Microwave Systems Replacement

Regulatory Business Case (RBC) 2024-29

PowerWater

Contents

1. Summary

This business case has been prepared to support the 2024-29 Regulatory Proposal. The business case demonstrates that Power and Water has undertaken appropriate analysis of the need for the expenditure and identified credible options that will resolve the need and ensure that Power and Water continues to meet the National Electricity Objectives and maintain the quality, reliability, and security of supply of standard control services and maintain the safety of the distribution system.

The proposed investment identified in this business case will undergo further assessment and scrutiny through Power and Water's normal governance processes prior to implementation and delivery.

This business case addresses the very high risk of loss of the microwave communications links due to identified condition, compliance and obsolescence issues.

1.1 Business need

The SCADA and Communications network is critical to ensure the safe and reliable operation of the electrical network. The microwave communications systems are used to provide tele-protection to ensure public safety and minimise potential damage to the electricity assets by clearing electrical faults as quickly as possible. Microwave radio terminals are relied upon for long distance communications where fibre is not economical. Power and Water has 64 microwave terminal units installed at 18 locations across the network.

Power and Water is required to maintain a communications network. The Network Licence, enforced by the Electricity Reform Act 2000, requires the communications network to remain compliant with legislative requirements, including:

- System Control Technical Code.
- Power Networks Technical Code and Planning Criteria.
- ICT requirements of Power and Water and the NT Government.
- The recently legislated Commonwealth Critical Infrastructure Bill.

To meet these obligations, it is necessary for Power and Water to manage assets that are obsolete, no longer supported by the vendor, or at the end of their design life.

The vendor has issued End of Support notices for two asset types, meaning that these assets are approaching the end of their serviceable life. After the End of Support date, technical assistance, replacement assets and software and firmware patches will no longer be available. The impact is an increasing risk to the network as the spare assets are consumed and the technology becomes obsolete and less likely to be compliant with cyber security requirements.

The End of Support notice affects 48 assets installed at eight locations on the network:

- Last time buy for 16 Ceragon Indoor Unit 1500HP units occurs on 31 December 2022
- End of Support for 32 Ceragon Indoor Unit IP-10G units occurs on 30 November 2022

1.2 Options analysis

The options considered to resolve this need are shown in Table 1.

Table 1 Summary of credible options

Option No.	Option name	Description	Recommended
1	Reactive replacement	Replacement at failure of microwave communications assets	No. Reactive replacement is imprudent for critical assets and could have a high cost of risk. Run to failure does not manage increased risk to worker safety, reliability and security of supply. Not an accepted industry approach.
2	Proactive replacement	Pro-active (age-based) replacement of poor condition, high risk and non-compliant microwave communications assets	Yes. Prudent and efficient approach, especially for assets like microwave communications systems that provide tele-protection of critical electricity assets
3	Migrate to fibre where possible	Transfer communications to fibre where possible. Microwave radio will be retained where necessary and as a back up.	No. Not efficient because fibre communications are not economical for long distance communications as is common in the NT.

As part of a holistic assessment, non-network solutions, capex/opex trade-offs and retirement or derating options were also considered but found that none of these options addressed the underlying network issues.

A cost benefit analysis was completed for each of the options where the risk reduction, compared to Option 1, was used as the benefit achieved by the option.

1.3 Recommendation

The recommended option is Option 2 - Proactive replacement of microwave communications assets that are either at or approaching end of vendor support, at an estimated cost of $1.3 million (real 2021/22). The option proposes to replace the 48 assets identified when at or approaching end of vendor support with the modern equivalent recommended by the vendor by June 2026. As assets are replaced, they will be retained as spares in case there are any failures to enable a managed replacement program.

Table 2 shows a summary of the expenditure requirements for the 2024-29 regulatory period.

