of the existing OHEW is required then the earth wire will be replaced with AAAC or ACSR and the structures and fittings will be replaced as necessary to comply with current standards.

4.3 REPLACE OHEW WITH OPGW

There may be situations where communication links for network protection or communication may be required in the foreseeable future. In these instances OPGW may be considered in lieu of ACSR.

OPGW will place additional load on the existing structures and therefore these structures and other elements will be upgraded to comply with AS/NZS 7000.

4.4 REPLACEMENT PRIORITY

The replacement priority schedule shown in Table 4 below was developed using:

- a. Condition category from TB-0194;
- b. The Network Bushfire Risk Analysis spreadsheet developed by Assets Standards & Design using the CSIRO Phoenix/Tolhurst models and NSW Rural fire service fire history data to develop the bushfire risk for each feeder; and
- c. Maximum wind speeds along the feeder using data from the CSIRO (The NSW WIND ATLAS) [1].

TABLE 4: STEEL OHEW REPLACEMENT PRIORITY

Feeder number	Location	Voltage	Approx feeder route length (km)	Approx route length of steel EW (km)	Approx. route length of corroded steel EW (km)	Survey category	Bushfire risk (probability of a bushfire and the consequential number of properties lost)	Wind Speed max metres per second	Replacement /Removal priority
934	Wallerwang BSP - O/B Hawkesbury TS (used at 11kV in parts)	132kV	80.8	80.8	80.8	5	73	9.2	1
940/941/942/93E	Wallerawang BSP to Penrith TS	132kV	77.7	77.7	65.2	4	1106	9.2	2
7510	Bomaderry ZS to Meroo Meadow Tee	33kV	4.5	4.5	4.5	4	581	8.2	3
223/237	Sydney West BSP - Rooty Hill ZS / BHP	132kV	10.8	6.2	6.2	4	56	6.5	4
93U	Sydney West BSP - Abbotsbury ZS	132kV	10.5	5	5	4	56	6.5	5
237/23C	Rooty Hill ZS - Onesteel	132kV	1.9	1.08	1.08	4	56	6.5	6
7176	Gerrington ZS to Berry ZS	33kV	13.1	13.1	13.1	4	35	8.2	7
988	Dapto BSP - Tee 1 (Burrawang Pumps)	132kV	32.6	21.6	21.6	4	10	7.5	8
7534	Ulladulla ZS to Rec A8324	33kV	14	14	14	4	8	8.2	9
23C/23F	Doonside ZS – Rooty Hill ZS/Doonside ZS - Onesteel	132kV	3.3	1.4	1.4	4	5	6.5	10
7175	Gerrington ZS to Jerrara SS	33kV	10.4	10.4	10.4	4	0	8.2	11
93J	Sydney West BSP – West Wetherill Park TS	132kV	6.5	2.1	2.1	3	56	6.5	12
93J	West Wetherill Park TS – Guildford TS	132kV	4.6	4.6	4.6	3	56	6.5	13
98M	Evans lane to Batemans Bay Tee	132kV	53.7	52.5	52.5	3	23	8.2	14
464	Kingswood ZS - tee to Glenmore Park ZS	33kV	3.9	3.9	3.9	3	21	7.5	15
933	Penrith TS – near Mt Druitt TS	132kV	9.4	9.4	9.4	3	7	7.5	16
685	Guildford TS to Yennora ZS	33kV	5.1	5	5	3	2	6.5	17
686_2	Tee to Yennora ZS	33kV	4.2	1.6	1.6	3	2	6.5	18
686_1	Tee to Comalco HVC	33kV	4.2	0.6	0.6	3	2	6.5	19
7041	Mt Terry TS to Dapto ZS	33kV	12	11	11	3	2	8.2	20
7120	Dapto ZS to Unanderra ZS	33kV	8	8	8	3	2	8.2	21
93W	Abbotsbury ZS - West Liverpool TS	132kV	5.2	4.9	4.9	3	0	6.5	22
O/S 31	Pole 801353 to PL 536261	33kV	0.3	0.3	0.3	3	0	6.5	23
9J3/9J4	Blacktown TS - Baulkham Hills TS	132kV	5.47	3.962	3.962	3	0	6.5	24
7515	Recloser 27291 to Berry ZS	33kV	14	14	14	3	0	8.2	25
98L	Mt Terry TS - Shoalhaven TS	132kV	46.1	36.4	36.4	2	581	8.2	26
98U	Mt Terry TS - Shoalhaven TS	132kV	46.3	35.4	35.4	2	581	8.2	27
93X	Sydney West BSP – Nepean TS (tee Bringelly)	132kV	32.3	24.9	24.9	2	566	7.5	28
9L5	Nepean TS - Denham Court TS (tee South Leppington ZS)	132kV	14.4	9.1	9.1	2	347	7.5	29
937	Regentville BSP - North Warragamba ZS	132kV	10.2	10.2	10.2	2	265	7.5	30
93Y	West Liverpool TS – Nepean TS	132kV	9.4	6	6	2	185	6.5	31
988/98C	Tee B - Fairfax Lane TS	132kV	2.9	2.9	2.9	2	151	7.5	32
98C	Marulan BSP – Tee B	132kV	35.5	34.4	34.4	2	151	7.5	33
988	Tee 1 – Tee B	132kV	8	8	8	2	10	7.5	34
988/1	Tee 1 – Burrawang Pumps	132kV	2.2	2.2	2.2	2	10	7.5	35
933	- Mt Druitt TS	132kV	0.5	0.5	0.5	2	7	7.5	36
7123	Albion Park ZS to Open Bond at PL 4AV794	33kV	15.5	9.8	9.8	2	3	8.2	37
7341	Kembla Grange ZS to Dapto ZS	33kV	6	6	6	2	2	8.2	38

Feeder number	Location	Voltage	Approx feeder route length (km)	Approx. route length of steel EW (km)	Approx. route length of corroded steel EW (km)	Survey category	Bushfire risk (probability of a bushfire and the consequential number of properties lost)	Wind Speed max metres per second	Replacement /Removal priority
98J	Shoalhaven TS - Evans Lane SS	132kV	59.4	32.3	32.3	1	1474	8.2	39
98P	Shoalhaven TS – West Tomerong TS	132kV	15.5	15.5	15.5	1	1474	8.2	40
28P	West Tomerong TS - Evans Lane SS	132kV	39.5	39.5	39.5	1	468	7.5	41
7253	Darkes Forest ZS to Helensburgh ZS	33kV	6.9	0.96	0.96	1	309	8.2	42
7252/3	Fdr 7252/3 Plateau Rd Stanwell Tops den Stanwell Tops	33kV	7	7	7	1	309	8.2	43
7095	FROM ABS 79473 to ABS 73347 near Lake Cordeaux	33kV	14.4	14.4	14.4	1	307	8.2	44
220/239	Blacktown TS - Doonside ZS	132kV	4.5	2.6	2.6	1	26	6.5	45
98H	Evans Lane Sw/Stn to Moruya North TS	132kV	72.4	71.3	71.3	1	23	7.5	46
7252/2	Fdr 7252/2 Saywell Place Wombarra Fdr 7252/2 St 5Y	33kV	3.5	3.5	2	1	6	8.2	47
7252	Darkes Forest ZS to TEE	33kV	0.92	0.92	0.92	1	6	8.2	48
983/987	Dapto BSP - Tallawarra SS	132kV	3.1	3.1	3.1	1	2	7.5	49
931	Baulkham Hills TS - Carlingford TS	132kV	7.4	4.5	4.5	1	0	6.5	50
7252/1	Fdr 7252/1 ICC Princes Hwy Maddens Plain	33kV	0.93	0.93	0.93	1	0	8.2	51
Total route length (km)			940	740	726				

5.0 SCOPE OF WORK

It is proposed that approximately 222km (route length) of corroded steel OHEW are replaced in the FY18 and FY19 period on the feeders listed below:

132kV Feeders

1. Feeder 934 located near Transgrid's Wallerawang Bulk Supply Point to Hawkesbury TS (80.8km);
2. Feeder 940/941/942/93E which runs from Wallerawang Bulk Supply Point to Katoomba North TS, Lawson TS, Warrimoo TS and Penrith TS (65.2km);
3. Feeder 223/237/23C/23F – Sydney West BSP to Rooty Hill ZS / BHP (8.7km);
4. Feeder 93U – Sydney West BSP to Abbotsbury ZS (5km);
5. Feeder 988 – Dapto BSP to Tee 1 - Burrawang Pumps (21.6km);

33kV Feeders

1. Feeder 7510 – Bomaderry ZS to Meroo Meadow Tee (2.8km);
2. Feeder 7176 – Gerringong ZS to Berry ZS (13.1km);
3. Feeder 7534 – Ulladulla ZS to Relcoser A8324 (14km);
4. Feeder 7175 – Gerringong ZS to Jerrara SS (10.4km).

