

Energy
Infrastructure
Investments

Murraylink Transmission Annual Planning Report 2026

Contents

Executive Summary **3**

1. Introduction **4**

1.1 Purpose of this Transmission Annual Planning Report 4

1.2 APA Group and Related Entities 4

1.3 Disclaimer 5

2. Acronym and Definitions **5**

2.1 Acronyms 5

2.2 Definitions 6

3. Asset Overview **7**

3.1 Scope of the Asset 8

3.2 Asset Utilisation 9

4. The Changing Energy Landscape **9**

4.1 Role of the Murraylink Interconnector 10

5. Asset Management **11**

5.1 Asset Performance 12

5.1.1 Asset Availability 12

6. Current 2023 – 28 Regulatory Period **13**

6.1 DryHED Capacitors 13

6.2 IGBTs 14

6.3 Enhanced Cooling 14

7. Future Asset Requirements **15**

7.1 Future Investments Proposed 15

8. Asset Outlook **16**

References **18**

Executive Summary

TAPR provides key asset planning information for Murraylink, a high voltage direct current (HVDC) interconnector that connects the South Australia and Victoria regional electricity transmission networks.

Murraylink is owned by Energy Infrastructure Investments (EII) and operated by APA. Murraylink Transmission Company Pty Ltd is wholly owned by EII and is a registered Transmission Network Service Provider (TNSP) in the National Electricity Market (NEM) as prescribed by the National Electricity Rules (NER). Under the Management, Operations, Maintenance and Commercial Service Agreement (MOMSCA), APA has prepared this Transmission Annual Planning Report (TAPR) on behalf of EII in accordance with the requirements of section 5.12 of the NER.

This report outlines the factors influencing Murraylink's ability to provide a reliable and secure HVDC transmission service. It summarises the current capital and operational initiatives underway to maintain asset performance, reliability and security of supply, consistent with the EII Asset Management Plan and National Electricity Rules (NER) requirements. In addition, it examines the asset's future role, and the future investment requirements, to ensure Murraylink continues to support interregional connectivity, system reliability and the evolving needs of the National Electricity Market (NEM).

Murraylink provides 220 MW of controllable, bidirectional interconnection between South Australia and Victoria. Its HVDC capability supports flexible power transfer and broader power-system needs, including power-flow control, voltage management and system strength and security. Its value proposition is not simply related to MWh transferred between state, but the assets function in preserving controllable HVDC capability within an increasingly variable and interconnected NEM.

As the surrounding transmission network evolves, including through EnergyConnect, Murraylink continues to provide complementary interconnection capability. This capability remains relevant in the context of the 2026 Integrated System Plan (ISP)[3], which forecasts continued growth in renewable generation and storage as the NEM transitions away from base load generation. The growing pipeline of renewable and energy storage projects in the area is expected to create increasingly variable generation, reinforcing the value of maintaining flexible and controllable interconnection capability within the interconnected network.

Maintaining the safe, reliable and efficient operation of Murraylink through prudent lifecycle investment therefore remains a key focus of its forward asset management strategy.

1. Introduction

1.1 Purpose of this Transmission Annual Planning Report

This TAPR is prepared in accordance with the requirements of the National Electricity Rules (NER). Given the nature of the asset and the absence of any directly connected customers, this report covers those aspects of the prescribed TAPR content required by the NER[1] where specific comment is possible.

This TAPR has been prepared aligned with the requirements of rule 5.12 of the NER[1] and the applicable TAPR Guidelines[2]. Murraylink's position as an HVDC interconnector, including the absence of directly connected customers or generators, means that certain prescribed information may not arise or may have limited application.

The purpose of this report is to present key factors impacting the future safety and reliability of the Murraylink high voltage direct current (HVDC) transmission asset. It describes the associated asset planning needs and the capital investment being considered by EII to address asset objectives.

This report looks to identify the need and opportunity for improvements in efficiency, reliability, general functionality and potential capacity expansion of the asset in efficiently delivering required services. It considers the forecast asset and network investment requirements over the asset lifecycle, with greater certainty applied to near-term investments and indicative requirements identified over the longer term.

This TAPR seeks to provide broader stakeholders with an overview of the planning processes and future investment applied to this asset. The aim is to provide information that helps stakeholders understand Murraylink's role and capability within the National Electricity Market and contribute to the future development of the transmission network, where the net benefit is warranted.

