

Program of Works

2017 – 2022

Instrument Transformer Replacement (PUBLIC VERSION)

Document number	N/A
Issue number	1.0
Status	Approved
Approver	S. Owens
Date of approval	23/06/2015

ISSUE/AMENDMENT STATUS

Issue Number	Date	Description	Author	Approved by
0.1	17/04/15	Initial Draft	D. Platt	S. Owens
1.0	23/06/15	Initial Issue	S. Jayakody	S. Owens

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Instrument Transformer Replacement

1 Summary

PROGRAM	Instrument Transformer Capital Replacement Program 2017 – 2022
SERVICE DATE	On-going throughout period 2017 – 2022
LOCATION	Multiple Terminal Stations of Victorian Network
VALUE	\$7.4M

Table 1 – Program Overview

1.1 Program Scope

Overall 70 high failure risk instrument transformers have been identified for replacement prior to March 2022. The replacement is listed by type in Table 2.

Total	Type	Unit Rate (\$k)	Units	Total (\$k)
500	CT	C-I-C	28	C-I-C
220	CT	C-I-C	12	C-I-C
66	CT	C-I-C	2	C-I-C
500	CVT	C-I-C	1	C-I-C
220	CVT	C-I-C	4	C-I-C
66	CVT	C-I-C	1	C-I-C
66	MVT	C-I-C	14	C-I-C
22	MVT	C-I-C	8	C-I-C

Table 2 – Program scope summary

The proposed replacements are additional to instrument transformers proposed to be replaced during major terminal station rebuilds.

The works proposed include the removal of the existing plant and the installation of new plant on new foundations.

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1.2 Program Expenditure Forecast

2017/18 (\$k)	2018/19 (\$k)	2019/20 (\$k)	2020/21 (\$k)	2021/22 (\$k)	Total (\$k)
1,480	1,480	1,480	1,480	1,480	7,400

Table 3 – Program timing and forecast expenditure

Forecast costs shown in Table 3 are \$2014/15 P50 direct costs. These costs exclude overheads, finance charges and cost escalation. Unit costs are described in Appendix 4D: Unit Rates.

2 Program Drivers

- Network reliability, quality and security of supply:
 - The failure of these Instrument Transformers will result in unplanned extended outages and may cause adjacent circuit outages due to collateral damages caused by the failure.
- Health and Safety:
 - The consequence of an explosive failure of an instrument transformer is unacceptable to the safety of any personnel in the vicinity.
- Environment:
 - There is a low risk of a failure at the station perimeter igniting a grass fire;
 - Due to the low volumes of oil within instrument transformers, oil contamination is not a large issue.
- Financial Impacts:
 - A forced outage due to an instrument transformer failure may result in market impact costs and potential litigation as a result of missed generation.
 - The financial penalties from incentive schemes.
 - Increased costs associated with emergency replacements following major failures.
 - Costs associated with the repair of collateral damage to the adjacent plant caused as a result of oil fires and projectiles.
 - Costs associated with injuries / fatalities suffered by staff and contractors working on site as a result of fires and projectiles.
- Regulatory Compliance:
 - To comply with all applicable regulatory obligations or requirements associated with the provision of prescribed transmission services.
- Corporate Image:
 - To maintain the corporate image as a prudent asset manager by managing risk as low as practicable.

3 Obligations

The National Electricity Rules (clauses 6A.6.6 and 6A.6.7) require AusNet Services to forecast operating and capital expenditures to, amongst other objectives, *comply with all applicable regulatory obligations or requirements associated with the provision of prescribed transmission services*;

The Electricity Safety Act (clause 98) requires a major electricity company, such as AusNet Services to design, construct, operate, maintain and decommission its supply network to minimise as far as practicable—

- (a) the hazards and risks to the safety of any person arising from the supply network; and
- (b) the hazards and risks of damage to the property of any person arising from the supply network; and
- (c) the bushfire danger arising from the supply network.

