MURRAYLINK: TRANSMISSION DETERMINATION PROPOSAL

Murraylink Transmission Co Pty Ltd 580 George Street, Sydney

Executive Summary

We are proud to provide this transmission determination proposal for the period 1 July 2023 to 30 June 2028.

The cost of Murraylink to customers is falling in real terms.

The revenue forecast outlined in this proposal reflects the cost management that Murraylink has exercised across the period, resulting in lower forecast capital expenditure and operating expenditure for the forecast period compared to the current transmission determination period.

This proposal and the supporting materials incorporates input and feedback received during stakeholder engagement we undertook in preparing this proposal.

A key challenge we faced in preparing this proposal was that late in the process Hitachi informed us that circumstances for Murraylink in relation to the supply of critical technology had changed and as a result the planned major project we were forecasting was no longer feasible. We sought stakeholder feedback on how to deal with this late change. Based on this feedback, in this proposal we outline an approach to working with our stakeholders to understand the options available to Murraylink and how to evaluate and rank them.

We welcome any feedback stakeholders have in response to this proposal. Submissions can be sent to Murraylink2024@apa.com.au

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1. Key Outcomes

This section sets out the key elements of the Murraylink Proposal.

The revenue proposal for Murraylink proposes a revenue for the first year of the transmission determination period of $13.1m which is a reduction of revenue of $2.6m compared to the current financial year.

This reduction reflects an emphasis on cost control within Energy Infrastructure Investments (EII) and APA and a reduction in the rate of return as determined under the AER's rate of return instrument.

1.1. Revenue

The proposal contains a smoothed revenue forecast for the transmission determination period as set out in Table 1

Table 1: Forecast Revenue

Forecast Revenue ($m Real FY23)	2023-24	2024-25	2025-26	2026-27	2027-28	Total
Revenue	13.1	13.6	14.1	14.6	15.1	**70.4**

This revenue is slightly higher than the amount outlined in the Stakeholder Engagement Workshop 2 presentation on 18 November ($67.7m). This is due to changes in forecast capital expenditure identified in the due diligence exercise in putting together the final stages of this proposal.

This represents a decrease of 14% compared to the current transmission determination period. The revenue from both periods are set out below.

The revenue is calculated using the AER's Post Tax Revenue Model (PTRM) in attachment 14.

Table 2: Forecast and current period allowed revenue

Revenue comparison ($m Real FY23)	Revenue
Current	81.6
Forecast	70.4
Difference	**-11.2**

1.1.1. Building Block Revenue

The building block revenue for the forecast period and the current period are set out below.

Table 3: Forecast period building block revenue

Building Block Revenue Forecast ($m Real FY23)	2023-24	2024-25	2025-26	2026-27	2027-28	Total
Return on Capital	4.9	4.8	4.7	4.5	4.2	**23.0**
Regulatory Depreciation	3.4	3.9	5.1	5.4	5.7	**23.6**
Operating Expenditure	4.6	4.6	4.6	4.6	4.5	**22.8**
Revenue Adjustments	0.1	0.2	0.0	0.1	0.1	**0.5**
Net Tax Allowance	0.1	0.1	-	0.1	0.3	**0.6**
Total	**13.1**	**13.5**	**14.4**	**14.6**	**14.8**	**70.4**

The building block revenue for the current period is set out below.

Table 4: Current Period Building Block Revenue

Building Block Revenue Current ($m Real FY23)	2018-19	2019-20	2020-21	2021-22	2022-23	Total
Return on Capital	6.8	6.7	7.0	7.0	6.8	**34.3**
Regulatory Depreciation	3.7	3.8	3.7	3.7	5.6	**20.4**
Operating Expenditure	4.8	4.8	4.8	4.8	5.0	**24.1**
Revenue Adjustments	-0.2	-0.2	0.5	-	0.1	**0.2**
Net Tax Allowance	0.4	0.5	0.5	0.5	0.6	**2.5**
Total	**15.5**	**15.5**	**16.5**	**16.0**	**18.1**	**81.6**

The major differences are in return on capital, operating expenditure, and the tax allowance. These are discussed in more detail below.

1.2. Return on capital

The dollar value of the return on capital is calculated by multiplying the regulatory asset base by the rate of return.

The most significant difference is the rate of return as calculated using the AER's rate of return instrument. We have also used the value of imputation credits set by the AER. The current year's value and the forecast value are set out in the table below.

Rate of return	Current	Forecast	Difference
Return on Capital	5.7%	4.3%	-1.4%

This combined with a regulatory asset base that is declining over time as set out below. Results in a material decline in the return on capital.

Figure 1: Closing asset base

Forecast Opening Asset Base ($m Real FY23)	2023-24	2024-25	2025-26	2026-27	2027-28

Return on Capital	115.1	112.8	107.6	100.4	93.2

The declining asset base is being driven by the declining level of new capex associated with the asset.

The calculation of the return on capital is set out in attachment 20 and the requested averaging period is set out in attachment 19. The calculation of the opening asset base is set out in the AER's Roll Forward Model (RFM) set out in attachment 15.

1.3. Forecast Capex

The forecast capital expenditure program is discussed in more detail in Chapter 4. The total for forecast capital expenditure is set out in section 4.13.

Table 5: Forecast Capital Expenditure

Forecast Capital Expenditure ($m Real FY23)	2023-24	2024-25	2025-26	2026-27	2027-28	Total
Forecast Capital Expenditure	4.3	4.3	2.5	0.7	0.8	**12.7**

This is higher than the forecast capital expenditure published in the Stakeholder Workshop 2. While undertaking due diligence it was identified that the forecast capital expenditure didn't capture the total forecast cost for the projects. In particular, it was not correctly applying the APA margin under the service contract (MOMCSA).

The forecast capital expenditure is substantially below the capital expenditure proposed, and being incurred, in the current regulatory period. The comparison is set out in the table below.

Table 6: Forecast Capex vs Current Period Allowance

Capital Expenditure	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Forecast Capital Expenditure	4.3	4.3	2.5	0.7	0.8	**12.7**
Current Period Capital Expenditure	11.0	7.1	5.9	2.5	3.6	**30.1**
Difference	**-6.7**	**-2.8**	**-3.4**	**-1.8**	**-2.8**	**-17.5**

1.4. Historic Capex

Murraylink is expecting to outperform the allowance the AER set for the current transmission determination period. This is reflected in Table 7 below.

Table 7: Capital expenditure in current transmission determination period

($m FY 23)	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Current Period	11.0	7.1	5.9	2.5	1.1	**27.6**
AER Forecast	4.9	13.5	10.9	2.4	0.9	**32.7**
Difference	**6.1**	**-6.4**	**-5.0**	**0.1**	**0.2**	**-5.0**

Noting that the last year of this table is an estimate based on APA budgeting processes.

The key project in the historic capital expenditure was the replacement of the control and protection system. The previous control and protection system was obsolete and no longer supported by the vendor. The control and protection system is discussed further below in section 1.5.1.

1.5. Additions to the asset base

Under NER S6A.2.2.A the AER is required to compare Murraylink's actual capital expenditure from financial year 2017 to financial year 2021 to the forecast for the same period. This calculation is carried out in Table 8.

Table 8: Capital expenditure added to the regulatory asset base

	2016/17	2017/18	2018/19	2019/20	2020/21	Total
Actual	0.9	15.5	10.6	6.8	5.5	**39.3**
AER Forecast	0.4	0.5	4.8	13.1	10.3	**29.2**
Difference	**0.4**	**15.0**	**5.8**	**-6.3**	**-4.8**	**10.1**

Where the actuals are in excess of the allowance the AER is required to review that capital expenditure for the period to ensure it is consistent with the requirements of the national electricity rules.