1.2 APA Group and Related Entities

Murraylink is a registered TNSP and is owned by Energy Infrastructure Investments (EII), with Marubeni holding a 49.9% interest, Osaka Gas holding a 30.2% interest and APA Group holding the remaining 19.9% interest.

The asset is operated and maintained by APA Group under a Management, Operations, Maintenance and Commercial Services Agreement (MOMSCA). The Murraylink transmission asset provides transmission services to the NEM as prescribed by the NER.

The NER sets out the required processes for developing networks as well as minimum performance requirements of the network, which subjects the interconnector to the

[1] NER Clause 5.12 – Transmission Annual Planning Process

application of the Australian Energy Regulator's (AER's) Regulatory Investment Test for Transmission (RIT-T), where required.

1.3 Disclaimer

This TAPR has been prepared by EII for information and planning purposes only and reflects information, forecasts and assumptions available at the date of publication. These may change over time.

Information sourced from AEMO, Network Service Providers and other third parties has been sourced in good faith. Readers should undertake their own assessment and seek appropriate advice before relying on this report.

To the extent permitted by law, EII accepts no liability for loss or damage arising from reliance on this report. Interested parties are encouraged to contact APA directly for more information.

2. Acronym and Definitions

2.1 Acronyms

Table 1: Acronyms

Acronym	Meaning
AC	Alternating Current
AEMO	Australian Energy Market Operator
ALARP	As low as reasonably practicable
APA	APA Group company and operator of Murraylink
DC	Direct Current
EII	Energy Infrastructure Investments
HED	High Energy Discharge
HSEH	Health, safety, environment and heritage
HVDC	High Voltage Direct Current
IGBT	Insulated Gate Bipolar Transistor
ISP	Integrated System Plan

ML	Murraylink
MOMSCA	Management, Operations, Maintenance and Commercial Services Agreement
NEM	National Electricity Market
NER	National Electricity Rules
NSP	Network Service Provider
NSW	New South Wales
OEM	Original Equipment Manufacturer
RIT-T	Regulatory Investment Test for Transmission
SA	South Australia
TNSP	Transmission Network Service Provider
VCU	Valve Control Unit
VIC	Victoria
VSC	Voltage Source Converter

2.2 Definitions

For the purposes of this report, the terms below have the meanings set out in the following table.

Table 2: Definitions

Term	Definition
Berri Converter Station	The converter station located at 18903 Sturt Highway in Monash, South Australia, and consisting of one Murraylink Converter Station.
Converter	Equipment used to convert electricity between AC and DC using power electronic devices and associated electrical and auxiliary equipment.
Converter Building	Structure housing the converter and associated electrical and auxiliary equipment, including the control room, cooling rooms, valve enclosures, reactor room, indoor AC yard and indoor DC yard.

Converter Station	Site where the converters and associated high-voltage switchgear are installed.
Murraylink	The HVDC Transmission System that connects the high voltage power networks at Red Cliffs in Victoria and Monash in South Australia via High Voltage DC cables.
Hitachi	Company and supplier of the asset HVDC equipment (originally ABB) - main Contractor and OEM for this asset
Red Cliffs Converter Station	The Murraylink converter station located at 716 Woomera Avenue, Red Cliffs, Victoria, and consisting of one Murraylink Converter Station.
Site	Either or both Red Cliff Converter Station and/or the Berri Converter Station.
VSC Technology	Voltage Source Converter technology used by Murraylink to convert electricity between AC and DC systems.

3. Asset Overview

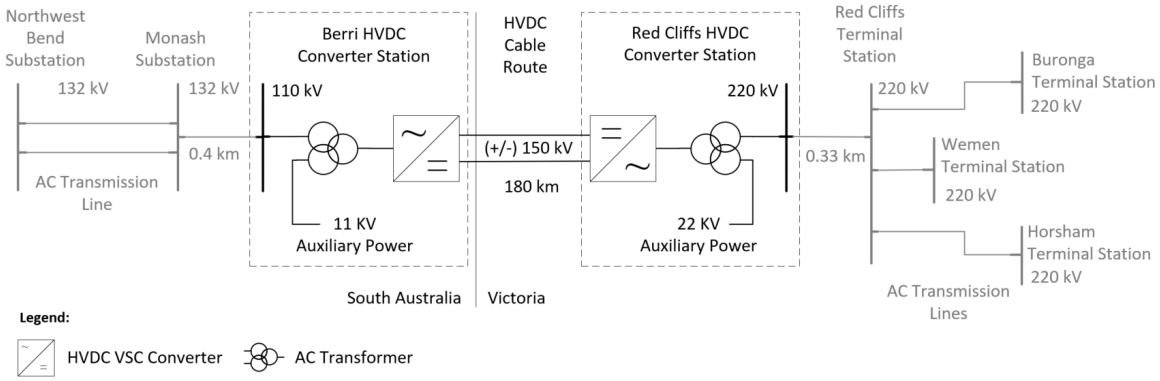
Murraylink is a HVDC facility, with 176 km of HVDC transmission line between Red Cliffs in Victoria and Berri in South Australia, originally commissioned in 2002. The asset can transmit up to 220 MW of power bi-directionally between the two states.