In the definitions of this Act, the term 'practicable', means having regard to—

- (a) the severity of the hazard or risk in question; and
- (b) the state of knowledge about the hazard or risk and any ways of removing or mitigating the hazard or risk; and
- (c) the availability and suitability of ways to remove or mitigate the hazard or risk; and
- (d) the cost of removing or mitigating the hazard or risk;

This means “as low as reasonably practicable” which has been interpreted as until the safety related costs are (grossly) disproportionate to the safety related benefit.

The Occupational Health and Safety Act requires AusNet Services to provide and maintain so far as is reasonably practicable for employees a working environment that is safe and without risks to health.

4 Overview

Oil filled porcelain-clad HV instrument transformers progressively deteriorate with duty cycles and service age and, beyond a manageable level of deterioration, can fail terminally in a manner which can include explosion and fire. The consequences of such a failure are well known and present a number of risks, including;

- Health & Safety to field staff working in the vicinity.
- Collateral damage to nearby equipment.
- Unplanned network outages and associated penalties.

Since 2005, AusNet Services has undertaken six instrument transformer replacement projects to remove high failure risk instrument transformers. The 381 instrument transformers replaced in these six projects are additional to those instrument transformers removed during station rebuild projects. A further 51 high risk instrument transformers are planned for replacement as part of the 2014-17 regulatory period.

As the condition of instrument transformers deteriorates progressively specific instrument transformers that were assessed as a lower risk in previous programs have deteriorated to the point where they have become high failure risk and are proposed to be replaced during the 2017-2022 regulatory period.

The condition of Current Transformers (CTs) is assessed primarily on DGA (dissolved gas analysis) tests. It is necessary to obtain an oil sample from the CT for this assessment which is an invasive method and is not recommended during the first 15 years of a current transformer life. Therefore, it is proposed to implement an online instrument transformer condition monitoring system which will enable better condition assessment of CTs.

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However it is proposed to continue to obtain annual oil samples for DGA assessment of C-I-C CTs and C-I-C CTs due to their deteriorated condition as described in the Asset Health Report.

Incipient failure of CVTs (Capacitive Voltage Transformers) is currently detected in real time via CAMS (CVT Asset Monitoring System) where failing units can be removed from service in time. It is proposed to continue to roll out the CAMS system for future CVTs to be installed as well as those which had not been included in the CAMS system to date. A key focus in CVT maintenance is to ensure there is adequate like-spares to facilitate a speedy swap out in the event of failure.

The replacements suggested in this program of works align with the analysis described in AMS 10-64 Instrument Transformers.

5 Options

5.1 Option 1 – Do Nothing

The 'Do nothing' involves routine inspection and maintenance but takes no action to refurbish or replace assets as they deteriorate and ultimately fail in service. In this option the functionality of the assets is progressively lost and service to consumers progressively declines and ultimately ceases.

This option includes the probability that the terminal failure of assets may involve explosions and fires which presents safety risks to workers within the switchyard and collateral damage risks to adjacent electrical equipment.

This option does not address AusNet Services's obligations under the National Electricity Rules to undertake capital expenditure to comply all regulatory obligations applicable to the provision of transmission services, such as the Electricity Safety Act and the Electricity Safety Management Scheme.

This option is inconsistent with the requirements of the Electricity Safety Act which require AusNet Services to operate and maintain its supply to minimise as far as practicable the hazards and risks to the safety of any person involved in operation and maintenance.

This option is also inconsistent with AusNet Services' accepted Electricity Safety Management Scheme.

5.2 Option 2 – Replace on Condition

This option involves replacing 70 instrument transformers, comprising 42 CTs, 6 CVTs and 22 MVTs, that have been identified as presenting a high risk of failure due to deteriorating condition and the supply reliability, safety and collateral damage consequences of failures in service.

Replacement will significantly reduce the risk of these assets failing in service due to declining condition. In conjunction with instrument transformer replacements included in the scope of major station re-build projects this program will ensure replacement of deteriorated instrument transformers in AusNet Service Electricity Transmission Network.