Table 2 Annual capital and operational expenditure ($'000, real 2021/22)

Item	FY25	FY26	FY27	FY28	FY29	Total
Capex	1,000	250	-	-	-	1,250
Opex	-	-	-	-	-	-
Total	**1,000**	**250**	**-**	**-**	**-**	**1,250**

2. Identified need

This section provides the background and context to this business case, identifies the issues that are posing increasing risks to Power and Water and its customers, describes the current mitigation program and its delivery status, highlights the consequence of asset failure, and provides a risk assessment of the inherent risk if no investment is undertaken.

2.1 Asset profile

Power and Water relies on microwave radio terminals as part of the communications network. The microwave systems are part of the ring network in the greater Darwin area and for the Lake Bennet to Katherine Microwave link. There are 64 terminal units installed.

The microwave network is used for the following services:

- Tele-protection
- SCADA
- UHF private mobile radio site interconnections
- Communications Network Management System and
- Corporate IT connections

The protection and SCADA services are critical services for the management and operation of the electrical network. The microwave network assists in providing links within a ring network where fibre optic bearers do not exist or are not economic to build.

The SCADA and Communications network is critical to ensure the safe and reliable operation of the electrical network. The microwave communications systems are used to provide tele-protection to ensure public safety and minimise potential damage to the electrical assets by clearing electrical faults as quickly as possible. The Communications network must also remain compliant with legislation and regulations.

To meet these obligations, it is necessary for Power and Water to manage assets that are at the end of their design life, obsolete or no longer supported by the vendor.

2.2 Asset condition and issues

A Last Time Buy, End of Maintenance and End of Support notice was issued to Power and Water on the 2nd February 2017 for the Ceragon Indoor Unit IP-10G which is used in the Power and Water microwave network. Maintenance and Support both end on 30 November 2022. Power Water has 32 units installed on the network.

A notice stating the Ceragon Indoor Unit 1500HP would be discontinued was issued to Power and Water in May 2022. Last orders will be accepted up to 31 December 2022 while service support will be maintained according to contractual obligations. Power Water has 16 units installed on the network. The numbers and locations of the communication units affected are shown in Table 3 Numbers of microwave communications units with imminent end of life notices below.

Table 3 Numbers of microwave communications units with imminent end of life notices

Microwave Systems (REPEATERS ONLY)	Unit	Number
PRWT-CIRS	Ceragon Indoor Unit 1500HP	4
CIRS-DRDCS	Ceragon Indoor Unit 1500HP	4
MMCS-Hughes (HURS)	Ceragon Indoor Unit 1500HP	4
Hughes-LB(LBCS)	Ceragon Indoor Unit 1500HP	4
LB-RF(RFCS)	Ceragon Indoor Unit IP-10G	4
RF-FH(FHCS)	Ceragon Indoor Unit IP-10G	4
FH-PCM	Ceragon Indoor Unit IP-10G	4
PCM(PMCS)-OS(OHCS)	Ceragon Indoor Unit IP-10G	4
PCM-PC132	Ceragon Indoor Unit IP-10G	4
OS-KA132	Ceragon Indoor Unit IP-10G	4
LB(LBCS)-BAWT	Ceragon Indoor Unit IP-10G	4
KA132-KA12	Ceragon Indoor Unit IP-10G	4
Total		**48**

The notices received for the Ceragon Indoor Unit IP-10 and 1500HP terminal units demonstrate that these assets have reached end of life.

No more of these assets can be purchased and end of maintenance and support from the vendor for Ceragon Indoor Unit IP-10 will be on 30 November 2022. This increases the risk of retaining these assets on the network as no spares will be available should an asset fail, and no support will be available for resolution of asset or software issues.

On average each wet season two microwave communications units are damaged due to lightning strikes and require repair or replacement. Repair is only able to be done by the vendor but it is not guaranteed that a unit damaged by lightning will be repairable and support will only be available for the Ceragon Indoor 1500HP terminal units after 30 November 2022.

Hence, once units are no longer available to be purchased, as in the case of the Ceragon Indoor Unit IP-10 and 1500HP terminal units, the risk of not having sufficient spares of the required technical specifications are increased and it is more likely that a modern equivalent unit will need to be deployed at an elevated cost.