The converter stations are connected by a 176 km long HVDC cable system.

The alternating current (AC) is converted to direct current (DC) using voltage source converter (VSC) HVDC technology.

A simplified single line diagram of Murraylink is shown in Figure 1.

Figure 1: Murraylink Simplified Single Line Diagram



Power transfers across the interconnector are scheduled and dispatched by AEMO as part of the National Electricity Market's central dispatch process.

The approximate converter station locations and cable routes are shown in Figure 2.

Figure 2: Murraylink Cable Routes and Converter Station Locations



3.1 Scope of the Asset

The scope of Murraylink includes:

- Two HVDC converter stations located at Berri (SA) and Red Cliffs (VIC).
- The converter stations interface the DC cables to the high voltage alternating current (AC) transmission systems in South Australia (132kV) and Victoria (220kV) via a short length of underground high voltage AC cable.
- The DC transmission line consists of a pair of ±150 kV HVDC cables buried underground between the converter stations at Berri and Red Cliffs over a route length of approximately 176 km.
- Associated AC connection assets, including:
    - The connection to the SA AC transmission system is established through the 132 kV Monash Station. This substation contains two-line bays to accommodate the existing 132 kV transmission lines and a bay for connection of a 400 m underground AC cable tie to the Berri Converter Station.
- In Victoria, the Red Cliffs Converter Station is connected to a 220 kV bay at the Red Cliffs Terminal Station, by a 330 m underground AC cable tie.
- Associated control, protection, telecommunications, auxiliary systems, easements and supporting infrastructure required for the operation of the interconnector.

Being a point-to-point transmission network, there are no connections for generation or load on Murraylink and there are no individual connection point demand requirements associated with the asset. Murraylink is a transmission licensee in South Australia and exempt in Victoria.

3.2 Asset Utilisation

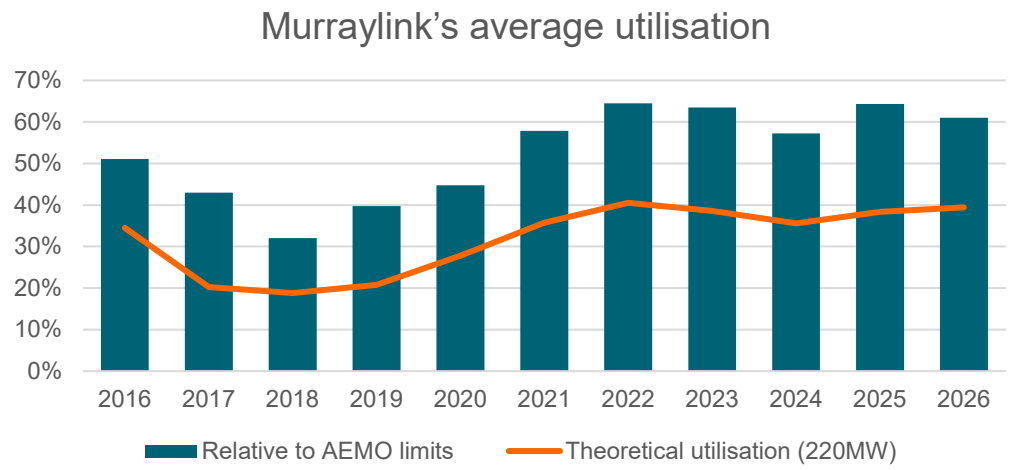
Murraylink is directly dispatched and constrained by AEMO for system security and network support (not purely for energy arbitrage). Its utilisation is often intentionally lower and more variable than its 220 MW technical capacity.

