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Generator Connection Process Guideline

Chapter 5 Connections

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Ausgrid

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Introduction

This guideline is designed to improve clarity and transparency of the connection process and allow connection applicants to participate more effectively in this process. It applies to Embedded Generator (EG) connections that will follow the Chapter 5 process of the National Electricity Rules (NER).

The connection process can be complex and challenging for proponents who are unfamiliar connecting in distribution networks, working with different Network Service Providers (NSPs) and with the Australian Energy Market Operator (AEMO). Ausgrid believes that supporting EG proponents provides the best customer experience for those wishing to connect to the Ausgrid network. Having a document that clearly and simply explains the connection process empowers and informs proponents, allowing them to fully participate in the connection process and efficiently develop their connections.

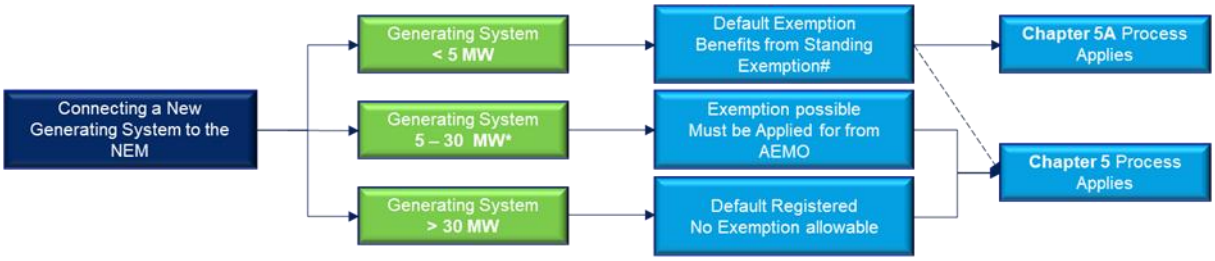
This guideline, in conjunction with other documents referenced within this guideline, satisfies Ausgrid's compliance obligations to publish an information pack under clause 5.3A.3 in Chapter 5 of the NER.

Generation Connections in the National Electricity Market

Proponents who wish to connect generation to a transmission or distribution network in the National Electricity Market (NEM) are required to follow the processes defined in the NER. The NSP responsible of the electricity network where the proponent intends on connecting manages the connection process and is the primary contact for the connection proponent.

The specific process followed to connect generation to the NEM depends on the Registration status of the generator. By default, all generation in the NEM must be Registered with AEMO, unless it benefits from an exemption. Guidance on which NER process should be followed and Registration requirements are shown in Figure 1. More information on registration can be found on the AEMO website: www.aemo.com.au.

Figure 1: NER Connection Process Paths



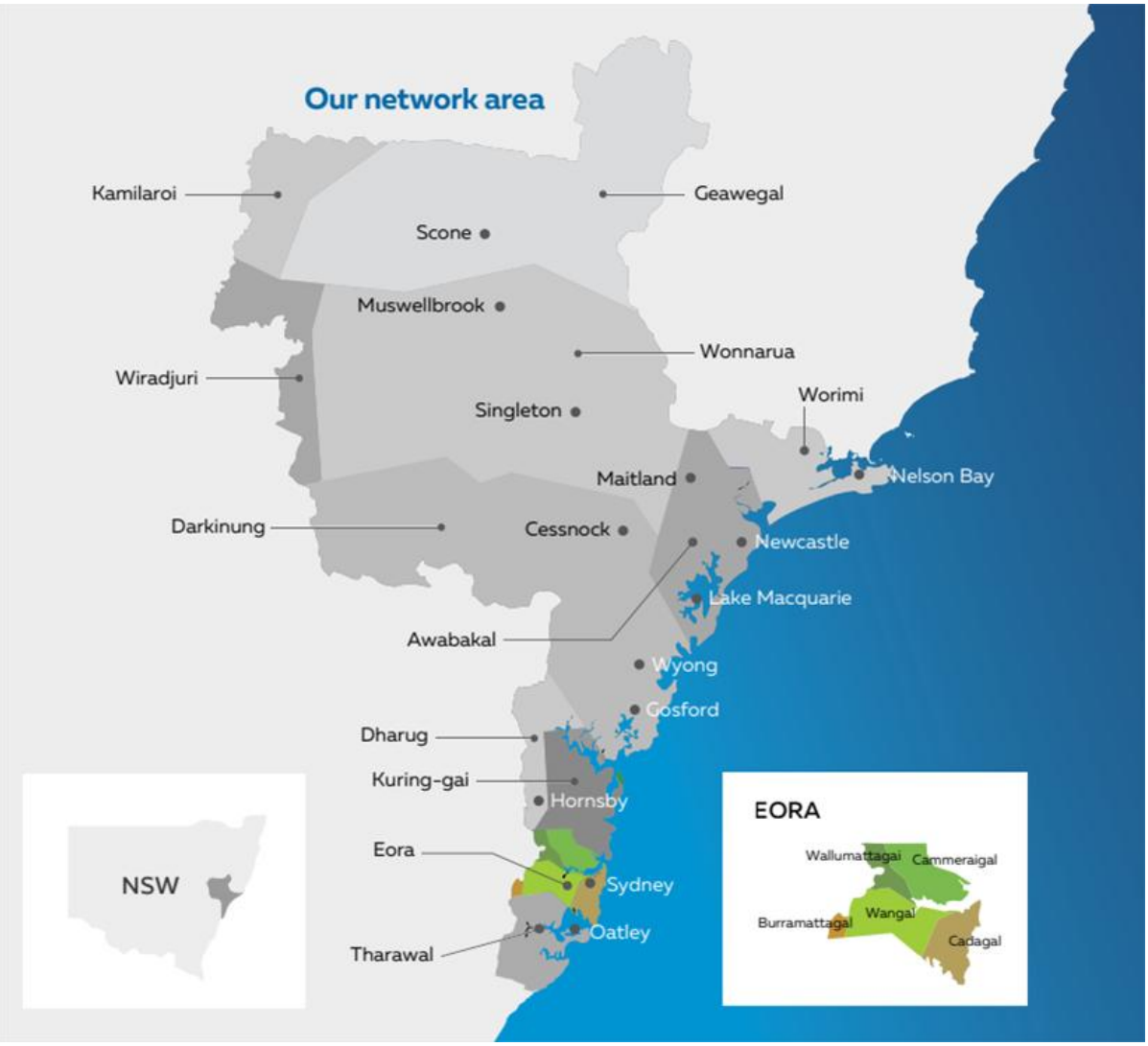
*Note: Any bi-directional unit component must be < 5 MW
Note: Participants eligible for a Default Exemption may elect to use the Chapter 5 process

This guideline specifically applies to generation participating in the Chapter 5 process.

Ausgrid as a Distribution Network Service Provider

Ausgrid is the largest distributor of electricity on Australia's east coast, providing power to 2 million customers. The Ausgrid network is made up of substations, powerlines, underground cables and power poles, spanning 22,275 square kilometres throughout Sydney, the Central Coast and the Hunter Valley.[1]

Figure 2: Ausgrid's Network Area



Ausgrid takes electricity supply from Transgrid as the New South Wales (NSW) Transmission Network Service Provider (TNSP), as well as having interconnection points with other NSW DNSPs. In addition to supplying electricity to 2 million customers, we connect major EG connections to the NEM, including renewable and traditional thermal energy sources. The Ausgrid network is unique; operating at voltages including 132 kV (including sections in parallel with the Transgrid network), 66 kV, 33 kV, 11 kV. This gives connection applicants an opportunity to connect to the Ausgrid network at a wider range of voltages, selecting the most suitable for both their location and size.

[1] Ausgrid – About Us, https://www.ausgrid.com.au/About-Us/Who-we-are, accessed 27 May 2024.

Technical Standards and References

A selection of technical references, standards and guidelines that will support proponents through the connection process are listed below in Table 1 and Table 2. This list is not exhaustive, and proponents should seek further information as required.

Table 1: Ausgrid Technical Standards and References

Ausgrid Documentation	
Network Standards and Technical Requirements	
NS194 Embedded Generation	NS 194B Guidelines for Rotating machines connected to the Ausgrid Network
NS 195 High Voltage Customer Connections	NS 238 Supply Quality
NS 143 Easements, Leases and Rights of Way	NS 178 Secondary Systems Requirements for Major Substations
Sample protection schematic	ES3 Metering Installation Requirements Part A
Policy for ASP/1 Premises Connections	Network standards
Model Contracts and Agreements	
Generator Connection Agreement	Contract for Design Related Services
Process Information	
Connecting large registered embedded generators	The Contestable Connection Process

Table 2: Third Party Technical Standards and References

External Documentation	
AEMO Documentation	
Generator Connection Application Checklist	Generator Performance Standards (GPS) Template
Modelling requirements (website)	Power System Model Guidelines
Guidelines for Assessment of Generator Performance Standards	System Strength Impact Assessment Guidelines
Generator Connection R1 Submission Checklist	Power System Stability Guidelines
GPS Compliance Assessment and R2 Model Validation Test Plan Template	
Other References	
National Electricity Rules	ASP Scheme and Contestable Works

Abbreviations

AAS	Automatic Access Standard
AEMO	Australian Energy Market Operator
DNSP	Distribution Network Service Provider
EG	Embedded Generator
FIA	Full Impact Assessment
GPS	Generator Performance Standard
IBR	Inverter Based Resources
MAS	Minimum Access Standard
NAS	Negotiated Access Standards
NEM	National Electricity Market
NER	National Electricity Rules
NSP	Network Service Provider
PIA	Preliminary Impact Assessment
SSC	System Strength Charges
SSCW	System Strength Connection Works
SSIAG	System Strength Impact Assessment Guideline
SSLF	System Strength Locational Factor
SSRS	System Strength Remediation Scheme
SSSP	System Strength Services Provider (Transgrid in New South Wales)
TNSP	Transmission Network Service Provider

