

Murraylink

IGBT Lifecycle Upgrade

RIT-T – Project Specification Consultation Report

12 November 2026

Energy Infrastructure Investments



Acknowledgement of Country

At Murraylink, we acknowledge the Traditional Owners and Custodians of the countries on which Murraylink operates.

We acknowledge their connections to land, sea and community.

We pay our respects to their Elders past and present, and commit to ensuring Murraylink operates in a fair and ethical manner that respects First Nations peoples' rights and interests.

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Glossary

Term	Meaning
AC	Alternating current
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
DC	Direct current
HVDC	High voltage direct current
IGBT	Insulated Gate Bipolar Transistor
ISP	Integrated System Plan
MMC	Modular multi-level converter (a newer technology)
MW	Megawatt
NEM	National Electricity Market
NER	National Electricity Rules
PACR	Project Assessment Conclusions Report
PADR	Project Assessment Draft Report
PSCR	Project Specification Consultation Report
PWM	Pulse Width Modulation
REZ	Renewable Energy Zone
RIT-T	Regulatory Investment Test for Transmission
Sub-module	A component within a larger piece of equipment
TNSP	Transmission Network Service Provider
VSC	Voltage Source Converter


Red Cliffs converter

Executive summary

Murraylink Pty Ltd is a Transmission Network Service Provider (**TNSP**) owned by Energy Infrastructure Investments Pty Ltd. Murraylink Pty Ltd owns the Murraylink interconnector.

The Murraylink Interconnector is a 220 MW High Voltage Direct Current (**HVDC**) interconnector linking the Victorian and South Australian power networks, from Red Cliffs in Victoria to Berri in South Australia. The facility includes a converter station at each end, the Direct Current (**DC**) cables that connect them, and the Alternating Current (**AC**) cables, switchgear and converter transformers that connect each converter station to its nearby AC substation.

It is the smaller of two existing interconnectors that currently operate between South Australia and Victoria. A third interconnector, to help deliver the energy transition, is currently being constructed (Project EnergyConnect) and is due for completion in late-2027.

HVDC interconnectors are becoming more valuable as the grid changes. The Australian Energy Market Operator (**AEMO**) relies on their fast, controllable power flows to manage voltage, respond quickly to disturbances and support neighbouring regions – day to day, and especially during peak periods or outages.

Murraylink has been in service for more than 24 years. It uses an early form of Voltage Source Converter (**VSC**) technology, known as three-level Pulse Width Modulation (**PWM**), and was one of only a handful of VSC systems to apply this technology using Insulated-Gate Bipolar Transistors (**IGBTs**).

IGBTs are high-speed, high-efficiency electronic switches that convert electricity from AC to DC and back again. They are central to Murraylink's operation.

The Generation 2 IGBTs used at Murraylink are obsolete. Hitachi Energy no longer manufactures or supports them, and spares can no longer be purchased. At current failure rates, our remaining spares will support less than five more years of operation.[1]

To keep Murraylink operating at full capacity, the IGBTs must be upgraded between 2028 and 2031 – either to the supported Generation 3 version of the current technology, or to a newer converter technology.

Murraylink is required to apply the Regulatory Investment Test for Transmission

The estimated capital cost of the most expensive credible option exceeds the threshold (currently $8 million) that requires us to apply the Regulatory Investment Test for Transmission (**RIT-T**).

The identified need is to continue meeting the reliability and service standards set by AEMO, VicGrid and ElectraNet and Schedule 5.1 of the National Electricity Rules (**NER**). The investment is therefore classified as a 'reliability corrective action' under the NER.

This is not an actionable Integrated System Plan (**ISP**) project. As the estimated capital cost of the preferred option is below $54 million, we propose to use the expedited process for non-ISP projects.

This Project Specification Consultation Report (**PSCR**) is the first step in that process.

Why action is needed

Murraylink's IGBTs were manufactured by Hitachi Energy (formerly ABB).

Murraylink's converters rely on 'valves' – stacks of IGBTs connected in series that must open and close at exactly the same moment, acting as a very fast high-voltage switch. At Murraylink, each valve switches 150 kV on and off 1,350 times per second (1,350 Hz).

This demanding duty means IGBTs fail regularly and must be replaced. Because Murraylink was an early adopter of this technology, there is no industry experience to predict how its failure rates will change as the equipment ages.

We have acquired 24 of the last remaining Generation 2 IGBT spares available worldwide. Based on forecast failure rates, we expect our spares to run out by May 2031.

[1] The bathtub failure curve means there is a risk that failures could rise dramatically.

Murraylink has 5,832 IGBTs installed across six phases – 972 IGBTs per phase, with three phases at each converter station. They need to be upgraded so that Murraylink can continue to operate at full capacity.

If we do nothing, IGBT failures will continue until Murraylink can no longer operate, at existing failure rates in 2031. Murraylink would then be unable to meet its obligations under the NER to provide Prescribed Transmission Services.

We consider this a 'reliability corrective action' under the RIT-T because the investment is needed to meet externally imposed regulatory obligations and service standards – namely, continued service under the NER and Murraylink's connection agreements.

Three credible network options can meet the identified need

There are three credible options that meet the identified need from a technical, commercial and delivery perspective. Each option keeps Murraylink's existing 220 MW capacity. Based on our preliminary analysis, Option 1 is the proposed preferred option because it has the lowest cost, the shortest outage and the shortest lead time.

Table E-1 Summary of the credible options

Option	Description	Estimated capital cost	Estimated annual operating cost	Estimated completion date/duration
1	Upgrade of the IGBTs of one phase at one converter station from Generation 2 to Generation 3, releasing 972 spares for use in the other 5 phases, with successive phases to be upgraded based on IGBT failure rate and sparing threshold	$40m	OPEX Cost of continuing replacement of failed IGBTs for the other five phases, potentially escalating as IGBTs age	2031 70 day outage Potentially escalating annual outages to replace failed IGBTs for the other five phases
2	Upgrade one converter station from VSC to modular multi-level converter (**MMC**) technology, releasing 2,916 spare IGBTs for use at the other converter station or potential sale	$74m	OPEX Cost of continuing replacement of failed IGBTs for the other three phases, potentially escalating as IGBTs age	2032+ 150 day outage Potentially escalating annual outages to replace failed IGBTs for the other three phases
3	Upgrade both converter stations from VSC to MMC technology	$195m	OPEX Savings due to eliminated IGBT replacement works	2032+ 150 day outage
4	Do nothing	Excluded on the basis that failures continuing at the current rate will lead to Murraylink being offline and unable to be repaired by May 2031.		