The differences are discussed further in section 6

There were two major projects in the time period for the AER's capital expenditure review.

- Control and protection system
- Fire suppression

Together these projects cost $37.4m of the capital expenditure between FY2017 and FY2021. This accounted for 95% of the capital expenditure in that period. More information on both these projects is available in section 6.

1.5.1. Control and protections system

The control and protection systems that are necessary for Murraylink to function had been in service for just under 15 years at the time of this proposal. The manufacturer, Hitachi ABB, announced it would no longer support the systems from 2021. Moreover, components of the system were failing with increasing frequency and spares had become difficult to source.

The replacement of the control and protection system was included in the AER's forecast of capital expenditure for the current period. The table below compares the AER's estimate for the control and protection against the expected expenditure over the life of the project.

Control and protection system	2016/ 17	2017/ 18	2018/ 19	2019/ 20	2020/ 21	2021/ 22	2022/ 23	Total
Actual	-	6.2	9.3	7.0	5.2	0.6	0.2	**28.6**
AER Forecast	-	-	4.4	12.8	9.9	1.4	-	**28.5**

Difference	-	6.2	4.9	-5.7	-4.7	-0.8	0.2	0.1

As can be seen this is mostly a timing difference with when the expenditure is incurred compared to the transmission determination periods and the AER's forecasts.

1.5.2. Fire suppression

When constructed both Murraylink and Directlink had fire monitoring equipment in the expectation that fire detection would occur early enough so that equipment could be shut down quickly enough to prevent the fire spreading and damaging equipment.

Following the loss of one of the converter stations at Directlink due to fire, it became apparent fire detection equipment at remote sites was insufficient to prevent loss of equipment due to fire. It also demonstrated that fire was a real and credible risk. Fire suppression equipment was installed at both converter buildings. This work was competitively tendered to ensure value for money. The fire at Directlink resulted in outages of the system for an extended period of time.

The expenditure on fire suppression is set out below Table 9.

Table 9: Fire Suppression Expenditure

Fire Protection System ($m nominal)	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Actual	-	8.3	1.3	0.0	-	**9.6**

1.6. Forecast taxation

The tax allowance is calculated in the AER's Post Tax Revenue Model. The AER has modified the way in which the tax allowance is calculated. This revised calculation reduces the forecast taxation to zero. This is $2.0m less than the allowance in the current period.

The total of these calculations is set out below:

Table 10: Tax and Return on capital

Tax (Current and Forecast)	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Forecast	0.1	0.1	-	0.1	0.3	**0.6**
Current	0.4	0.5	0.5	0.5	0.6	**2.5**
Total	**-0.3**	**-0.4**	**-0.5**	**-0.4**	**-0.3**	**-2.0**

1.7. Forecast operating expenditure

Murraylink has based its operating expenditure on the operating expenditure incurred in financial year 2021. Financial year 2021 was selected as it was the most recent year and represented the best basis for the forecast.

We note that financial year 2021 is higher than the operating expenditure in financial year 2020. The main reasons for this are the commercial services fee under the MOMCSA and the cost of insurance for Murraylink.

The commercial services fee is a flat rate fee charged by APA to EII. The commercial services fee is then allocated to EII assets based on their annual contribution to total revenue. The dollar amount allocated to Murraylink has been increasing over time reflecting the revenue from Murraylink and other EII assets.

The cost of insurance has been rising on international markets. This global phenomenon is reflected in the premiums being charged to EII. APA tenders out the insurance for EII to ensure efficiency in procurement.

Previous years prior to financial year 2021 were much higher this is the result of higher connection charge being levied by ElectraNet in previous years. Due to the operation of the cost pass through requested by Murraylink in the last transmission determination proposal these cost savings are already being passed through to customers in the current transmission determination period.

The profile of historic operating expenditure is set out in Figure 2.

Murraylink has escalated it to $FY2023 consistent with the requirements of the AER's post tax revenue model. The model used to do this is provided in attachment 16. The forecast operating expenditure for the next transmission determination period is set out in the table below:

Table 11: Forecast Operating expenditure

$m Real FY23	2023-24	2024-25	2025-26	2026-27	2027-28	Total
Controllable	3.7	3.7	3.7	3.7	3.7	**18.5**
Uncontrollable	0.8	0.8	0.8	0.8	0.8	**4.0**
Debt Raising Costs	0.1	0.1	0.1	0.1	0.1	**0.3**
Total	**4.6**	**4.6**	**4.6**	**4.6**	**4.5**	**22.8**

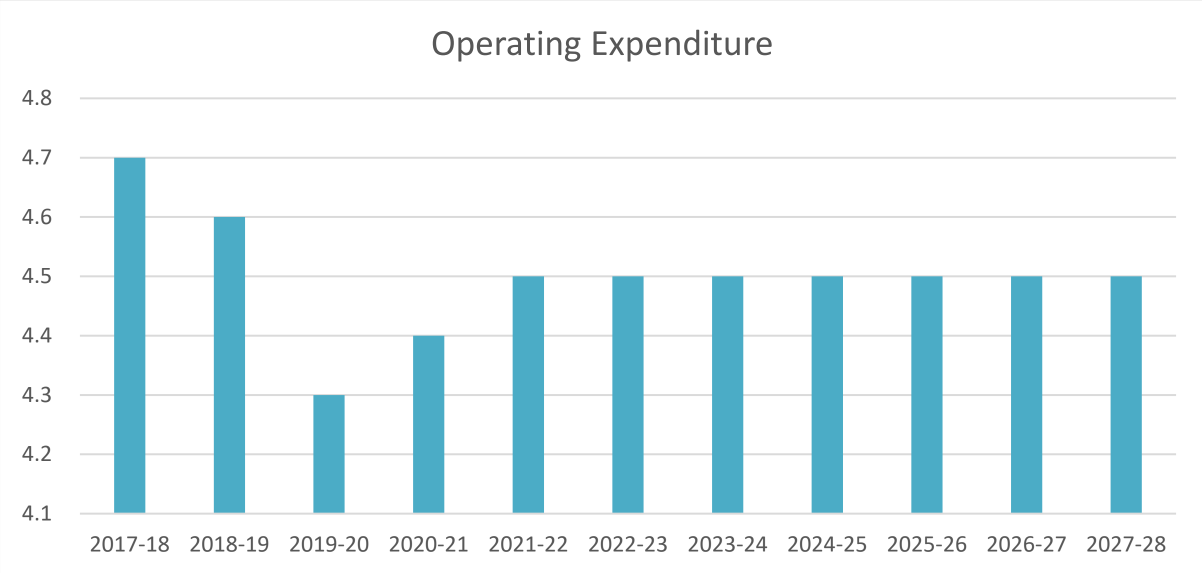
The operating expenditure is separated into three categories controllable, uncontrollable and Debt Raising Costs. Debt Raising costs are calculated in the AER's post tax revenue model.

Uncontrollable costs are comprised of those costs that Murraylink is unable to directly influence. This is the connection cost to the ElectraNet and AusNet networks and asset insurance. The connection costs are determined by the AER as part of the transmission determination for these networks. Insurance is largely asset insurance which is determined by the replacement cost of Murraylink and the international insurance market neither of which Murraylink is unable to influence. In theory overtime, assuming the insurance market is efficient, then the cost to Murraylink customers of insurance and damage to the asset is the same regardless of the level of insurance excess adopted.