Chapter 5 Connection Process

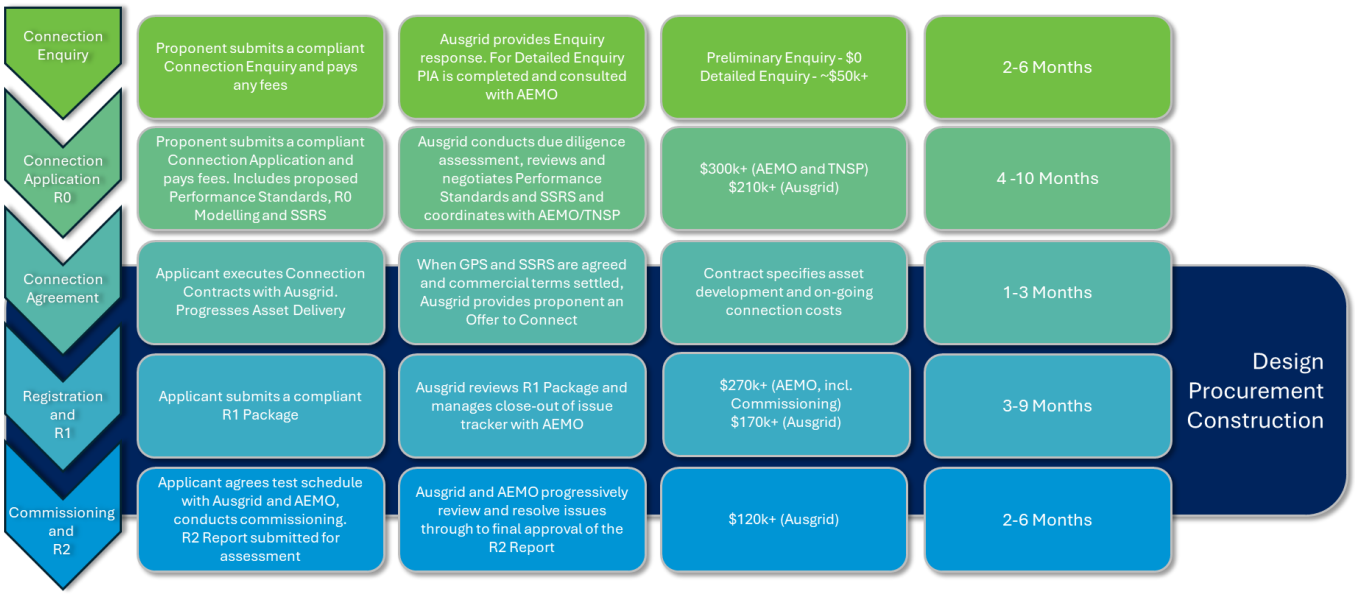
Chapter 5.3A of the NER defines the process that must be followed by a generation proponent to allow their intended facility to be connected to the Ausgrid network and participate in the NEM.

A proponent's journey through the process may not be linear, as certain elements may commence and progress in parallel to ensure the timely connection of the proponent's generation.

Process Overview

The Connection Process (as defined by the NER), starts at the Enquiry phase and ends once a generator is commissioned, with its R2 report approved and all outstanding issues resolved. An overview of this process is shown in Figure 3, with a more detailed view shown in Appendix E: End-to-End Connection Process Overview. Other parts of the generation development, operation, and participation process are defined elsewhere. Examples of the costs associated with completing this process are shown in Appendix C: Example Costs Associated with Connection.

Figure 3: End-to-End NER Process Overview



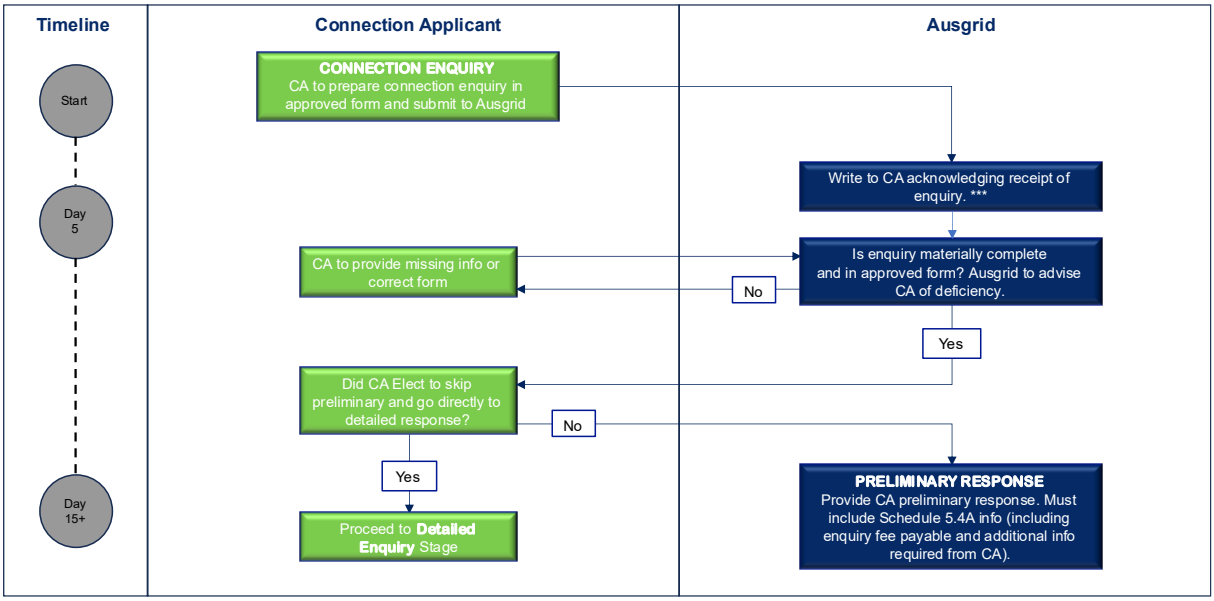
Connection Enquiry

Preliminary Enquiry

The Preliminary Enquiry provides general, high-level information to help the proponent understand their connection options prior to submitting a Detailed Enquiry. This step is optional, and the proponent can proceed directly to the Detailed Enquiry stage. Ausgrid recommends proponents who have not previously engaged with Ausgrid for an EG connection submit a Preliminary Enquiry to help build their understanding of the connection process and the Ausgrid network and requirements.

A joint DNSP examination may be required if the chosen network location is near an interconnecting DNSP; this will require a separate process to be followed.

Figure 4: Preliminary Enquiry Process



*** 5.3A.5(e) Separate process applies if joint DNSP examination required

Table 3: Preliminary Enquiry Information

Applicant Inputs		Ausgrid Outputs	
Input	Guidance	Output	Guidance
• Submitted Connection Enquiry Form	• Containing the information in S5.4 • Containing any additional information requested in Ausgrid's Enquiry Form • May elect to proceed to Detailed Response	• Acknowledgement of Enquiry • Notification of joint DNSP examination* • Notification of Enquiry deficiency*	• 5.3A.5(d) • 5.3A.5(e) • 5.3A.5(f)
• Preliminary Response Requested	• 5.3A.5(g)	• Preliminary Response	• Containing the information in S5.4A
Proponent Costs	*Cost Estimate – Free of charge*		
Critical Timelines	*Ausgrid must provide the Preliminary Enquiry Response within 15 business days of receiving a complete Preliminary Enquiry unless an extension has been applied under rule 5.3A.7(c).*		

* If required

System Planning Advice

Where the proponent is not able to identify a clear connection option preference to proceed with a Detailed Enquiry, system planning advice can be beneficial in quantifying the anticipated scope and costs associated with different connection options. This step is optional and the proponent can choose to skip this step and proceed directly to the Detailed Enquiry stage.

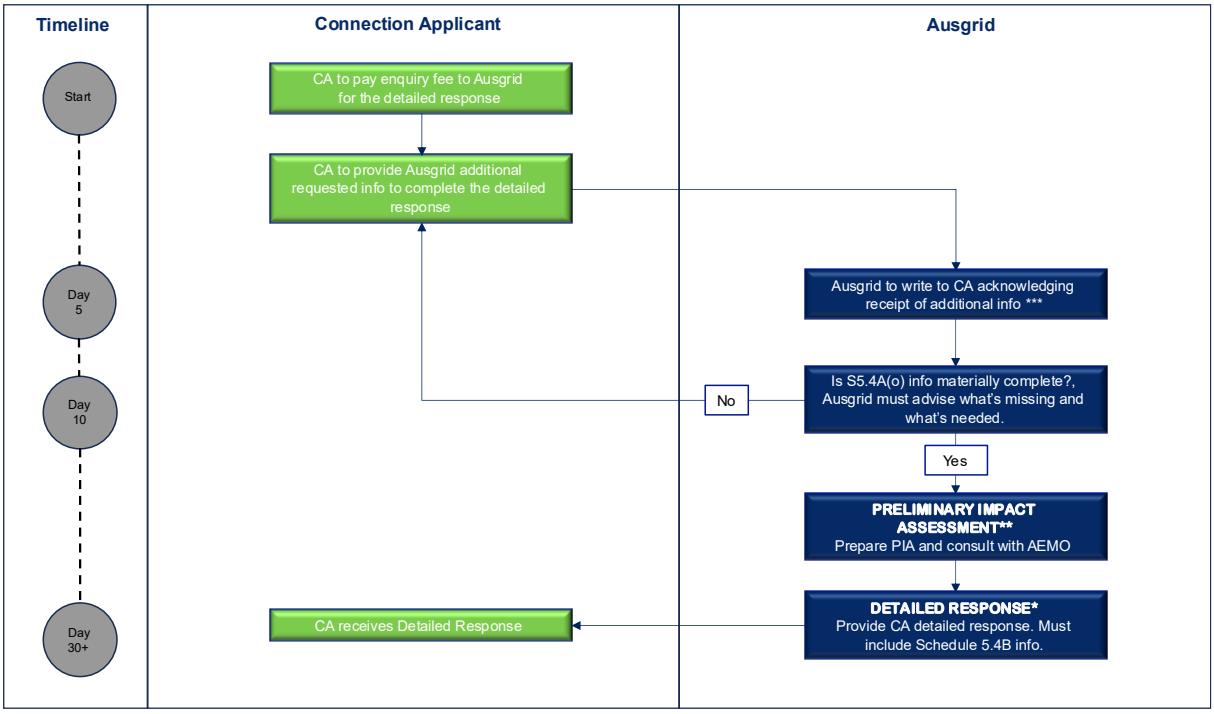
Table 4: System Planning Advice Information