Non-network options are not expected to be able to assist

We do not expect a non-network solution to be commercially feasible. IGBTs perform a unique and specific role in transmitting electricity across Murraylink. A non-network option would need to replicate 220 MW of controllable transfer capacity between two NEM regions, at a cost comparable to the preferred network option.

Nevertheless, consistent with the RIT-T, this PSCR sets out the technical characteristics a non-network option would need to provide, so that all alternatives are properly considered. We welcome contact from any party who believes they could provide these characteristics cost-effectively.

Modelled wholesale market benefits

Each option is expected to deliver significant wholesale market benefits compared with the base case, because each avoids losing Murraylink and keeps its full capacity available.

Informed by discussions with stakeholders, we propose to estimate the following market benefits for each option in the Project Assessment Conclusions Report (**PACR**):

- Changes in fuel consumption in the NEM arising through different patterns of generation dispatch
- Changes in costs for parties, other than the RIT-T proponent – that is, changes in investment in generation and storage

If these benefits alone are not sufficient to demonstrate a positive net benefit, we will also estimate:

- Differences in unrelated transmission investment (in particular, the cost of connecting Renewable Energy Zones), and
- Benefits of voltage and frequency control provided by the HVDC conversion.

This staged approach keeps the cost of the RIT-T – which is ultimately borne by consumers – proportionate, by avoiding modelling that is not needed.

These benefits are relevant to this RIT-T but are not expected to change which option is preferred. Each of the three options keeps Murraylink's existing capacity and so delivers broadly the same wholesale market benefits compared with the base case.

Submissions and next steps

We welcome written submissions on this PSCR. Submissions are due by Thursday 4 February 2027.

Please email submissions to yoursay@apa.com.au with 'Murraylink IGBT Lifecycle Upgrade RIT-T PSCR' in the subject line.

We will publish submissions on the APA Group website. If you do not want your submission published, please say so clearly when you lodge it.

Subject to the issues raised in submissions, we expect to publish the PACR in March-2027.



1 Introduction

Murraylink is a 220 MW electricity transmission interconnector between Victoria and South Australia.

It consists of a single bipole route of 180 km, buried underground at a nominal depth of 1.2 metres, with a converter station at Red Cliffs (Victoria) and Berri (South Australia). Running underground allows the cable to pass through environmentally sensitive areas where an overhead line would be unlikely to gain approval.

IGBTs are central to Murraylink's operation. They carry out the switching that converts electricity from AC to DC, and back again.

We have started this RIT-T to assess, and consult on, the options for upgrading Murraylink's IGBTs, which are now obsolete and have a limited supply of spares.

1.1 Purpose

The purpose of this PSCR is to:

- set out the reasons why we propose that action be undertaken (that is, the ‘identified need’)
- present credible network options that can address the identified need
- set out the technical characteristics that a non-network option would need to deliver to address the identified need, and
- discuss specific categories of market benefit that, in the case of this RIT-T assessment, are expected to be material (and those that are not).

Appendix B outlines the full RIT-T process. The next steps for this RIT-T are set out below.

1.2 How to make a submission and next steps

We welcome written submissions on this PSCR. Submissions are due by Thursday 4 February 2027.

Please email submissions to yoursay@apa.com.au with 'Murraylink IGBT Lifecycle Upgrade RIT-T PSCR' in the subject line.

We will publish submissions on the APA Group website. If you do not want your submission published, please say so clearly when you lodge it.

Subject to the issues raised in submissions, we expect to publish a PACR, including a full options analysis, in March-2027.

2 The 'identified need'

This section explains the identified need for this RIT-T and the assumptions behind it, starting with background on the Murraylink interconnector.

2.1 Background to the identified need

About Murraylink

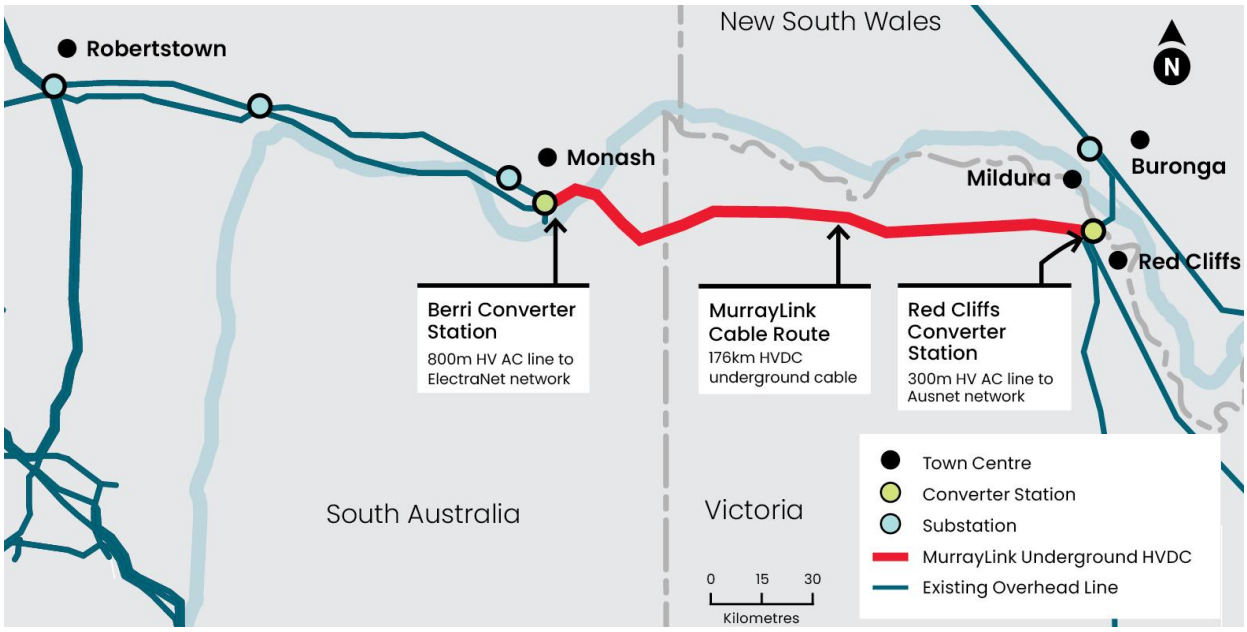
Murraylink was commissioned in 2002. It comprises an underground HVDC cable with converter stations at Red Cliffs (Victoria) and Berri (South Australia).

