Retirement of DWDM systems

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 increasing risk to the safety and reliability of the network presented by existing DWDM systems at the end of their technical life.

1.1 Business need

Dense Wavelength Division Multiplex (DWDM) systems are used to increase the data carrying capacity of optical fibre cables. They operate by transmitting data using multiple wavelengths through a single fibre optic core. Each Wavelength acts as a separate communication channel, hence increasing the capacity of a single fibre and negating the need for multiple fibres to be installed.

DWDM technology was initially implemented by Power and Water due to insufficient fibre optic cores for critical communications. However, in recent years Power and Water has expanded its fibre optic network so the need for DWDM has reduced.

Power and Water currently has two DWDM nodes in service on the network, one located at the Hudson Creek Control Centre and one at the Disaster Recovery Control Centre (DRCC). The equipment is at end of life and operating beyond the end of support advised by the vendor.

In 2015 the Vendor issued a notice that specified:

- Last time buy at 31 December 2015
- End of Support at 31 December 2018

The communications supported by the DWDM are critical for control of the network as they provide a critical link between Hudson Creek Control Centre and the DRCC. If these assets cease to function, then in emergency situations (such as cyclones), the DRCC may lose the functionality required to maintain control of the network. Therefore, Power and Water must assess options to mitigate this network risk.

1.2 Options analysis

Two credible options were identified as set out in Table 1 and the issues they address are shown in Table 1.

Table 1 Summary of credible options

Option No.	Description	Recommended
1	Replace with modern equivalent	No
2	Retire DWDM and move to direct fibre	Yes

As part of a holistic assessment we considered non-network solutions and capex/opex trade-offs, but found that neither of these options addressed the underlying network issues.

1.3 Recommendation

The recommended option is Option 2 – Retire DWDM and move to direct fibre at an estimated cost of $0.4 million (real 2021/22) to be most prudent and cost effective to meet the identified needs.

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

Table 2 Annual capital and operational expenditure ($'000, real FY22)

Item	FY25	FY26	FY27	FY28	FY29	Total
Capex	-	200	-	200	-	400
Opex	-	-	-	-	-	-
Total	-	**200**	-	**200**	-	**400**

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

Dense Wavelength Division Multiplex (DWDM) systems are used to increase the data carrying capacity of optical fibre cables. They operate by transmitting data using multiple wavelengths through a single fibre optic core. Each Wavelength acts as a separate communication channel, hence increasing the capacity of a single fibre and negating the need for multiple fibres to be installed.

DWDM technology was initially implemented by Power and Water due to insufficient fibre optic cores for critical communications. DWDM was chosen to provide the required capacity using the limited fibre cores.

Power Services has progressively increased its fibre footprint over the years as OPGW has been installed as a standard asset and additional cores have been provided through the Optus fibre optic cable installation projects.

Power Water currently has two DWDM nodes in service on the network (reduced from 4 nodes initially to 2 over time), one located at the Hudson Creek Control Centre (HCCC) and one at the Disaster Recovery Control Centre (DRCC). The equipment is at end of life and operating beyond vendor support.

In 2015 the Vendor issued a notice that specified:

- Last time buy at 31 December 2015
- End of Support at 31 December 2018

While Power and Water has sufficient spares available to support the system should one of the DWDM fail, as it is no longer manufactured, additional spares will not be available for purchase. The End of Support means that any issues with the asset's software will not be resolved by the vendor. Hence, the risk of retaining these assets on the network will increase over time as they deteriorate with age and possible become vulnerable with respect to cyber security.

Since Power and Water has expanded its fibre optic capacity, the need for DWDM has reduced.

2.2 Current management programs

There are no current management programs in place.

2.3 Regulatory compliance

Power and Water is also required to maintain the communications network to meet regulatory obligations. Refer to Appendix B for details.

2.4 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, since we currently do not have adequate data to undertake a quantitative analysis on the DWDM, a qualitative assessment of the risk has been undertaken using the relevant key consequence areas set out in the Risk Quantification Procedure.