Applicant Inputs		Ausgrid Outputs	
Input	Guidance	Output	Guidance
• Preliminary Response	• Identifies connection options	• System Planning Advice	• Provision of scope and cost information for alternative connection options
• Executed Design Related Services Agreement	• Agreed scope of works		
• Payments	• Quoted price		
Proponent Costs	*Unregulated service, quoted price based on agreed scope, documented in Design Related Service Agreement.*		
Critical Timelines	*Unregulated service, delivery timeline based on agreed scope.*		

Detailed Enquiry

The Detailed Enquiry provides detailed, in-depth analysis on the requirements to connect the proposed project. It also provides detailed information about the requirements for submitting a Connection Application. This step is mandatory under the NER and attracts a fee for service. The proponent should consider the technical requirements detailed in Appendix D: Key Technical Requirements as part of their connection enquiry submission.

Figure 5: Detailed Enquiry Process



* 5.3A.7(c) DNSP may seek extension of time (not to be unreasonably withheld)

** 5.3.4B(a4) CA may ask NSP to carry out a further PIA and provide a revised system strength locational factor

*** 5.3A.5(e) 5.3A.8(c)(2) Separate process applies if Regulatory Investment Test (RIT-D) applies (usu. > $5m)

Table 5: Detailed Enquiry Information

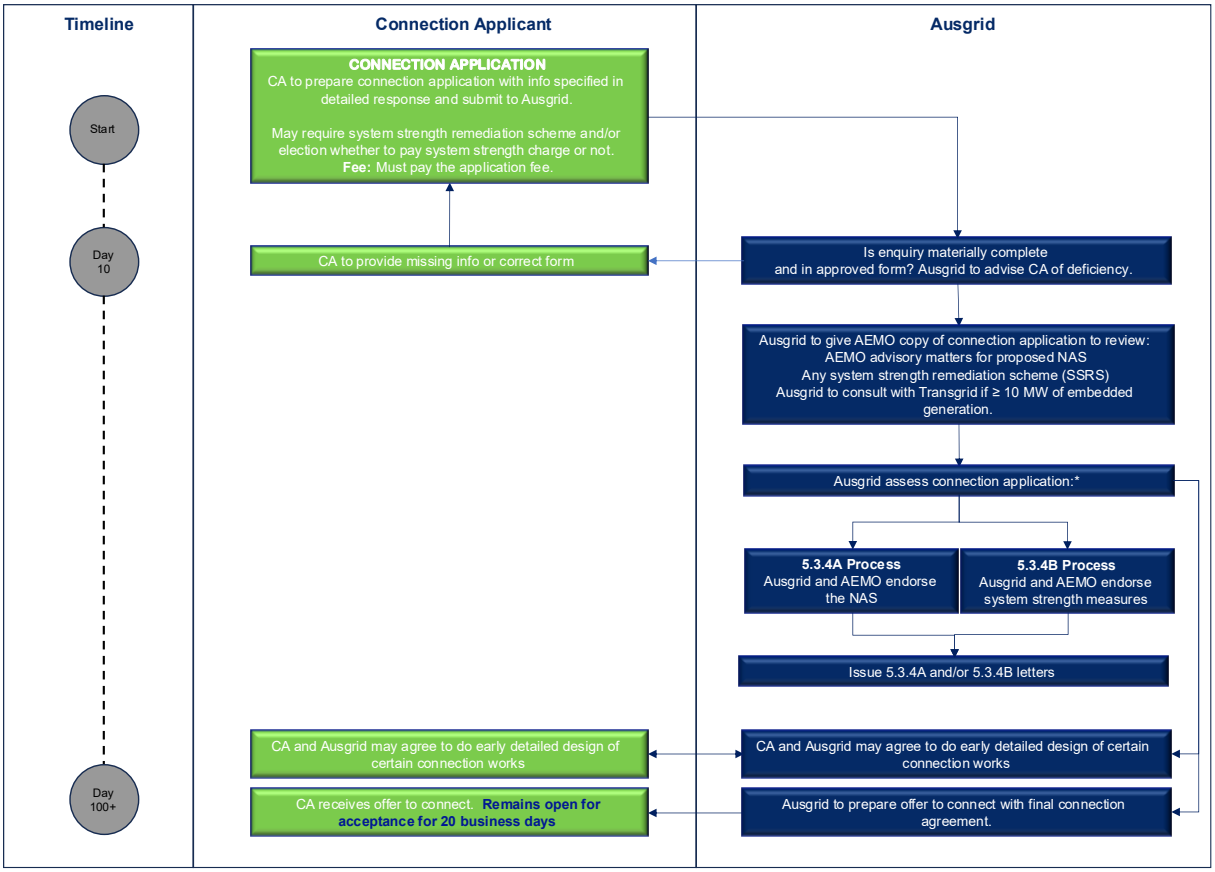
Applicant Inputs		Ausgrid Outputs	
Input	Guidance	Output	Guidance
• Submitted Connection Enquiry Form	• Containing information requested in Preliminary Response • Containing the information in S5.4, specifically S5.4S(o)	• Acknowledgement of Enquiry • Notification of joint DNSP examination* • Notification of Enquiry deficiency*	• S5.4A(o)
• Executed Design Related Services Agreement	• Agreement for the delivery of Detailed Response	• Preliminary Impact Assessment (PIA)	• Includes consultation with AEMO. • Informs System Strength obligations
• Fees paid	• Payment of fees to provide the Detailed Response	• Detailed Enquiry Response	• Containing the information in S5.4B • Includes Ancillary Network Service fee estimate to prepare an offer to connect
Proponent Costs	*Refer to Appendix C for example costs.*		
Critical Timelines	*Ausgrid must provide the Detailed Enquiry Response within 30 business days of receiving a complete Detailed Enquiry and the proponent has paid the required fees, unless an extension has been applied under rule 5.3A.7(c).*		

* If required

Connection Application

Submitting a Connection Application initiates key activities in the connection process. Connection applicants should submit their application and supporting documents and information to Ausgrid through their Connection Manager, whose information will be provided in the Detailed Enquiry Response. The application must include a completed AEMO Generator Connection Application Checklist and the relevant supporting information. The Connection Application is assessed by Ausgrid, AEMO and Transgrid (if required) to determine if the proposed installation is suitable for connection. This step is mandatory under the NER and attracts a fee for service.

Figure 6: Connection Application Process



* Note: Ausgrid to maintain issues tracker during technical liaison with AEMO and CA

Table 6: Connection Application Information

Applicant Inputs		Ausgrid Outputs	
Input	Guidance	Output	Guidance
• Submitted Connection Application (CA)	• Proposed Performance Standards* • Description of the proposed installation, including data requirements outlined in S5.4 and S5.5	• Notification of CA deficiency • Proforma Connection Agreement • CA shared with AEMO • Consultation with Transgrid (if required)	• Liaise and agree on legal terms for Connection Agreement (5.3A.10) • AEMO reviews Advisory matters for Performance Standards • AEMO reviews SSRS

Applicant Inputs		Ausgrid Outputs	
	• Model package, including simulation models and associated design data • Project and commissioning programs.		• AEMO Generator Connection Application Checklist
• Executed Design Related Services Agreement	• Agreement for the delivery of Connection Application assessment	• Ausgrid Due Diligence, confirming the proponent's assessment of the generator, performance standards and capabilities	• Dynamic Model Acceptance Test • GPS Review • Power Systems Studies • Harmonic Analysis • Small Signal Stability Analysis • Wide Area Assessment
• Fees paid	• Payment of fees to process the CA • Additional fees for any Transgrid and AEMO activities associated with CA	• Agreed Performance Standards (5.3.4A process) • Agree System Strength measures (5.3.4B process)^	• GPS negotiated and agreed with CA, Ausgrid and AEMO to receive 5.3.4A Letter • System strength measures agreed with CA, Ausgrid and AEMO to issue 5.3.4B Letter^
Proponent Costs	*Refer to Appendix C for example costs.*		
Critical Timelines	*After the required information is provided and the fees are paid Ausgrid will provide a detailed response (including an Issue Tracker and Performance Standards feedback) within 30 business days. For each subsequent re-submission of a revised package, Ausgrid will provide a response within 30 business days. An Offer to Connect must be provided within 4 months of receiving a Connection Application.*		