5.1 FEEDER 934 – FROM WALLERAWANG BSP TO HAWKESBURY TS

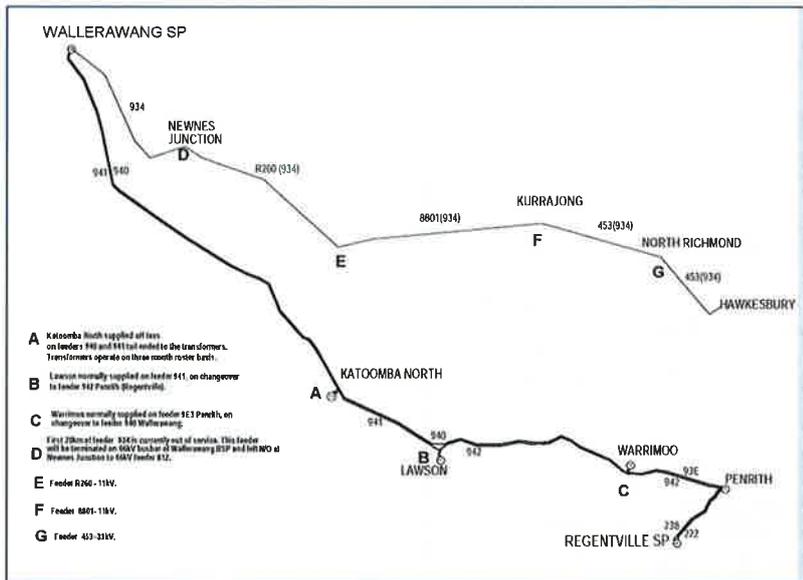
Feeder 934 was originally 132kV construction on twin wood poles with two OHEW and was 81km long. It is now split up and is operated as follows:

1. The original Feeder 934 from Wallerawang BSP to Newnes Junction which is 20km in length and is currently out of service. However, there is a plan to re-use this section to supply the Marangaroo development project at 66kV from Wallerawang BSP with an alternate open connection point to Feeder 812 at Newnes Junction;
2. From Newnes Junction to pole PL480331 (16km), it is operated at 11kV and is called Feeder R260;
3. From pole PL480331 to pole PL435155 which is near Kurrajong ZS it is called Feeder 8801 (28km) and is operated at 11kV. R260 and 8801 are connected to each other with underslung links at pole PL480331; and

- The last 17 km section runs from near Kurrajong ZS to North Richmond ZS tee then on to Hawkesbury TS and is called Feeder 453, which is operated at 33kV.

Refer FIGURE 4 below for the arrangement of Feeder 934.

FIGURE 4 : FEEDER 934 ARRANGEMENT

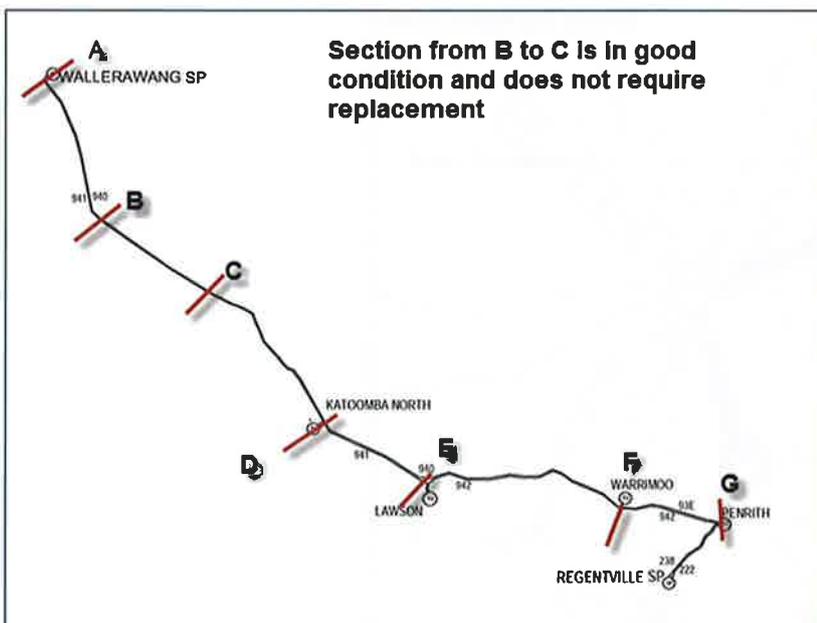


5.2 FEEDERS 940/941/942/93E WALLERAWANG BSP TO PENRITH TS

This 132kV steel tower double circuit line originally ran from Wallerawang BSP to Penrith TS and since then it has been teed off to Katoomba North TS and turned in and out of Lawson TS and Warrimoo TS on its way to Penrith TS. The total route length is 78km.

The majority of the twin OHEW on these towers are classified as category 4. However, there is a 12.5km section midway between Wallerawang BSP and Katoomba North TS which appears to have been replaced and is in good condition (category 2) and therefore does not require replacement. This section is shown in FIGURE 5 below.

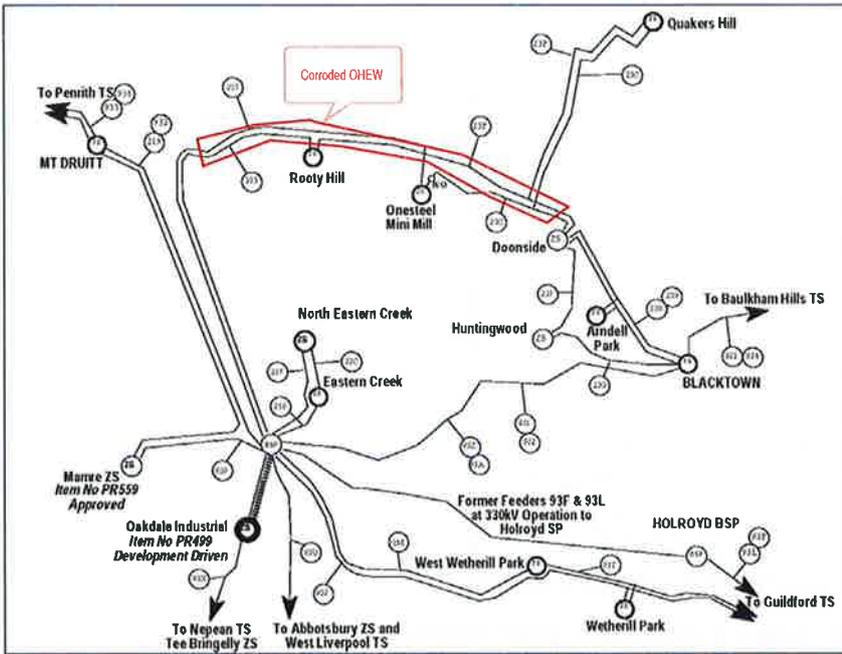
FIGURE 5 : FEEDERS 940/941/942/93E LAYOUT



5.3 FEEDER 223/237/23C/23F – SYDNEY WEST BSP TO ROOTY HILL ZS / BHP / DOONSIDE

The corroded earth wires are in the vicinity of tower PL530324 and extend in both directions as shown by the red outline in FIGURE 6 below.

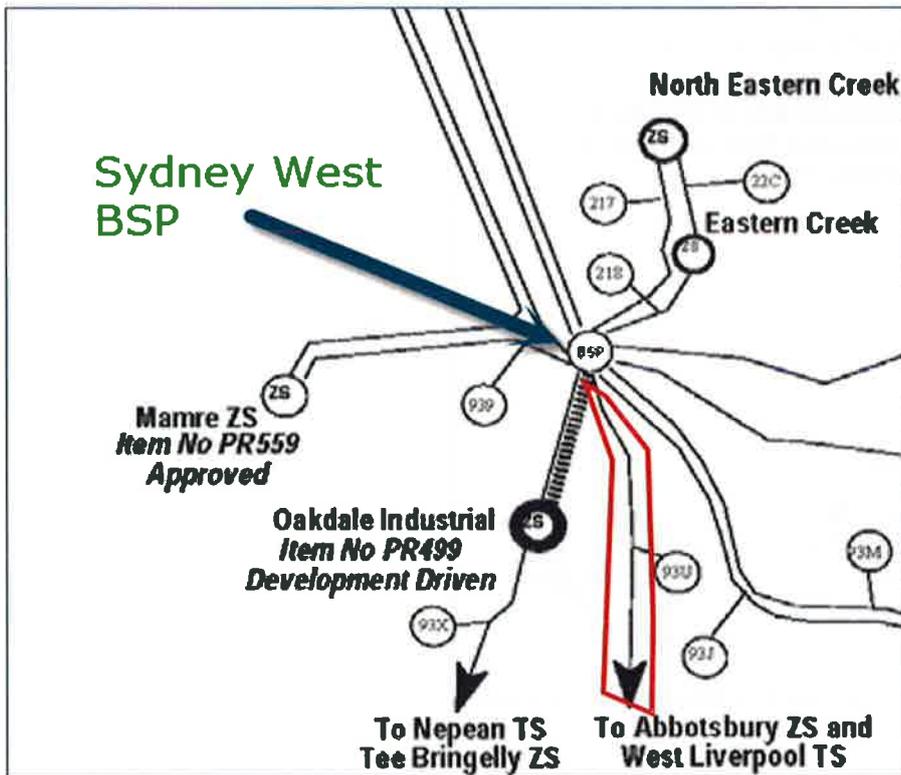
FIGURE 6 : FEEDER 223/237/23C/23F



5.4 FEEDER 93U – SYDNEY WEST BSP TO ABBOTSBURY ZS

The corroded OHEW is on the 93U side of the double circuit line and runs the entire length from Sydney West BSP to Abbotsbury ZS as shown by the red outline in FIGURE 7 below. The other OHEW is OPGW and does not require replacement.

