Secondary Systems

2023-28 Revenue Proposal

Transgrid

8 November 2022

→ **The Power of Commitment**

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Executive summary

Secondary systems, which include protection, control, metering and associated infrastructure that are generally replaced at the end of their economic life rather than refurbished (unlike some primary plant). In addition, secondary systems tend to be replaced based on technology obsolesce rather than for condition.

Technology risk has several components:

- **Life cycle risk** – As time passes:
    - These systems are no longer manufactured as they are replaced with new technology
    - OEM support for the systems is no longer offered. This includes ongoing software patching that increases IT security risk
    - Spares diminish and typical strategies include the cannibalisation of existing systems where renewal programs are active.

  This strategy has an end point and as time increases the risk of failure leading to extended outage increases. The level of risk is dependent upon whether the secondary systems represent a single point of failure or has redundancy.
- **Technology risk** – At any point new technology can offer operational benefits to justify investment based upon Net Present Value (NPV) analysis (such as self-supervision). Upon investment, life cycle risks are typically reduced substantially.

In line with the Australian Energy Regulator's (AER)'s Asset replacement planning note[1] the Options Evaluation Reports (OERs) that support this program consider replacement options against a base case where Transgrid continues to operate and maintain the existing site secondary systems as required. NPV outcomes are used to determine the preferred option and across the sites considered the operational benefits of the new technology drive replacement decisions.

Following the feedback received detailed in the AER's Draft Determination, Transgrid has updated their OER's to address the use of Disproportionality Factors (DF) and have reduced other benefits by 25 percent.

Review of the operational benefits detailed in Table 2 indicate that benefits claimed are reasonable, acknowledging that the relevant elements of benefits are difficult to forecast and support. This is particularly the case given that they are now reduced by 25 percent.

After these changes the NPV's support the preferred options presented in the OERs, in line with the scenario analysis performed on the original OER's before the incorporation of the AER's feedback. This indicates that the current OERs are supportable.

[1] Industry practice application note, Asset replacement planning, January 2019, AER

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1. Introduction

Transgrid submitted its 2023-28 Revenue Proposal in January 2022. According to the AER regulatory timetable, Transgrid can submit a Revised Revenue Proposal in December 2022.

Transgrid has engaged GHD to perform several independent assessments of Repex projects to support the development of the Revised Revenue Proposal.

1.1 Purpose of this report

This report outlines an independent assessment of OERs which TransGrid submitted to the AER for funding associated with the remediation of secondary system risks.

This report may be used to support Transgrid's Revised Revenue Proposal to be submitted at the AER.

1.2 Scope and limitations

GHD has been engaged by Transgrid to perform an independent assessment of the OERs prepared to support the funding request for remediation of remediation of secondary system risks.

The scope of this report includes an assessment of whether the OERs:

- Alignment with the AER's Asset replacement planning note[2]
- Have been updated to reflect the feedback detailed in the AER's Draft Determination.

GHD has not verified reliability gains as this element was not questioned by the AER.

This report has been prepared by GHD for Transgrid and may only be used and relied on by Transgrid for the purpose agreed between GHD and Transgrid as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person or organisation other than Transgrid arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

[2] Industry practice application note, Asset replacement planning, January 2019, AER

2. Background

Secondary systems which include protection, control, metering and associated infrastructure that are generally replaced at the end of their economic life rather than refurbished (unlike some primary plant). In addition, secondary systems tend to be replaced based on technology obsolesce or additional technology requirements rather than for condition. Technology elements has several components:

- **Life cycle risk** – As time passes:
    - These systems are no longer manufactured as they are replaced with new technology
    - OEM support for the systems is no longer offered. This includes ongoing software upgrades
    - Spares diminish and typical strategies include the cannibalisation of existing systems where renewal programs are active.

  This strategy has an end point and as time increases the risk of failure leading to extended outage increases. The level of risk is dependent upon whether the secondary systems represent a single point of failure, or the level of redundancy associated with the secondary system.
- **Technology risk** – At any point new technology can offer operational benefits to justify investment based upon NPV analysis (such as self-supervision). Upon investment, life cycle risks are typically reduced substantially.