^ If required

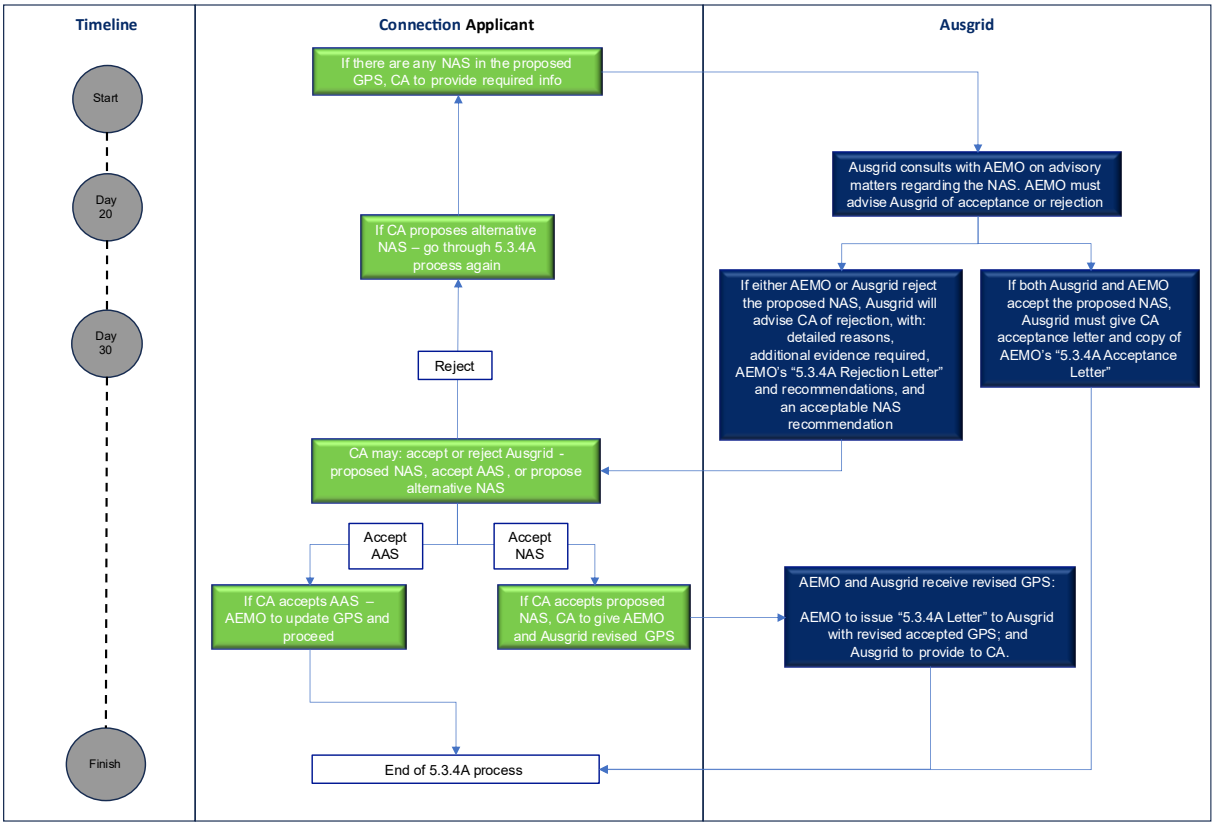
* Completed in AEMO's Performance Standards template

See AEMO's Modelling requirements page for more details on the data and model packages required.

Acceptance Of Proposed Performance Standards - 5.3.4A Letter

The proposed performance standards must be consistent with the access standards detailed in the relevant Schedules of Chapter 5 of the NER. Information about the performance standards is included in Appendix A: Access Standards Consultation Requirements. Once performance standards are agreed, they become the agreed performance standards for the facility to be built and a 5.3.4A letter will be provided. This letter is a prerequisite for Ausgrid to issue an Offer to Connect.

Figure 7: Acceptance of Performance Standards Process



* Note: Ausgrid to maintain issues tracker during technical liaison with AEMO and CA

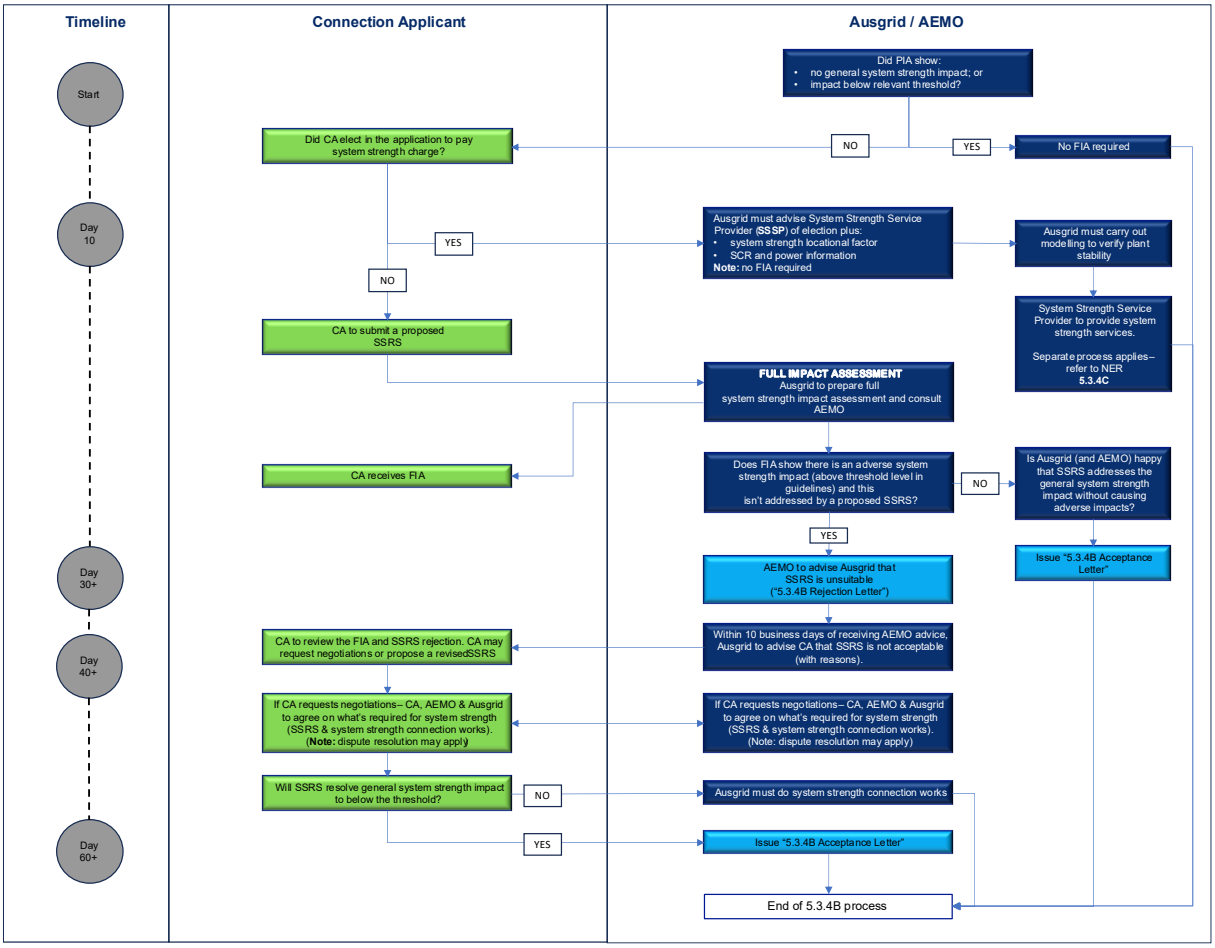
Table 7: Acceptance of Performance Standards Information

Applicant Inputs		Ausgrid Outputs	
Input	Guidance	Output	Guidance
• Proposed Performance Standards (NAS)	• Required when AAS cannot be met • Requires justification for why AAS cannot be met • Proposed standard equal to or above MAS and as close to AAS as possible	• Rejected NAS	• Includes detailed reasons, evidence requirements and recommendations
		• Accepted NAS	• Iterative process • 5.3.4A Letter provided
Proponent Costs	*Included in Connection Application fees*		
Critical Timelines	*Accepted standards must be advised within 20 business days, rejected standards must be advised within 30 business days*		

Acceptance Of System Strength Remediation - 5.3.4B Letter

If the Preliminary Impact Assessment (PIA) indicated that the connection applicant's installation will have a system strength impact, the Connection Application must indicate how this impact will be remediated. Further details on system strength are included in this guideline. Where a connection applicant elects to implement an SSRS, a 5.3.4B letter is provided when Ausgrid and AEMO are satisfied the SSRS remediates the system strength impact. This letter is a prerequisite for Ausgrid to issue an Offer to Connect.

Figure 8: Acceptance of System Strength Remediation Process



* Note: Ausgrid to maintain issues tracker during technical liaison with AEMO and the connection applicant

Table 8: Acceptance of System Strength Remediation Information

Applicant Inputs		Ausgrid Outputs	
Input	Guidance	Output	Guidance
• Proposed system strength remediation	• Payment of SSC; or • Implementation of SSRS (behind the CP); or • Completion of SSCW	If payment of SSC elected • Ausgrid notifies SSSP • Ausgrid confirms plant stability	• SSSP delivers service • No requirement for 5.3.4B Letter
		If implementing SSRS elected • Ausgrid/AEMO assess SSRS	• Rejected SSRS: Includes detailed reasons,

Applicant Inputs		Ausgrid Outputs	
		• Potentially iterative process	evidence requirements and recommendations • Accepted SSRS: 5.3.4B Letter provided
Proponent Costs	*Included in Connection Application fees*		
Critical Timelines	*Accepted SSRS will be advised within 20 business days, rejected SSRS will be advised within 30 business days*		

Offer to Connect

Ausgrid and the generation proponent will enter into two separate connection contracts under the registered generator connection process.