2.3 Regulatory compliance

Power and Water is required by regulations to provide a communications network to ensure the secure and reliable operation of the electricity network. To achieve compliance with this requirement, Power and Water must act to ensure reliability communications between Darwin and Alice Springs.

A summary of the compliance requirements are set out in Appendix B.

2.4 Current management programs

Our current approach to managing assets is to hold operational spares so when there is a failure, the failed asset is replaced with the same make and model of asset with the same technical specifications for a quick swap. As assets are removed from the network but are still in serviceable condition, they are held as spares. The current level of spares is:

Table 4 Summary of available spares

Unit type	Number of spares
Ceragon 1500HP Indoor	6
Ceragon 1500HP Outdoor	6
Ceragon IP10G Indoor	6
Ceragon IP10G Outdoor	32

It is important to note that these assets have different technical specifications and operate between 6GHz and 12GHz and outdoor units can be either Transmit High or Transmit Low. This limits the level of redundancy.

Communications assets have many variations to technical specifications for the same asset type including the frequency used and whether they are high or low band. So, while there may be many units available in store, there are typically only one or two that are compatible with the technical specifications of each specific type of unit that is deployed on the network. This means that the level of redundancy is less than what it appears at face value based on the number of spares.

Where the same type of asset is not available, a modern equivalent is used. In these cases, the asset must be replaced at both ends of the link to ensure compatibility and there are additional wiring and installation requirements that result in an increased cost and time to complete the replacement. In addition, this work would be undertaken in a reactive manner, which typically involves increased costs.

For the current fleet of assets, the modern equivalent asset will be available is the Ceragon IP 20. However, the functionality of this unit has not been fully assessed by Power and Water to ensure it meets our needs, and anecdotal evidence from other DNSPs suggests it may have synchronisation issues that may prevent it from being compatible with MPLS technology. This would therefore result in a suboptimal outcome that is not aligned to our MPLS transition strategy. Power and Water is currently undertaking testing and a trial of potential replacement technology.

2.5 Risk assessment

Power and Water has developed the Risk Quantification Procedure to enable consistent quantification of risk from their assets into dollar terms. The procedure is applicable to most assets where there is a direct link between an asset failure and the impact of that failure on the defined consequence categories.

However, there is insufficient data to undertake a quantitative analysis on the impact of loss of the microwave communications links, so a qualitative assessment of the risk has been undertaken using the relevant key consequence areas set out in the Risk Quantification Procedure.

The microwave communications links are critical for control of the network for protection systems, to undertake network switching operations and to have visibility of the network status. Without adequate reliability there is a high risk of loss of communications, contributing to issues in Alice Springs including:

- **Health and Safety:** Loss of visibility of the network could endanger Power and Water's field crews and the public through failure to manage the network configuration to isolate faults, incorrect operation of protection systems, or through operation of switches that could energise faulted sections of the network.
- **Service delivery:** Loss of visibility of the network could result in delayed response times, extending outages and therefore result in poor service to our customers

The risk assessment is shown in Figure 1 in the matrix format as specified in the Enterprise Risk Management Standard. It shows the current risk ranking and the target risk ranking.

	Insignficiant	Minor	Moderate	Major	Severe
Almost certain	Medium	High	Very High	Extreme	Extreme
Likely	Low	Medium	High	Very High	Extreme
Possible	Low	Low	Medium	High	Very High
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	Medium

Figure 1 Qualitative risk assessment

2.6 Summary

This section has set out the risks posed to Power and Water to meet their obligations caused by the two communications network devices reaching end of support from the manufacturer.

The communications network is critical to ensure the safe and reliable operation of the electrical network, and that the Network Licence, enforced by the Electricity Reform Act 2000, requires the communications network to remain compliant with legislative requirements, including:

- System Control Technical Code
- Power Networks Technical Code and Planning Criteria
- ICT requirements of Power and Water and the NT government
- The forthcoming Critical Infrastructure Bill

To meet these obligations, it is necessary for Power and Water to proactively manage assets that are obsolete, no longer supported by the vendor, or at the end of their design life, through replacement or spares management.