Murraylink can deliver up to 220 MW into the AC networks in Victoria and South Australia.

Murraylink differs from the more conventional transmission assets operated by other TNSPs in the NEM. For example, it is a point-to-point link rather than a network with multiple customer connections. Its cables also carry direct voltage, which creates different stresses and insulation breakdown risks compared with AC cables.

The figure below illustrates the Murraylink transmission route in Victoria and South Australia.

Figure 2-1 Map of the Murraylink transmission route



Murraylink plays a key role in moving electricity between the South Australian and Victorian regions of the NEM. In 2025, more than 378 GWh of electricity flowed across it. This delivers significant benefits to the NEM, helping to lower electricity prices for consumers and supporting network stability in the Robertstown region of South Australia and north-west Victoria.

Because the NEM is an AC network, electricity must be converted from AC to DC as it enters Murraylink, and back to AC as it re-enters the NEM. The two converter stations, shown in Figure 2-1 above, perform this conversion.

Insulated-gate bipolar transistors (IGBTs)

An IGBT is a power semiconductor device used as an electronic switch in high-voltage, high-current applications. IGBTs are integral to the operation of the Murraylink converter stations. Each IGBT 'position' combines the IGBT power electronics with a gate control unit. The gate control unit contains the electronics that switch and monitor the IGBT, and communicate with the valve control unit via fibre optic links.

Murraylink uses an early form of VSC technology – a three-level PWM design – and was one of only a handful of VSC systems to use the IGBTs that Hitachi (formerly ABB) refers to as 'Generation 2'.

Two- and three-level PWM systems use 'valves' made up of IGBTs connected in series, which must open and close at precisely the same moment to act as a very fast high-voltage DC switch. At Murraylink, each valve switches 150 kV on and off 1,350 times per second (1,350 Hz).

In December 2020, Hitachi – the sole supplier of these IGBT positions – advised that they are no longer in production and that spares can no longer be purchased.

Murraylink has 5,832 Generation 2 IGBTs in total. Each converter station has three phases of 972 IGBTs. Each phase is made up of six arms, or valve groups (three positive and three negative), of 162 IGBTs each.

2.2 Description of the identified need

The demanding switching duty described above means IGBTs fail and need replacing regularly. Because Murraylink was an early adopter of this technology, there is no industry evidence on whether failure rates will rise once the equipment reaches a certain age.

A fault in any component of the gate control unit can cause the IGBT to report as failed, or can damage the IGBT power electronics itself.

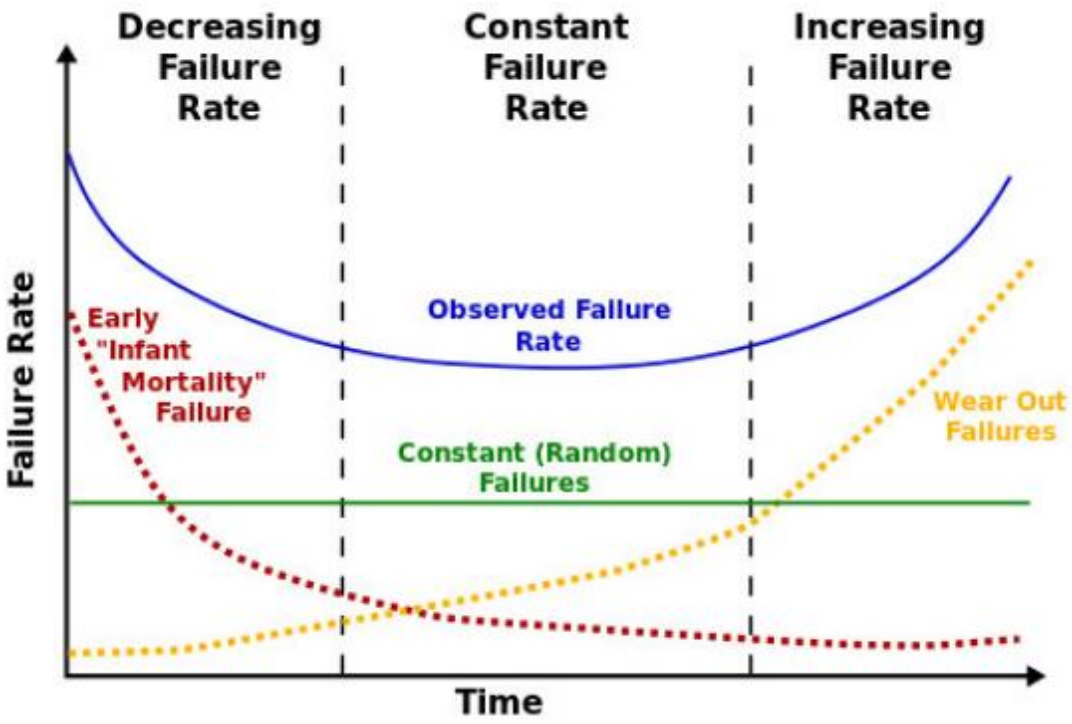
2.3 Assumptions used in identifying the identified need

IGBT failure rates are unlikely to stay constant. Electrical equipment such as IGBT positions typically follows a 'bathtub curve', which combines three types of failure:

- Failure of units early in life, also known as “infant mortality”. These failures are predominantly caused by manufacturing defects, with the early failure rates decreasing over time.
- Intrinsic failure of units, remaining largely constant for the life of the components.
- Wear-out failure caused by aging of components. As the components approach their design life, the failures due to wear-out increase.

Combined, these produce an overall failure rate shaped like a bathtub, as shown in Figure 2-2.