Table 9: Offer to Connect Information

Ausgrid Inputs		Proponents Outputs	
Input	Guidance	Output	Guidance
• Connection offer - Negotiated Ongoing Connection Contract for Embedded Generators (Connection Agreement)	• The negotiated terms on which Ausgrid will provide the services to the proponent to enable the facility to be and remain connected.	• Executed Agreement	• Negotiations commence while Connection Application assessed
• Connection Offer for Negotiated Contract for Connection Services for Contestable ASP/1 Connections – Embedded Generation	• Sets out the roles and obligations of Ausgrid and the connecting customer with regards to the ASP1 connection project.	• Executed Agreement	• Negotiations commence while Connection Application assessed
Proponent Costs	*As described in the relevant Contracts*		
Critical Timelines	*Offer to Connect valid for 20 business days*		

Generator Committed Status – 5.3.7G

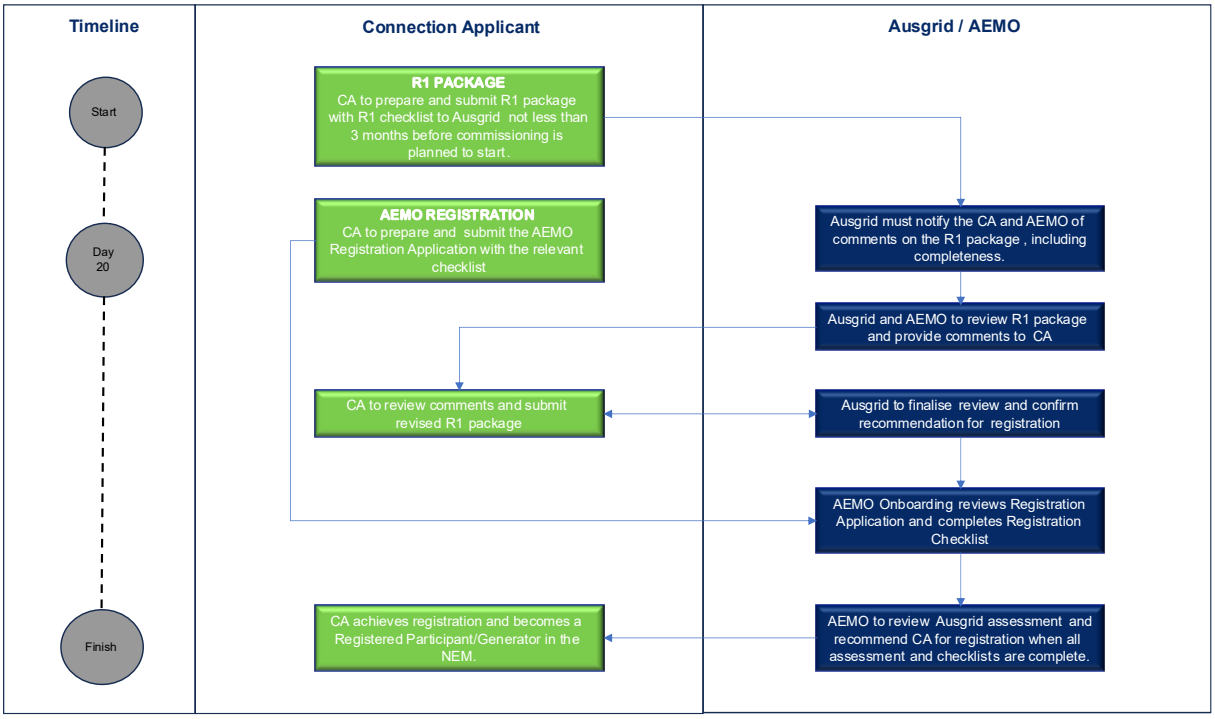
Ausgrid and the connection applicant must jointly notify AEMO that a Connection Agreement has been entered into within 20 business days of execution. This includes providing AEMO with the relevant technical details of the plant. This requires other generation proponents to consider this committed generator in their connection application assessments.

R1 Submission and Registration

The connection applicant will need to submit a complete R1 package with a completed AEMO Generator Connection R1 Submission Checklist to Ausgrid for assessment. This must be submitted no less than 3 months before commissioning is due to commence. The R1 package reflects the proponent's installation after detailed design has been completed, to assess any changes that have occurred since the Connection Application was assessed. Once Ausgrid reviews and confirms the R1 package, it then goes to AEMO for approval.

The R1 package assessment is a component of the broader AEMO Registration Process. Commissioning and R2 validation of the generation facility cannot occur until the entire Registration process is complete. Refer to the AEMO website for information about the Registration process.

Figure 9: R1 Submission and Registration Process



* Note: Ausgrid to maintain issues tracker during technical liaison with AEMO and the connection applicant

Table 10: R1 Submission and Registration Information

Applicant Inputs		Ausgrid Outputs	
Input	Guidance	Output	Guidance
• R1 Package Submission • Completed R1 Checklist	• Models may need to be resubmitted to reflect the detailed design and changes since the Connection Application • GPS may need to be adjusted to reflect changes • Includes Commissioning Plan • All items on the R1 Checklist	• Ausgrid confirms R1 package is complete	• Review of changes since Connection Application • Review and assessment of modelling and/or GPS changes • Protection Report • Commissioning Plan
		• Ausgrid Due Diligence, confirming the proponent's assessment of the generator, performance standards and capabilities	
		• Accepted R1 package submission	• Endorsement from Ausgrid for the Registration of the Generator
Proponent Costs	*Refer to Appendix C for example costs.*		
Critical Timelines	*R1 Package to be submitted no less than 3 months before commissioning* *Ausgrid must provide comments on the R1 Package within 20 business days*		

Commissioning

The commissioning process involves several steps to ensure the safe integration of the generating facility and its connection assets into the Ausgrid network and demonstrating generating plant performance to allow its integration into the NEM.

The testing is comprised of three parts:

1. Compliance testing will be required of the customer to demonstrate the facility complies with Ausgrid's network standards and other relevant technical requirements.
2. Pre-connection off-line testing will be required of the customer to demonstrate the generation system is ready for connection to the network.
3. Post-connection on-line testing will be required of the customer to demonstrate the generation system performs as agreed.

The commissioning phase for the generator installation will generally be coordinated as required with the commissioning phase for the generating plant and contestable services.

Commissioning Program

Following the acceptance of the Commissioning Plan in R1, a Commissioning program, including schedule and procedure, must be agreed with Ausgrid and AEMO at least 3 months (for transmission connections) and 1 month (for distribution connections) before commissioning starts. The commissioning program includes all three parts described above.

Figure 10: Commissioning Program Process

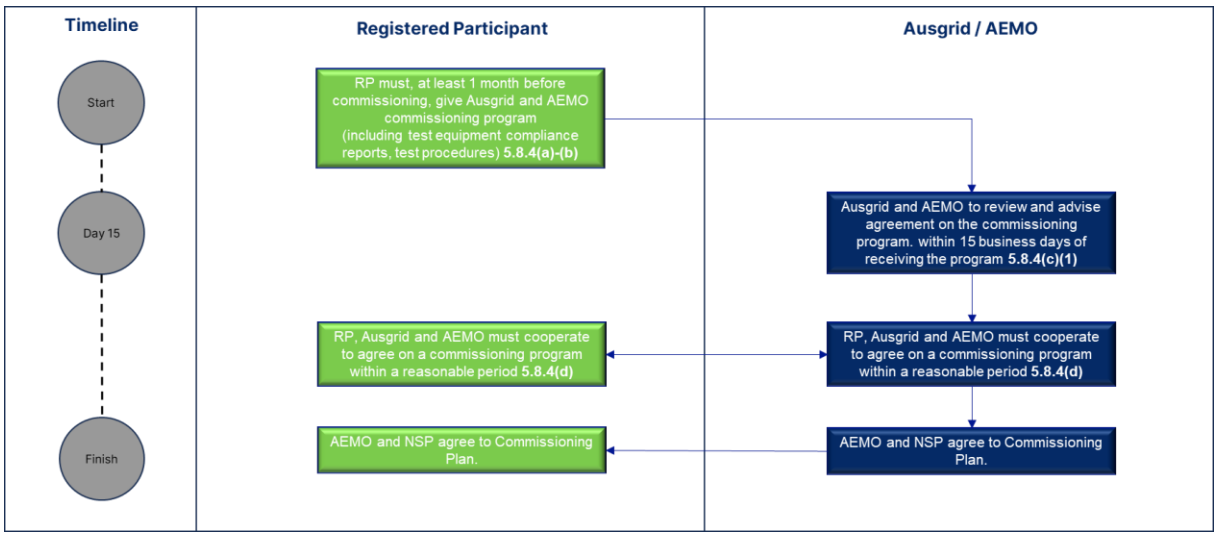


Table 11: Commissioning Program Information

Applicant Inputs		Ausgrid Outputs	
Input	Guidance	Output	Guidance
• Commissioning Plan	• Including all the information in 5.8.4(a) – (b) • Consistent with GPS Compliance Assessment and R2 Model Validation Test Plan Template. • Minimum of four hold points, HP0 – HP3 • Required for R1 and Registration	• Ausgrid and AEMO review and approve of Commissioning Program and Commissioning Plan	• Include incorporating testing and commissioning of Ausgrid assets
• Commissioning Program	• A highly detailed outline of the Commissiong Plan and specifies each test		
Proponent Costs	*Refer to Appendix C for example costs.*		
Critical Timelines	*Commissioning program to be submitted no less than 1 month before commissioning is due to commence* *Ausgrid and AEMO to review and respond to proposed program within 15 business days*		

Energisation Commissioning

On-site testing must be conducted to demonstrate that the new or modified plant meets the relevant technical requirements before it can be connected to Ausgrid's network and energised. This includes:

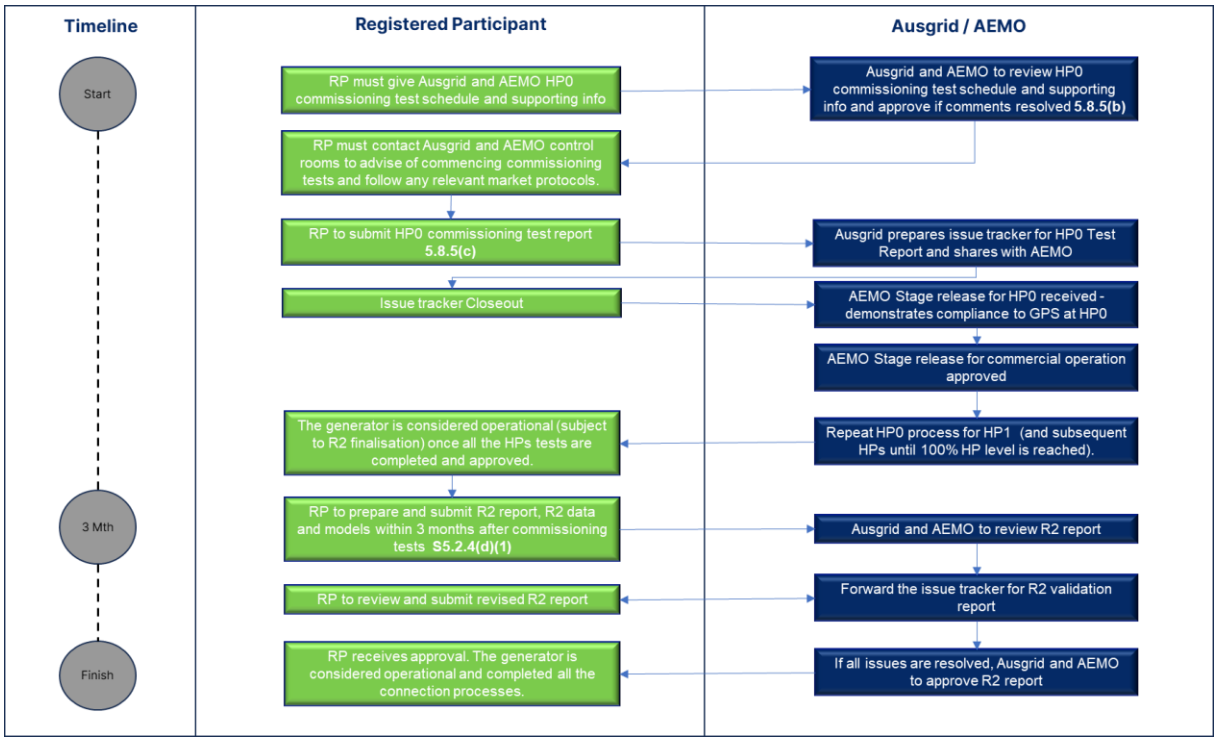
- Compliance testing to demonstrate the facility, connection assets and any associated network augmentation or extensions complies with Ausgrid's network standards and other relevant technical requirements.
- Pre-connection off-line testing will be required of the customer to demonstrate the generation system is ready for connection the network.

During this process, Ausgrid may elect to witness various test stages, review the test results and satisfy themselves that the plant is fit for energisation and further commissioning.

Generation Commissioning and Hold Point Testing

The commissioning of the generator to demonstrate compliance with its GPS and to provide for R2 model validation is to be conducted as per the AEMO GPS Compliance Assessment and R2 Model Validation Test Plan Template. During this process, Ausgrid may elect to witness various test stages will review and approve the resulting Hold Point Test Reports.

Figure 11: Generation Commissioning and Hold Point Testing Process



* Note: Ausgrid to maintain issues tracker during technical liaison with AEMO and CA

Table 12: Generation Commissioning and Hold Point Testing Information

Applicant Inputs		Ausgrid Outputs	
Input	Guidance	Output	Guidance
• Commissioning Tests/Hold Point Testing undertaken	• AEMO an Ausgrid Control Rooms notified as required • Completed as per agreed Commissioning Program	• Ausgrid and AEMO review and approve of commissioning program	• Ausgrid and/or AEMO may elect to witness commissioning tests or stages
• Hold Point Report Completed and Submitted.	• Demonstrates capability to meet agreed performance standards	• Hold Point Report Approved • Approval to continue Commissioning	• Both Ausgrid and AEMO must approve Hold Point Test Reports
• Commissioning Report and R2 Model Submission	• Due within three months of completed commissioning • Model updated to reflect commissioned performance.	• R2 Report and R2 Model approved	• Both Ausgrid and AEMO must approve R2 Model and R2 Test Report
Proponent Costs	*Refer to Appendix C for example costs.*		
Critical Timelines	*Commissioning Report and final R2 modelling submitted to Ausgrid and AEMO within three months of completing commissioning.*		

Operation

Once a generation facility transitions from commissioning to operation, proponents need to consider their ongoing obligations with respect to compliance monitoring and operations and maintenance.

Proponents need to meet all their obligations with respect to operations and maintenance as defined in their Negotiated Ongoing Connection Contract for Embedded Generators (Connection Agreement). This includes making the required notifications to Ausgrid as and when required.

Proponents must also continuously comply with their generator performance obligations. This includes routinely assessing that generator performance remains consistent with the agreed performance standards and notifying Ausgrid and AEMO (as relevant) if a non-compliance is observed.

Critical Connection Process Steps

Within the connection process, there are several critical steps that significantly influence the success and timeliness of a proponent's connection journey. Ausgrid believes that keeping this front of mind from the beginning of the connection process will lead to a more efficient approach throughout.

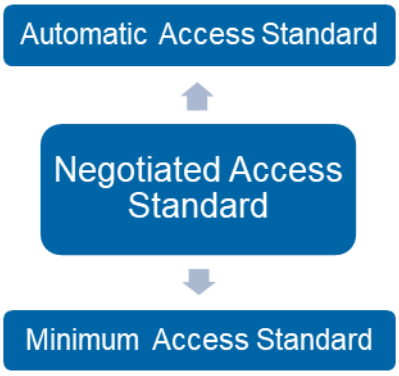
Third Party Interactions

The connection process requires collaboration from several stakeholders, often dependent upon network location. For Ausgrid, this includes AEMO, Transgrid, and may include interconnected DNSPs like Essential Energy or Endeavour Energy.

Ausgrid will always seek to process Connection Applications as efficiently as possible.

Additional costs and processing time may be incurred from reviews, analysis, or approvals required by third parties. The connection applicant must factor this into their project timelines.

Negotiated Performance Standards



Where a generating system is not able to meet the Automatic Access Standard (AAS), and sufficient justification of this has been provided, the connection applicant may propose a Negotiated Access Standard (NAS).

A NAS must be no less onerous than the corresponding Minimum Access Standard (MAS).

NAS may be an iterative process requiring collaboration with AEMO and/or Transgrid, especially so when GPS wording deviates from standard wording. This should be factored into project timelines.

Please see Appendix B: Process for Negotiated Access Standards for more information on NAS.

System Strength

To ensure adequate system strength is available on the power system to maintain stable operation, asynchronous generators are assessed for their system strength impacts during the Detailed Enquiry (PIA) and Connection Application (FIA) stages of the generator connection process.

Unless the PIA indicates that it is not needed, Ausgrid will undertake an FIA in accordance with the System Strength Impact Assessment Guidelines (SSIAG). In this assessment, EMT-type studies will be used to determine whether the proposed generator connection will result in an adverse system strength impact.

If the connection is assessed as having an adverse system strength impact, remediation will be required. The proponent must nominate how they will remediate any system strength impact as part of their Connection Application. This includes choosing to either:

- Pay the SSC, with SSSP (Transgrid in New South Wales) providing the required remediation.
- Propose an SSRS (works behind the Connection Point) that will remediate the system strength impact (for example installing synchronous condensers, tuning inverter control schemes or implementing post-contingency control scheme)
- Pay for SSCW (works by Ausgrid) in front of the Connection Point) that will remediate the system strength impact.

Additional costs and processing time may be incurred from reviews, analysis, or approvals required by third parties if the FIA and SSRS assessments need to be repeated. The connection applicant must factor this into their project timelines. For the most current information on system strength guidelines and pricing, please refer directly to AEMO and the regional SSSP's relevant documentation.

Small Signal Stability Studies

NSPs are required to assess the effect of the generating system on the damping of inter- and intra-area modes of oscillation. As these oscillations are more inherent to transmission networks, and not distribution networks where EGs would be located, these studies are most often conducted by the TNSP.

The scope and extent of these studies is dependent upon a range of conditions including the size and location of the Connection. The scope may be significantly reduced if a small generating system can demonstrate it has minimal influence on the transmission system.

If these studies are required by Transgrid, Ausgrid will invoice the connection applicant directly for any Transgrid costs associated with the studies. The Connection Applicant will be made aware of these costs as soon as reasonably practicable.

Proponents should allow for additional cost and processing time where small signal stability studies are required. See the AEMO Power System Stability Guidelines for more information.

Wide Area Studies

In addition to small signal stability studies, wide areas studies are required to confirm the proponent's generation can be integrated into the wider area network without having adverse effects on other network users. These studies can require both static and dynamic assessments of the proponent's generation combined with the established and committed generation projects in the relevant area.

Changes to the network (i.e. Ausgrid or Transgrid augmentations) or additional generation becoming "committed" can invalidate the results of these studies and require them to be re-done. This is particularly relevant in sections of the network where a number of competing generators have made connection applications.

Additional costs and processing time may be incurred from reviews, analysis, or approvals required by third parties if wide area studies need to be repeated. The connection applicant must factor this into their project timelines.