The communications supported by the DWDM are critical for control of the network as they provide a critical link between Hudson Creek and the Disaster Recovery Control Centre (DRCC). If these assets cease to function correctly, then in emergency situations (such as cyclones), the DRCC may lose the functionality required to maintain control of the network. This will impact:

- **Service delivery:** Power and Water's ability to maintain visibility of its assets restore power following an outage. This will prolong the duration of outages and therefore impact our ability to provide adequate service levels to our customers in line with the performance targets set by the Utilities Commission.
- **Health and Safety:** Power and Water's ability to undertake switching to isolate faults and ensure the network remains in a safe state. Inadequate communications are likely to impact the DRCC's visibility of the network. This could result in dangerous situations of power is restored to sections of the network that are in an unsafe condition.
- **Compliance and cyber security:** The DWDM assets are not supported by vendors and therefore updates and patches to the firmware to address new risks are not provided. This is likely to impact Power and Water's ability to comply with the SOCI Act and expose vulnerabilities that

The key risks described above result in a High risk rating with a target risk rating of Low. The qualitative risk assessment of the inherent risk and targeted risk is shown in Figure 1 using the matrix approach set out in the Enterprise Risk Management Standard. We note that due to the change in technology from DWDM to fibre optic and the resulting increase in redundancy, the impact of a single failure will reduce from Major to Moderate.

	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

Overall, we consider these assets to have a high consequence on the safety and reliability of the network and the likelihood of the consequence materialising is increasing due to the asset age and lack of vendor support or replacement assets.

2.5 Summary

Power Water deployed DWDM to efficiently provide the communications capacity while there was limited fibre optic cable available. However, since then Power and Water has expanded its fibre optic capacity, reducing the need for DWDM, such that there are now only two DWDM nodes on the network.

In 2015 the Vendor issued a notice that specified these assets would not be available for purchase after 31 December 2015 and the vendor would not provide any further support after 31 December 2018.

The end of support means that any issues with the asset's software will not be resolved by the vendor. Hence, the risk of retaining these assets on the network will increase over time as they deteriorate with age and possibly become vulnerable with respect to cyber security.

These assets pose an increasing risk to the safety and reliability of the network and are considered to be at the end of their technical life. Section 3 describes the options Power and Water has considered to address this risk.

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 with modern equivalent. This option proposes to continue with the DWDM assets and would require replacing the assets on the network with similar supported models as they are at end of life.
- Option 2 – Retire DWDM assets and move to direct fibre. This option involves installation of fibre optic cable to complete the fibre optic loop and retire the DWDM assets as they would no longer be required. Sufficient fibre will be installed to enable adequate cores to be available to meet the service requirements.

A comparison of the two identified credible options and the issues they address in the identified need is depicted in the table below. A detailed discussion of each option is provided below.

Table 3 Summary of options analysis outcomes

Assessment metrics	Option 1	Option 2
NPC ($'000, real FY22)[1]	2,242	349
BCR	NA	NA
Capex ($'000, real FY22)	1,500	400
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

Note 1: Net present cost is shown as the project benefit was not quantified. The analysis was undertaken for a 30 year assessment horizon to account for the 15 year life of the replacement DWDM assets.

3.1.1 Option 1 – Replace with modern equivalent

This option proposes to replace the existing DWDM assets with the modern equivalent as proposed by the vendor in the End of Life notice. This option will not result in any need to change the operation of the network. It will require assets to be replaced every 10 to 15 years as they reach end of design life or end of life/support as notified by the vendor.

The manufacturer of the existing assets used by Power Services is no longer in business so a new vendor will be required. As a result, the software platform that is used to manage the assets and run the DWDM will also need to be changed. The impact of this is an increase in cost for the first instance of replacing the DWDM assets.

There is no change to network risk with this option as it maintains the status quo.

This option is estimated to cost [redacted] (real 2021/22) to be incurred in 2024/25 to replace the assets and software platform. The replacement cost will be ongoing at a similar amount approximately every 15 years to continue replacing the assets as they reach end of life.

This option was found to have a net present cost [redacted] (real 2021/22). This option has a higher cost than the alternative of retiring the assets, hence this option is not recommended.

3.1.2 Option 2 – Retire DWDM and move to direct fibre

This option will take advantage of the fibre loop that has been progressively built in the relevant section of the network to enable the DWDM assets to be retired.