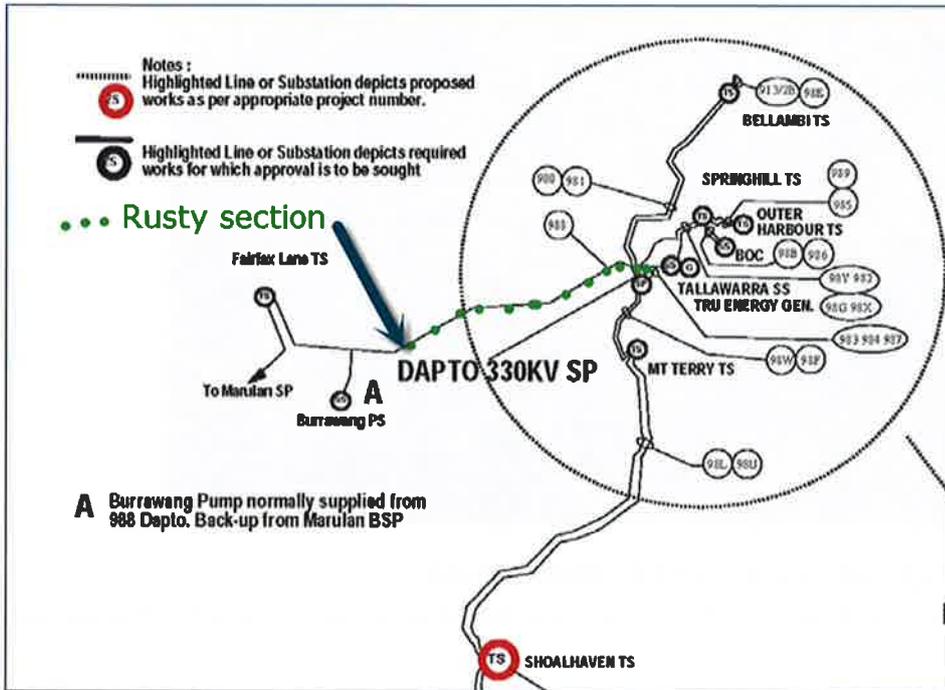
FIGURE 7 : FEEDER 93U



5.5 FEEDER 988 – DAPTO BSP TO TEE 1 - BURRAWANG PUMPS

Feeder 988 runs from Dapto TS to Fairfax Lane TS with a tee to Burrawang Pumping station. The corroded section is approximately 20km in length and is located between Dapto TS and the tee to Burrawang Pumping Station. Refer FIGURE 8 below which shows the corroded section as green dots.

FIGURE 8 : FEEDER 988



5.6 FEEDER 7510 – BOMADERRY ZS TO MEROO MEADOW TEE

The OHEW on the entire feeder from Bomaderry ZS to the tee at Merroo Meadow ZS as shown in FIGURE 10 is corroded.

FIGURE 9 : FEEDER 7510



5.7 FEEDER 7176 – GERRINGONG ZS TO BERRY ZS

The OHEW on the entire feeder from Gerringong ZS to Berry ZS as shown in FIGURE 10 is corroded.

FIGURE 10 : FEEDER 7176



5.8 FEEDER 7534 – ULLADULLA ZS TO RECLOSER A8324

The OHEW on the entire feeder from Ulladulla ZS to the recloser A8324 as shown in FIGURE 11 is corroded.

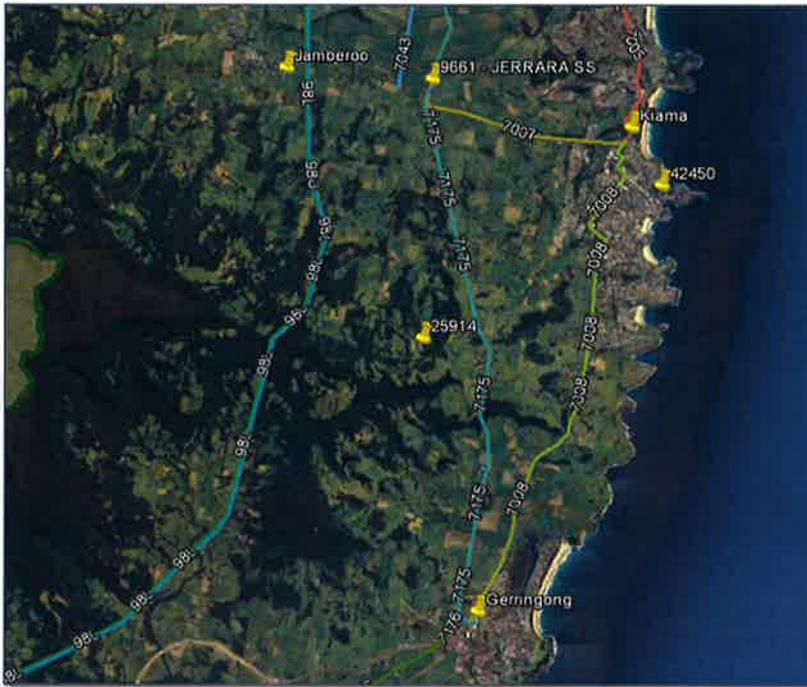
FIGURE 11 : FEEDER 7534



5.9 FEEDER 7175 – GERRINGONG ZS TO JERRARA SS

The OHEW on the entire feeder from Gerringong ZS to Jerrara SS as shown in FIGURE 12 is corroded.

FIGURE 12 : FEEDER 7175



6.0 COST ESTIMATES

Cost estimates have been provided by Assets Standards and Design section taking into account major road crossings and access issues. Table 5 below shows a summary of the cost estimates in real 2017/18 terms. The average unit rate is \$34,000 per route length km. The actual unit rate varies from site to site due to constraints such as access, road and rail crossings and is shown as per circuit length basis (rather than the per route length) in the table.

Refer Appendix C for further detail of the cost estimates.

TABLE 5 : COST ESTIMATES FOR STEEL OHEW REPLACEMENTS (REAL\$ 2017/18)

Feeder number	Location	Voltage	Construction	Feeder route length (km)	Route length of steel EW (km)	Cost Estimate (\$)	Unit rate/km based on circuit length (\$)
934	Wallerawang BSP - Hawkesbury TS (used at 11kV in parts)	132kV	SC WP	80.8	80.8	3,250,000	20,000
940/941/942/93E	Wallerawang BSP to Penrith TS	132kV	DC ST	77.7	65.2	2,170,000	17,000
223/237	Sydney West BSP - Rooty Hill ZS / BHP	132kV	DC ST	10.8	6.2	240,000	39,000
237/23C	Rooty Hill ZS - Onesteel	132kV	DC ST	1.9	1.08	90,000	42,000
23C/23F	Doonside ZS – Rooty Hill ZS/Doonside ZS - Onesteel	132kV	DC ST	3.3	1.4	140,000	50,000
93U	Sydney West BSP - Abbotsbury ZS	132kV	DC ST	10.5	5	120,000	24,000
988	Dapto BSP - Tee 1 (Burrawang Pumps)	132kV	SC WP	32.6	21.6	640,000	30,000
7510	Bomaderry ZS to Meroo Meadow Tee	33kV	SC WP	4.5	2.8	90,000	32,000
7176	Gerringong ZS to Berry ZS	33kV	SC WP	13.1	13.1	310,000	24,000
7534	Ulladulla ZS to Rec A8324	33kV	SC WP	14	14	320,000	23,000
7175	Gerringong ZS to Jerrara SS	33kV	SC WP	10.4	10.4	200,000	19,000
Totals				260	222	7,570,000	
Total cost (to nearest \$0.1 million)						7,600,000	

6.1 DISPOSAL OF SCRAP METAL

OHEW removed from the network is to be disposed of as per the scrap metal disposal process, "GSU 0009 DISPOSAL OF SCRAP METAL". Generally the disposal of scrap steel is cost neutral (as the scrap metal dealer supplies and picks up the bins containing scrap metal at no cost to Endeavour Energy) and therefore this is expected to have no impact on the cost of this project.

6.2 CONTINGENCY PROVISION

A contingency amount of \$0.4 million is proposed to allow for additional costs, which may be incurred due to additional fittings needing replacement that may be discovered during the replacement works.