The AER's Draft Determination reduced secondary system funding request from $145.4M to $99.7M a 31 percent reduction due to the following concerns noted during their review of OER's:

- Use of a DF of 6 for safety risk.
- Overstatement of environmental risks and the use of a DF of 6 when calculating risk.
- Overstatement of other benefits.

Transgrid has accepted the AER's feedback on the application of DFs and has reduced other benefits by 25 percent in the preparation of updated OERs. GHD's assessment covers these updated OERs.

3. Secondary system OER assessment

3.1 Options analysis

The OER's are aligned with Transgrid's Automation Renewal and Maintenance Strategy 2021/22 which identified the following challenges:

- International Electrotechnical Commission (IEC) 61850 standards gaps
- Achieving cost opex reductions and efficiencies
- Optimising capex expenditure to address capital constraints
- Monitoring and improving systems to ensure consistent and accurate data capture

These OERs consider technology risk stemming from components that are no longer manufactured, no longer supported or where limited spares are held.

All cases consider the following option analysis, selecting a preferred outcome based upon the results of the NPV analysis.

- Base case where Transgrid continues to operate and maintain the existing site secondary systems as required.
- Option A replaces all secondary system assets identified as end-of-life in a like for like approach for individual assets. This option does not leverage any technological advancements within the latest design standards.
- Option B renews all identified assets at the site including protection, control, metering and underlying infrastructure to leverage technological advancements in modern equipment and deliver lifecycle benefits to consumers.
- Option C involves the complete upgrade and renewal of the secondary systems by using modular secondary systems buildings and installing new cabling throughout the site. This option will also leverage technological advancements in modern equipment and deliver lifecycle benefits to consumers.
- Option D involves the complete upgrade and renewal of the secondary systems leveraging another suitable technology, standards and methodologies where available.

The result of this analysis is presented in the table below.

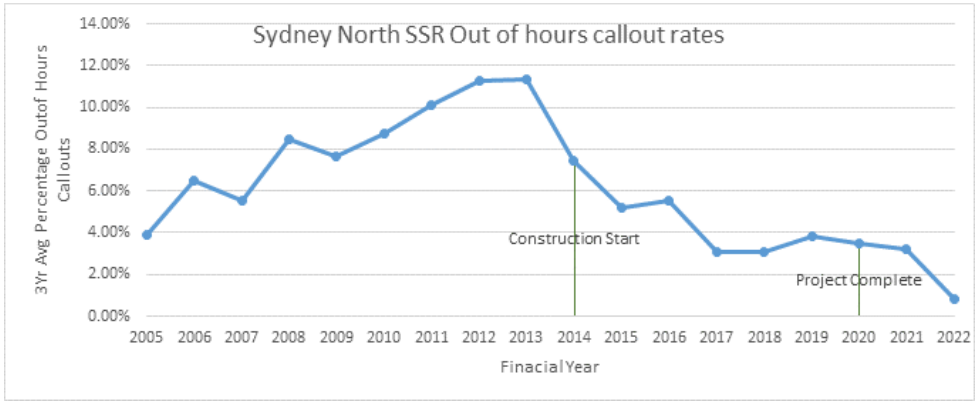
Table 1 Summary of preferred option analysis

OER	Preferred option	OER content			NPV spreadsheets			
		Preferred option supported by NPV analysis	Cost	NPV	Cost	NPV	Correct use of DFs	25% reduction in other benefits
N2405	Complete secondary systems buildings replacement	Yes	$27.7M	$4.5M	$27.7M	$4.5	Yes	Yes
N2430	Individual asset replacement	Yes	$2.4M	$0.8M	$2.4M	$0.8M	Yes	Yes
N2431	Complete in-situ replacement	Yes	$9.2M	$1.9M	$9.2M	$1.9M	Yes	Yes
N2432	Individual asset replacement	Yes	$2.9M	$0.7M	$2.9M	$0.7M	Yes	Yes
N2444	Individual asset replacement	Yes	$3.8M	$1.1M	$3.8M	$1.1M	Yes	Yes
N2446	Individual asset replacement	Yes	$1.5M	$0.2M	$1.5M	$0.2M	Yes	Yes