A total of 48 assets in 12 locations have been identified that will reach the end of their serviceable life as identified through the End of Support and Last Time Buy notices.

In addition, the ability of spares management to provide an effective path to manage the asset fleet through a transition to a new type of asset is limited due to the variation of the technical specifications of individual units.

3. Options analysis

This section describes the various options that were analysed to address the increasing risk to identify the recommended option. The options are analysed based on ability to address the identified needs, prudency and efficiency, commercial and technical feasibility, deliverability, benefits and an optimal balance between long term asset risk and short-term asset performance.

3.1 Comparison of credible options

Credible options are identified as options that address the identified need, are technically feasible and can be implemented within the required timeframe. The following options have been identified:

- Option 1 - Replace on failure. This option proposes to continue to operate / extend the lives of existing assets and replace on failure.
- Option 2 - Planned replacement. This option involves replacing the assets with a modern equivalent as a proactive programme.

Table 5 provides a high-level comparison of the two identified credible options. A detailed discussion of each option is provided in the following sections.

Table 5 Summary of options analysis outcomes

Assessment metrics	Option 1	Option 2
NPC ($'000, real FY22)	965	1,290
BCR	NA	NA
Capex ($'000, real FY22)	500	1,250
Meets customer expectations	○	●
Aligns with Asset Objectives	○	●
Technical Viability	○	●
Deliverability	◑	●
Preferred	✗	✓

● Fully addressed the issue ◕ Adequately addressed the issue ◑ Partially addressed the issue ○ Did not address the issue

3.1.1 Option 1 – Replace on failure

This option proposes to continue to operate / extend the lives of existing assets and replace on failure at an estimated cost of $0.5 million (real 2021/22). Once spares are consumed, it will result progressive replacement with the modern equivalent asset (currently the IP 20) rather than a planned transition to new asset/technology type.

As discussed in section 2.4, Power and Water holds a number of spares to manage failures but there are few spares available for each individual unit due to technical specifications. On average each wet season two microwave communications units are damaged due to lightning strikes and require replacement, consuming the operational spares of the Ceragon IP-10 and 1500HP assets. This will result in relatively rapid reduction of the available spares of specific technical specifications and the need to start installing the modern equivalent.

Identified issues with this approach include:

- The current microwave systems use SDH and PDH technology. The modern equivalent units (IP 20) use MPLS technology so there may be additional compatibility issues if the assets are not replaced with a coordinated approach.
- Lack of support from the vendor, including cessation of any software or firmware patches will increase the risk of cyber security vulnerability and compliance with regulation.
- Each replacement will be more expensive than for an equivalent planned replacement.
- The risk to reliability and security of the communications network will increase due being in a N-1 configuration for the extended period of time required to install the modern equivalent asset (compared to like for like replacement).

Hence, as the number of operational spares reduces, the risk of this approach increases.

The total capex for this option was forecast based on 2 units failing per year (one each of IP10 and IP1500) and the probability of requiring a modern equivalent replacement estimated based on the number of spares available so each year had a probability weighted cost.

The analysis was completed over a 15 year period to be equivalent to Option 2 where new assets are installed and have an approximate 15 year life span (CA RIN Table 5.2).

The total net present cost of this option was found to be $1.0 million (real 2021/22) for the 15 year period. While this option has a lower cost, it will have a higher level of risk and suboptimal outcome in terms of cyber security, compliance with regulation and functionality compared to Option 2.

This option is not recommended.

3.1.2 Option 2 – Proactive replacement

This option involves replacing the assets with a modern equivalent as a proactive programme at a cost of $1.3 million (real 2021/22). The scope of this option is to replace 32 IP-10G units in 2024/25 and replace 16 1500HP units in 2025/26 with a modern equivalent asset that aligns with the network migration to a modern equivalent product.

The timing of these replacements is based on the time required to identify and trial an alternative technology to ensure it meets Power and Water's needs, our ability to manage the asset with the existing stock of spares and resourcing of our team with other commitments.

