

Strategic Scope Remote Terminal Units 2020-25

January 2019



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1. Project Summary Information

PROJECT SUMMARY INFORMATION			
Work Request Description	Remote Terminal Units (RTUs)		
Work Request Number	To Be Advised	Work Request Required by Date	
Initiating Work Group	Asset Lifecycle Management – Intelligent Assets	Strategic Scope Contact	Carlos Venegas
Business Owner	Tim Hart		
Direct Value:	\$4.4M		

NOTE: – This document does not constitute approval of any funds or financial delegation. It is used to provide a high level description and justification of an allocation of funds in future years. The direct value presented above is \$18/19 direct dollars.

2. Existing Arrangements / Background

Ergon Energy manages RTU assets in the Northern and Southern regions based on risk factors facing the RTU fleet. These include technical capability, spares holdings, obsolescence, legislation and age. In alignment with asset management strategies, Ergon Energy has an ongoing program of work to address the replacement of high-risk RTUs. However, there is the added challenge of aligning asset management standards, after the merge with Energex, for a unified EQL approach and to maximise cost efficiencies.

Ergon Energy currently has in excess of 700 RTUs in-service throughout the network, within substations. RTUs are a vital asset that enables the safe operation of the electric network, through remote control of substations.

The key functions performed by these assets include:

- Control and Monitoring
- On Load Tap Changer Voltage Regulation also known as Voltage Variance Regulation (VVR)
- Auto-Reclose
- Plant Overload Protection
- Diagnostics
- Auto-Changeover

Many of the existing assets are now approaching, have reached or have passed their original design life. Ergon Energy is aware of the need to effectively manage the fleet by identifying and targeting high risk assets for proactive replacement. This is achieved by quantifying risk factors for RTUs through a Risk Evaluation Analysis (REA). The REA then produces an overall risk score for each RTU in the fleet that prioritises the unit for replacement.

Finally due to the implementation of different RTU models throughout Ergon Energy and Energex the technical capabilities and observed retirement age will differ. Therefore, the REA will produce different risk scores for individual RTUs in the Energex and Ergon fleets however the tolerable risk score is the same.

All dollar values in this document are based upon 2018/2019 dollars, and exclude overheads.

3. Rationale / Benefits

RTUs form the backbone of the larger SCADA system that is utilised to safely control and monitor the network remotely. Due to the important functions performed by these devices it is vital that Ergon Energy continues to maintain the fleet in order to minimise risks to the community, staff, equipment and environment.

Ergon Energy asset management standards require that the business implement procedures, plans and programs that ensure compliance with legislation and statutory requirements. Therefore Ergon Energy is obligated to ensure the safety and performance requirements of these assets are met.

In-service failure of an RTU poses certain risks, as detailed below:

- Failure to regulate substation voltage, potentially breaching legislative requirements.
- Extended outages to customers as unable to re-configure the power network during RTU failure resulting in abnormal network configurations.
- Inability to remotely control substation impacting planned and emergency works.
- Plant damage due to loss of applications (POP schemes & CVT monitoring)

To manage the risks to As Low As is Reasonably Practicable (ALARP) Ergon Energy must proactively replace RTUs deemed to be a high-risk of in-service failure.

Customer and other benefits include:

- Meeting health and safety objectives for staff and the community,
- Supports maintaining current level of cost associated with plant stress, pre-mature aging and damage via mitigating impacts of plant overload
- Supports maintaining current customer outage durations vis ensuring remote reconfiguration of the power network not impacted extended outages to RTU units
- Adherence to legislative acts, regulations and guidelines by reducing risk of compliance breaches,
- Maintaining network reliability and operational performance by reducing risk of in-service failures,
- Maintaining network security,
- Reduced corrective maintenance costs associated with in-service failure, and

- Improved plant expected life by mitigating plant overload impacts with RTU application software.