Controllable costs are all other operating costs paid by EII.

The nature of the forecast means the profile of the future operating expenditure is expected to be flat. This can be seen in Figure 2 below.

Figure 2: Operating expenditure FY18 to FY28



The reduction in expenditure from financial year 2018 to financial year 2021 reflects a reduction in connections costs from ElectraNet. Connection costs are subject to a pass through which means that the reduction in this expenditure is being paid back to customers through lower Murraylink revenue in the current transmission determination period.

The data underpinning the chart is set out below

Figure 3: Cross period operating expenditure

OperatingExpenditure(excludingdebtraisingcosts)	2017-18	2018-19	2019-20	2020-21	2021-22
OperatingExpenditure	4.7	4.6	4.3	4.4	4.5
OperatingExpenditure(excludingdebtraisingcosts)	**2022-23**	**2023-24**	**2024-25**	**2025-26**	**2026-27**
OperatingExpenditure	4.5	4.5	4.5	4.5	4.5

1.8. Incentive arrangements

Murraylink has demonstrated strong cost control and this resulted in modest rewards to be paid under the Efficiency Benefit Sharing Scheme and Capital Expenditure Sharing Scheme. This is set out in the table below.

Table 12: Incentive Arrangements

Incentive arrangements	2023-24	2024-25	2025-26	2026-27	2027-28	Total
Forecast Period	0.1	0.1	-0.1	-	0.1	**0.2**
Current Period	0.1	0.1	0.1	0.1	0.1	**0.3**

Total	**-0.0**	**0.0**	**-0.1**	**-0.1**	**0.0**	**-0.2**

1.9. Contingent Projects

On December 13, 2021 Murraylink was advised by Hitachi that there is only 115 Gen 2 IGBTs left available to buy.

When the IGBTs run out Murraylink will be forced to upgrade all the IGBTs in a valve room to enable the ongoing operation of the converter station.

The timing of upgrading the valve room is dependent on the rate at which the existing IGBTs need to be replaced. Based on existing failure rates this project could occur late in the next transmission determination period or early in the one after.

One realistic option could be for Murraylink to propose the replacement of valve room as a contingent project. The replacement of the valve room is approximately $30 million.

The proposed preconditions for such a project are:

- Completion of a required Regulatory Investment Test - Transmission
- Approval of the Project by the EII Board
- The stock of spare IGBTs falling to a minimum level to enable confidence that they are likely to last until the replacement is complete (currently estimated at 72).

2. Stakeholder Engagement

Murraylink is proud of its stakeholder engagement and grateful to those that have given their time, knowledge and efforts to the process.

The objective of our stakeholder engagement as stated in our engagement plan is:

"We want to understand our stakeholders' priorities and reflect these in our transmission determination proposal"

2.1. Key conclusions from Engagement

There were three key takeaways from the stakeholder engagement that Murraylink undertook. These are set out in more detail below.

2.1.1. Importance of stakeholder engagement

A theme that strongly came through our stakeholder engagement was the support that our stakeholders had for the open and transparent engagement process that Murraylink was seeking to implement.

2.1.2. Support for consideration of IGBT purchases

At the original stakeholder engagement on forecast capital expenditure projects there was broad support for the approach that Murraylink was taking to consideration of the potential obsolescence of Generation 2 IGBTs of the type used in the Murraylink converter stations. However, this was overtaken by notification from Hitachi of the limited number of available spares discussed further in section 5. Further stakeholder engagement will take place on this issue.

2.1.3. Consideration of pricing options

There was no support for undertaking a review of the current approach to allocating revenue recovery between ElectraNet and AusNet Services

2.2. Process

Murraylink's stakeholder engagement to date had five stages. The Stakeholder Engagement Plan is attachment 18.

2.2.1. Co-design Workshop

This workshop was held on 30 August and focused on developing a stakeholder engagement process that met the needs of both the stakeholders and Murraylink.

This session successfully identified the format and topics for future engagement by Murraylink prior to the submission of our transmission determination proposal.

There was strong support from Stakeholders for an engagement that is proportionate to the significance of the asset to the National Electricity Market and consumers.

2.2.2. Workshop 1

Workshop 1 focused on the nature of Murraylink and its role in the NEM, in particular how this would be expected to affect the nature and contents of our transmission determination proposal.

2.2.3. Workshop 2

Workshop 2 was focused on the building block elements of the transmission determination proposal and specific consultation on the proposal with respect to IGBTs and potential alternative approaches to the division of revenue recovery between Victoria and South Australia.

2.2.4. Circulation of draft proposal

A draft copy of this proposal was circulated to the stakeholder engagement group. We received feedback from the Australian Energy Regulator which has been incorporated into this revised proposal.

2.2.5. Workshop 3

Workshop 3 was focused on the notification from Hitachi that there were only 115 IGBTs available to Murraylink. The workshop focused on next steps and material for inclusion in the proposal. Stakeholders were clear that they desired a clear engagement process to discuss solutions to the IGBT issue on Murraylink. We outline the process going forward in section 5.4.

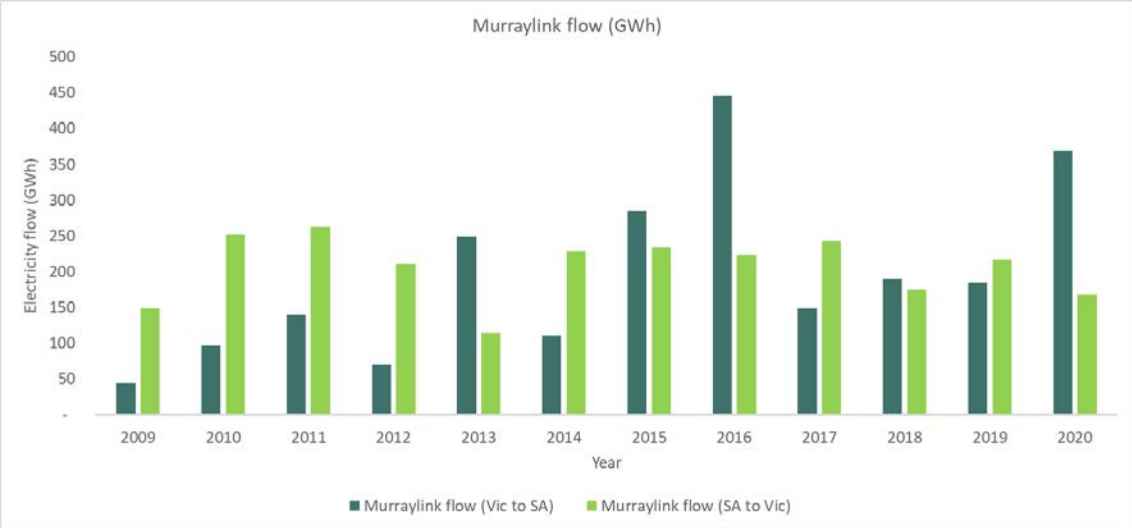
2.3. Key questions asked by stakeholders

2.3.1. Value of Murraylink

Murraylink provides interconnection between the NEM regions of Victoria and South Australia. Electricity flows both ways (i.e., Victoria to South Australia and vice versa) to enable the importing region to take advantage of the lower electricity prices in the exporting region (subject to constraints).

Figure 4 shows the annual amounts of energy flowed through Murraylink from 2009 to 2020. It can be seen from this figure that significant energy has flowed both ways, enabling both South Australia and Victoria to take advantage of lower electricity prices available in the other state.