Power and Water is currently assessing the preferred device to replace the Ceragon IP-10 and 1500HP. Once decided, the design and works required to install the new unit will be designed. This option will address the need by replacing the end of life asset. Undertaking this in a planned approach minimises the risk to the communications network, ensures the optimal technical solution for Power and Water is implemented, and therefore ensures the security and reliable operation of the electricity network.

The advantages of this option are:

- Current microwave systems use SDH and PDH technology. The modern equivalent units are likely to use MPLS technology. Replacing the entire system will avoid any compatibility issues and ensures alignment with the broader strategy to migrate to MPLS technology.
- Avoids any communications networks downtime between asset failure and installation of the new asset. Therefore minimising risk to network safety and reliability.
- Benefits are that this will have efficiency benefits and result in a safer and more reliable comms network compared to Option 1.

On average each wet season causes the loss of two microwave communications units from lightning strikes. This uses up spare assets so require proactive replacement (freeing up additional spares) for managed transition to new asset types. Hence a planned replacement to an asset type that will have spares available to order is a prudent approach. There are sufficient existing spares available to support these assets until the planned replacement dates.

To model this option for assessment compared to Option 1, replacement of all Ceragon Indoor Unit IP-10 and 1500HP terminal units was assumed, with eight sites occurring in 2024/25 and four in 2025/26. A cost of $20,000 per year was included to represent the cost of replacing assets that failed due to lightning strikes, hence applying the same assumption to both Options and making them comparable.

The total net present cost of this option was found to be $1.3 million (real 2021/22). While this is a slightly higher than for Option 1, it results in a significantly better network outcome. This option will result in a lower level of risk, improved outcome in terms of cyber security, compliance with regulation and functionality compared to Option 1. It is highly likely that if the benefits of this option could be quantified, then it would result in a more positive NPV for Option 2 compared to Option 1.

This option is recommended.

3.2 Non-credible options

Our analysis also identified a number of options found to be non-credible. These options are described below and were not taken through to detail analysis for the reasons provided.

3.2.1 Migrate to fibre – not technically or economically viable

This option would transfer communications to fibre where possible. Microwave radio will be retained where necessary and as a back-up.

There are two microwaves links that will be replaced by fibre optic during the current period, however the remainder are significantly more expensive, and it is not considered economic to convert due to the large distances between the remaining microwave link stations. This option is not considered economically prudent nor is it feasible to complete the construction within the timeframe required to replace the microwave assets that are at end of life.

3.2.2 Retire or de-rate assets to extend life – does not address the need

Total retirement of the assets is not a credible option as the communications network is required for safe and reliable operation of the electricity network. However, each option will assess where an asset type can be retired or the topology can be changed to ensure prudency and efficiency of the option.

3.2.3 Non-Network alternatives – does not address the need

Due to the type and function of the assets in the SCADA and Communications network, there are no non-network alternatives or solutions that can be implemented in place of direct asset replacement with like for like or modern equivalent assets.

3.2.4 Capex/Opex Substitution – does not address the need

Power and Water communications network is primarily used for the provision of protection services. The protection services are critical to ensure safety of the public and personnel and to minimise damage to assets. Protection systems require high reliability and availability communications systems. Third party communications providers do not guarantee availability or reliability to the levels required for a protection system.

Due to the criticality of the protection service, opex substitution is not available, leaving the only option to replace the assets.

4. Recommendation

The recommended option is Option 2 – Proactive age based replacement at an estimated cost of $1.3 million (real 2021/22) to be most prudent and cost effective to meet the identified needs.

The proposed program is consistent with the National Electricity Rules Capital Expenditure Objectives as the expenditure is required to maintain the quality, reliability and security of supply of standard control services and maintain the safety of the distribution system.

4.1 Strategic alignment

The "Power and Water Corporation Strategic Direction" is to meet the changing needs of the business, our customers and is aligned with the market and future economic conditions of the Northern Territory projected out to 2030.

This proposal aligns with Asset Management System Policies, Strategies and Plans that contributes to the D2021/260606 "Power and Water Strategic Direction" as indicated in the table below.