4. Drivers

The key drivers behind the need of this program are as follows:

- Analysis of risk factors facing the RTU fleet and their criticality
- The increasing likelihood of in-service failure of RTUs that have surpassed their expected life
- The risks to the customers, staff, network and business if an in-service failure occurs
- No spares in stores and an inability to procure equipment to replace the units if an in-service failure occurs
- Obsolete RTU technology does not support modern communication protocols, DNP3, IP and new protection relay technology resulting in sub-optimal management of the power network or extra expense implementing, maintaining and replacing other components to perform required functions (e.g. Voltage VAR Regulation Relays).

5. Scope

RTUs in the Ergon Energy fleet will be considered for proactive replacement throughout the following AER period based on an analysis of factors, summarised in the options below. Included in the replacement of these units will also be the upgrade of existing HMI where the cost to interface to a replaced unit is not cost efficient compared to replacement.

6. Exclusions

Excluded from the scope of this program are the following:

- Current replacement programs for RTUs being carried out in 2015-2020 period
- Data Concentrators (These units would be replaced under a DMS or master station program)

7. Assumptions

Assumptions include:

- Spare parts for equipment that is to remain in the network will be available for the complete AER period.
- In accordance with the Energy Queensland Control System asset management plan, the opportunistic bundling of RTU replacements will continue where large numbers of protection relays or substation wiring is required, in other projects.

8. Project / Program Dependencies

The following items have potential impact upon the proposed program of work:

- This program may rely upon the outcomes of the Commercial off the Shelf (COTS) RTU program to determine the replacement equipment for the current RTU units used in the fleet. For more information please refer to the Control systems Asset Management Plan.
- The selection of which RTU and communications protocol is being used could be impacted by changes in cyber security policies, potentially impacting the cost.

9. Supporting Information

This program considers the following risks when identifying RTUs for proactive replacement:

- Age
- Technical Capability
- Spares Availability

Through the REA the factors above are quantified and each RTU in the fleet is given a risk score. Due to the implementation of different RTU models throughout Energex and Ergon the technical capabilities and observed retirement age will differ. Therefore, the REA will produce different risk scores for RTUs in the Ergon and Energex fleets and also have different tolerable scores.

9.1 Age Risk

As per the Control System Asset Management Plan (AMP) Ergon Energy has 89 RTUs that will be operating beyond their nominal life by the end of 2025. In the Ergon Energy regions, for RTUs, the observed nominal life is 25 years. Past this age the likelihood of an in-service failure increases. Furthermore as the asset continues to remain in-service there are other escalating risk contributors such as obsolescence, lack of spares, and lack of technical expertise. There is also the increasing cost necessary to continue to maintain the asset operational. These contributing factors also make an in-service failure more laborious to manage and result in extended SCADA outages.

9.2 Technical Capability Risk

As per the Control System AMP, RTUs currently over the age of 30 are obsolete RTU technologies and therefore use obsolete communication standards and do not align with current deployment architecture, internet protocol (IP). Furthermore due to the age of the RTUs the firmware installed on the units are at risk of failing, resulting in the RTU not restarting after configuration changes are made, therefore restricting network augmentation capabilities.

Finally as the RTUs do not meet the current IP deployment architecture standards Ergon Energy is at risk of incurring extra costs to retain equipment in the network.

9.3 Spares Availability Risk

The assets currently over the age of 30 are of significant risk of in-service failure, having greatly surpassed their expected life. Furthermore, it is not possible to procure compatible hardware as these units have been declared obsolete. As a result there are no spares available across the regions, with a spare unit only being generated when a unit is replaced or removed from service. Therefore if an in-service failure occurs the entire RTU will need to be replaced and substation circuits re-wired, therefore increasing the risk of extended customer outages. For further information please refer to the Control System AMP.

10. Options Considered

Listed below are the options considered to manage the RTU fleet. It should be noted that all options below are based on the data currently available for analysis. As data quality improves over time, the options analysis will also improve.