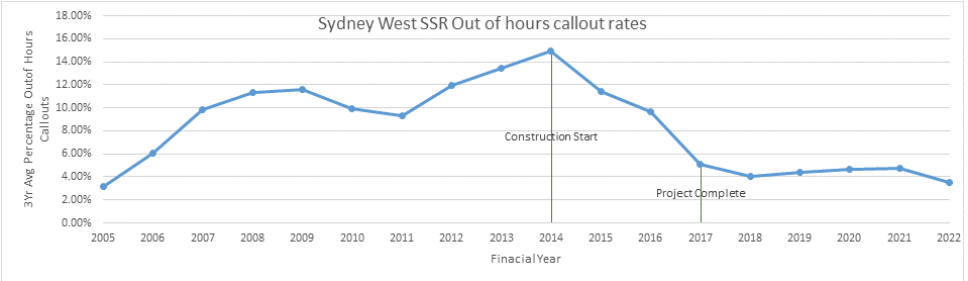
As indicated above the preferred option is driven by NPV analysis that includes operational benefits. This is required to support and analysis of whether the investments proposed cost is proportional when considering ALARP as outlined in the AER's Asset Replacement Planning Note[3].

The following table reflects the operational benefits included in the OERs, which have now been reduced by 25 percent.

Table 2 Secondary Systems Operational Benefits Claimed

Benefit	Per Breaker ($/yr)	Per Feeder ($/yr)	Per site ($/yr)	Comment
Remote Interrogation and better discrimination between alarms			21800	Estimated as potential saving in out of hours callouts per annum due to more detailed information being remotely available. Taken as 20 callouts per site with possible reduction at 5 hours per callout and $178/h – amounting to $17,800 Potential savings in the number of hours required by NP&O to undertake the required analysis and decision-making requiring 20hours per site per annum at a rate of $200/h – total of $4,000 Analysis of past completed projects indicate the reduction in the call out hours profile that supports the assumptions used. Refer the figures presented below ***Figure 1 Sydney North SSR Out of Hours Callout Rates*** 

[3] Industry practice application note, Asset replacement planning, January 2019, AER

Benefit	Per Breaker ($/yr)	Per Feeder ($/yr)	Per site ($/yr)	Comment
				Figure 2 Sydney West SSR Out of Hours Call Out Rates 
Reduced urgency of response			10000	Removal of single point of failure for all control and indication at the site when using distributed architecture. Assumed avoidance of 10 callout per site p.a. @ $1000 per call out
Remove transducers/power meters			3259	Removal of cost of defects, routine testing costs and spares holdings apportioned to a single site
Standardised Breaker Control Routines	712			Taken as an estimated saving of 4 hours of technician time per breaker across all sites at $178/h
Standardised Auto Reclose Routines		1000		Auto reclose checks no longer required
Integration of Sync Check			1704	Sync check relay maintenance and spares holdings apportion to site. (Not considered material)
Integration of VT unbalance function			1763	Removal of proprietary and unavailable CVT unbalance relays from the network. Maintenance and spares holdings apportioned to site. (Not considered material)
Standardised AVR Routines			1994	Reduction in time taken to investigate/update issues with AVR systems due to the removal of intergenerational designs requiring significant time to study and understand modifications. Taken as 5 hours of technician time per site per year at $178/h. (Not considered material)
Standardised Voltage Control Routines			194	Reduction in time taken to investigate/update issues with AVC (Automatic Voltage Control) systems due to the removal of complex designs requiring significant time to study and understand. Taken as 5 hours of technician time per site per year at $178/h. (Not considered material)
Removal of Fault Recorders			10790	Removal of spares holdings taken as current recorder relevant spares holdings across 99 sites. Removal of maintenance tasks for recorders taken as total forecast maintenance required for the recorders for next 15 years across 99 sites

Benefit	Per Breaker ($/yr)	Per Feeder ($/yr)	Per site ($/yr)	Comment
Withdrawn Outages	360			Replacement outages requirement at a bay level reduced by 50%. Estimated as 1x switcher every 10 years for 24 hours at $300/hr. (Not considered material)
Removal of Battery Room upkeep			693	Battery rooms not required to meet Australian Standards for VRLA systems taken as average of $880 per job, 29 jobs per year across the state. (Not considered material)
Reduction in LAN components			627	Network LAN reduced to two devices with triple redundancy. (Not considered material)
Lan deployment savings		10000		For a current secondary systems renewal (SSR) with 20 duplicated protection schemes, Transgrid would deploy 20 network components (switches). New solution would deploy 6 network components for a typical SSR. Each network component is approximately $5000 (does not include installation, commissioning or ongoing costs)
HV Defect efficiencies			8924	Estimated 10% efficiencies in HV defects due to improved monitoring and analysis
Digital Defect Efficiencies			5024	Efficiencies through the removal of obsolete technologies and non-standard designs (beyond those listed already) at 80% savings
Total	**1072**	**11000**	**66772**	