Figure 4: Murraylink annual flows (in GWh)



2.3.2. Maximum capability of Murraylink (220MW)

The question was raised as to why customers should be paying the full price for Murraylink if they were not able to get the full capacity

Murraylink transfer capacity is limited by ambient temperature and by the transfer limits on the AC network either side of Murraylink.

Murraylink has 220MW of available at all times, provided the ambient temperature is below 40°C. At higher ambient temperatures Murraylink limits its transfer capacity to avoid causing heat damage to its equipment. We have a project in our forecast capital expenditure that will remove this limitation.

The AC network either side of Murraylink has limits set by the thermal capacity of AC transmission lines and the voltage stability limits of the AC network. Murraylink has runback schemes in place that can be used to maximise the Murraylink power transfer capacity, while protecting the AC network. The runback schemes automatically reduce the power transfer across Murraylink if the AC network enters a condition where the AC network could be at risk of outage. The runback schemes monitor equipment on the AC networks and override Murraylink when appropriate.

Runback schemes operate for ElectraNet and AusNet and owned by those organisations respectively. A runback scheme is installed, but used in operations, for NSW and this runback scheme is owned by Murraylink.

2.3.3. Insurance

A question was asked about whether additional storage of IGBTs on site could have insurance implications. We have consulted our insurance experts and confirm that storing additional IGBTs on location will not materially increase the cost of insurance for Murraylink.

3. Background

3.1. About Murraylink

Murraylink is one of three high voltage direct current electricity transmission lines. The others being Directlink (NSW-Qld) and Basslink (Tas-Vic).

Being a high voltage direct current network means it possesses certain characteristics that are not shared by other transmission networks. There is a converter station at either end of Murraylink that receives high voltage AC/DC electricity converts it into direct current electricity and transmits it across the border where it converts it back into AC/DC power. This gives it operational capability that is not possessed by other networks, it can be turned on, off, scaled up and down .

It is a point-to-point transmission network. There are no connections for generation or load on Murraylink. There are not individual connection point demand requirements associated with the asset.

Murraylink is licenced in South Australia and exempt in Victoria.

Murraylink has 220 MW capacity. It is the smaller of two interconnectors that operate between South Australia and Victoria. Heywood, the other SA-Vic interconnector, has 650MW. Transgrid and ElectraNet have a proposal to construct an interconnector from Wagga Wagga in NSW and runs through to Robertstown in South Australia, it has a spur to Red Cliffs in Victoria. This will further increase the capability of transferring electricity between Victoria and South Australia. Construction is expected to be completed after 2023. Murraylink and Project Energy Connect is described in further detail at section 3.3.

The Murraylink cable is a Single 180 km cable with a converter station at Red Cliffs (Vic) and Berri (SA). The cable runs underground at a nominal depth of 1.2 metres. Running underground enables the cable to go through sensitive environmental areas that an above ground transmission line would be unlikely to get approvals to traverse.

Murraylink's primary role in the National Electricity Market is simple - it enables the transfer cheaper electricity between South Australia and Victoria. However, the characteristics of Murraylink means it has greater flexibility in operation that other interconnectors possess.

AEMO dispatches Murraylink at its discretion within the physical constraints imposed by the AusNet and ElectraNet networks

3.2. Regulatory Background

3.2.1. History

Murraylink is a former Market Network Service Provider. This means when first constructed it earnt it revenue by buying cheap electricity in South Australia or Victoria and selling it into the other market. However, policy makers and regulators permitting the construction of regulated TNSP interconnectors undermined this efficient business model.

In making the asset valuation decision as part of the conversion to a regulated transmission network the AER/ACCC based the value assigned to Murraylink on the calculated value that would be provided by a HV AC/DC line despite it being pointed out that such an asset could not be constructed in this location. This resulted in Murraylink being valued lower than the construction cost of the asset.

3.2.2. Current

Murraylink is not a large asset in the context of the National Electricity Market. As the start of the next Transmission Determination Period the regulated asset base is $115m. Its current revenue is around $16m. For context the current regulated asset base for ElectraNet is $1860m and annual revenue is approximately $300m.

Revenue is collected from AusNet and ElectraNet. It is split between the two based on asset value in the two jurisdictions

3.3. Murraylink and Project Energy Connect (SA-NSW interconnector)

ElectraNet and TransGrid are partnering to deliver a 900km energy interconnector between the power grids of South Australia and New South Wales, with an added connection to Victoria.

The broad route passes though renewable energy zones in South Australia, New South Wales and Victoria. This means future renewable projects in these areas will be able to connect to the grid and supply new energy into the network.

Given the long distances that project energy connect will cover and connection of intermittent renewable energy and the role it will play in meeting the future energy needs of South Australia the need for the flexibility provided by Murraylink, the ability to ramp up and down output, will become more critical to the stability of the South Australian energy grid.

3.4. Climate Change

One of the expected impacts of Climate Change is the expected increase in maximum daily temperatures.

This will impact the operating characteristics of all electricity networks as some of the equipment critical to their operation has maximum operating temperatures.

On Murraylink this is expected to mostly affect equipment operating in the converter stations.

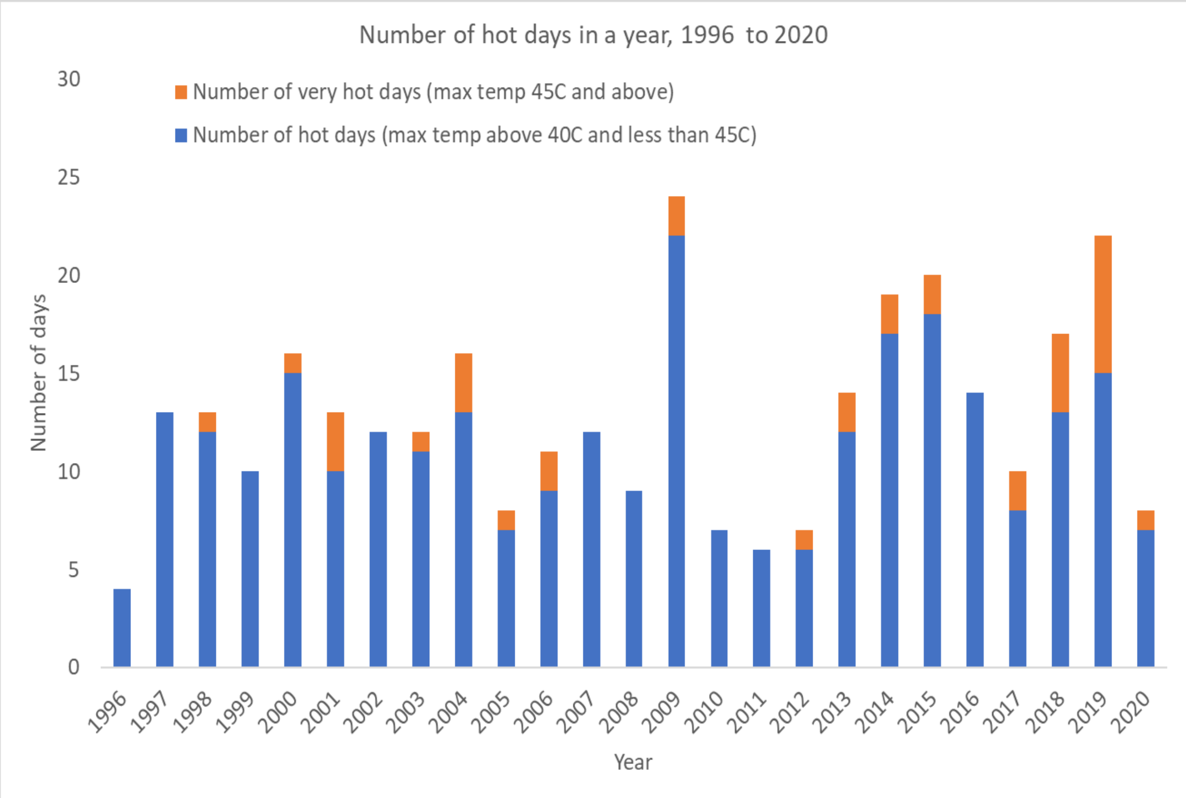
While the cables have operating ranges which are can be negatively affected if the temperature of the cable rises, their location underground provides some insulation from ambient temperatures.