The specific contingencies that are allowed are shown in Table 6 below and represent 5% of the base cost of the project.

Table 6: CONTINGENCY ALLOWANCE

Contingency item	Allowance (\$)
Additional fittings requiring replacement which are discovered whilst the work is being carried out.	400,000
Total	400,000

7.0 FUNDING PROVISION

Funding for these works are provided in SARP program TM171-Replacement of Corroded Earthwires. It is estimated that these OHEW replacements will be carried out over the two year period from 2017/18 to 2018/19.

PIP V 8.5 includes a funding provision of \$10.6 million over this period, which is adequate for this project.

A cash flow representing the expected expenditure spread is shown in Table 7 below.

TABLE 7 – CAPEX PROJECT EXPENDITURE SPREAD

Estimated cost	2017/18	2018/19	Total costs (\$)
PIP 8.5 (nominal \$)	2.3	8.3	10.6
Project base costs (real 2017/18 \$)	3.8	3.8	7.6
Project costs (nominal \$)	3.8	3.9	7.7
Contingency	0.2	0.2	0.4
Total project costs (\$)			8.1

8.0 RECOMMENDATIONS

Accordingly, it is recommended that:

- A capital expenditure of \$7.7 million for TM171 – Replacement of corroded earth wires as outlined in this business case during 2017/18 – 2018/19 be approved; and
- A contingency sum of \$0.4 million, representing approximately 5% of the estimated cost of the project to cover the replacement of additional fittings that may be discovered during the replacement works.

The total project estimate, including the base cost and contingency allowance totals \$8.1 million.

9.0 APPENDICES

Appendix A - TB-0194 Assessment criteria for overhead steel conductors

Appendix B - TM171 – Steel OHEW Survey 2015/16

Appendix C – Cost estimate detail

10.0 REFERENCES

1. TM171 – Replacement of corroded earth wires, Business Case for 2015/16 Scoping Study, October 2015.
2. The New South Wales Wind Atlas - Wind Energy Research Unit and their wind resource assessment tools is available online at <http://www.clw.csiro.au/products/windenergy/>

This page intentionally blank

APPENDIX A - TB-0194 ASSESSMENT CRITERIA FOR OVERHEAD STEEL CONDUCTORS

This page intentionally blank

TECHNICAL BULLETIN

TB-0194

Assessment Criteria for Overhead Steel Conductors

Purpose

The purpose of this technical bulletin is to inform staff and/or contractors of the assessment criteria for overhead steel conductors, to be used in conjunction with "TB-0189 - Further actions for overhead conductors found in poor condition".

Background

In TB-0189, it was stated that closer inspections of overhead steel conductors shall be undertaken if an overhead line was found to be in a poor condition. The following assessment criteria shall be used to evaluate the condition of overhead steel conductors and assign a defect priority for the replacement of the affected conductor span.

Actions

For overhead steel conductor inspections, particular attention should be given to the colour and pitting of the metal as well as fraying or broken strands. Other contributory factors such as the location of the overhead mains (e.g. bush fire prone area), and the criticality of the feeder may be included in a risk assessment. The risk assessment may necessitate a more immediate defect prioritisation than those given in the table below.

The following table provides guidance on the prioritisation of defects for the condition of overhead steel wires:

Table 1 – Conditional categories for Overhead Steel Wires

Category	Description	Defect Priority
1	<ul style="list-style-type: none">No corrosion, 100% galvanized	No action required
2	<ul style="list-style-type: none">Light surface corrosion with negligible pitting	No action required
3	<ul style="list-style-type: none">Medium surface corrosion with mild pitting	Plan to replace within 5 years.
4	<ul style="list-style-type: none">Heavy surface corrosion with mild to medium pitting (refer to Category 4 in Appendix 1)Annealing or thinning of conductor	Replace within 1 year
5	<ul style="list-style-type: none">Heavy surface corrosion with medium to heavy pitting (refer to Category 5 in Appendix 1)Broken, frayed or split conductors under tensionHeavy surface corrosion as well as a history of conductor failure	Replace within 3 months or prior to the commencement of the bushfire season, whichever is earliest

Contact: Andrew Tang

Phone: 9853 6714

Date: 2 July 2015

Authorised by: Jude Perera, Manager Primary Systems

51 Huntingwood Drive, Huntingwood NSW 2148

Telephone: 131 718 Fax: (02) 9853 6000

Postal Address: PO Box 811 Seven Hills NSW 1730.

Page 1 of 2



TECHNICAL BULLETIN

TB-0194

Assessment Criteria for Overhead Steel Conductors

Appendix 1 - Visual comparison of conductor corrosion categories

- Category 1
- Category 2
- Category 3
- Category 4
- Category 5



Contact: Andrew Tang

Phone: 9853 6714

Date: 2 July 2015

Authorised by: Jude Perera, Manager Primary Systems

51 Huntingwood Drive, Huntingwood NSW 2148

Telephone: 131 718 Fax: (02) 9853 6000

Postal Address: PO Box 811 Seven Hills NSW 1730.

Page 2 of 2



Appendix B- TM171 – STEEL OHEW SURVEY 2015/16

Feeder number	Location	Voltage	Construction	Approx. feeder route length (km)	Approx. route length of steel EW (km)	Approx. route length of corroded steel EW (km)	Steel OHEW type	Approx. location of steel EW section	Survey category	Comments
7253	Darke Forest ZS to Helensburgh ZS	33kV	SC WP	6.9	0.96	0.96	7/0.128 SC/GZ	Entire length	5.00	Near Darke Forest ZS 875m and near Parkes St Helensburgh 80m
7095	FROM ABS 79473 to ABS 73347 near Lake Cordeaux	33kV	SC WP	14.4	14.4	14.4	7/0.128 SC/GZ	Entire length	5.00	majority of the feeder
934	Wallerawang BSP - Hawkesbury TS (used at 11kV in parts)	132kV	SC WP	80.8	80.8	80.8	2 x SC/GZ 7/0.128	Check EW entire length – confirm details	5.00	To be replaced
220/239	Blacktown TS - Doonside ZS	132kV	DC ST	4.5	2.6	2.6	2 x SC/GZ 7/0.144	Near Doonside ZS	5.00	some sections have been replaced - Need OPGW
7252/2	Fdr 7252/2 Saywell Place Wombarra Fdr 7252/2 St 5Y	33kV	SC WP	3.5	3.5	0.36	7/0.128 SC/GZ	Entire length	5.00	364m section from the bottom to top of the escarpment from pole PL793542 to pole PL779360
7252	Darke Forest ZS to TEE	33kV	SC WP	0.92	0.92	0.92	7/0.128 SC/GZ	Entire length	5.00	From Darke Forest ZS across Princess Highway to pole PL3JT019 (the Tee)s in poor condition
931	Baulkham Hills TS - Carlingford TS	132kV	DC ST	7.4	4.5	4.5	SC/GZ 7/0.128	Steel EW at Carlingford end, one side, OPGW other side	5.00	930 is on the same tower and has OPGW
940/941/942/93E	Wallerawang BSP to Penrith TS	132kV	DC ST	77.7	62.2	62.2	2 x SC/GZ 7/0.128	Entire length	4.00	
223/237	Sydney West BSP - Rooty Hill ZS / BHP	132kV	DC ST	10.8	6.2	6.2	2 x SC/GZ 7/0.144	Sections 3km away from Sydney West	4.00	
93U	Sydney West BSP - Abbotsbury ZS	132kV	DC ST	10.5	5	5	SC/GZ 7/0.128 + OPGW	Near Abbotsbury ZS	4.00	
237/23C	Rooty Hill ZS - Onesteel	132kV	DC ST	1.9	1.08	1.08	2 x SC/GZ 7/0.144	Almost entire section	4.00	
7176	Gerrington ZS to Berry ZS	33kV	SC WP	13.1	13.1	13.1	7/0.128 SC/GZ	Entire length	4.00	some sections cat 4
988	Dapto BSP - Tee 1 (Burrawang Pumps)	132kV	SC WP	32.6	21.6	21.6	2 x SC/GZ 7/0.128	1.6km 330m from Dapto BSP + 20km to tee to Burrawang. Note 3.6km section of CDC 4.1km from Dapto	4.00	half the feeder 10km
23C/23F	Doonside ZS - Rooty Hill ZS/Doonside ZS - Onesteel	132kV	DC ST	3.3	1.4	1.4	2 x SC/GZ 7/0.144	Near Doonside ZS	4.00	23C OPGW 23F STEEL
7510	Bomaderry ZS to Meroo Meadow Tee	33kV	SC WP	4.5	4.5	4.5	7/0.128 SC/GZ	Entire length	4.00	Not in original scope
7534	Ulladulla ZS to Rec A8324	33kV	SC WP	14	14	14	7/0.128 SC/GZ	Entire length	4.00	Not in original scope
7175	Gerrington ZS to Jerrara SS	33kV	SC WP	10.4	10.4	10.4	7/0.128 SC/GZ	Entire length	4.00	Not in original scope
93J	Sydney West BSP - West Wetherill Park TS	132kV	DC ST	6.5	2.1	2.1	SC/GZ 7/0.128 + 11.4mm OPGW	Steel EW last 2.1km into West Wetherill Park TS	3.00	93M OPGW/ 93J STEEL
93J	West Wetherill Park TS - Guildford TS	132kV	DC ST	4.6	4.6	4.6	SC/GZ 7/0.128 + 11.4mm OPGW	Steel EW 4.6km out of West Wetherill Park TS	3.00	93T on the same tower - OPGW
98M	Evans Lane SS - Batemans bay TS	132kV	SC WP	53.7	52.5	52.5	2.7 GAL	Steel EW starts 1.2km south of Evans Lane SS	3.00	about half the feeder is 3 most sections 1
933	Penrith TS - near Mt Druitt TS	132kV	DC ST	9.4	9.4	9.4	2 x SC/GZ 7/0.128	Check EW type	3.00	936 on same tower - OPGW