Accordingly, energy throughput alone does not provide a complete measure of the role of controllable interconnection, particularly during periods of network constraint or system stress.

The recent SA 21st / 22nd June wind drought, where imports to SA were limited and higher price flows were forced through to VIC to manage local constraints demonstrates the evolving and strategic role of interconnectors with the changing variability of generation sources within the respective regions.

Murraylink's historical utilisation is shown in Figure 3.

Figure 3: Murraylink Historical Utilisation



4. The Changing Energy Landscape

AEMO's ISP (2026) reinforces the need for an increasingly interconnected National Electricity Market (NEM), with transmission, renewable generation, energy storage and gas-firming capacity forming AEMO's least-cost development path to 2050. The ISP highlights significant changes across South Australia and western Victoria, driven by the continued development of Renewable Energy Zones, large-scale battery storage

and complementing major new transmission investment such as Project EnergyConnect.

Further investment in the transmission network is anticipated to support the development of geographically dispersed renewable generation, to provide greater system flexibility, security and access to new and existing generation resources across the NEM.

4.1 Role of the Murraylink Interconnector

Murraylink's prescribed transmission service is to provide 220MW of interconnector capacity between SA and Victoria. It also provides market, network and power-system benefits beyond its core function of transferring electricity between SA and VIC. Key benefits include:

- **Efficient inter-regional energy transfer** – facilitates the transfer of lower-cost generation between regions, supporting efficient utilisation of generation resources.
- **Security of supply** – provides bidirectional transfer capability between South Australia and Victoria, supporting supply during periods of high demand and network or generation outages.
- **Network resilience** – its underground cable configuration provides inherent resilience to bushfires and extreme weather and reduces exposure to overhead transmission line faults.
- **Support during transmission outages** – its controllable transfer capability can support the NEM during planned and unplanned outages of other critical transmission infrastructure, including Heywood and Project EnergyConnect.
- **System strength support** – provides a non-synchronous source of system strength in an electrically weak area of the NEM.
- **Fast frequency response** – rapid active-power control can support frequency performance following power-system disturbances.
- **Isolation of AC disturbances** – the asynchronous HVDC connection assists in limiting the propagation of fault currents and frequency disturbances between interconnected AC regions.
- **Voltage and reactive-power support** – dynamic reactive-power capability supports voltage control and local voltage stability at Murraylink's connection points.
- **Controllable power transfers** – precise control of inter-regional power flows provides operational flexibility as the NEM accommodates increasing levels of variable renewable generation.

The commissioning of EnergyConnect changes the transmission environment in which Murraylink operates. Murraylink's existing HVDC technology provides controllable, bidirectional transfer capability with operational characteristics complementary to the broader AC transmission network. Future planning for Murraylink will consider how these capabilities can continue to support the evolving needs of the South Australian and Victorian power systems alongside new transmission infrastructure.

5. Asset Management

The EII asset management planning process is a structured framework for managing asset condition, performance and risk throughout the asset lifecycle. The process supports the sustainable delivery of services by balancing reliability, safety, risk, compliance and value outcomes, while ensuring assets continue to meet current and future operational requirements.

The asset management planning process:

- Provides a comprehensive assessment of asset condition, performance, utilisation and management practices;
- Identifies asset management strategies and recommendations to support future operational requirements;
- Supports the development, prioritisation and approval of maintenance, replacement and capital work programs; and
- Identifies asset-specific risks, issues and opportunities, together with proposed remediation activities for consideration through planning and budgeting processes.

The objective of the asset management planning process is to maintain the safety, reliability and availability of the Murraylink interconnector. Asset management activities are undertaken in accordance with APA's approved policies, standards and procedures, ensuring a consistent and integrated approach to the operation, maintenance and renewal of the asset.

Comprehensive health, safety, environment and heritage (HSEH) management systems are in place to support the safe and effective operation of all APA operated assets. These ensure the risks relating to the operation of all APA assets are effectively managed to keep risks as low as reasonably practicable (ALARP). APA's HSEH management system, *Safeguard*, provides the framework by which the processes relating to APA's HSEH activities are developed, implemented, communicated, managed and continually improved. The management system is subject to periodic review to ensure ongoing compliance with regulatory obligations and alignment with organisational objectives.