The equipment in the converter stations at Red Cliffs and Berri are rated to 40 degrees centigrade. After which the capability of the interconnector is de-rated.

In 2020 there were 8 days above 40 degrees and 1 day where the maximum temperature exceeded 45 degrees. Maximum temperatures are expected to rise across Australia

The graph below sets out the high temperature data:

Figure 5: High temperature days 1996 to 2020



Research has shown that most of the changes observed over recent decades will continue into the future. Projections suggest that for Australia:[1]

- hot days will become more frequent and hotter (very high confidence)
- sea levels will rise (very high confidence)
- oceans will become more acidic (very high confidence)
- snow depths will decline (very high confidence)
- extreme rainfall events will become more intense (high confidence).

It is the increased frequency of days above 40 degrees that are relevant to the future of the operation of Murraylink, in particular it will drive the need to improve the resilience of

[1] https://www.csiro.au/en/research/environmental-impacts/climate-change/climate-change-information

Murraylink to more frequent high temperature in order to continue to provide the level of service it currently provides.

4. Forecast Capital Expenditure

This chapter contains Murraylink's capital expenditure forecasts for each year of the 2024-28 transmission determination period, as well as the total for the period. The chapter also describes the capital expenditure categories used and the methodology adopted to forecast the capital expenditure. The major inputs and assumptions underpinning the forecasts are explained.

The major projects that contribute to the capital expenditure forecast are described. The forecast capital expenditure is then demonstrated to be efficient. Finally, a contingent project during the new regulatory control period is outlined in section 1.9.

4.1. Asset Management Plan

Energy Infrastructure Investment (EII) has an asset management plan (AMP) that identifies the necessary actions required to optimally manage the EII assets. A long-term consideration of the integrity of assets is necessary to ensure that they remain fit-for-purpose.

The AMP is written on the basis of the best known information at the time of writing.

The purpose of the AMP is:

- To provide a comprehensive understanding of the current management approach relating to the assets, their condition and their utilisation;
- To identify strategic recommendations for future utilisation;
- To provide a platform for approval of work programs by providing discussion of the options available and recommendations; and
- To identify specific issues affecting the assets and the proposed remediation for budget consideration.

The objective of this AMP is to ensure that a strong focus on safety and reliability is maintained in relation to the operation and management of the EII assets. In developing the operating and maintenance procedures incorporated within the AMP, the Operator (being APA Operations EII) has considered the approved policies and procedures of the APA Group.

Suitable safety management systems are in place and operating to ensure that the risks relating to the operation of all EII assets are effectively managed to keep risks as low as reasonably possible. The APA HSE Management System is called 'Safeguard' and provides a framework by which the processes relating to EII's HSE activities are written, approved, issued, communicated, implemented and controlled. Additionally, the management system is also subject to review and improvement to ensure objectives and obligations are continually satisfied.

The AMP is reviewed each year to ensure that the content is current.

Changes to the assets will inevitably occur during the life of the AMP. Unless there are issues identified that significantly impact the validity of the Plan it is only intended to amend the AMP at each annual review.

The AMP will identify any material changes to budget items for the previous period.

A copy of the Murraylink AMP is included in attachment 12

4.1.1. Cost escalation

Murraylink is not proposing any real cost escalation beyond adjustments for consumer price inflation. There are no step changes in input costs for capital expenditure.

4.2. Forecasting methodology

Murraylink's forecast of capital projects in the Replacement/refurbishment categories was developed in the context of its asset management practices,

These management practices and a description of the associated projects are discussed in section 4

The 2021 Murraylink Asset Management Plan follows the strategic direction established in the Asset Management Strategy109. The Plan contains detail of asset management processes developed in accordance with standard PAS 55-1 and lists individual maintenance and improvement projects.

This document has been supplemented with a document outlining the business cases for the significant projects that are expected to be required during the course of the regulatory control period, in Attachment 13.

The projects and calculation of total forecast capital expenditure is set out in attachment 17.

4.2.1. Key inputs and assumptions

Asset replacement/refurbishment framework

Murraylink's asset management processes are described in the Asset Management Plan. This process calls for the:

- maintenance history;
- condition; and
- service performance;

of each component of equipment to be monitored.

Plans to replace or refurbish equipment components are formulated when:

- The service performance of the equipment deteriorates, to the point where it jeopardises the reliability and availability performance of the link;

- Maintenance costs escalate, to the point where it becomes economic to replace or refurbish the equipment; and
- Equipment associated with auxiliary systems becomes obsolete, with the potential to jeopardise the availability performance of the link due to unavailability of spares.

Major projects are discussed in more detail below.

4.3. Enhanced Cooling

Murraylink's power transmission capability deteriorates when the ambient temperature exceeds 40°C. At ambient temperatures above 45°C the cooling systems struggle to reject heat generated by the AC-DC conversion process, ultimately leading to significantly reduced transmission capability.

The reduced transmission capability reduces the amount of electricity that can be imported into a NEM region. This undermines the ability of the importing region to take advantage of the lower cost electricity from the exporting region. This gives rise to an inefficiency where the costs will be borne by electricity consumers.

Based on the historical NEM and temperature data and the Murraylink technical data, it is estimated that the cost of the reduced transmission capability is $6M over a five-year period. This gives some insight into the cost of further deterioration of the availability of Murraylink going forward.

Such cost can be prevented by an investment in an enhanced cooling system to reject the heat generated by the AC-DC conversion process. The cost is $3.21M over the 5-year revenue period.

As demonstrated above, the investment is expected to deliver a net saving to electricity consumers.

In addition, the enhanced cooling system is expected to prolong the life of the IGBTs, deferring the need to incur the large plant upgrade cost. This delivers further savings to the electricity consumers.

4.4. Stay in business

Murraylink recommends a series of Stay In Business (SIB) projects. The following table shows what these projects are, and the likely consequences, if they are not undertaken.

SIB Project	Consequence of not undertaking the project
Replacement of aging equipment to prevent unplanned equipment failure and associated reduction in the reliability of transmission services.	Murraylink will operate with a higher risk of unplanned equipment failure and an associated reduction in the reliability of transmission services.

Modifying the NSW runback scheme to meet the requirement of Project Energy Connect. Note: • Murraylink interfaces with the runback schemes that protect the AC network in NSW, Victoria and South Australia. • Murraylink owns all the equipment in the NSW Runback scheme.	Higher constraints will be applied to Murraylink, therefore reduction in the benefit of the Murraylink transmission services.
SCADA upgrades, AC protection relay upgrades and reactor cooling pipework support replacement	• Murraylink operating with systems that are no longer effectively performing their functions. • Higher risk of unplanned interruption to transmission services.
Periodic refurbishment on rotating machinery to ensure on-going reliable operation.	Potential increase in unplanned disruption to transmission services.

The cost of the Murraylink SIB projects is $3.17M over the 5-year revenue period.