Feeder number	Location	Voltage	Construction	Approx. feeder route length (km)	Approx. route length of steel EW (km)	Approx. route length of corroded steel EW (km)	Steel OHEW type	Approx location of steel EW section	Survey category	Comments
7041	Mt Terry TS to Dapto ZS	33kV	SC WP	12	11	11	7/0.128 SC/GZ	First section from Mount Terry TS	3.00	6.5 km section from pole PL4DJ048 (pole 51) to pole PL4AX074 (pole 14) - OPGW ?
685	Guildford TS to Yennora ZS	33kV	SC WP	5.1	5	5	7/0.104 SC/GZ	Entire Length	3.00	
686_2	Tee to Yennora ZS	33kV	SC WP	4.2	1.6	1.6	7/0.104 SC/GZ	Near Yennora ZS	3.00	
686_1	Tee to Comalco HVC	33kV	SC WP	4.2	0.6	0.6	7/0.104 SC/GZ	Near Comalco HVC	3.00	HVC decommissioned - line OOS
93W	Abbotsbury ZS - West Liverpool TS	132kV	DC ST	5.2	4.9	4.9	SC/GZ 7/0.128 + OPGW	Entire length	3.00	
O/S 31	Pole 801353 to PL 536261	33kV	SC WP	0.3	0.3	0.3	7/0.104 SC/GZ	Binalong Road to Wentworth Ave, Pendle Hill	3.00	
9J3/9J4	Blacktown TS - Baukham Hills TS	132kV	DC ST	5.47	3.962	3.962	2 x SC/GZ 7/0.128		3.00	
464	Kingswood ZS - tee to Glenmore Park ZS	33kV	SC WP	3.9	3.9	3.9	SC/GZ 7/0.104	Entire length	3.00	
7120	Dapto ZS to Unanderra ZS	33kV	SC WP	8	8	8	7/0.128 SC/GZ	Entire length	3.00	Not in original scope - OPGW ?
7515	Recloser 27291 to Berry ZS	33kV	SC WP	14	14	14	7/0.128 SC/GZ	Entire length	3.00	Not in original scope
98L	Mt Terry TS - Shoalhaven	132kV	SC WP	46.1	36.4	36.4	2 x SC/GZ 7/3.25	Steel EW for 32km starting 4.2km south of Mt Terry and for 4km into Shoalhaven TS	2.00	good - some sections AAC
98U	Mt Terry TS - Shoalhaven TS	132kV	SC WP	46.3	35.4	35.4	2 x SC/GZ 7/3.25	Steel EW for 32km starting 4.2km south of Mt Terry and for 4km into Shoalhaven TS	2.00	Entire length in good condition
93X	Sydney West BSP - Nepean TS (tee Bringelly)	132kV	SC WP	32.3	24.9	24.9	2 x SC/GZ 7/0.128	Scattered along length of the feeder	2.00	New ADSS proposed
9L5	Nepean TS - Denham Court TS (tee South Leppington ZS)	132kV	SC WP	14.4	9.1	9.1	2 x SC/GZ 7/0.128	Scattered along length of the feeder	2.00	New ADSS link from Smeaton Grange to Narellan proposed. Together with existing link from Nepean will make OPGW on PL5 unnecessary
937	Regentville BSP - North Warragamba ZS	132kV	SC ST	10.2	10.2	10.2	SC/GZ 7/0.128	Entire length	2.00	
93Y	West Liverpool TS - Nepean TS	132kV	SC WP	9.4	6	6	2 x SC/GZ 7/0.128	Scattered along length of the feeder	2.00	
98C	Marulan BSP - Tee B	132kV	SC WP	35.5	34.4	34.4	2 x SC/GZ 7/0.128	Almost entire length	2.00	All inspected but no camera available, all earth wire in good condition for the complete feeder length
933	- Mt Druitt TS	132kV	SC WP	0.5	0.5	0.5	SC/GZ 7/0.128 + aluminium	Section into Mt Druitt TS	2.00	
7123	Albion Park ZS to Open Bond at PL 4AV794	33kV	SC WP	15.5	9.8	9.8	7/0.104 SC/GZ	First section from Albion Park ZS	2.00	in good condition
7341	Kambala Grange ZS to Dapto ZS	33kV	SC WP	6	6	6	7/0.128 SC/GZ	Entire length	2.00	Entire length in good condition
988/98C	Tee B - Fairfax Lane TS	132kV	DC ST	2.9	2.9	2.9	2 x SC/GZ 7/0.128	DC section into Fairfax Lane TS	2.00	half the feeder



Feeder number	Location	Voltage	Construction	Approx. feeder route length (km)	Approx. route length of steel EW (km)	Approx. route length of corroded steel EW (km)	Steel OHEW type	Approx. location of steel EW section	Survey category	Comments
988	Tee 1 – Tee B	132kV	SC WP	8	8	8	2 x SC/GZ 7/0.128	Entire length	2.00	2.00 half the feeder
988/1	Tee 1 – Burrawang Pumps	132kV	SC WP	2.2	2.2	2.2	2 x SC/GZ 7/0.128	Entire length	2.00	8.5 km section from pole PL206618 to Tallarawarra SS is cat 4. S
98J	Shoalhaven TS - Evans Lane SS	132kV	SC WP	59.4	32.3	32.3	2 x SC/GZ 7/3.25	Steel EW for 8.7km starting 3.8km out of Shoalhaven TS then for 23.6km starting at 32.8km from Shoalhaven. Ends 3.0km from Evans Lane SS.	1.00	
98P	Shoalhaven TS – West Tomerong TS	132kV	SC WP	15.5	15.5	15.5	2 x SC/GZ 7/3.25	Entire length	1.00	Entire length in good condition
28P	West Tomerong TS - Evans Lane SS	132kV	SC WP	39.5	39.5	39.5	2 x SC/GZ 7/3.25	Entire length	1.00	Entire length in good condition
7252/3	Fdr 7252/3 Plateau Rd Stanwell Tops den Stanwell Tops	33kV	SC WP	7	7	7	7/0.128 SC/GZ	Entire length	1.00	good
98H	Evans Lane Sw/Sin to Moruya North TS	132kV	SC WP	72.4	71.3	71.3	2 x SC/GZ 7/0.128	Steel EW starts 1.1km out of Evans Lane SS	1.00	Entire length in good condition
983/987	Dapto BSP - Tallararra SS	132kV	DC ST	3.1	3.1	3.1	SC/GZ 7/0.128 + 11.4mm OPGW	Entire length	1.00	Entire length in good condition
7252/1	Fdr 7252/1 ICC Princes Hwy Maddens Plain	33kV	SC WP	0.93	0.93	0.93	7/0.128 SC/GZ	Entire length	1.00	good
Total route length (km)				861	740	726				

APPENDIX C : COST ESTIMATE DETAIL

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No	TM171	Revision	A
Project Name	Replace corroded overhead earthwire feeder 988		
Estimate Description	Dapto to tee 1 replace 2 X 1.6km and 2 X 20km corroded overhead earthwire		
Estimate Date	14/09/2017	Estimate Type	Business Case
Applicable Labour Rates	Std Internal Rates (PPMS)		

Designed & Constructed In-House

Design	\$	15,261		160	Design Man Hours
Project Management	\$	45,069		400	Project Management Man Hours
Labour (Construction)	\$	194,991		2448	Construction Man Hours
Plant & Equipment	\$	62,787		3008	Total Man Hours
Materials - Stores	\$	158,182	\$	0	Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$	0			
Direct Charges/Materials	\$	119,450	\$	0	1.5 OT Included in Labour Subtotal
Survey	\$	10,000	\$	0	2.0 OT Included in Labour Subtotal
Civil Works	\$	0			
Restoration	\$	0			
Provisions	\$	30,000			
Contingency	\$	0			
Profit	\$	0			
				SUB TOTAL \$	635,740

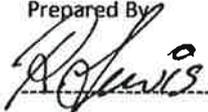
ROUNDED TOTAL \$ **635,800**

Outsourcing Adjustment Factors

Design	%		%	
Labour	%		%	Plant & Equipment
Civil/Restoration	%		%	Direct Charges/Materials
				ROUNDED REVISED TOTAL \$

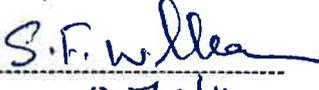
Notes

1. Provision for overtime RMS & railway crossing

Prepared By


Checked By

25/9/17

Approved By

25/9/17.