10.1 Option 1 – Testing optimised replacement volumes

This option would see the forecast replacement of RTUs through a REA. The REA quantifies the life limiting factors of RTUs, including those in the **Error! Reference source not found.** section.

Expected impacts of this approach:

- Only units that are the most risk to the safe operation of the network, due to in-service failure risk, will be replaced.
- Maximised cost efficiency, due to a targeted number of replacements.
- Impact to spares holdings for new RTUs would be minimised due to targeted replacements.
- Opportunistic bundling of works, to reduce costs of RTU replacements.
- Alignment of asset management strategies with business objectives and asset management plan.

The risk factors discussed in the **Error! Reference source not found.** section are quantified through the REA and a risk score is calculated for each RTU, with a tolerable score being up to 21. This score is indicative of an RTU that is within the tolerable limits for technical capability, meets or supports legislative requirements by running latest Voltage VAR Regulation (VVR) applications or supporting modern relays, has spares available and has not greatly surpassed design life.

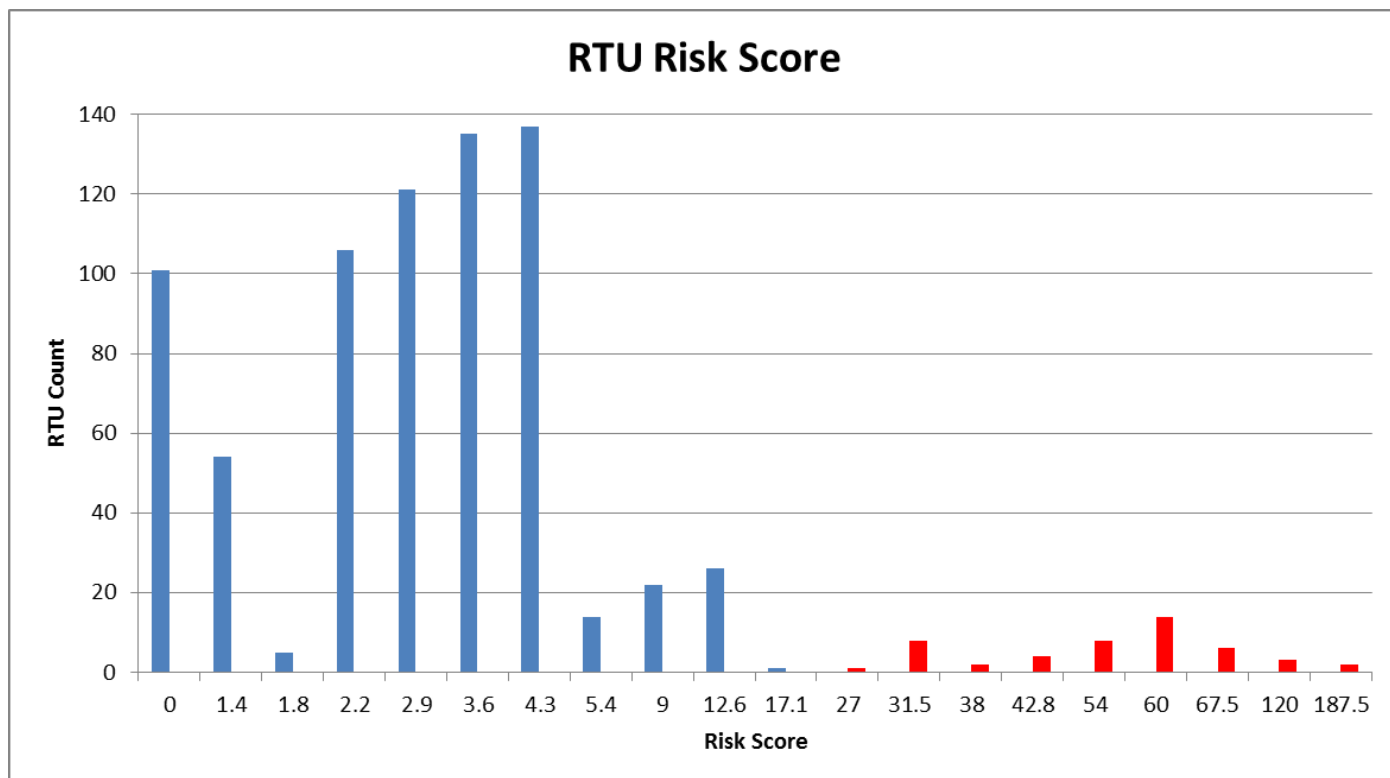


Figure 1 – RTU Risk Score

Based on the analysis above, a total of 49 RTUs are required to be replaced.

Out of this total:

- 11 RTUs will be decommissioned,
- 8 RTUs will be replaced in this current AER period (2015-2020), and
- 1 RTU is bundled with another project and will be completed in 2020.

Therefore, only 29 RTUs will be required to be replaced in the upcoming AER period (2020-2025). Some of the older RTUs, known as PC-SACS, were built as a complete unit which equates to multiple current standard RTUs; therefore to replace a single unit of PC-SACS requires multiple RTU installations. A site by site requirement analysis reveals a total of 48 installations are required.

Year	Total Installations	Total Cost
2020 - 2025	48	\$4,362,780

Table 1 – Installations

This option would address the risks by removing from service the most at risk units that would cause significant SCADA outages and other network impacts, prior to in-service failure.

The network (business) risk the organisation would be exposed to if this program was not undertaken is not deemed to be as low as reasonably practicable (ALARP). Addressing the risks as detailed above through implementation of this preferred option will reduce Energy Queensland's risk exposure.

Finally deferring of capital expenditure by targeting a smaller number of RTUs, unlike option 2, will result in a much better NPV and thus better value for Ergon Energy. Therefore option 1 is the recommended and preferred option.