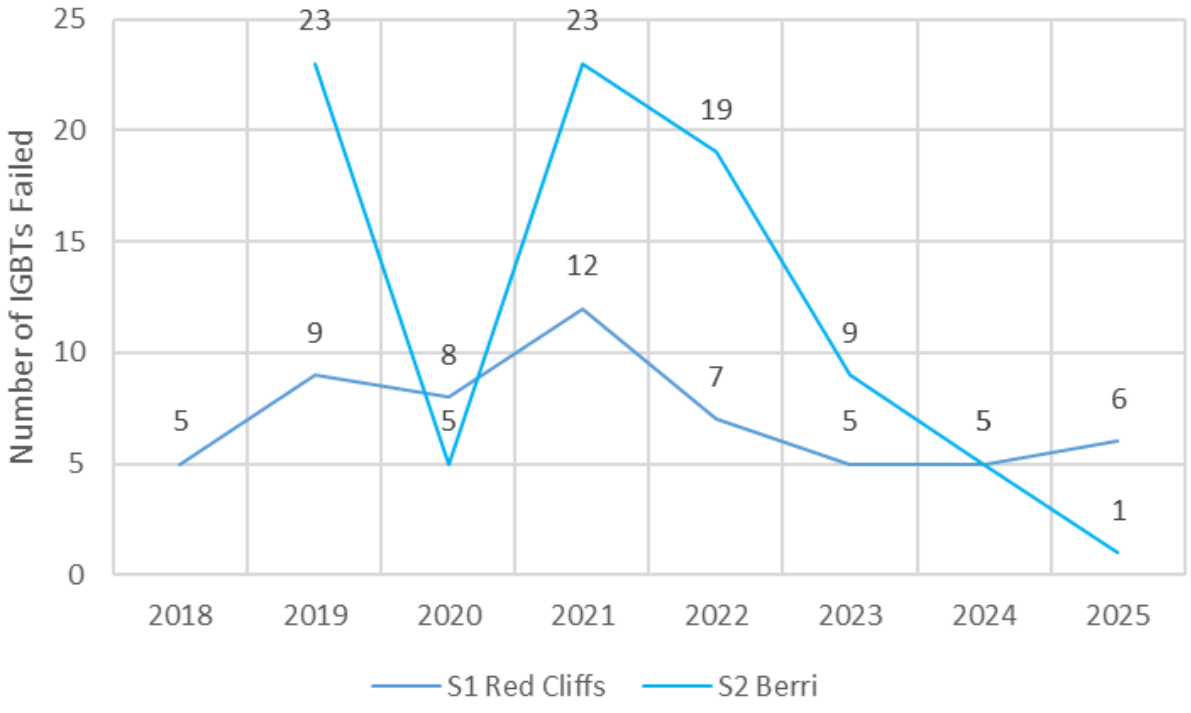
Figure 2-2 Bathtub Failure Curve



Each valve group of 162 IGBTs can tolerate up to five failed IGBTs; a sixth failure trips the valve group. A single tripped valve group (one of 36 across both converter stations) takes Murraylink out of service until that group is returned to service.

In May 2026, we analysed the number of remaining IGBTs and the current failure rate. The results are shown in Figure 2-3.

Figure 2-3 IGBT Failures per annum



At recent failure rates, we will run out of spare IGBTs in:

- 5.87 years for Red Cliffs Converter Station
- 5.13 years for Berri Converter Station

If failures at Berri continue at this rate, we will have no spare Generation 2 IGBTs by May 2031. Murraylink would then stop operating, breaching both its licence and its NER obligations.

We consider this a 'reliability corrective action' under the RIT-T because the investment is needed to meet externally imposed regulatory obligations and service standards – that is, continued service under the NER, consistent with Murraylink's connection agreements with ElectraNet and AusNet.

3 Options that meet the identified need

We considered four options. Three are credible options that meet the identified need from a technical, commercial and delivery perspective; the fourth is the 'do nothing' base case. The options are summarised below.

Table 3-1 Summary of the credible options

Option	Description	Estimated capital cost	Estimated annual operating cost	Estimated completion date/duration
1	Upgrade of the IGBTs of one phase at one converter station from Generation 2 to Generation 3, releasing 972 spares for use in the other 5 phases, with successive phases to be upgraded based on IGBT failure rate and sparing threshold	$40m	OPEX Cost of continuing replacement of failed IGBTs for the other five phases, potentially escalating as IGBTs age	2031 70 day outage Potentially escalating annual outages to replace failed IGBTs for the other five phases
2	Upgrade one converter station from VSC to MMC technology, releasing 2,916 spare IGBTs for use at the other converter station or potential sale	$74m	OPEX Cost of continuing replacement of failed IGBTs for the other three phases, potentially escalating as IGBTs age	2032+ 150 day outage Potentially escalating annual outages to replace failed IGBTs for the other three phases
3	Upgrade both converter stations from VSC to MMC technology	$195m	OPEX Savings due to eliminated IGBT replacement works	2032+ 150 day outage
4	Do nothing	Excluded on the basis that failures continuing at the current rate will lead to Murraylink being offline and unable to be repaired by May 2031.		

The rest of this section describes each option in more detail. Every credible option keeps Murraylink's existing 220 MW capacity.

No option is considered likely to have material inter-network impacts.

3.1 Description of the ‘base case’

As required by the RIT-T, we will compare the costs and benefits of each option against a 'do nothing' base case – Option 4 in Table 3-1 above.