Fault Level

Certain sections of the Ausgrid network are electrically close to several large thermal generators, resulting in high fault levels at or near technical limits. When connection applications are made in proximity to these network sections, the fault level requirements for proponents can be comparatively strict. This includes limiting the fault level contribution of new generators to ensure that fault levels remain below the fault rating of established equipment and requiring the fault ratings of a proponent's facility to be higher than expected, to ensure it can withstand the system fault levels.

In addition, some areas of the Ausgrid network have traditionally supplied mining infrastructure and, as such, are earth fault restricted networks. Connections to these parts of the network will be required to maintain the earthing impedance of the network (e.g. solidly earthing of star points).

Generator Modelling Information

The model package and associated documentation must comply with the requirements of AEMO's Power System Model Guidelines. It should be revised periodically throughout the connection process as follows:

- R0 (preliminary) model package – based on preliminary design data and submitted with connection application;
- R1 model package – based on detailed design data and submitted prior to commissioning; and
- R2 model package – based on site validated data and submitted with an R2 model verification report.

It is recommended that proponents use experienced power system modellers to prepare, run and assess the models and their results. During the due diligence process (in both the Connection Application and Registration stages), Ausgrid will be assessing and reviewing the proponent's models and results.

Where questions or challenges arise, additional modelling or re-modelling may be required, which can extend project timelines.

Connection Studies Report

The generator must be able to demonstrate compliance with the proposed GPS through network studies. A Connection Studies Report must be submitted with the Connection Application demonstrating compliance with the proposed access standards through network studies. It will include results from both steady state and dynamic studies as outlined below. The connection applicant's appointed engineer is expected to propose a set of contingencies and network scenarios for connection studies. Ausgrid will comment on and approve the proposal and reserves the right to propose further contingencies and scenarios that need to be studied.

Steady State Studies

The steady state criteria define the ability of the network to accept the connection of embedded generation within the component ratings, voltage limits and power quality limits defined in the NER. The main objectives of these studies are to:

- identify any network thermal limitations which would lead to Embedded Generator operating constraints. This may in turn facilitate the need for network augmentation before connecting;
- assess the impact of connecting the Embedded Generator on the voltage levels including voltage dips/rise and voltage fluctuations at the connection point, considering both normal and single contingency scenarios;
- assess voltage harmonics and flicker emissions (Note: The acceptable harmonics and flicker emission limits will be allocated prior to the system studies); and
- determine the impact of the Embedded Generator on existing network fault levels in order to assess if existing switchgear has the capability to accommodate increased fault levels.

The steady state studies are used to assess the Embedded Generator's compliance with the relevant NER performance standards.

Dynamic Studies

The dynamic study assesses the ability of the Embedded Generator to remain connected and recover from the critical faults on the network. This study also assesses the Embedded Generator's response to voltage and frequency disturbances in the network and the network's stability with the presence of the generator.

The dynamic assessment of the Embedded Generator includes, but is not limited to, reactive capability, protection settings and the performance in controlling voltage, controlling frequency and controlling active and reactive power according to the NER. The study results will define and confirm the access standards proposed in the GPS.

Construction and Delivery Process

If connecting the applicant's generating facility will require the electricity network to be extended, or its capacity to be increased, the connection applicant will be required to fund the costs. Ausgrid administers the New South Wales Accredited Service Provider (ASP) Scheme which is governed by the Electricity Supply (General) Regulation 2014 and establishes a competitive framework for the provision of connection works[2]. Ausgrid's Network Standards define the minimum requirements for the design and construction of network assets.

Under this framework, connection works are provided as follows:

- Contestable Works: Where possible, the design and construction of network connection assets will be developed as a contestable connection under the NSW ASP Scheme. Ausgrid will provide Ancillary Services to integrate any contestable network extension or augmentation.
- Non-Contestable Works: Where there is a network security or safety risk, Ausgrid will carry out design and construction services to facilitate a new connection. An example of this is making modifications within an existing Ausgrid substation. This work will be carried out by Ausgrid as an Ancillary Service.

Where Contestable Works are to be delivered, the customer will engage an ASP of their choice to design (ASP Level 3) and construct (ASP Level 1) those assets. A list of level 1, 2 and 3 ASPs may be is obtained from NSW Climate and Energy Action. The costs associated with the contestable work performed by ASPs should be obtained from ASPs.

The relationship between the Chapter 5 connection process and the construction and delivery process is shown in Figure 12 and described in more detail in Table 13.

Figure 12:Chapter 5 Process and Construction Process

[2] https://www.ausgrid.com.au/Connections/Contestable-Connections-Process

Table 13: Relationship between Chapter 5 Process and Contestable Works Process

Chapter 5 Process	Non-Contestable Works	Contestable Works
Concept Development		
Detailed Enquiry	<u>Concept Scope</u> Ausgrid will outline any enabling work that is expecting would be classified as ancillary network services.	<u>Concept Scope</u> Ausgrid provides a high-level planning scope for any works required to connect the generation.
Detailed Design		
Connection Application	<u>Preliminary Cost Estimate (Optional)</u> Upon request and payment of fees, Ausgrid can scope non-contestable work to provide design and construction cost estimates. This is most efficiently provided with the Design Information Package	<u>Design Information Package</u> Upon request and payment of fees, Ausgrid will develop and provide a design information package. ASP/3 will use this to develop a detailed design for the connection works.
Connection Application – Offer to Connect	<u>Detailed Design</u> Detailed design will commence once there is reasonable certainty the connection will proceed (i.e. 5.3.4A Letter) and the customer has paid the applicable fee estimate for these design related services.	<u>Design Development and Certification</u> The ASP/3 design is submitted for review at the 30%, 70% and 100% design stages. Each stage must contain specific minimum levels of design information. Once satisfied, Ausgrid will certify the design.
		<u>ASP/1 Connection Offer</u> Once the negotiated contract terms have been agreed, Ausgrid will make a connection offer to the customer for the contestable ASP/1 connection.
Construction		
R1 and Registration	<u>Construction</u> Construction will commence once the applicable service fee has been paid and construction activities have commenced for the generating plant and the contestable works.	<u>Construction</u> Construction is carried out by the customers ASP/1. Ausgrid, the customer and the ASP/1 will agree key milestones to incorporate into the project plan.
	Ausgrid will co-ordinate delivery of the Ancillary Network Services required to facilitate the ASP/1 activities.	
Commissioning		
Commissioning	<u>Commissioning</u> The commissioning phase of any non-contestable elements will generally be coordinated as required with the commissioning phase for the generating plant and contestable services.	<u>Commissioning</u> The ASP/1 is required to submit a Commissioning Outage Request form along with any relevant equipment test results or data sheets to Ausgrid at least eight weeks prior to the proposed commissioning date. A further information submission from the ASP/1 is required at least 2 weeks prior to commissioning in order to keep the proposed commissioning date:

Commercial and Contractual Process

To enable Ausgrid to effectively deliver the Chapter 5 Connection Process, a parallel commercial and contractual process is required to ensure that both parties' rights, obligations and responsibilities are documented. It also allows Ausgrid to recover its costs (as allowable) throughout the Chapter 5 process.

This is broken into two parts; a commercial process which supports the delivery of various activities under the Chapter 5 process and a contractual process which captures the contractual arrangements related to making a connection to the Ausgrid network.

Commercial Process

The commercial process supports the delivery of various activities under the Chapter 5 process. This includes the provision of the following services:

- Connection Enquiry: System Planning Advice
- Connection Enquiry: Detailed Enquiry Response
- Construction and Delivery: Preliminary Cost Estimate (Non-Contestable Works)
- Construction and Delivery: Detailed Design (Non-Contestable Works)
- Construction and Delivery: Detailed Design Information (Contestable Works)
- Construction and Delivery: Design Development and Certification (Contestable Works)
- Connection Application: Connection Application Assessment

These services are defined as "Design Related Services" and are provided under Ausgrid's Contract for Design Related Services. Under this contract, the services to be provided are defined and Ausgrid provides an estimate of the expected costs to provide the services. Where Ausgrid's actual costs incurred exceed the estimate, the Customer or, if applicable, the ASP/3 will be billed for Ausgrid's actual costs.

Where costs are incurred by third parties (i.e. AEMO and Transgrid) for providing services as part of the Chapter 5 connection process, these will be invoiced by Ausgrid to the proponent.

Contractual Process

The contractual process captures the contractual arrangements related to making a connection to the Ausgrid network. This includes the contracts that form the Offer to Connect. This includes:

- Connection Offer – Negotiated Ongoing Connection Contract for Embedded Generators (Connection Agreement)
- Connection Offer for Negotiated Contract for Connection Services for Contestable ASP/1 Connections – Embedded Generation.

The Connection Offer – Negotiated Ongoing Connection Contract for Embedded Generators (Connection Agreement) covers the agreement for Ausgrid to provided power transfer capability across the connection point (i.e. the ongoing connection of the generator to the Ausgrid network). It details the payments required to cover the costs of providing these services. It is also the agreement under which Ausgrid provides the final assessment elements of the connections process, including assessment of the R1 Package, Generator Commissioning and Hold Point Testing, and R2 Validation.

The Connection Offer for Negotiated Contract for Connection Services for Contestable ASP/1 Connections – Embedded Generation covers the costs of developing the physical connection to the Ausgrid network. This includes the delivery and commissioning of any non-contestable works (ancillary services) and integrating and commissioning any contestable works into the network. This contract also sets out the roles and obligations of Ausgrid and the connecting customer with regards to the ASP/1 portion of the project. Ausgrid's relationship to the ASP/1 is not via this contract but rather the ASP/1 Authorisation Agreement. The connection applicant is required to enter into their own contract with the ASP/1 for the services provided by the ASP/1 (i.e. there is no three-way contracts).