Functionally, Murraylink's equipment can be broadly categorised into two groups:

- **Primary equipment** – this includes main circuit equipment such as power transformers, phase reactors, IGBTs, filtering equipment and underground

cables. These generally have a standard design life of 40 years or more with some of these now beyond the midpoint of their useful service lives; and

- **Secondary equipment** – this includes ancillary equipment necessary for the operation of the converters, notably uninterruptable power supplies, building ventilation, air conditioning, cooling water pumping and treatment systems and control and protection systems. Ancillary equipment generally has shorter service lives (between 15 and 25 years) with elements of the equipment currently at various stages in their service life.

The principal challenges associated with the interconnector relate to maintaining the electrical installation, with its many components, to meet high reliability and availability standards. Even so, components need to be replaced or refurbished when:

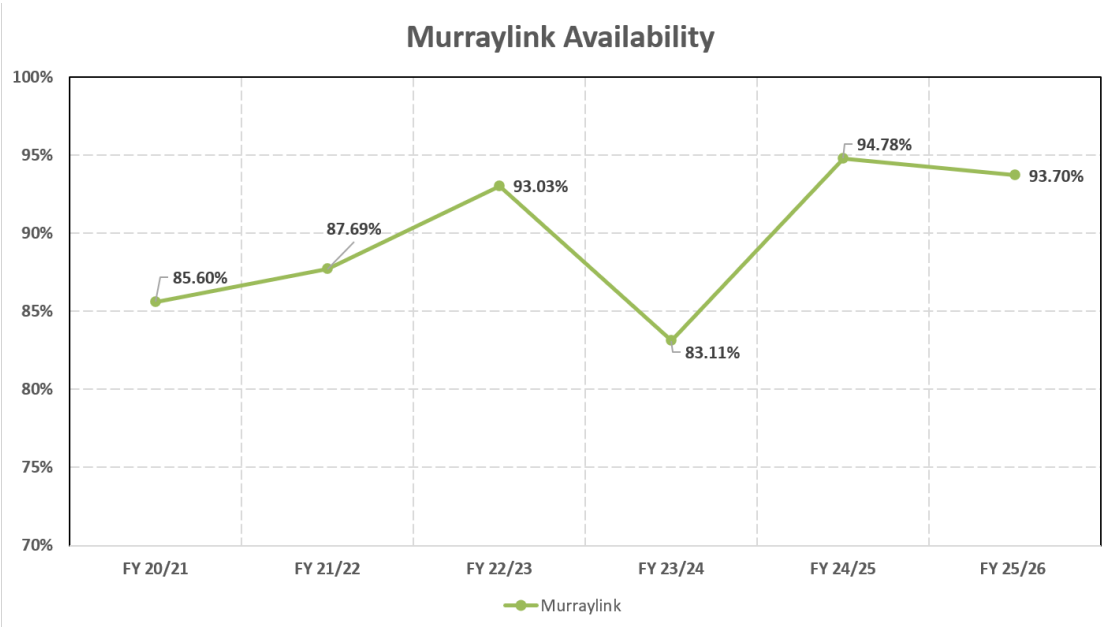
- Asset condition or service performance deteriorates, to the point where it may adversely impact the reliability, availability or operational risk;
- Increasing maintenance requirements or lifecycle costs make refurbishment or replacement the most cost-effective option; or
- Obsolescence of equipment or supporting systems introduces risks associated with limited technical support, spare parts availability or long-term maintainability.

5.1 Asset Performance

5.1.1 Asset Availability

The annual availability across Murraylink over the past six financial years of operation is shown in Figure 4.

Figure 4: Murraylink Availability



A single cable fault in September 2023 resulted in a 25-day outage and was a significant contributor to unplanned outage time. The cable fault resulted in Dry High Energy Discharge (HED) Capacitor failures with the root cause analysis resulting in the replacement of defective original manufacturer's equipment.

A subsequent cable fault in April 2024 contributed to a 23-day unplanned outage. APA has since acquired a cable fault location system to reduce cable fault outage time.

While availability has recovered from the FY2023/24 reduction associated with significant cable-related outages, the duration of individual failures demonstrates the importance of maintaining effective fault-location capability, critical spares and restoration preparedness to minimise the consequence of future unplanned events.

6. Current 2023 – 28 Regulatory Period

Capital investment during the current regulatory period is focused on maintaining the reliability, availability, safety and security of Murraylink's prescribed transmission services. The program approved for the period includes stay-in-business works, enhanced cooling, cable protection and modification, reliability improvements, essential spares and security-related investment. These works address ageing and obsolete equipment, thermal performance constraints, cable damage risks, critical spare holdings and other conditions that could increase the likelihood or duration of unplanned interruptions.