A proactive program of replacement means that outages can be optimised reducing expenses. Replacements with new plant means the probability of failure remain low for the expected average service life of 45 years.

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6 Financial Analysis

Net present value analysis has been undertaken on the two options and the option to undertake replacement program has yielded the least cost option with a positive NPV.

Economic Analysis of Options (\$'000s)	PV Capital Cost	PV Opex Costs	PV Community Benefits	PV Proceeds From Sales	Total PV Cost	NPV including Reg Return
Do Nothing	-	(10,189)	(482)	-	(10,671)	(1,123)
Undertake replacement program XC44 & XC45	(5,756)	(1,861)	(329)	-	(7,947)	500
	-	-	-	-	-	-
	-	-	-	-	-	-
	-	-	-	-	-	-

Table 4 – NPV Analysis

The total forecast expenditure is \$7.4M, with to be spent in the 2017 – 2022 regulatory period.

7 Recommended Action

Undertake the replacement program described in option 2 and summarised in Table 5.

Total	Type	Unit Rate (\$1'000s)	Units	Total (\$1'000s)
500	CT	C-I-C	28	C-I-C
220	CT	C-I-C	12	C-I-C
66	CT	C-I-C	2	C-I-C
500	CVT	C-I-C	1	C-I-C
220	CVT	C-I-C	4	C-I-C
66	CVT	C-I-C	1	C-I-C
66	MVT	C-I-C	14	C-I-C
22	MVT	C-I-C	8	C-I-C

Table 5 – Scope summary

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8 Risk Matrix

By completing the replacement program the likelihood of catastrophic failure of an instrument transformer is significantly reduced. As a result, the likelihood of personnel being in the vicinity of a failing instrument transformer is also reduced.

With high risk instrument transformers removed, incipient failure of those with a lower risk can be detected early, tracked and removed in a controlled manner. This means that the consequence of an incipient failure can be reduced to the cost of a planned outage, the requisition of a strategic spare and disposal of the deteriorating instrument transformer.

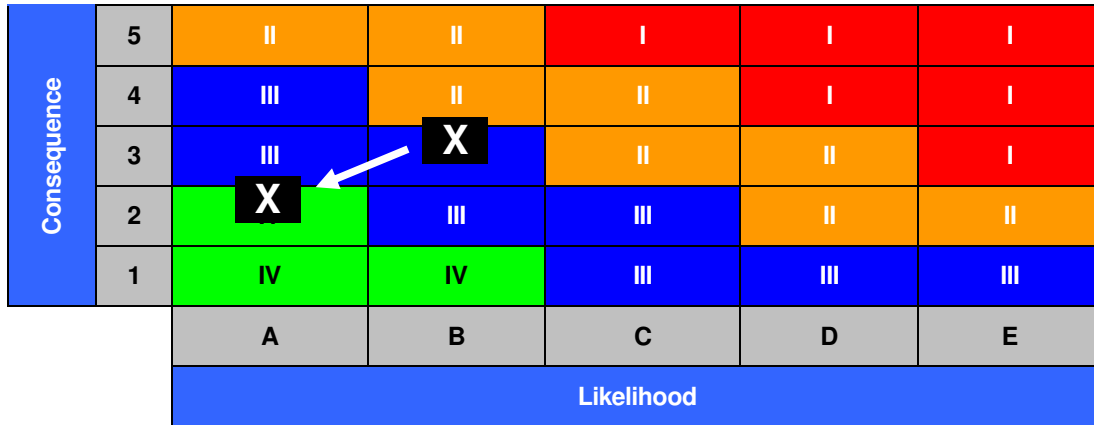


Figure 1 – Risk Matrix

9 REFERENCE DOCUMENT

- AMS 10-64 Instrument Transformer Asset Management Strategy.
- AHR 10-64 Instrument Transformer Asset Health Report.