The option involves installation of 12 km of fibre optic cable to complete the loop between Hudson Creek and Woollner which will enable the DWDM assets to be removed from service.

This project is dependent upon two existing planned projects that will prepare or complete significant sections of the fibre optic ring that will provide the capacity and redundancy required:

- the pole upgrade project along the Tiger Brennan road between Hudson Creek and Woollner Zone Substation which will strengthen the poles in this 12 km section to hold the new OPGW cable.
- Berrimah ZSS replacement which includes installation of fibre from Berrimah ZSS to Hudson Creek which will complete the fibre shortage on the other section of the ring between Hudson Creek and Disaster Recovery Control Centres. It is planned for completion in 2024 and will be underground cable rather than OPGW.

These projects are scheduled to commence in the current regulatory period.

Once the two projects above are completed, the cost to complete the remaining sections with 48 core overhead fibre optic ground wire (OPGW) including service migrations and reconfigurations is estimated to be $0.4 million (real 2021/22) with a net present cost of $0.4 million (real 2021/22). This is planned to be undertaken in two stages during 2024/25 and 2026/27. There are no ongoing replacement or maintenance costs.

Power and Water has sufficient spare hardware assets to ensure network functionality until the dependent projects are completed, even if delayed.

This option will result in a reduction of network complexity and risk as the fibre optic loop provides redundancy to the communications, making the network more resilient and enables retirement of an asset that is no longer supported by the vendor. This is the least cost option.

This option is recommended.

3.2 Non-credible options

In our analysis, we also identified a number of options that we found to be non-credible. These options were identified to not be credible for the reasons set out below:

3.2.1 Non-Network alternatives – does not address the need

Due to the type and function of the assets in the 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.

3.2.2 Capex/Opex Substitution – does not address the need

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

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

4. Recommendation

The recommended option is Option 2 – Retire DWDM and move to direct fibre at an estimated cost of $0.4 million (real 2021/22) as the 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 "PWC Strategic Direction" as indicated in the table below.

Table 4 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

This project is dependent on two other network projects:

- Pole upgrade along the Tiger Brennan road between Hudson Creek and Woollner Zone Substation
- Berrimah ZSS replacement which includes installation of fibre from Berrimah ZSS to Hudson Creek

While dependant on these projects, they also enable Power and Water to minimise the cost of managing the end of life of the DWDM assets. Additionally, Power and Water holds sufficient spares to manage the DWDM system until these dependent projects are completed, even if there are unforeseen delays.

4.3 Deliverability

This project is considered deliverable. Once the two required fibre routes are completed, the existing assets are decommissioned and the communications transferred to standard communications assets.

4.4 Customer considerations

As required by the AER's Better Resets Handbook, in developing this program Power Services 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 5 show a summary of the expenditure requirements for the 2024-29 regulatory period.

Table 5 Annual capital and operational expenditure ($'000, real FY22)

Item	FY25	FY26	FY27	FY28	FY29	Total
Capex	-	200	-	200	-	400
Opex	-	-	-	-	-	-
Total	-	**200**	-	**200**	-	**400**

4.6 High-level scope

The project will include:

- Installation of OPGW cable.
- Installation and commissioning of standard (MPLS compatible 1/10G card) communications assets for operating direct fibre communications, at both Hudson Creek and DRCC.
- Performance and stability tests.
- Outage planning to undertake cut over to the new direct fibre.
- Decommissioning and removing the existing DWDM assets.
- Updating documentation.

Appendix A. Cost estimation

The cost is based on a bottom up build as shown in Table 6.

Table 6 Cost estimate build up ($'000 real 2021/22)

Items	Cost estimate
Installation of OPGW cable and equipment	[redacted]
2 off MPLS compatible 10G card (design, install and commission)	[redacted]
Outage planning to undertake cut over to the new direct fibre	[redacted]
Decommissioning and removing the existing DWDM assets	[redacted]
Updating documentation, project management and admin	[redacted]
Total	[redacted]

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, we have considered compliance 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 (Power Services).
- 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 FY22[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 amendments to the proposed Security of Critical Infrastructure ActBill. 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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