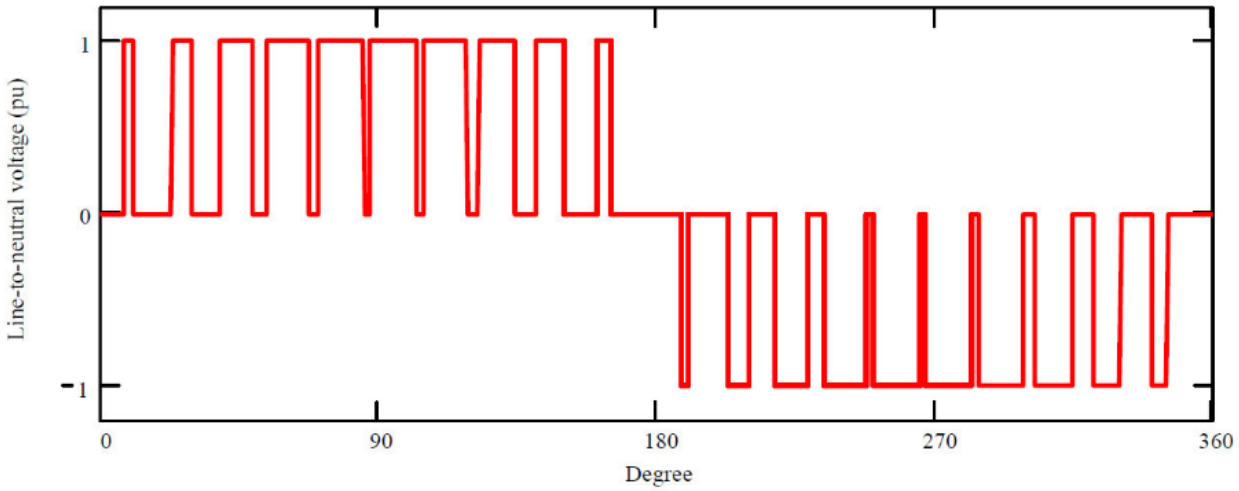
The base case is the hypothetical outcome if no credible option is implemented. Murraylink would keep operating until its spare IGBTs run out and one of its 36 valve groups reaches six failed IGBTs.

3.2 Overview of Available Switching Technology

Murraylink uses three-level VSC technology, which was new when it was installed. Three-level VSC converters use PWM to switch between two DC voltages (±150 kV at Murraylink) at a frequency of 1,350 Hz.

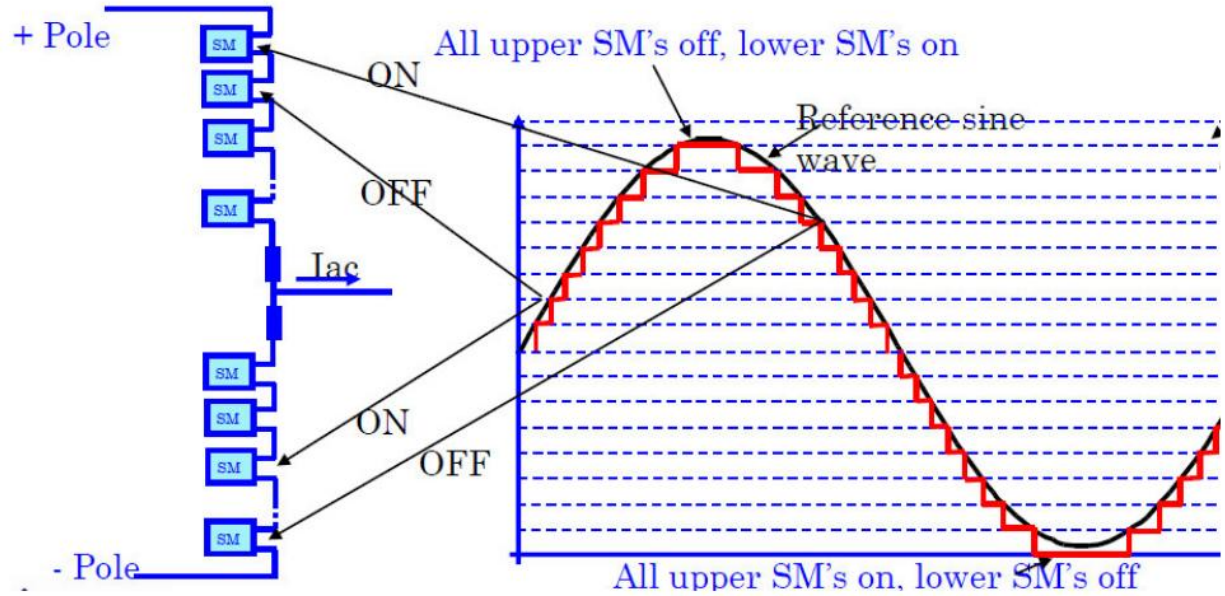
A phase reactor acts as a low-pass filter to create a sinusoidal AC voltage waveform from the high-frequency PWM voltage. Harmonic filters then smooth the waveform and remove higher-order harmonics. Figure 3-1 shows the DC voltage switching for a three-level VSC converter. On the DC side, the three voltage waveforms on the positive and negative sides combine to create a steady DC voltage.

Figure 3-1 Three Level VSC Switching



A VSC HVDC link like Murraylink built today would typically use modular multi-level converter (**MMC**) technology. An MMC switches 'sub-modules' – capacitor banks switched by IGBTs – in and out, using the capacitors' varying states of charge to build the AC and DC voltage waveforms. Figure 3-2 shows an example MMC switching profile. Little or no AC filtering is usually needed. Because MMC switches at a lower frequency than three-level VSC, its losses and cooling needs are significantly lower.

Figure 3-2 Modular Multi-Level Converter Switching



The options below compare keeping the current three-level VSC technology with upgrading one or both converter stations to MMC technology.

3.3 Option 1 – Upgrade 1 Phase from Generation 2 to Generation 3 IGBTs

Option 1 replaces all Generation 2 IGBTs in one phase at one converter station with Generation 3 IGBTs. Each converter station has three phases of 972 Generation 2 IGBTs.

Generation 2 and Generation 3 IGBTs are not physically or electrically interchangeable, so the smallest practical upgrade is a full phase at one converter station.

Upgrading one phase is not expected to affect the overall operation of the converter station, and the AC and DC waveforms should be no different from those produced by the current Generation 2 IGBTs.

The existing cooling, protection and control systems, and the AC and DC filtering, would be retained. The control and protection system was recently replaced with Hitachi's latest offering and should need only minor changes, if any, to work with the newer IGBTs.

The serviceable IGBT positions removed from the upgraded phase would be kept as spares for the remaining Generation 2 valves at both converter stations, extending their operating life.

If failure rates remain constant, the 972 recovered IGBT positions are expected to extend Murraylink's operation by decades.

Option 1 is estimated to cost $40 million, require a 70-day outage and take at least two years from project start to completion.

3.4 Option 2 – Upgrade 1 Converter Station from VSC to MMC Technology

Option 2 upgrades one converter station from three-level VSC to MMC technology. Each converter station has three phases of 972 Generation 2 IGBTs.