4.5. Cable Protection/Modification

In order to prevent or mitigate unintended third-party interference with the Murraylink cables, Murraylink recommends the following:

- **Replacing the DC cables marker signage** where the cables pass through public land; and
- **Relocating DC cables** from the South Australian government inspection station near the South Australia – Victoria border. This is because the level of development activities in the surrounding this area is high. Such high activity level would potentially increase the frequency and complexity associated with cable fault repair. It also poses a risk to the cable during construction.

The cost of the project is $2.37M over the five-year revenue period.

4.6. Reliability

This program of work seeks to mitigate the risks that threaten the reliable operation of Murraylink. The recommended measures are as per the following table.

Recommended reliability measures	Consequence of not implementing the measures
Maintain the reliability of the control system: The UPS maintains power supply to the control and protection equipment in the event of an auxiliary power outage. This is essential to maintain the reliability of the control system.	Murraylink transmission services can be disrupted for a significant time.

Flood mitigation measures: The Red Cliffs converter station is located close to the Murray River and protected only by a levy bank on an adjoining property. Should the levy fail, and flood waters can enter the converter building. Appropriate measures need to be in place to manage such risk.	In the event the flood waters enter the converter building, transmission services are expected to be disrupted for several weeks.

The above consequences can mean failure to meet the expectation of the regulators, the industry, and Murraylink's consumers.

The project cost is $1.77M over the 5-year revenue period.

4.7. Essential Spares

The program of essential spares purchasing seeks to maintain Murraylink's availability by ensuring spare parts are available to replace failed equipment as required.

The spare parts inventory covers all Murraylink sub-systems including low voltage auxiliary power, cooling, air conditioning, control systems, and high voltage components.

This business case includes the purchasing for all spare parts, however it excludes purchasing of spare IGBTs, which is covered by a separate business case.

The costs to maintain the Murraylink inventory is $1.18 over the 5-year revenue period.

4.8. SOCI

The energy sector is particularly susceptible to security threats. These threats are increasing as demonstrated by recent events worldwide.

The Australian Government has proposed legislative measures to protect Critical Infrastructure. The existing Security of Critical Infrastructure Act 2018 (the Act) will be superseded by the Security Legislation Amendment (Critical Infrastructure) Bill (SoCI Amendment Bill) 2020, proposed to pass in two separate Bills to address urgent elements of the reform as soon as possible. These Bills include:

- **Security Legislation Amendment (Critical Infrastructure) Bill 2021**: passed on 22 November 2021 subject to Royal Assent. The reforms are expected to be passed in their entirety by mid-2022.
- **The Security of Critical Infrastructure Amendment Bill (SoCI 2020)**: it introduces an enhanced framework, significantly expanding the scope of the existing legislation and governance rules requiring formally defined responsibilities and activities that support good risk practice and a greater awareness of threats and vulnerabilities to critical infrastructure assets.

The SoCI 2020 bill increases the obligations and requirements APA must comply with.

APA engaged EY to conduct a gap analysis of APA's capabilities to meet the SOCI obligations. EY found that the scope of obligations under SoCI 2020 is greater than the existing legislative mandate and that Murraylink requires a range of capabilities to meet new compliance requirements in the following the domains:

- Physical security;
- Cyber security; and
- Supply chain.

The cost to meet such compliance in relation to Murraylink is estimated be $579K over the five-year period.

4.9. Regulatory Reset

The regulatory reset forecast represents those external costs incurred in the preparation of transmission determination. This forecast is the actual external costs incurred for the preparation of the previous transmission determination cost.

The total cost is expected to be $200 thousand over the five year-period. Mostly this is related to the cost of consultants discussed in section 5.4

4.10. Related Parties

APA is not a related party to EII. Our ownership share is below the 20% that is considered a prerequisite to be a related party. Neither of the other owners of EII are related parties to APA. Both of the other owners of EII have a larger shareholding than APA. This makes the decision making of EII independent of that of APA. This in turn means that the incentives that the AER apply to EII are as effective for EII as they are for any other independent transmission business in the NEM.

4.10.1. MOMCSA

APA provides services to Murraylink under the Management, Operations and Maintenance and Commercial Services Agreement (MOMCSA). The contract works in two parts

- asset management, operating, maintenance and capital services; and
- corporate services.

The asset management , operating, maintenance and capital services is provided on a cost plus 10% basis.

The commercial services are covered by a commercial services fee. The commercial services fee is a flat rate fee set in the contract. This fee was set based on analysis of the cost of providing these services provided by KPMG. This fee has not been indexed so has fallen in real terms since being established. A portion of the fee is allocated to Murraylink based on Murraylink's share of EII revenue.

Attachment 11 addresses outsourcing arrangements and margins in more detail, including:

- providing an overview of the MOMCSA;
- setting out EII's understanding of the framework that the AER has developed for the purposes of assessing the consistency of outsourcing arrangements with the Rules; and
- applying the AER's framework to the MOMCSA and demonstrates the consistency of its arrangement with the operating and capital expenditure criteria.

4.10.2. Efficiency of APA Margin

The analysis outlined in attachment 11 demonstrates that the margin and commercial services fee is in line with industry arrangements where information is publicly available.

4.11. Future Asset Classes

We are proposing minor modifications to the asset classes. The current asset classes in the roll forward model and those we are proposing are set out below.

Table 13: Asset Classes

Asset Class #	Current Asset Class	Forecast Asset Class
1	**Switchyard**	**Switchyard**
2	**Transmission line**	**Transmission Cable**
3	**Easements**	**Easements**
4	**Ancillary 15 - control systems**	**Control Systems**
5	**Ancillary 30**	**Ancillary asset- 30 Years**
6	**Ancillary 7 - pressure vessel testing and inspection**	**Ancillary asset - 7 Years**
7	**Other operating assets**	**Other operating assets**
8	**Office machines**	**Non ancillary asset**

There are two reasons for proposed changes:

- to clarify better the nature of the assets being added and
- some asset classes are overly restrictive.

Asset Classes 2, 4 and 5 are just renaming to clarify the nature of the assets currently being added to these asset classes. This will not change the nature of the assets to be added to this asset class.

Asset class 6 and 8 are overly narrow. This results in little addition to the capital expenditure to these asset classes and overuse of the "Other operating asset class". There are other assets of a similar nature and economic life that are precluded from being added to these asset classes. For example other testing equipment not related to pressure vessel testing can not be added to this asset class.