Table 6 Alignment with corporate strategic focus areas

	Strategic direction focus area	Strategic direction priority
1	Customer and the community at the centre	Improve Public Health and Safety
2	Always Safe	Cost Prudency

4.2 Dependent projects

There are no known projects or other network issues that are dependent on the resolution of this network issue.

4.3 Deliverability

The project involves a relatively small amount of expenditure and asset volumes, uses well understood replacement equipment and is distributed across two regulatory years.

4.4 Customer considerations

As required by the AER's Better Resets Handbook, in developing this program Power and Water has taken into consideration feedback from its customers.

Feedback received through customer consultation undertaken at the time of writing this PBC, has demonstrated strong support amongst the community for appropriate expenditure to enable long term maintenance of the network to ensure continued reliability, maintainability and safety of supply.

4.5 Expenditure profile

Table 7 shows a summary of the expenditure requirements for Regulatory Period 2025-29 and financial evaluation metrics, respectively.

Table 7 Annual capital and operational expenditure ($'000, real FY22)

Item	FY25	FY26	FY27	FY28	FY29	Total
Capex	1,000	250	-	-	-	1,250
Opex	-	-	-	-	-	-
Total	1,000	250	-	-	-	1,250

4.6 High-level scope

A breakdown of the scope of the works in the preferred option in terms of types of microwave communications units to be replaced is shown in Table 8.

Table 8 High level scope of Option 2 (preferred) works in terms of replacement unit numbers and costs

Communication unit to be replaced	#Units					
	RY25	RY26	RY27	RY28	RY29	Total
Ceragon Indoor Unit IP-10G	32	0	0	0	0	32
Ceragon Indoor Unit 1500HP	0	16				16
Total	**32**	**16**	**0**	**0**	**0**	**48**

Appendix A. Cost estimation

The estimated cost for this program is based on unit costs for replacement of different type of microwave communications units.

There are two radio link units required per link and each link has duplicated assets for redundancy, hence there are four assets per link. The cost is estimated to be $25,000 per unit (installed and commissioned) based on recent projects which equates to $100,000 (real 2021/22) per radio link.

There are 12 Links that require replacement at $100,000 per link, with a total cost of $1.2 million (real 2021/22).

Appendix B. Compliance requirements

Power and Water is required to maintain the communications network to ensure compliance with a number or legislative requirements. This is consistent with the principles of the Risk Quantification Procedure, and while there are legislated penalties for non-compliance, compliance has been considered in a qualitative manner.

The relevant Legislation, Regulation and Codes include:

- Electricity Reform Act 2000
- Network Licence (varied 15 May 2020)
- National Electricity (NT) Rules (NT NER)
- Network Technical Code and Network Planning Criteria (Network Technical Code)
- System Control Technical Code

The key clauses that relate to the provision of communications systems are:

- The System Control Technical Code Clause 6.18(a) requires System Participants (the definition includes Power and Water as the network operator) to provide control and monitoring, alarms and measurements to the Power System Controller's SCADA system via communication links.
- The Network Technical Code Clauses 3.2.6 and 3.3.6.2 define the communications links between a User (generator or load) and the control centre (System Control) to be the responsibility of the Network Operator.
- The Network Licence Clause 10 requires Power and Water to comply with all applicable provisions of the System Control Technical Code and the Network Technical Code.
- The Electricity Reform Act 2000 Clause 31 provides a maximum penalty of 2,500 penalty units for contravening the licence conditions. A penalty unit is worth $157 in 2021/22[1], providing a maximum penalty of $392,500 per contravention.

There are clear legislative and government requirements for Power and Water to maintain a modern communications system and that the requirements are expected to become more stringent within the next few years with the introduction of the proposed Critical Infrastructure Bill. Decisions made on the technology and asset types installed now must provide real options[2] for providing the cyber security capability and technology compatibility required in the near future.

[1] https://justice.nt.gov.au/attorney-general-and-justice/units-and-amounts/penalty-units

[2] Regulatory Investment Test for Distribution, Application Guidelines, December 2018, Australian Energy Regulator, Section 3.2.3

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