Because MMC uses a completely different switching design, its valves cannot be installed in containers like Murraylink's current valves. They must be installed in tiers, usually in a clean-room valve hall with humidity and environmental controls. MMC valves also create the AC and DC waveforms in a fundamentally different way, so it is not practical to replace a single phase – at a minimum, all three phases at a converter station must be replaced. It is technically possible for an HVDC link to operate with an MMC converter at one end and a three-level PWM converter at the other.

MMC technology does not usually need AC filters unless harmonic requirements are particularly tight, which is not expected at Murraylink. The existing AC filters could therefore be removed and the large AC filter room repurposed as a valve hall for the three phases of MMC sub-modules.

MMC technology is offered by several HVDC vendors, including three European suppliers and a few emerging Japanese suppliers. Installing MMC from another supplier would likely also require a new, compatible control and protection system.

The main benefit of converting to MMC is access to supported spare sub-modules. As MMC is relatively new, suppliers are likely to support these sub-modules for many years, if not decades. Other benefits include lower converter losses, expected improved reliability (fewer failures and outages), better thermal performance due to the lower switching frequency, and the ability to seek competitive quotes from multiple suppliers.

The benefits of replacing only one converter station are limited, as lower losses and improved reliability and thermal performance would apply only at that station. However, the 2,916 IGBT positions removed could support the other converter station and extend its life, with the same outcomes and risks as Option 1 (Section 3.3).

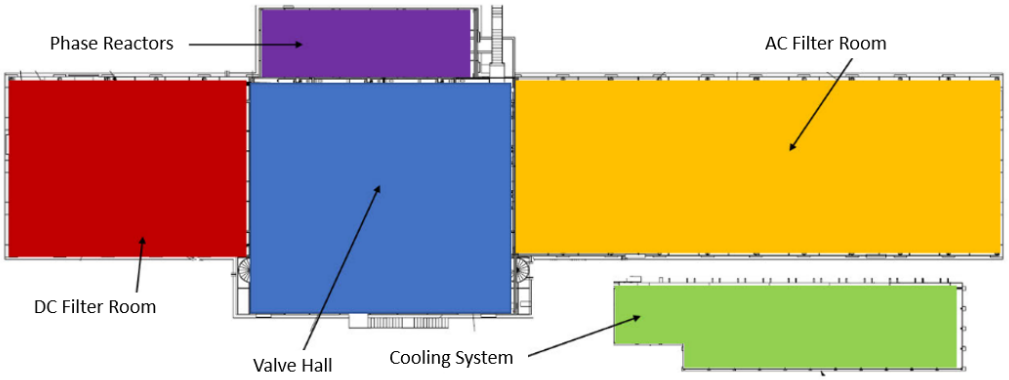
If failure rates remain constant, the 2,916 recovered IGBT positions are expected to extend Murraylink's operation by more than 40 years before further action is needed. In practice, however, any increase in failure rates would raise the risk of more frequent trips and longer outages while failed IGBTs are replaced.

Option 2 is estimated to cost $74 million, require a 150-day outage and take at least three years from project start to completion.

MMC Layout Considerations

Replacing a converter station with MMC technology would require changes to the converter station buildings and site layout.

Figure 3-3 Murraylink AC Barn Layout & Sections



When the converter operates as a rectifier (exporting power), power flows from the incoming AC feeder through the power transformers (not shown) into the AC filter room (yellow). From there it passes through the phase reactors (purple) into the valve containers (blue). Six valve 'arms' produce the positive and negative DC voltages for each phase and are cooled by the cooling system (green).

From the valve halls, power flows through the DC filter room (red) into the two DC cables (not shown). When the converter operates as an inverter (importing power), the flow is reversed.

For the MMC options, most of the equipment in the AC filter room is expected to become redundant. MMC produces a voltage waveform with excellent harmonic performance, so AC filtering is not needed for the harmonics created by the conversion process. Most of the existing filtering equipment could therefore be removed, with the aim of fitting as much of the MMC valves and associated equipment as possible into this space and limiting changes to the rest of the building and site.

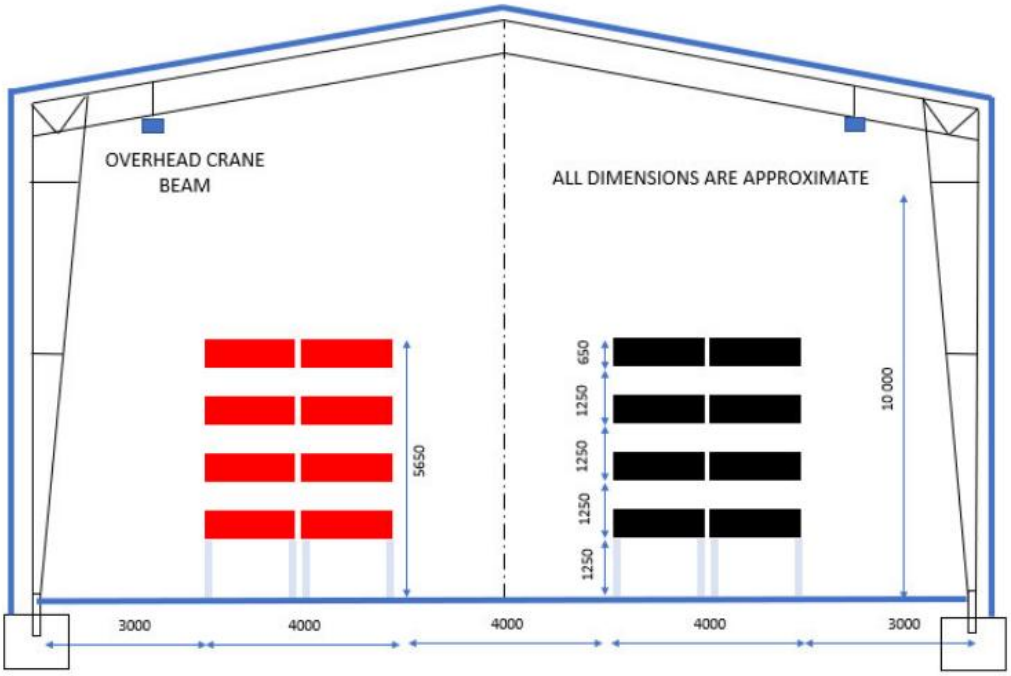
To house the new MMC equipment, the AC filter room would need to become a 'clean room'. At a minimum, this would involve:

- Installation of dust seals, air handling and filtration plant.
- Thermal cladding of the walls and roof.
- Humidity control.
- Cable tray systems.
- Arc flash detection and associated protection.
- CCTV.
- Vermin proofing.
- Painting the floors and walls to seal the surfaces.