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No	TM171	Revision	A
Project Name	Replace corroded overhead earthwire feeder 988		
Estimate Description	Replace 2 X 2.5kM corroded overhead earthwire from tee 1 to Burrawang pumps		
Estimate Date	14/09/2017	Estimate Type	Business Case
Applicable Labour Rates	Std Internal Rates (PPMS)		

Designed & Constructed In-House

Design	\$	7,630	80	Design Man Hours
Project Management	\$	13,521	120	Project Management Man Hours
Labour (Construction)	\$	29,312	368	Construction Man Hours
Plant & Equipment	\$	8,748	568	Total Man Hours
Materials - Stores	\$	18,183	0	Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$	0		
Direct Charges/Materials	\$	17,980	0	1.5 OT Included in Labour Subtotal
Survey	\$	10,000	0	2.0 OT Included in Labour Subtotal
Civil Works	\$	0		
Restoration	\$	0		
Provisions	\$	0		
Contingency	\$	0		
Profit	\$	0		
			SUB TOTAL \$	105,374
			ROUNDED TOTAL \$	105,400

Outsourcing Adjustment Factors

Design	%	Plant & Equipment	%
Labour	%	Direct Charges/Materials	%
Civil/Restoration	%	ROUNDED REVISED TOTAL \$	

Notes

Prepared By

R. Lewis

Checked By

M. Muncumb
15/9/2017

Approved By

S.F. Williams
25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No	TM171	Revision	A
Project Name	Replace corroded overhead earthwire feeder 988		
Estimate Description	Tee 1 to tee B replace 2 X 8kM corroded overhead earthwire		
Estimate Date	14/09/2017	Estimate Type	Business Case
Applicable Labour Rates	Std Internal Rates (PPMS)		

Designed & Constructed In-House

Design	\$	7,630		80	Design Man Hours
Project Management	\$	13,521		120	Project Management Man Hours
Labour (Construction)	\$	81,565		1024	Construction Man Hours
Plant & Equipment	\$	28,582		1224	Total Man Hours
Materials - Stores	\$	69,650	\$	0	Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$	0			
Direct Charges/Materials	\$	58,200	\$	0	1.5 OT Included in Labour Subtotal
Survey	\$	40,000	\$	0	2.0 OT Included in Labour Subtotal
Civil Works	\$	0			
Restoration	\$	0			
Provisions	\$	0			
Contingency	\$	0			
Profit	\$	0			
			SUB TOTAL \$	299,148	
			ROUNDED TOTAL \$	299,200	

Outsourcing Adjustment Factors

Design		%	Plant & Equipment		%
Labour		%	Direct Charges/Materials		%
Civil/Restoration		%	ROUNDED REVISED TOTAL \$		

Notes

Prepared By

A. Lewis

Checked By

M. M. M. M.
15/09/2017

Approved By

S.F. W. W.
25/9/17

TRANSMISSION MAINS DEVELOPMENT

PROJECT ESTIMATE SUMMARY

Project No	TM171	Revision	A
Project Name	Replace corroded OHEW feeder 23C/23F Doonside to One Steel 1 X 1.4kM		
Estimate Description	Replace overhead earthwires pole 20B to pole 12 38 on feeder 23F only		
Estimate Date	05/09/2017	Estimate Type	Business Case
Applicable Labour Rates	Std Internal Rates (PPMS)		

Designed & Constructed In-House

Design	\$	7,630	80	Design Man Hours
Project Management	\$	24,788	220	Project Management Man Hours
Labour (Construction)	\$	53,527	672	Construction Man Hours
Plant & Equipment	\$	8,883	972	Total Man Hours
Materials - Stores	\$	12,606	0	Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$	0		
Direct Charges/Materials	\$	10,160	0	1.5 OT Included in Labour Subtotal
Survey	\$	0	0	2.0 OT Included in Labour Subtotal
Civil Works	\$	0		
Restoration	\$	0		
Provisions	\$	20,000		
Contingency	\$	0		
Profit	\$	0		
			SUB TOTAL \$	137,594
			ROUNDED TOTAL \$	137,600

Outsourcing Adjustment Factors

Design	%		Plant & Equipment	%
Labour	%		Direct Charges/Materials	%
Civil/Restoration	%		ROUNDED REVISED TOTAL \$	%

Notes

1. Provision for 1 X rail crossing span at overtime rates.
2. Provision for 1 X RMS crossing spans at overtime rates.
3. Existing OPGW on feeder 23C (pole 20 to pole 24A)

Prepared By

R. Lewis

Checked By

M. ...
15/09/2017

Approved By

S.F. Wilson
25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No	<input type="text" value="TM171"/>	Revision	<input type="text" value="A"/>
Project Name	<input type="text" value="Replace corroded OHEW feeder 93U Sydney West BSP to Abbotsbury 1 X 5kM"/>		
Estimate Description	<input type="text" value="Replace 1 X overhead earthwire Abbotsbury to structure 18"/>		
Estimate Date	<input type="text" value="13/09/2017"/>	Estimate Type	<input type="text" value="Business Case"/>
Applicable Labour Rates	<input type="text" value="Std Internal Rates (PPMS)"/>		

Designed & Constructed In-House

Design	\$ <input type="text" value="7,630"/>	<input type="text" value="80"/>	Design Man Hours
Project Management	\$ <input type="text" value="24,788"/>	<input type="text" value="220"/>	Project Management Man Hours
Labour (Construction)	\$ <input type="text" value="39,508"/>	<input type="text" value="496"/>	Construction Man Hours
Plant & Equipment	\$ <input type="text" value="8,947"/>	<input type="text" value="796"/>	Total Man Hours
Materials - Stores	\$ <input type="text" value="15,683"/>	\$ <input type="text" value="0"/>	Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$ <input type="text" value="0"/>		
Direct Charges/Materials	\$ <input type="text" value="14,250"/>	\$ <input type="text" value="0"/>	1.5 OT Included in Labour Subtotal
Survey	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	2.0 OT Included in Labour Subtotal
Civil Works	\$ <input type="text" value="0"/>		
Restoration	\$ <input type="text" value="0"/>		
Provisions	\$ <input type="text" value="10,000"/>		
Contingency	\$ <input type="text" value="0"/>		
Profit	\$ <input type="text" value="0"/>		
		SUB TOTAL \$	<input type="text" value="120,806"/>
		ROUNDED TOTAL \$	<input type="text" value="120,900"/>

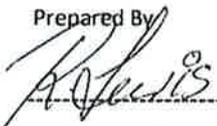
Outsourcing Adjustment Factors

Design <input type="text" value=""/>	Plant & Equipment <input type="text" value=""/>
Labour <input type="text" value=""/>	Direct Charges/Materials <input type="text" value=""/>
Civil/Restoration <input type="text" value=""/>	ROUNDED REVISED TOTAL \$ <input type="text" value=""/>

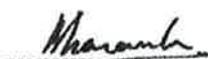
Notes

1. Provision for 1 X RMS crossing spans at overtime rates.
 2. Existing OPGW on feeder replace 1 X steel OHEW only

Prepared By



Checked By



15/09/2017

Approved By



25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No

Revision

Project Name

Estimate Description

Estimate Date

Estimate Type

Applicable Labour Rates

Designed & Constructed In-House

Design	\$ <input type="text" value="7,630"/>	<input type="text" value="80"/> Design Man Hours
Project Management	\$ <input type="text" value="24,788"/>	<input type="text" value="220"/> Project Management Man Hours
Labour (Construction)	\$ <input type="text" value="116,612"/>	<input type="text" value="1464"/> Construction Man Hours
Plant & Equipment	\$ <input type="text" value="21,857"/>	<input type="text" value="1764"/> Total Man Hours
Materials - Stores	\$ <input type="text" value="25,322"/>	\$ <input type="text" value="0"/> Total Recovered Overheads Included in subtotals to left
Cable - Non Stores	\$ <input type="text" value="0"/>	
Direct Charges/Materials	\$ <input type="text" value="28,570"/>	\$ <input type="text" value="0"/> 1.5 OT Included in Labour Subtotal
Survey	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/> 2.0 OT Included in Labour Subtotal
Civil Works	\$ <input type="text" value="0"/>	
Restoration	\$ <input type="text" value="0"/>	
Provisions	\$ <input type="text" value="20,000"/>	
Contingency	\$ <input type="text" value="0"/>	
Profit	\$ <input type="text" value="0"/>	
		SUB TOTAL \$ <input type="text" value="244,779"/>
		ROUNDED TOTAL \$ <input type="text" value="244,800"/>