4.12. Forecast Capital Expenditure by Program

The table below sets out the forecast capital expenditure by program

Table 14: Forecast capex by program

Program	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Stay in business	1.1	1.0	0.9	0.2	0.2	**3.4**
Enhanced Cooling	1.6	1.6	-	-	-	**3.2**
Cable Protection/Modification	0.2	0.2	1.4	0.2	0.2	**2.4**
Reliability	0.5	1.2	-	-	-	**1.7**
Essential Spares	0.2	0.2	0.2	0.2	0.2	**1.2**
SOCI	0.6	-	-	-	-	**0.6**
Regulatory Reset	0.0	-	-	-	0.2	**0.2**
IGBTs	-	-	-	-	-	**-**
Total	**4.3**	**4.3**	**2.5**	**0.7**	**0.8**	**12.7**

4.13. Forecast Capital Expenditure by Asset Class

The table below sets out the forecast capital expenditure by asset class

Table 15: Forecast capex by asset class

Program	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Switchyard	0.2	0.2	0.2	0.2	0.2	**1.2**
Transmission Cable	0.2	0.2	1.4	0.2	0.2	**2.4**
Easements	-	-	-	-	-	**-**
Control Systems	-	-	-	-	-	**-**
Ancillary asset- 30 Years	-	-	-	-	-	**-**
Ancillary asset - 7 Years	-	-	-	-	-	**-**
Other operating assets	3.8	3.9	0.9	0.2	0.2	**8.9**
Non ancillary asset	0.0	-	-	-	0.2	**0.2**
Total	**4.3**	**4.3**	**2.5**	**0.7**	**0.8**	**12.7**

5. Obsolete IGBTs

On 13 December 2021 Hitachi wrote to Murraylink informing us:

> *Currently the number of Gen2 IGBTs installed is about 21000, out of which 5832 are in Murraylink.*
>
> *Hitachi Energy has approximately 400 units of Gen2 IGBTs in stock, which are intended to be distributed among the installed base as equally as possible based on the share of the total installed units. This would mean that about 115 of these Gen2 IGBTs in stock could be available for APA.*
>
> *Based on the current global failure rate, the current Gen2 IGBTs stock might exhaust in upcoming 4-5 years.*

Murraylink has approximately 30 IGBTs in stock making for a total of 145 IGBTs available to keep Murraylink operating in its current configurations.

The IGBTs are an integral part of the operation of the Murraylink converter stations. When the converter station runs out of IGBTs it will cease operation. The Directlink PADR demonstrates that the best solution is to upgrade a valve room to a newer compatible technology and use the removed IGBTs to support the ongoing operation of other valve rooms.

The current estimated failure rate on Murraylink is 24 per annum. At this failure rate it means Murraylink could operate for 6 more years prior to the obsolescence of IGBTs will result in outages on Murraylink.

At that point the only means to maintain Murraylink in operation is to upgrade one phase or more of Murraylink to a new Hitachi IGBT technology compatible with the control and protection system. An estimate of the cost of this option is around 30 million dollars.

While it is the best basis on which to forecast the replacement of one of the valve rooms on Murraylink, there is some uncertainty about the failure rate that the timing of the need to upgrade the valve room is uncertain.

As the notification from Hitachi was received less than a month ago EII is still in the process of evaluating options.

5.1. The issues

Any solution in relation to the obsolescence of the must be in the long term interest of consumers.

5.2. Longer Term issues

The core operating assets of the converter station are the IGBTs and the Control and Protection system. This is not to say they are the only critical assets to the operation of converter stations but rather that they are key systems.

The operation of this equipment is such that these two systems must operate flawlessly together otherwise it will result in damage to significant numbers of IGBTs. The easiest and, likely, most cost effective is to procure both systems off the same producer. This is what was done with the existing systems on Murraylink, they were both manufactured and installed by Hitachi (formerly ABB).

If the systems are upgraded individually then this means that there is only one vendor capable of constructing, in a cost effective manner, a system compatible with the other. The only way to avoid this is to upgrade them at the same time. At this time it is not clear what cost savings are available from this approach nor what technical improvements would be obtained from doing so.

The challenge is that for regulatory purposes the standard life for the Control and Protection System is 15 years and the IGBTs are given a life of 40 years. Given that new capex is added at the standard life it is highly unlikely that the two assets will reach the end of their regulatory life at the same time.

Further complicating matters is that while there is some evidence that the standard life of the Control and Protection system is reasonably accurate the experience of both Directlink and Murraylink is that the 40 year life currently given to IGBTs is materially longer than their technical life.

5.2.1. Used IGBTs

One potential alternative to the replacement of the generation 2 IGBTs is purchasing large number of used IGBTs.

There is an equivalent HVDC technology in New York State in the United States called Cross Sound Cable (Cross Sound). They have a large number of IGBTs in use. They will also have an allocation of the remaining new IGBTs. One option is for Murraylink to approach Cross Sound and offer to purchase their generation 2 IGBTs.

It is unclear how many IGBTs would be available through this method, what it will cost to acquire them or what life can be expected from them once they have been acquired.

5.3. Short Term Issues

If careful attention is paid to the letter from Hitachi it is clear that they have not given an undertaking to APA to make 115 IGBTs available to us. The 115 IGBTs are linked to numbers remaining globally. If EII elects to delay the purchase of the remaining IGBTs available to us it is likely that there will be fewer than 115. The estimated cost of 115 IGBTs is $1.5 million.

5.4. Future engagement

APA held a stakeholder workshop on 17 January to update stakeholders on the impact of the obsolete IGBTs on our transmission determination proposal.

Stakeholder were very clear with us that what they wanted to see in relation to this issue is a clear proposal for engagement with them in relation to this issue.

We are proposing a multiple stage engagement. We outline this approach below. We encourage feedback on our proposed approach.

5.4.1. Engaging consultants – technical / economic - February 2022

In the initial weeks after the proposal is submitted to the AER we will circulate a draft request for proposal from vendors to stakeholders for their feedback. We will then issue the request for proposal to qualified consultants and select the best qualified using the assessment criteria outlined in the request for proposal. The capital expenditure has been increased to reflect the anticipated cost of these consultants.

5.4.2. Meeting of the consultants, us and stakeholders - March 2022

Once the consultants have been engaged a workshop will be held with stakeholders, us and the consultants to provide an opportunity for the consultants to outline their approach to the analysis and any strengths and weaknesses to the approach proposed. This will provide stakeholder and opportunity to understand the nature of the analysis proposed and provide feedback.

5.4.3. Consultants prepare draft reports (unknown pending response to request for proposals)

The consultants will prepare a draft report for circulation to stakeholders. This gives stakeholder an opportunity to understand the nature of the results of the analysis and provide feedback as to any additional work or clarification that may be required.

5.4.4. Consultants finalise reports based on stakeholder feedback - 5.4.3 plus 8 weeks (6 weeks consultation plus 2 weeks finalisation)

This is the finalised consultant reports that we will use in creating our position paper for the AER's consideration in its determination (draft or final depending on timing).

5.4.5. Draft proposal paper - 5.4.4 plus 4 weeks

We will write a draft position paper and circulate to stakeholders for their consideration and feedback.

5.4.6. Finalise proposal paper - 5.4.5 plus 8 weeks (6 weeks consultation plus 2 weeks finalisation)

We finalise the proposal paper and publish and submit to the AER.

Based on this timetable the finalised position paper will be available 20 weeks after the consultants issue their draft report. Assuming the preparation of consultant reports takes 8 weeks. This means the expected completion of the proposal paper is mid September 2022.

The AER's draft determination is set for September 2022. We will engage with the AER to determine if it is possible to have the proposal paper available for their draft determination.

APA invites stakeholders to comment on the nature of the engagement and the timeline for the engagement.

6. Historic Capital expenditure

Under NER S6A.2.2.A Murraylink is required to compare its actual capital expenditure from financial year 2017 to financial year 2021 to the AER's forecast for the same period. This calculation is carried out in Table 16.

Table 16: Capital expenditure added to the regulatory asset base

	2016/17	2017/18	2018/19	2019/20	2020/21	Total
Actual	0.9	15.5	10.6	6.8	5.5	**39.3**
AER Forecast	0.4	0.5	4.8	13.1	10.3	**29.2**
Difference	**0.4**	**15.0**	**5.8**	**-6.3**	**-4.8**	**10.1**

Where the actuals are in excess of the allowance the AER is required to review that capital expenditure for the period to ensure it is consistent with the requirements of the national electricity rules.

There were two projects that formed part of the actual capital expenditure during this period that were not forecast at the time of the AER final determination when it was issued in April 2013.