There are several ways the MMC equipment (valves, sub-modules and reactors) could be configured at each site. In all cases, changes to the building, below-ground infrastructure and site equipment would be needed to achieve an acceptable engineering solution.

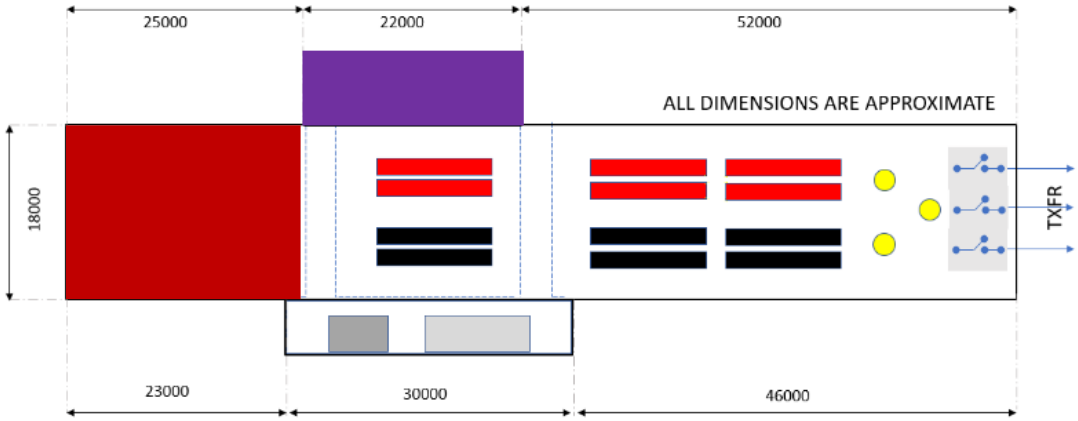
Given the relatively narrow converter station buildings, the space available and the need for simpler connections to the indoor DC yard and existing outgoing cable ducts, parallel valve stacks are preferred. Fitting 160 modules of 0.4 m width, with a phase arm length of around 10 m, requires a four-level double-stack arrangement.

Figure 3-4 Side View of potential MMC valve stack layout



Allowing for electrical and maintenance clearances, the existing AC filter room alone cannot fit all six converter arms and their reactors. The concept therefore involves removing the existing valve enclosures to make room for two of the converter arms. The reactors would need to be stacked vertically, and it may be possible to reuse the existing isolators in the AC filter room.

Figure 3-5 Top down view of potential MMC valve stack layout



3.5 Option 3 – Upgrade Both Converter Stations from VSC to MMC Technology

Option 3 is the same as Option 2 (Section 3.4), but with both converter stations upgraded. The capital cost is much higher – around $195 million. However, both stations could be upgraded at the same time, so the outage would be about the same as for Option 2.

Under this option, the benefits described above would apply across the whole HVDC link – lower losses and better reliability and thermal performance at both converter stations, effectively doubling the benefits. It would also future-proof the entire link, removing any reliance on Generation 2 IGBTs.

It may be possible to engage with the owners and operators of other HVDC systems that still use the Generation 2 IGBT positions to sell them spare generation 2 IGBTs as a means of offsetting the cost transferring technologies.

However, there is only one other user of the technology and they would know that if we are selling spares we are moving to a new technology if we enter negotiations prior to transitioning or are aware we have moved to a new technology after we have transitioned. In either circumstance the counter party has the upper hand in the knowledge that Murraylink no longer will be using generation 2 IGBTs and has no one else to sell to. This will substantially reduce their resale value.

3.6 Options considered but not progressed

We also considered whether other network options could meet the identified need. Table 3-2 explains why these have not been progressed.

Table 3-2 Options considered but not progressed

Option	Reason(s) for not progressing
Source alternative Generation 2 IGBTs from a supplier other than Hitachi	Not recommended. Technical viability is unproven and would need extensive research and development to test and prove. The available timeframe does not allow this option to be pursued.
Do nothing	Excluded on the basis that failures continuing at the current rate will lead to Murraylink being offline and out of service by May 2031.

4 Non-network options

We do not expect a non-network solution to be commercially feasible for this RIT-T.

IGBTs play a unique and specific role in transmitting electricity across Murraylink. A non-network option would need to replicate the capacity and system security services of a 220 MW controllable interconnector between two NEM regions.

Nevertheless, consistent with the RIT-T, this section sets out the technical characteristics a non-network option would need to provide, so that all alternatives are properly considered. This is intended to help interested parties propose genuine, practical non-network solutions – such as local generation or demand side management. We encourage potential providers to contact us if they believe they could provide these characteristics cost-effectively.

4.1 Required technical characteristics and costs of non-network options

As described in Section 3.1, without network investment Murraylink would stop operating once its spare IGBTs run out, forecast for 2031. A non-network option would therefore need to provide 220 MW of capacity to be technically feasible.

To be commercially feasible, a non-network option would need to provide 220 MW of capacity and equivalent system security at a cost similar to the preferred network option, or deliver greater market benefits. Our preliminary analysis indicates that Option 1, at an estimated $40 million, is the preferred network option at this stage.

The ability of a non-network solution to provide additional market services in future would also be considered when comparing it with network options.


Berri converter station

5 Materiality of market benefits

This section sets out the categories of market benefit prescribed in the NER and whether we expect each to be material for this RIT-T.

Because the RIT-T looks forward, the modelling will take account of expected changes in the market that will affect the benefits Murraylink provides. These include:

- Project EnergyConnect;
- New developments of renewable energy generation in Victoria and South Australia; and
- Retirements of coal fired generation assets.

5.1 Material market benefits that will be captured in the RIT-T modelling

As outlined in Sections 2 and 3, without action, IGBT failures are likely to cause Murraylink to stop operating, possibly as early as 2031.