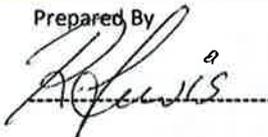
Outsourcing Adjustment Factors

Design	<input type="text" value=""/> %	Plant & Equipment	<input type="text" value=""/> %
Labour	<input type="text" value=""/> %	Direct Charges/Materials	<input type="text" value=""/> %
Civil/Restoration	<input type="text" value=""/> %	ROUNDED REVISED TOTAL \$	<input type="text" value=""/>

Notes

1. Provision for 1 X rail crossing spans at overtime rates.
2. Provision for 1 X RMS crossing spans at overtime rates.
3. Part existing OPGW on feeder 223 (structure 24 to tower 38)

Prepared By



Checked By


15/09/2017

Approved By


25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No	TM171	Revision	A
Project Name	Replace corroded OHEW feeder 237/23C Rooty Hill ZS to Onesteel 1 X 1.4kM & 1 X 0.4kM		
Estimate Description	Replace overhead earthwires tower 38 to tower 24A on feeder 237 & towers 41 to 24A onfeeder 23C		
Estimate Date	04/09/2017	Estimate Type	Business Case
Applicable Labour Rates	Std Internal Rates (PPMS)		

Designed & Constructed In-House

Design	\$	7,630	80	Design Man Hours
Project Management	\$	14,647	130	Project Management Man Hours
Labour (Construction)	\$	34,410	432	Construction Man Hours
Plant & Equipment	\$	7,081	642	Total Man Hours
Materials - Stores	\$	8,640	0	Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$	0		
Direct Charges/Materials	\$	10,460	0	1.5 OT Included in Labour Subtotal
Survey	\$	0	0	2.0 OT Included in Labour Subtotal
Civil Works	\$	0		
Restoration	\$	0		
Provisions	\$	10,000		
Contingency	\$	0		
Profit	\$	0		
			SUB TOTAL \$	92,869
			ROUNDED TOTAL \$	92,900

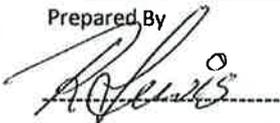
Outsourcing Adjustment Factors

Design	%	Plant & Equipment	%
Labour	%	Direct Charges/Materials	%
Civil/Restoration	%	ROUNDED REVISED TOTAL \$	

Notes

1. Overtime provision for RMS crossing.
2. Feeder 23C existing 48 fibre OPGW

Prepared By



Checked By


15/09/2017

Approved By


25/9/17.

TRANSMISSION MAINS DEVELOPMENT

PROJECT ESTIMATE SUMMARY

Project No

Revision

Project Name

Estimate Description

Estimate Date

Estimate Type

Applicable Labour Rates

Designed & Constructed In-House

Design	\$	<input type="text" value="30,522"/>	<input type="text" value="320"/>	Design Man Hours
Project Management	\$	<input type="text" value="67,604"/>	<input type="text" value="600"/>	Project Management Man Hours
Labour (Construction)	\$	<input type="text" value="1,172,492"/>	<input type="text" value="14720"/>	Construction Man Hours
Plant & Equipment	\$	<input type="text" value="280,270"/>	<input type="text" value="15640"/>	Total Man Hours
Materials - Stores	\$	<input type="text" value="412,611"/>	\$ <input type="text" value="0"/>	Total Recovered Overheads Included in subtotals to left
Cable - Non Stores	\$	<input type="text" value="0"/>		
Direct Charges/Materials	\$	<input type="text" value="657,000"/>	\$ <input type="text" value="0"/>	1.5 OT Included in Labour Subtotal
Survey	\$	<input type="text" value="15,000"/>	\$ <input type="text" value="0"/>	2.0 OT Included in Labour Subtotal
Civil Works	\$	<input type="text" value="0"/>		
Restoration	\$	<input type="text" value="0"/>		
Provisions	\$	<input type="text" value="611,000"/>		
Contingency	\$	<input type="text" value="0"/>		
Profit	\$	<input type="text" value="0"/>		
			SUB TOTAL \$	<input type="text" value="3,246,498"/>

ROUNDED TOTAL \$

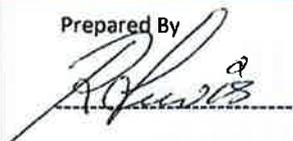
Outsourcing Adjustment Factors

Design	<input type="text" value=""/>	%	Plant & Equipment	<input type="text" value=""/>	%
Labour	<input type="text" value=""/>	%	Direct Charges/Materials	<input type="text" value=""/>	%
Civil/Restoration	<input type="text" value=""/>	%	ROUNDED REVISED TOTAL \$ <input type="text" value=""/>		

Notes

1. Provision for \$491,000 access tracks upgrade ★
2. Provision for \$65,000 vegetation management.
3. provision for \$72,00 for traffic control

Prepared By



Checked By


15/09/2017

Approved By


25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No	TM171	Revision	A
Project Name	Replacement of corroded overhead earthwire feeder 940/941 & 93E/942		
Estimate Description	replace both steel earthwires between Penrith ZS & Wallerawang 2 X 76kM		
Estimate Date	04/09/2017	Estimate Type	Business Case
Applicable Labour Rates	Std Internal Rates (PPMS)		

Designed & Constructed In-House

Design	\$	30,522		320	Design Man Hours
Project Management	\$	67,604		600	Project Management Man Hours
Labour (Construction)	\$	1,180,139		14816	Construction Man Hours
Plant & Equipment	\$	264,548		15736	Total Man Hours
Materials - Stores	\$	361,685	\$	0	Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$	0			
Direct Charges/Materials	\$	627,000	\$	0	1.5 OT Included in Labour Subtotal
Survey	\$	15,000	\$	0	2.0 OT Included in Labour Subtotal
Civil Works	\$	0			
Restoration	\$	0			
Provisions	\$	55,000			
Contingency	\$	0			
Profit	\$	0			
			SUB TOTAL \$	2,601,496	
			ROUNDED TOTAL \$	2,601,500	

Outsourcing Adjustment Factors

Design		%	Plant & Equipment		%
Labour		%	Direct Charges/Materials		%
Civil/Restoration		%	ROUNDED REVISED TOTAL \$		

Notes

1. provision for \$72,00 for traffic control

Prepared By

R. Lewis

Checked By

M. Ramulu
15/9/2017

Approved By

S.F. Wilson
25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No

Revision

Project Name

Estimate Description

Estimate Date

Estimate Type

Applicable Labour Rates

Designed & Constructed In-House

Design	\$	<input type="text" value="7,630"/>	<input type="text" value="80"/>	Design Man Hours
Project Management	\$	<input type="text" value="20,281"/>	<input type="text" value="180"/>	Project Management Man Hours
Labour (Construction)	\$	<input type="text" value="50,341"/>	<input type="text" value="632"/>	Construction Man Hours
Plant & Equipment	\$	<input type="text" value="14,021"/>	<input type="text" value="892"/>	Total Man Hours
Materials - Stores	\$	<input type="text" value="20,914"/>	<input type="text" value="0"/>	Total Recovered Overheads Included in subtotals to left
Cable - Non Stores	\$	<input type="text" value="0"/>		
Direct Charges/Materials	\$	<input type="text" value="20,550"/>	<input type="text" value="0"/>	1.5 OT Included in Labour Subtotal
Survey	\$	<input type="text" value="0"/>	<input type="text" value="0"/>	2.0 OT Included in Labour Subtotal
Civil Works	\$	<input type="text" value="0"/>		
Restoration	\$	<input type="text" value="0"/>		
Provisions	\$	<input type="text" value="10,000"/>		
Contingency	\$	<input type="text" value="0"/>		
Profit	\$	<input type="text" value="0"/>		
			SUB TOTAL \$	<input type="text" value="143,738"/>

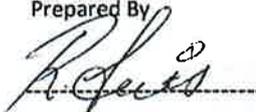
ROUNDED TOTAL \$

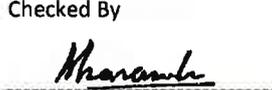
Outsourcing Adjustment Factors

Design	<input type="text" value=""/>	%	Plant & Equipment	<input type="text" value=""/>	%
Labour	<input type="text" value=""/>	%	Direct Charges/Materials	<input type="text" value=""/>	%
Civil/Restoration	<input type="text" value=""/>	%	ROUNDED REVISED TOTAL \$	<input type="text" value=""/>	

Notes

1. Provision for overtime RMS crossing

Prepared By


Checked By

15/09/2017

Approved By

25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No	TM171	Revision	A
Project Name	Replace corroded OHEW feeder 7175 Jerrara SS to Gerringong ZS 1 X 10kM		
Estimate Description	Replace overhead earthwire structure 1 to structure 52		
Estimate Date	06/09/2017	Estimate Type	Business Case
Applicable Labour Rates	Std Internal Rates (PPMS)		