There were two major projects in the time period for the AER's capital expenditure review.

- Control and protection system
- Fire suppression

Together these projects cost $37.4m in the capital expenditure between FY2017 and FY2021. This accounted for 95% of the capital expenditure in that period. The bulk of the actual expenditure was on a single project that was forecast and the expenditure was of a similar level to that which was forecast.

There are two material differences between the capital expenditure allowance and the capital expenditure

6.1. Obsolete Control and Protection System

This project was included in the AER's forecast capital expenditure it was included as occuring over the period FY 19 to FY 2022.

However, we were able to commence earlier than anticipated at the time of the proposal. The project is anticipated to be close to the forecast cost at the time of the proposal it just expected to have slightly different timing due to commencing earlier and minor finalisation work continuing into next year. The actual expenditure compared to the allowance is set out in the table below.

Table 17: Capital expenditure – Obsolete fire and protection system

Control and protection system	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Actual	6.2	9.3	7.0	5.2	0.6	0.2	**28.6**
AER Forecast	-	4.4	12.8	9.9	1.4	-	**28.5**
Difference	**6.2**	**4.9**	**-5.7**	**-4.7**	**-0.8**	**0.2**	**0.1**

If limited to the period the AER is required to consider (FY17 to FY21) the actual expenditure was $27.8m compared to the allowance of $27.1m a difference of $0.7m.

The reasons for this project and its compliance with the national electricity law are as outlined in the business case supplied to the AER in the last transmission determination proposal.

6.2. Fire Suppression

Following the fire at Directlink Mullumbimby converter station it became apparent that the fire suppression arrangements at both Directlink and Murraylink were insufficient to protect the stations.

Previously Murraylink and Directlink both had fire detection equipment that would set off alarms in the event that fire is detected but no automated capability to combat a fire should it break out or threaten to break out.

Directlink's Mullumbimby 1 converter station burnt down as a result of a fire in August 2012. It did not return to service until August 2015.

Directlink was commissioned in April 2000. It comprises 6 converter buildings in total. Murraylink was commissioned in August 2002 and comprises two converter buildings.

This means that between the commissioning of the two interconnects there were 1,128 operational months in August 2012. There was one converter station that was completely destroy and required 3 years to commence operation.

This means, based on the limited data available to EII, that in any month there is a 1 in 1,128 possibility that one converter station will be destroyed in the absence of fire suppression equipment.

If Murraylink loses a converter station the entire capacity of Murraylink is taken offline. Under the APA risk matrix a 1 in 1,128 event in a month is considered a high likelihood event. The complete loss of Murraylink operations is a high consequence event. This means that this ranks as a high risk event. The installation of fire suppression equipment to reduce the likelihood of the risk to low is consistent with the requirements of the national electricity rules requirement on Murraylink to maintain the quality, reliability and security of supply of prescribed transmission services.

The Capital expenditure associated with this project is set out in the table below.

Table 18: Capital expenditure - fire suppression

Fire Protection System ($m nominal)	2016/17	2017/18	2018/19	2019/20	2020/21	Total
Actual	-	8.3	1.3	0.0	-	9.6

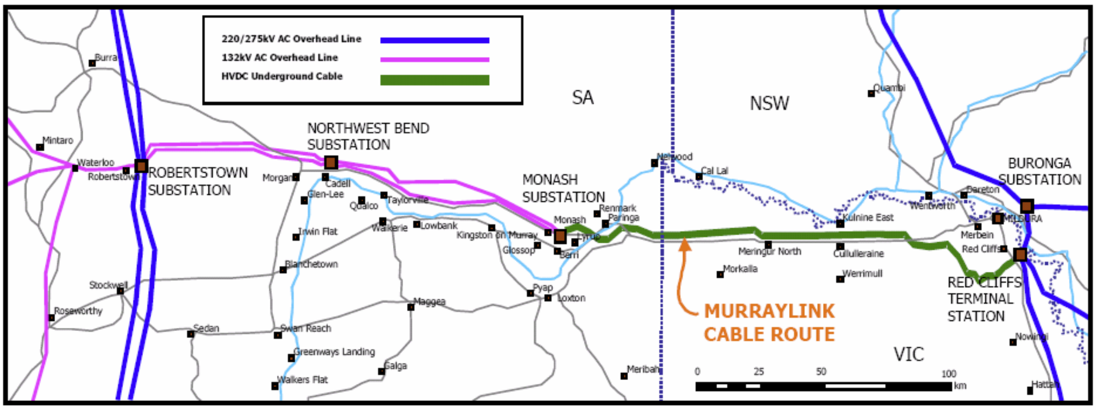
The upgrade and additions to the existing fire detection system installed within both the Red Cliffs and Berri converter stations are summarised below:

- New Fire Detection Control and Indicating Equipment
- New networked fire detection systems
- Wet Pipe Sprinkler Systems
- New fire hydrant system for manual fire protection at both sites.
- New inert gas suppression system-for the following risk areas:
- Main control room; and
- IGBT valve control enclosures.
- Associated water storage tanks, pump rooms, pump sets, piping reticulation, fire indicator panels, control and power cabling, light and power and any other facilities required for the proper operation of the proposed additional detection and suppression systems.

7. Legal Obligations not in RIN template

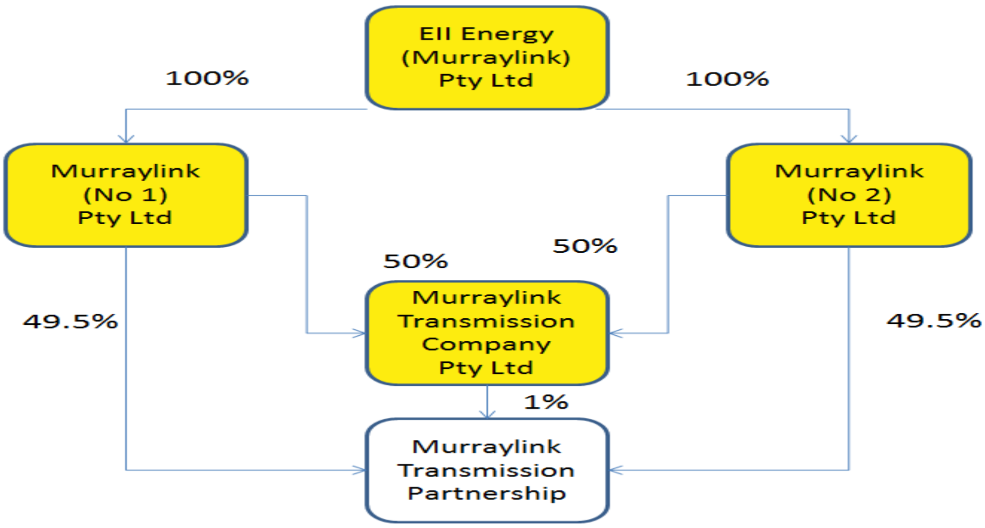
7.1. MAP

Figure 6: MAP of Murraylink



7.2. Corporate structure

Figure 7: Murraylink Corporate structure



7.3. Information provided method

Cost information provided is in accordance with Murraylink's cost allocation methodology. No changes to the cost allocation methodology have occurred in the current regulatory control period and none are forecast.

7.4. Length of the regulatory control period

For the avoidance of doubt the proposed regulatory control period is 1 July 2023 to 30 June 2028

7.5. Capital Expenditure and Operating expenditure

We have considered the interaction of capital expenditure and operating expenditure through the application of our asset management plan and business cases. We have identified no new significant interactions.