Each credible option is designed to avoid this outcome and keep Murraylink's full 220 MW capacity. Each is therefore expected to have a significant impact on the wholesale market compared with the base case.

Informed by discussions with stakeholders, we propose to estimate the following market benefits for each option in the PACR:

- Changes in fuel consumption in the NEM arising through different patterns of generation dispatch
- Changes in costs for parties, other than the RIT-T proponent – that is, changes in investment in generation and storage

If these benefits alone are not sufficient to demonstrate a positive net benefit, we will also estimate:

- Differences in unrelated transmission investment (in particular, the cost of connecting Renewable Energy Zones), and
- Benefits of voltage and frequency control provided by the HVDC conversion.

This staged approach keeps the cost of the RIT-T – which is ultimately borne by consumers – proportionate, by avoiding modelling that is not needed.

Section 6 outlines how we propose to model these benefits.

While these market benefits are relevant to this RIT-T, they are not expected to affect which option is preferred. This is because each of the three credible options keeps Murraylink's existing capacity and so delivers broadly the same wholesale market benefits compared with the base case. We will quantify these benefits in the PACR to show the overall value of the investment, but we do not expect them to change the choice of preferred option.

5.2 All other categories of market benefits are not considered material

We do not consider any other class of market benefit under the RIT-T to be material for this assessment, for the reasons set out in Table 5-1. We therefore do not intend to estimate them.

Table 5-1 Market benefit categories not considered material

Market benefit	Reason(s) it is not considered material for this assessment
Changes in involuntary load curtailment	In general, there is expected to be sufficient redundancy in the NEM to avoid involuntary load shedding if Murraylink's capacity is reduced.
Changes in voluntary load curtailment	There is not expected to be a significant impact on pool prices in the NEM from the options and so there is not expected to be material changes to the levels of voluntary load curtailment in the NEM.
Option value	Option value is likely to arise in a RIT-T assessment where there is uncertainty regarding future outcomes, the information that is available is likely to change in the future, and the credible options considered by the TNSP are sufficiently flexible to respond to that change.[2] The estimation of any additional option value benefit would require a significant modelling assessment, which would be disproportionate to any additional option value benefit that may be identified for this specific RIT-T assessment.

5.3 Additional qualitative benefits

Keeping Murraylink at full capacity will also support system security and reduce the risk of unserved energy under certain system conditions.

In some circumstances, Murraylink's capacity may be needed to maintain system security.

The networks around Murraylink also benefit from its continued operation as an HVDC interconnector.

[2] This is consistent with the AER's view, see: AER, *Regulatory Investment Test for Transmission Application Guidelines*, August 2020, pp. 53-54.

6 Overview of the assessment approach

This section outlines how we propose to assess the net benefits of upgrading Murraylink's IGBTs.

6.1 General modelling parameters adopted

The market modelling will use the scenarios and assumptions of AEMO's 2026 ISP Step Change scenario – the most recent final, consistent set of assumptions available.

We have chosen the Step Change scenario to keep the cost of modelling proportionate to its value in decision-making and to the cost of the credible options. Step Change is the most likely of the three main scenarios in the 2026 ISP, with a 46% weighting.

We will use a real, pre-tax discount rate of 7%, taken from the 2026 ISP Step Change scenario, to calculate the present value of market benefits.

The analysis will cover the 24 years from 2026–27 to 2049–50.

All other input assumptions will be drawn from the 2026 ISP Step Change scenario.

ACIL Allen will also model the 2026 ISP Higher Demand sensitivity, a key ISP sensitivity that tests faster-than-expected growth in electrification and data centres.

6.2 Summary of the wholesale market modelling proposed

Under the RIT-T, market benefits are calculated by comparing the 'state of the world' in the base case, where no action is taken, with the state of the world under each credible option separately. The 'state of the world' describes expected NEM outcomes in each case, including the type, quantity and timing of future generation investment and unrelated future transmission investment (for example, to connect Renewable Energy Zones (**REZs**) across the NEM).

We have retained ACIL Allen to undertake the wholesale market modelling exercise for this RIT-T assessment.

ACIL Allen will use PLEXOS, a globally recognised energy market simulation platform, for this modelling.

ACIL Allen uses PLEXOS where least-cost planning is required. The modelling will draw on the PLEXOS database AEMO publishes as part of the ISP, which underpins the ISP's detailed long-term planning and has previously been used for RIT-T assessments.

Appendix A – Compliance checklist

Rules clause	Summary of requirements	Relevant section(s) in PSCR
5.16.4 (b)	A RIT-T proponent must prepare a report (the project specification consultation report), which must include:	
	(1) a description of the identified need;	**Error! Reference source not found.**
	(2) the assumptions used in identifying the identified need (including, in the case of proposed reliability corrective action, why the RIT-T proponent considers reliability corrective action is necessary);	**Error! Reference source not found.**.3
	(3) the technical characteristics of the identified need that a non- network option would be required to deliver, such as: (i) the size of load reduction or additional supply; (ii) location; and (iii) operating profile;	4
	(4) if applicable, reference to any discussion on the description of the identified need or the credible options in respect of that identified need in the most recent Integrated System Plan;	N/A
	(5) a description of all credible options of which the RIT-T proponent is aware that address the identified need, which may include, without limitation, alternative transmission options, interconnectors, generation, demand side management, market network services or other network options;	3
	(6) for each credible option identified in accordance with subparagraph (5), information about: (i) the technical characteristics of the credible option; (ii) whether the credible option is reasonably likely to have a material inter-network impact;	3
	(iii) the classes of market benefits that the RIT-T proponent considers are likely not to be material in accordance with clause 5.16.1(c)(6), together with reasons of why the RIT-T proponent considers that these classes of market benefit are not likely to be material;	5
	(iv) the estimated construction timetable and commissioning date; and (v) to the extent practicable, the total indicative capital and operating and maintenance costs.	3

Appendix B – RIT-T process

Under the NER, the RIT-T is typically a three-stage process: (1) the PSCR; (2) the PADR; and (3) the Project Assessment Conclusions Report (**PACR**). The process is summarised in the figure below (in red).

The RIT-T can move from the PSCR to the PACR where certain criteria are met. The criteria are in the grey box below.

Figure 6-1 – The RIT-T assessment and consultation process