Designed & Constructed In-House

Design	\$	7,630		80	Design Man Hours
Project Management	\$	22,535		200	Project Management Man Hours
Labour (Construction)	\$	58,625		736	Construction Man Hours
Plant & Equipment	\$	18,762		1016	Total Man Hours
Materials - Stores	\$	41,889	\$	0	Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$	0			
Direct Charges/Materials	\$	38,400	\$	0	1.5 OT Included in Labour Subtotal
Survey	\$	0	\$	0	2.0 OT Included in Labour Subtotal
Civil Works	\$	0			
Restoration	\$	0			
Provisions	\$	10,000			
Contingency	\$	0			
Profit	\$	0			
			SUB TOTAL \$	197,841	
			ROUNDED TOTAL \$	197,900	

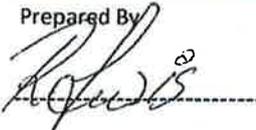
Outsourcing Adjustment Factors

Design	%	Plant & Equipment	%
Labour	%	Direct Charges/Materials	%
Civil/Restoration	%	ROUNDED REVISED TOTAL \$	%

Notes

1. 3 pans from Gerringong ZS existing 19/3.25AAC - no rail crossing required

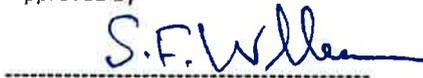
Prepared By



Checked By


15/09/2017

Approved By


25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No

Revision

Project Name

Estimate Description

Estimate Date

Estimate Type

Applicable Labour Rates

Designed & Constructed In-House

Design	\$	<input type="text" value="7,630"/>	<input type="text" value="80"/>	Design Man Hours
Project Management	\$	<input type="text" value="24,788"/>	<input type="text" value="220"/>	Project Management Man Hours
Labour (Construction)	\$	<input type="text" value="110,877"/>	<input type="text" value="1392"/>	Construction Man Hours
Plant & Equipment	\$	<input type="text" value="30,912"/>	<input type="text" value="1692"/>	Total Man Hours
Materials - Stores	\$	<input type="text" value="62,992"/>	<input type="text" value="0"/>	Total Recovered Overheads Included in subtotals to left
Cable - Non Stores	\$	<input type="text" value="0"/>		
Direct Charges/Materials	\$	<input type="text" value="55,390"/>	<input type="text" value="0"/>	1.5 OT Included in Labour Subtotal
Survey	\$	<input type="text" value="0"/>	<input type="text" value="0"/>	2.0 OT Included in Labour Subtotal
Civil Works	\$	<input type="text" value="0"/>		
Restoration	\$	<input type="text" value="0"/>		
Provisions	\$	<input type="text" value="20,000"/>		
Contingency	\$	<input type="text" value="0"/>		
Profit	\$	<input type="text" value="0"/>		
			SUB TOTAL \$	<input type="text" value="312,589"/>
			ROUNDED TOTAL \$	<input type="text" value="312,600"/>

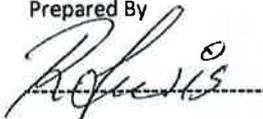
Outsourcing Adjustment Factors

Design	<input type="text" value=""/>	%	Plant & Equipment	<input type="text" value=""/>	%
Labour	<input type="text" value=""/>	%	Direct Charges/Materials	<input type="text" value=""/>	%
Civil/Restoration	<input type="text" value=""/>	%	ROUNDED REVISED TOTAL \$	<input type="text" value=""/>	

Notes

1. Provision for 1 X rail crossing spans at overtime rates.
2. Provision for 1 X RMS crossing spans at overtime rates.
3. Part existing OPGW from Gerringong ZS (4 spans)

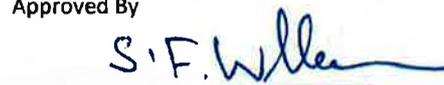
Prepared By



Checked By


15/09/2017

Approved By


25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No	<input type="text" value="TM171"/>	Revision	<input type="text" value="A"/>
Project Name	<input type="text" value="Replace corroded OHEW feeder 7150 Bomaderry ZS to ABS 66737 1 X 2.8kM"/>		
Estimate Description	<input type="text" value="Replace overhead earthwire structure 210 to structure 191"/>		
Estimate Date	<input type="text" value="05/09/2017"/>	Estimate Type	<input type="text" value="Business Case"/>
Applicable Labour Rates	<input type="text" value="Std Internal Rates (PPMS)"/>		

Designed & Constructed In-House

Design	\$ <input type="text" value="3,815"/>	<input type="text" value="40"/>	Design Man Hours
Project Management	\$ <input type="text" value="11,267"/>	<input type="text" value="100"/>	Project Management Man Hours
Labour (Construction)	\$ <input type="text" value="24,215"/>	<input type="text" value="304"/>	Construction Man Hours
Plant & Equipment	\$ <input type="text" value="7,516"/>	<input type="text" value="444"/>	Total Man Hours
Materials - Stores	\$ <input type="text" value="15,012"/>	\$ <input type="text" value="0"/>	Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$ <input type="text" value="0"/>		
Direct Charges/Materials	\$ <input type="text" value="15,410"/>	\$ <input type="text" value="0"/>	1.5 OT Included in Labour Subtotal
Survey	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/>	2.0 OT Included in Labour Subtotal
Civil Works	\$ <input type="text" value="0"/>		
Restoration	\$ <input type="text" value="0"/>		
Provisions	\$ <input type="text" value="10,000"/>		
Contingency	\$ <input type="text" value="0"/>		
Profit	\$ <input type="text" value="0"/>		
		SUB TOTAL \$	<input type="text" value="87,235"/>
		ROUNDED TOTAL \$	<input type="text" value="87,300"/>

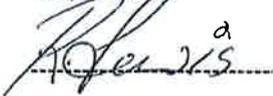
Outsourcing Adjustment Factors

Design <input type="text" value=""/>	%	Plant & Equipment <input type="text" value=""/>	%
Labour <input type="text" value=""/>	%	Direct Charges/Materials <input type="text" value=""/>	%
Civil/Restoration <input type="text" value=""/>	%	ROUNDED REVISED TOTAL \$	<input type="text" value=""/>

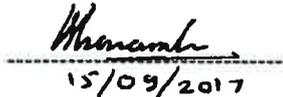
Notes

1. Provision for 1 X rail crossing spans at overtime rates.
 2. Provision for 1 X RMS crossing spans at overtime rates.
 3. Part existing OPGW from Geeringong ZS (4 spans)

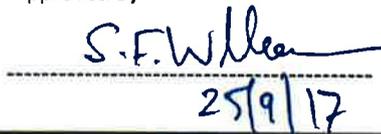
Prepared By



Checked By


15/09/2017

Approved By


25/9/17

TRANSMISSION MAINS DEVELOPMENT PROJECT ESTIMATE SUMMARY

Project No

Revision

Project Name

Estimate Description

Estimate Date

Estimate Type

Applicable Labour Rates

Designed & Constructed In-House

Design	\$ <input type="text" value="7,630"/>	<input type="text" value="80"/> Design Man Hours
Project Management	\$ <input type="text" value="22,535"/>	<input type="text" value="200"/> Project Management Man Hours
Labour (Construction)	\$ <input type="text" value="96,221"/>	<input type="text" value="1208"/> Construction Man Hours
Plant & Equipment	\$ <input type="text" value="34,855"/>	<input type="text" value="1488"/> Total Man Hours
Materials - Stores	\$ <input type="text" value="81,438"/>	\$ <input type="text" value="0"/> Total Recovered Overheads <i>Included in subtotals to left</i>
Cable - Non Stores	\$ <input type="text" value="0"/>	
Direct Charges/Materials	\$ <input type="text" value="70,850"/>	\$ <input type="text" value="0"/> 1.5 OT Included in Labour Subtotal
Survey	\$ <input type="text" value="0"/>	\$ <input type="text" value="0"/> 2.0 OT Included in Labour Subtotal
Civil Works	\$ <input type="text" value="0"/>	
Restoration	\$ <input type="text" value="0"/>	
Provisions	\$ <input type="text" value="10,000"/>	
Contingency	\$ <input type="text" value="0"/>	
Profit	\$ <input type="text" value="0"/>	

SUB TOTAL \$

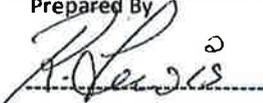
ROUNDED TOTAL \$

Outsourcing Adjustment Factors

Design	<input type="text" value=""/> %	Plant & Equipment	<input type="text" value=""/> %
Labour	<input type="text" value=""/> %	Direct Charges/Materials	<input type="text" value=""/> %
Civil/Restoration	<input type="text" value=""/> %	ROUNDED REVISED TOTAL \$	<input type="text" value=""/>

Notes

1. Provision for 1 X rail crossing spans at overtime rates.
2. Provision for 1 X RMS crossing spans at overtime rates.
3. Part existing OPGW from Geeringong ZS (4 spans)

Prepared By


Checked By

15/09/2017

Approved By

25/9/17