10.2 Option 2 – Testing higher replacement volumes

Option 2 does not consider other risk factors or asset performance information to forecast replacements and is simply based on the age of the RTU. In Ergon Energy regions for RTUs the nominal replacement age is approximately 25 years and would determine the replacement of the unit.

Expected impacts of this approach:

- Higher forecast replacement numbers over the period than the preferred option,
- Premature replacement of in-service RTUs that are performing as expected, resulting in non-prudent expenditure for the AER period,
- Financial Impacts to the business due to Increased costs from higher than necessary replacement numbers and inability to bundle works, and
- Limited application of asset management strategies and misalignment of business objectives.

Based on a 25 year replacement age it is expected that 89 RTUs would require replacement across the 2020 – 2025 period.

Year	Total RTUs	Total Cost
2020 - 2025	89	\$13,724,580

Table 2 - RTUs

This option would address the risks by removing from service the most at risk units, based on age, which have the potential to cause significant extended SCADA outages and other network impacts, prior to in-service failure. While this option would address risks and mitigate them to ALARP, the financial and business resourcing impacts of such a program would not be practical. Furthermore, the increased capital expenditure will result in a worse NPV than option 1. Therefore option 2 is not recommended.

10.3 Option 3 – Testing lower replacement volumes

Option 3 would see the replacement of RTUs on a fail/fix basis over the coming AER period, 2020-2025. A fail/fix option would place Ergon Energy at risk of extended SCADA outages, possible abnormal network configurations and inability to remotely control Ergon Energy substations.

In-service failures pose a low-moderate quality of supply risk, low-moderate reliability risk for network customers and low risk to staff safety (after operational mitigation). Breach of legislation or compliance entails a low risk of loss of public trust, public outrage, and negative media attention for the business.

In addition to the risks posed by this option is the cost of maintaining RTUs in service far past the identified nominal life comes at increasing cost. This is due to the need for increasing maintenance and the increasing cost of maintaining sparse technical expertise. Based on available failure data, it is expected 10 RTUs would require replacement as part of this option's program.