3.2 Scenario analysis

Transgrid had previously performed scenario analysis on the original OERs to understand the impacts of NPV based upon the following scenarios. These results have been retained in the report to illustrate the progression of work leading up to the current OERs.

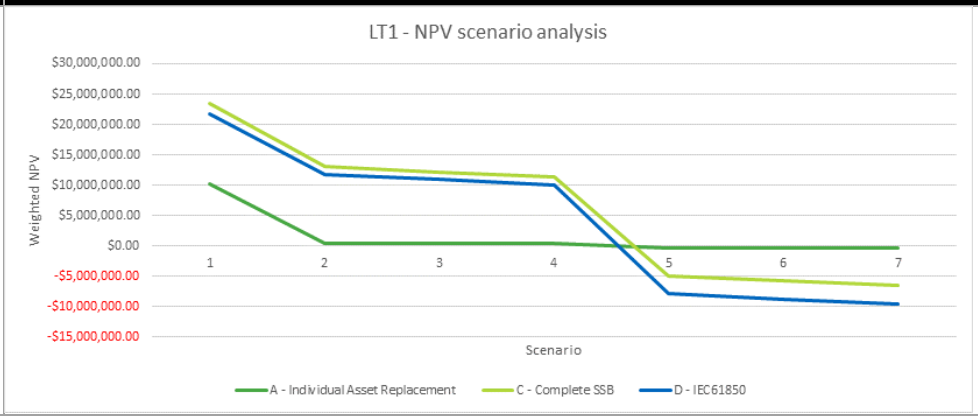
Table** 3 **Scenario Assumptions

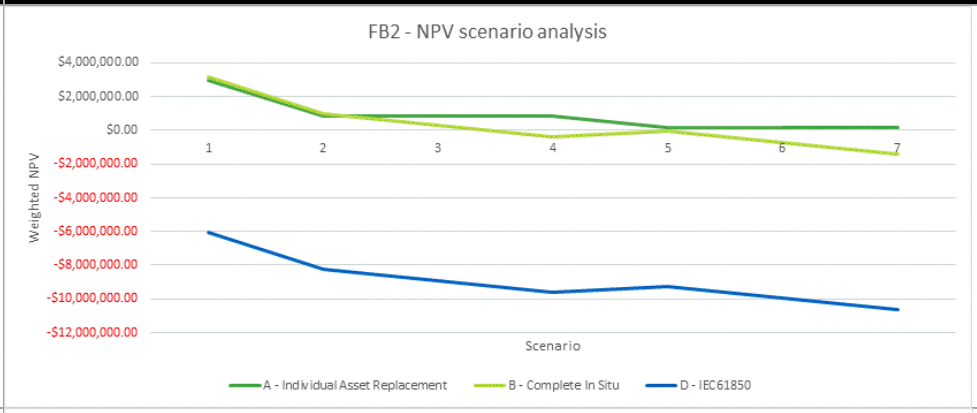
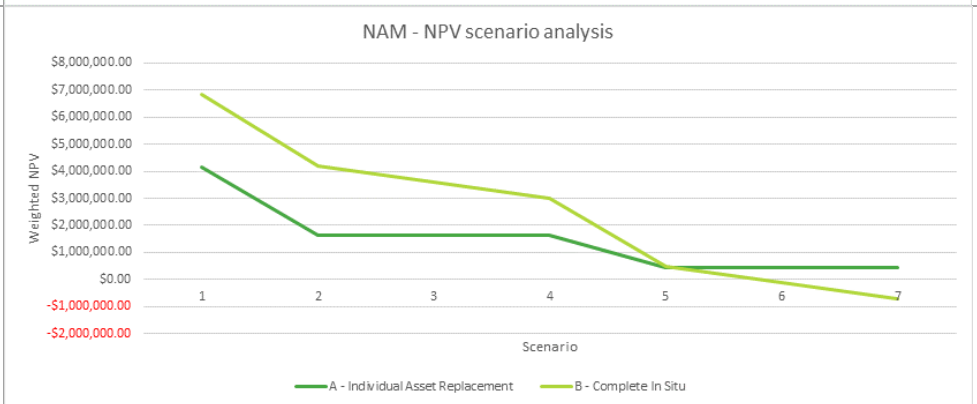
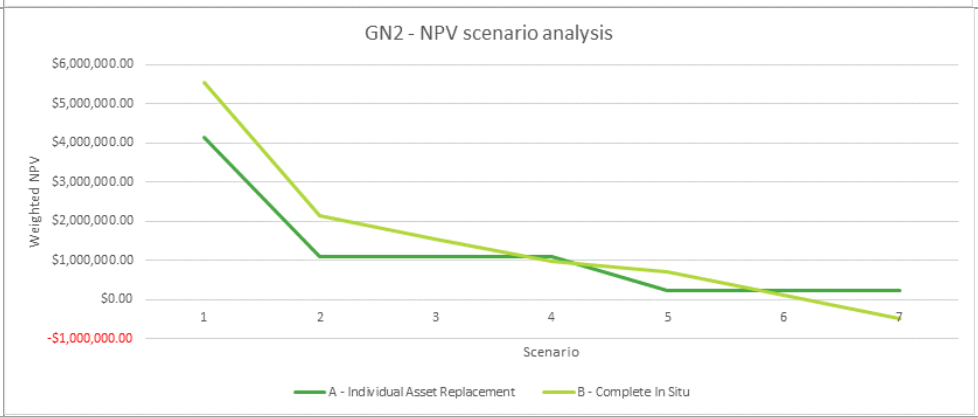
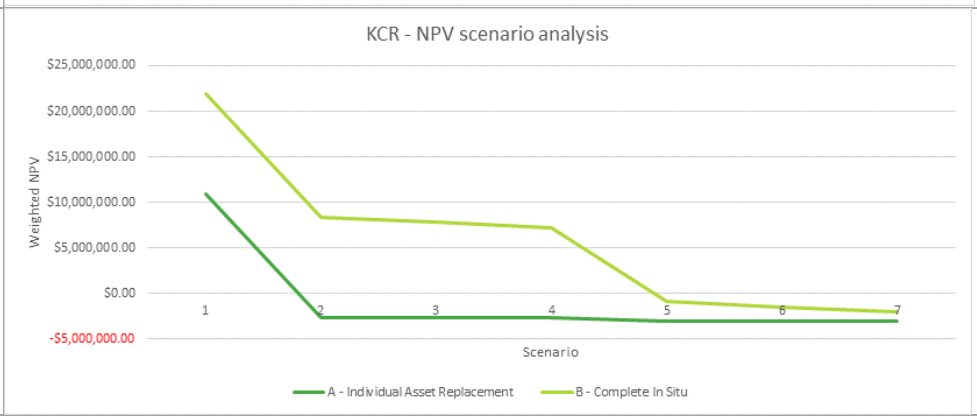
Scenario Number	Description	Commentary
1	Baseline	Baseline as submitted to AER. Corrective anticipates full renewal under defect covering obsolete assets. Corrective aspect flags additional OPEX that should be requested as health profile of asset base will shift up, should projects not proceed
2	Baseline defects, 100% of operational benefits.	Baseline as submitted to AER. Corrective anticipates full renewal under defect covering all obsolete assets. Corrective aspect flags additional OPEX that should be requested as health profile of asset base will shift up, should projects not proceed 100% of estimated operational efficiencies applied
3	Baseline defects, 50% of operational benefits.	Baseline as submitted to AER. Corrective anticipates full renewal under defect covering all obsolete assets. Corrective aspect flags additional OPEX that should be requested as health profile of asset base will shift up, should projects not proceed 50% of estimated operational efficiencies applied
4	Baseline defects, 0% of operational benefits.	Baseline as submitted to AER. Corrective anticipates full renewal under defect covering all obsolete assets. Corrective aspect flags additional OPEX that should be requested as health profile of asset base will shift up, should projects not proceed 0% of estimated operational efficiencies applied
5	Adjusted defect response, 100% of operational benefits.	Corrective analysis reduced to basic corrective costs, assuming devices can be adhoc configured on a bench and excluding full renewal of obsolete products. Assumption excludes: -MD1000 as we are depleting re-acquired devices with a reducing chance of spare working. -FAC/FV2 Busbar protections as we are depleting re-acquired spares and risk to the network is high in running a temporary solution for an extended period. -Obsolete Transformer protections as we are depleting re-acquired spares and risk to the network is high in running a temporary solution for an extended period. Corrective aspect flags additional OPEX that should be requested as health profile of asset base will shift negatively for the network, should projects not proceed 100% of estimated operational efficiencies applied