6.1 DryHED Capacitors

A significant urgent and unforeseen priority during this determination period has been the replacement of Murraylink's DryHED capacitors. On 3 September 2023, a cable fault at the Berri converter station resulted in the catastrophic failure of a DryHED capacitor and consequential damage to other capacitors in the same bank. Emergency works were undertaken and Murraylink remained out of service for 25 days while repairs were completed. A further capacitor failure occurred on 29 September 2023, requiring a controlled shutdown and additional replacement and testing. Subsequent investigations identified an underlying design issue in the original capacitors, compounded by age-related degradation of the grading resistors. Inspections undertaken in July and August 2025 identified further deterioration at both the Berri and Red Cliffs converter stations, confirming that the issue was fleet-wide rather than isolated.

To address the identified DryHED capacitor failure risk and maintain the reliable operation of the Murraylink interconnector, Murraylink completed a comprehensive and prudent capacitor replacement program during the September 2026 outage.

The DryHED capacitor issue was not known and could not reasonably have been anticipated when the current determination was made. Its cost is material relative to Murraylink's approved capital expenditure allowance, and absorbing the project within

that allowance has required the removal or deferral of other approved works into the FY29-33 regulatory period.

6.2 IGBTs

Murraylink is progressing a response to the increasing obsolescence risk associated with its Generation 2 Insulated-Gate Bipolar Transistors (IGBTs). Generation 2 IGBTs are no longer manufactured or supported by the OEM (Hitachi), and additional Generation 2 spares are no longer available for purchase. Current forecasts indicate that the available inventory could be exhausted by 2031 if recent failure rates continue, after which Murraylink would be unable to maintain ongoing operation without an upgrade.

To address this risk, Murraylink has commenced a Regulatory Investment Test for Transmission (RIT-T) to identify the preferred long-term solution. The proposed solution involves replacing one phase of the Generation 2 IGBTs with Generation 3 units. This would release 972 serviceable Generation 2 units for use across the remaining five phases and is expected to materially extend Murraylink's operating life. The proposed investment is classified as a reliability corrective action because it is required to maintain Murraylink's 220 MW capacity and continue meeting applicable service standards and regulatory obligations. The timing, scope and expenditure profile of the project remain subject to the outcome of the RIT-T assessment and ongoing commercial negotiations, however 90% of expenditure is forecast for the 2029-2033 determination period.

6.3 Enhanced Cooling

The Enhanced Cooling initiative included in the current revenue determination was intended to increase the cooling capability of the Murraylink converter stations during periods of high ambient temperature.

A subsequent thermal review identified that increasing converter cooling capability to support operation beyond Murraylink's existing design envelope could transfer the thermal constraint to other balance-of-plant components, including the transformers and underground HVDC cable system. Accordingly, the original Enhanced Cooling initiative is not proposed to proceed in its contemplated form, as improving one thermal constraint should not result in increased thermal or reliability risk elsewhere in the asset.

However, the underlying valve cooling reliability risk remains and requires intervention. Murraylink's existing valve cooling system was designed for a maximum ambient temperature of 40°C and a maximum IGBT valve inlet water temperature of 48°C. Above the 40°C design ambient, the existing air-cooled coolers cannot maintain valve inlet water temperature within design limits, increasing IGBT junction temperatures and the likelihood of failure. Historical failure analysis has also identified a temperature-related failure mode, with failures occurring at both converter stations on high ambient

temperature days, while the existing Gen 2 IGBT population is supported by a finite spare inventory. Existing temperature-based derating, automatic runback and temporary evaporative cooling reduce exposure but do not remove cooling water temperature as a potential driver of IGBT failures.

For the FY29–33 regulatory period, the cooling investment is therefore being refocused from increasing Murraylink's operating capability to protecting valve equipment and maintaining reliable operation within the asset's existing design limits. The proposed supplementary process chillers at Berri and Red Cliffs are intended to maintain valve inlet water temperature within design limits when ambient temperatures exceed 40°C, reducing thermal stress and temperature-driven consumption of the finite Gen 2 IGBT spare population. Importantly, the proposed works will not increase Murraylink's thermal rating; existing derating and runback arrangements will remain, and transformer and cable thermal limits will be unchanged.