Year	Total RTUs	Total Cost
2020 - 2025	10	\$1,545,151

Table 3 – RTUs

This option would not address the risks of in-service failure but instead retrospectively manage the incident through corrective maintenance works. The network (business) risk the organisation would be exposed to if this program was undertaken is not deemed to be as low as reasonably practicable (ALARP). Failure to address the risk of in-service failure will increase Energy Queensland's risk exposure. Furthermore while the estimated cost is lower than option 1, due to the urgent and unplanned nature of corrective maintenance, the final cost is expected to exceed the planned works of option 1. Therefore option 3 is not recommended.

11. Risk Assessment

The table below details the risk the organisation would be exposed to if the project was not undertaken, such as in option 3.

Risk Scenario	Risk Type	Consequence (C)	Likelihood (L)	Risk Score	Risk Year
Failure of an RTU to correctly control network or inability to control network resulting in network outage for 5,000 customers	Customer	3	3	9	2020
In-service failure of an RTU with no spares resulting in extended SCADA outages and inability to remotely control Ergon Energy substations, or abnormal network configuration	Business Impact	3	4	12	2020
Failure to replace aged RTUs resulting in significant cost premium (>50% of estimates) required to deliver other agreed strategic initiatives.	Business Impact	3	4	12	2020

Table 4 – Risk Assessment

Network Risk Evaluation Matrices:

- [Consequence and Likelihood Table](#)
- [Tolerability Scale](#)

Risk Based Option Analysis:

By proceeding with Option 1, the risks detailed above are mitigated by:

- Reducing the likelihood of customer outages and increasing outage sizes by replacing RTUs at risk of in-service failure.
- Reducing the need for abnormal network configurations as a result of RTU failure by replacing RTUs at risk of in-service failure.
- Efficiently bundling replacements of RTUs with other replacement activities to avoid extra inefficient costs replacing units during other works.

Risk Assessment Outcome:

The network (business) risk the organisation would be exposed to if the project was not undertaken is not deemed to be as low as reasonably practicable (ALARP). Addressing the risks as detailed above through implementation of the preferred option will reduce Ergon Energy's risk exposure.

12. Delivery Timeframe

Proactive replacement of RTU equipment would be progressively rolled out over the 2020 to 2025 regulatory period, however this ongoing program will continue into the next regulatory period.

It is noted that the delivery timeframe is subject to change by numerous stakeholders and parties, especially when subject to bundling of projects or the balancing of priorities, schedules and resources as this program of work progresses.

13. Project Cost Summary

The project cost summary below outlines the cost of the preferred option (Option 1) that will allow Ergon Energy to maximise cost efficiency and manage the RTU fleet effectively.

Volume & Unit Rate Details			15-20 Regulatory Period					20-25 Regulatory Period				
	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25
Actual Volume	5	39	17	15	9							
Forecast Volume						7	14	10	10	10	10	8
Actual Expenditure (\$,000)	\$444	\$3,466	\$1,511	\$1,333	\$800							
Forecast Expenditure (\$,000)						\$636	\$1,272	\$909	\$909	\$909	\$909	\$727

Table 5 – Cost Summary

Note – the above cost summary is presented in \$18/19 direct dollars.

Appendix A. Definitions, Abbreviations and Acronyms

BESS	Battery Energy Storage System
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DER	Distributed Energy Resource
DSO	Distribution System Operator
ENA	Energy Networks Association
ENTR	Electricity Network Transformation Roadmap
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
HV	High Voltage (35kV – 230kV AC)
IS	Isolated System
LV	Low Voltage (50V – 1 000V AC)
MEGU	Micro Embedded Generating Units
MV	Medium Voltage (1kV – 35kV AC)
NER	National Electricity Rules
PQ	Power Quality (of the network)
PV	(Solar) Photovoltaic System
QoS	Quality of Supply (to a customer)
SCADA	Supervisory Control and Data Acquisition
ZS	Zone Substation