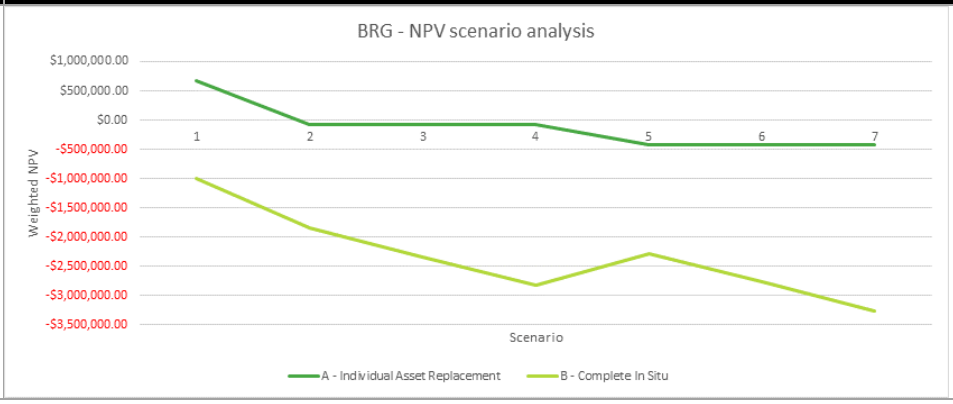
Scenario Number	Description	Commentary
6	Adjusted defect response, 50% of operational benefits.	Corrective analysis reduced to basic corrective costs, assuming devices can be adhoc configured on a bench and excluding full renewal of obsolete products. Assumption excludes: -MD1000 as we are depleting re-acquired devices with a reducing chance of spare working. -FAC/FV2 Busbar protections as we are depleting re-acquired spares and risk to the network is high in running a temporary solution for an extended period. -Obsolete Transformer protections as we are depleting re-acquired spares and risk to the network is high in running a temporary solution for an extended period. Corrective aspect flags additional OPEX that should be requested as health profile of asset base will shift negatively for the network, should projects not proceed 50% of estimated operational efficiencies applied
7	Adjusted defect response, 0% of operational benefits.	Corrective analysis reduced to basic corrective costs, assuming devices can be adhoc configured on a bench and excluding full renewal of obsolete products. Assumption excludes: -MD1000 as we are depleting re-acquired devices with a reducing chance of spare working. -FAC/FV2 Busbar protections as we are depleting re-acquired spares and risk to the network is high in running a temporary solution for an extended period. -Obsolete Transformer protections as we are depleting re-acquired spares and risk to the network is high in running a temporary solution for an extended period. Corrective aspect flags additional OPEX that should be requested as health profile of asset base will shift negatively for the network, should projects not proceed 0% of estimated operational efficiencies applied

The following table summarises the impact upon NPV under different scenarios. Generally, the preferred options align with the scenario analysis, with only N2430 and N2446 showing sensitivity to the scenarios.

Table 4 Scenario Results

Reference	Current preferred option	Scenario results
N2405	Complete SSB replacement	

Reference	Current preferred option	Scenario results
N2430	Complete In-Situ Replacement	
N2431	Complete In-Situ Replacement	
N2432	Complete In-Situ Replacement	
N2444	Complete In-Situ Replacement	

Reference	Current preferred option	Scenario results
N2446	Individual Asset Replacement	

A-1 Documentation considered

The following documentation was considered during our independent assessment:

- Australian Energy Regulator, “Industry practice application note, Asset replacement planning”, January 2019
- OER-N2405 Rev 0 - FY24-28 LT1 Secondary Systems Renewal.pdf
- OER-N2430 Rev 0 - FY24-28 FB2 Secondary Systems Renewal.pdf
- OER-N2444 Rev 0 - FY24-28 KCR Secondary Systems Renewal.pdf
- OER-N2446 Rev 0 - FY24-28 BRG Secondary Systems Renewal.pdf
- OER-N2431 Rev 0 - FY24-28 NAM Secondary Systems Renewal.pdf
- OER-N2432 Rev 0 - FY24-28 GN2 Secondary Systems Renewal.pdf
- Copy of N2405 - FY24-28 LT1 SSR - NPV Analysis Tool - Rev1.1_20221004 v1
- Copy of N2431 - FY24-28 NAM SSR - NPV Analysis Tool - Rev1.1_20221004 v1
- Copy of N2432 - FY24-28 GN2 SSR - NPV Analysis Tool - Rev1.1_20221004 v1
- Copy of N2444 - FY24-28 KCR SSR - NPV Analysis Tool - Rev1.1_20221004 v1
- Copy of N2446 - FY24-28 BRG SSR - NPV Analysis Tool - Rev1.1_20221004 v1
- Transgrid - OER-N2444 Rev 0 FY24-28 KCR Secondary Systems Renewal - 9 Nov 2021 - PUBLIC.pdf
- Transgrid - OER-N2443 Rev 0 FY24-28 NEW Secondary Systems Renewal - 9 Nov 2021 - PUBLIC.pdf
- Transgrid - OER-N2447 Rev 0 FY24-28 MPP Secondary Systems Renewal - 2 Nov 2021 - PUBLIC.pdf
- Transgrid - OER-N2446 Rev 0 FY24-28 BRG Secondary Systems Renewal - 2 Nov 2021 - PUBLIC.pdf
- Transgrid - OER-N2428 Rev 0 FY24-28 CW2 Secondary Systems Renewal - 2 Nov 2021 - PUBLIC.pdf
- Transgrid - OER-N2427 Rev 0 FY24-28 RGV Secondary Systems Renewal - 27 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2426 Rev 0 FY24-28 WW1 Secondary Systems Renewal - 28 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2436 Rev 0 FY24-28 INV Secondary Systems Renewal - 28 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2433 Rev 0 FY24-28 TOM Secondary Systems Renewal - 27 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2435 Rev 0 FY24-28 NB2 Secondary Systems Renewal - 28 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2434 Rev 0 FY24-28 LSM Secondary Systems Renewal - 27 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2430 Rev 0 FY24-28 FB2 Secondary Systems Renewal - 2 Nov 2021 - PUBLIC.pdf
- Transgrid - OER-N2432 Rev 0 FY24-28 GN2 Secondary Systems Renewal - 27 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2431 Rev 0 FY24-28 NAM Secondary Systems Renewal - 27 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2429 Rev 0 FY24-28 VP1 Secondary Systems Renewal - 27 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2419 Rev 0 FY24-28 PMA Secondary Systems Renewal - 28 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2410 Rev 0 FY24-28 FNY Secondary Systems Renewal - 26 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2411 Rev 0 FY24-28 WL1 Secondary Systems Renewal - 27 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2409 Rev 0 FY24-28 KS2 Secondary Systems Renewal - 27 Oct 2021 - PUBLIC.pdf

- Transgrid - OER-N2405 Rev 0 FY24-28 LT1 Secondary Systems Renewal - 9 Nov 2021 - PUBLIC.pdf
- Transgrid - OER-N2214 Rev 0 FY24-28 ER0 Secondary Systems Renewal - 27 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2213 Rev 0 FY24-28 BER Secondary Systems Renewal - 26 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-N2212 Rev 0 FY24-28 SE1 Secondary Systems Renewal - 26 Oct 2021 - PUBLIC.pdf
- Transgrid - OER-1194 Rev 0 Tenterfield Secondary Systems Renewal - 26 Oct 2021 - PUBLIC.pdf
- SSR Callout Performance.xlsx
- N2214 - ER0 SSR Benefits v3.0 - Scenario 1.xlsx
- Copy of Preliminary Scenario Analysis.xlsx
- Automation Renewal and Maintenance Strategy AMS Asset Class Strategy 2021/22

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