7. Future Asset Requirements

Investment proposed for the FY29–33 regulatory period is primarily directed towards preserving Murraylink's existing transmission capability and maintaining safe and reliable operation. The proposed program responds to identifiable lifecycle risks, including equipment condition, obsolescence, diminishing spare-part availability and reliability risks affecting critical primary, secondary and control systems. Investment requirements are prioritised having regard to asset risk, network need and efficient expenditure for customers.

7.1 Future Investments Proposed

The 2028-33 Regulatory [4] period seeks to maintain reliability and capability through managing lifecycle risk and asset-integrity risks to maintain relevance in the region, while seeking efficient outcomes for customers.

To preserve Murraylink's existing capability and support its continuing role within the NEM, the proposed FY29–33 investment programme targets the principal lifecycle, reliability, operational and security risks facing the asset. The program is structured around seven priority investment areas:

1. Manage Converter IGBT Obsolescence
2. Mitigate Critical Asset Reliability Risks
3. Manage Equipment Obsolescence and End-of-Life Risks
4. Maintain Buildings and Site Infrastructure
5. Enhance Asset Management and Information Capability
6. Sustain Control Systems and Cyber Security Compliance
7. Maintain Strategic and Essential Spares

Collectively, these initiatives are intended to maintain Murraylink's safe, reliable and secure operation, manage emerging asset risks and preserve the capability required to continue providing transmission services efficiently over the forthcoming regulatory period.

8. Asset Outlook

Based on APA's consultation with AEMO the energy transition requires stronger interconnection across the NEM, with the following network needs for the region;

- Expand transmission to connect Renewable Energy Zones (REZ)
- Increase interconnection between regions to share resources and improve system reliability
- Maintain system security as coal generation retires and renewables are taking up significantly - including system strength, inertia and voltage control
- Reduce network congestion and renewable curtailment across the NEM
- Enable integration of large-scale storage, including batteries and pumped hydro
- Manage high penetration of distributed energy resources and increasing two-way power flows

The need for stronger interconnection to connect REZs based on the current investment in renewable energy projects in the region demonstrates the value in the role of interconnectors for AEMO to optimise dispatch in combination with bids from local generation and storage. Murraylink's point-of-difference is its superior precise dispatch capability compared to phase-shifting transformers used on HVAC interconnectors.

APA considers Murraylink, Heywood and EnergyConnect to have complementary roles in enabling inter-regional energy transfers and managing periods of generation surplus and deficit.

APA has undertaken further joint planning further joint planning with VicGrid to explore the potential for Murraylink in providing additional voltage support and contribute to system security in western Victoria. APA has also approached ElectraNet to investigate Murraylink's potential to provide additional voltage support and network resilience in the Riverland area. In both instances, APA are looking to use existing HVDC capability to reduce or defer the need for future network augmentation or further infrastructure investment.

APA recognises the intrinsic value inherent in existing infrastructure and the benefits this provides the NEM. APA's current asset lifecycle review includes initial investigations into viable options for extending the life of the Murraylink. The review considers the value and benefits of existing infrastructure to the NEM and an approach to managing the converter station beyond its engineering design life of up to 40 years.

The unique and bespoke equipment incorporated into the converter stations requires ongoing monitoring, particularly where OEMs are the sole source of replacement equipment and critical spare parts, compounded by the obsolescence of some components. APA's engineering teams are working closely with the OEM and other international supply chains to see how this equipment can be replaced, prudently and efficiently to support continued operation beyond 40 years, where a market-benefit case can be demonstrated.

Future planning will assess how Murraylink can efficiently complement changes to the surrounding transmission network. This includes opportunities to utilise its existing controllable HVDC capability where this can support emerging network requirements and deliver benefits to customers. This allows the asset to maintain relevancy in the region, whilst allowing APA to instigate future opportunities to retain least-cost ways to maintain a resilient source of electricity where physical restriction of transmission services exists in either state.

APA will continue to monitor future developments, whilst sustaining and maintaining a safe and reliable service and continue to demonstrate prudent and efficient use of its maintain and sustain capital program.

References

[1] Australian Energy Market Commission, *National Electricity Rules*, Rule 5.12 – Transmission annual planning process.

[2] Australian Energy Regulator, *Transmission Annual Planning Report Guidelines*, December 2018.

[3] AEMO, *Integrated System Plan*, 2026.

[4] EII, 2028-33 *Revenue Proposal Overview – October 2026*.