Appendix A: Access Standards Consultation Requirements

Technical Requirement	Automatic	Minimum	Negotiated	Advisory Matter
Reactive Power Capability	Per NER 5.2.5.1	Per NER 5.2.5.1	Per NER 5.2.5.1	AEMO advisory matter
Quality of electricity generated	Per NER S5.2.5.2	Per NER S5.2.5.2	Per NER S5.2.5.2	
Generating system response to frequency disturbances	Per NER S5.2.5.3	Per NER S5.2.5.3	Per NER S5.2.5.3	AEMO advisory matter
Generating system response to voltage disturbances	Per NER S5.2.5.4	Per NER S5.2.5.4	Per NER S5.2.5.4	AEMO advisory matter
Generating system response to disturbances following contingency events	Per NER S5.2.5.5	Per NER S5.2.5.5	Per NER S5.2.5.5	AEMO advisory matter
Quality of electricity generated and continuous uninterrupted operation	Not Applicable	Per NER S5.2.5.6	Not Applicable	
Partial load rejection	Per NER S5.2.5.7	Per NER S5.2.5.7	Per NER S5.2.5.7	AEMO advisory matter
Protection of generating systems from power system disturbances	Not Applicable	Per NER S5.2.5.8	Not Applicable	AEMO advisory matter
Protection systems that impact on power system security	Per NER S5.2.5.9	Per NER S5.2.5.9	Not Applicable	AEMO advisory matter
Protection to trip plant for unstable operation	Per NER S5.2.5.10	Per NER S5.2.5.10	Per NER S5.2.5.10	AEMO advisory matter
Frequency control	Per NER S5.2.5.11	Per NER S5.2.5.11	Per NER S5.2.5.11	AEMO advisory matter
Impact on network capability	Per NER S5.2.5.12	Per NER S5.2.5.12	Per NER S5.2.5.12	AEMO advisory matter
Voltage and reactive power control	Per NER S5.2.5.13	Per NER S5.2.5.13	Per NER S5.2.5.13	AEMO advisory matter
Active power control	Per NER S5.2.5.14	Per NER S5.2.5.14	Per NER S5.2.5.14	AEMO advisory matter
Short circuit ratio	Per NER S5.2.5.15	Per NER S5.2.5.15	Per NER S5.2.5.15	AEMO advisory matter
Voltage phase angle shift	Not Applicable	Per S5.2.5.16	Not Applicable	AEMO advisory matter
Remote monitoring	Per NER S5.2.6.1	Per NER S5.2.6.1	Not Applicable	AEMO advisory matter
Communications equipment	Per NER S5.2.6.2	Per NER S5.2.6.2	Per NER S5.2.6.2	AEMO advisory matter
Power station auxiliary supplies	Per NER S5.2.7	Per NER S5.2.7	Per NER S5.2.7	AEMO advisory matter
Fault current	Per NER S5.2.8	Per NER S5.2.8	Per NER S5.2.8	

Appendix B: Process for Negotiated Access Standards

Information Phase	Negotiation process for access standards
Need for a negotiated access standard first identified	a) The connection applicant applies to Ausgrid to negotiate an access standard. or b) Ausgrid determines that a negotiated access standard is required on the basis of the provided information
Initial meeting	Ausgrid will arrange an initial meeting with the connection applicant as soon as practical to review and discuss: • Contact arrangements. • AEMO involvement in the process. • Negotiation principles including the need for good faith on both sides and confidentiality requirements. • The negotiation process described in this document. • The specific matters under consideration for the negotiations. Additional information that Ausgrid may provide and that may assist the connection applicant to negotiate on an informed basis. A preliminary negotiation program will also be discussed and determined at this initial meeting. In the case of complex negotiations this schedule may include a series of regular meetings and a set of key milestones.
Information request	In some cases, Ausgrid may require additional information from the connection applicant in order to continue with the negotiations on an informed basis. Ausgrid will (if practicable) request this additional information in writing. Note, however, that throughout the negotiations, Ausgrid may reasonably require additional information and there is no limit on the number of information requests it may make.
Information disclosure	Ausgrid provides any remaining information requested by the connection applicant as soon as practical. The connection applicant also prepares and provides the information requested by Ausgrid as soon as practical. A meeting between Ausgrid with the connection applicant may be needed at this stage to review and clarify the information each party has requested and received. Where Ausgrid considers it to be necessary or at the connection applicant's request, Ausgrid will arrange such a meeting.
Negotiations commence	Ausgrid will arrange a meeting to further discuss and refine the negotiation program based on the information provided and target date for completion. Negotiation may also commence at this meeting, facilitated by the Ausgrid representative. In straightforward cases agreement may also be able to be reached at this meeting.
Negotiations	Interactions including meetings and/or discussions proceed in line with the negotiation program. By agreement, Ausgrid will generally record these interactions through meeting minutes and file notes to clearly document the key issues and actions required to reach an effective outcome. Subject to progress, adjustments to the negotiation program may be required.
Negotiations conclude	Agreement is reached for all matters under negotiation allowing a negotiated access standard to be finalised.

Appendix C: Example Costs Associated with Connection

Based on AER approved labour rates (FY26)

Detailed Enquiry Response – Ausgrid	Typical Hours	Fee example (GST Inc.)
Coordinating, processing and assessing the connection enquiry	26 (R5)	$8,840.26
Development and collection of detailed system information (Such as harmonic allocations, system models, protection settings)	145 (R5)	$49,301.45
Total	**171**	**$58,141.71**

Connection Application – Ausgrid	Typical Hours	Fee example (GST Inc.)
Coordinating, processing and assessing the connection application	240 (R3)	$68,342.40
Review of the submitted dynamic and steady analysis	400 (R5) / Consultant Fee	$136,004.00
Harmonic assessment	100 (R5) / Consultant Fee	$34,001.00
Wide area assessment	120 (R5) / Consultant Fee	$61,201.80
Review of the protection fault and discrimination analysis	90 (R5)	$30,600.90
Development of the draft offer to connect and agreements	16 (R3)	$4,556.16
Total	**1026**	**$334,706.26**

Connection Application – Transgrid & AEMO		Fee example (GST Inc.)
TransGrid's connection assessment to be initiated as required by the connection applicant*	Cost pass through	$70,000.00
AEMO – Connection Application Assessment (R0)*	Cost pass through	$300,000.00
Total	**Cost pass through**	**$370,000.00**

*The cost of Transgrid and AEMO fees for connection assessment are passed through Ausgrid to the connection applicant.

Design Information Package – Connection Works - Ausgrid	Typical Hours	Fee example (GST Inc.)
Process and Project Facilitation (such as co-ordination and collection of relevant design information)	80 (R3)	$22,780.80
Develop detailed design information for the contestable design of the proposed connection (relevant to the scope of works such as network extension and new switching station)	100 (R5)	$34,001.00
Outline any Ausgrid specific requirements for the customers private installation (such as components that will interface with Ausgrid's network)	40 (R5)	$13,600.40
If required - With respect to any non-contestable connection enabling works within live substations - Estimate the costs and lead times for the delivery of these components (such as populate new feeder bay)	180 (R3)	$51,256.80
Total	**400**	**$121,639.00**

Design Certification – Contestable Works* - Ausgrid	Typical Hours	Fee example (GST Inc.)
Design Certification - Engineer	26 (R3)	$7,403.76
Design Certification – Senior Engineer	145 (R5)	$49,301.45
Sub Total	**171**	**$56,705.21**
If required - With respect to any non-contestable connection enabling works within live substations – Ausgrid will produce the design for those works	700 (R5) Design Quote	$238,007.00
Total	**871**	**$294,712.21**

*These are example costs for Ausgrid to facilitate the ASP3 contestable design works. Example costs for the ASP3 to deliver their contestable design scope of work is not provided in this guideline.

R1, Registration and Commissioning – Ausgrid	Typical Hours	Fee example (GST Inc.)
Process and project facilitation	400 (R3)	$113,904.00
Planning studies	400 (R5)	$136,004.00
Registered participant support	80 (R3)	$22,780.80
Total	**880**	**$272,688.80**

R1, Registration and Commissioning – AEMO	Typical Hours	Fee example (GST Inc.)
AEMO – R1 and Registration*	Cost pass through	$250,000.00
AEMO – R2 and Commissioning*	Cost pass through	$170,000.00
Total	**Cost pass through**	**$420,000.00**

*The cost of AEMO fees for R1, Registration and Commissioning are passed through Ausgrid to the connection applicant.

Construction & Commissioning – Connection works – Ausgrid*	Typical Hours	Fee example (GST Inc.)
Process and project facilitation	400 (R3)	$113,904.00
Access Permits (2 x access permits)	88 (R4)	$19,763.92
Network Construction – Level 1 ASP works (Inspection)	180 (R2)	$39,364.20
Property Tenure	24 (R5)	$8,160.24
Commissioning Assets	900 (R4)	$202,131.00
Sub Total	**1,592**	**$383,323.36**
If required - With respect to any non-contestable connection enabling works within live substations – Ausgrid will construct those works	Construction Quote	$1,500,000.00
Total	**1,592**	**$1,883,323.36**

*These are example costs for Ausgrid to facilitate the ASP1 contestable connection works including any connection enabling works that are excluded from contestability and carried out by Ausgrid. Example costs for the ASP1 to deliver their contestable connection scope of work is not provided in this guideline.

Appendix D: Key Technical Requirements

Technical Requirement	Refer to…
Protection systems and protection schemes (i)	Ausgrid Network Standard NS194 Embedded Generation
Fault level management principles (ii)	The EG connection agreement specifies the maximum design fault level and allocates the maximum permissible fault level contribution for that EG proponent. It is imperative for maintaining safety that the combined fault current contribution of all sources, including the contribution from embedded generators, does not exceed the level that can be interrupted by the installed protection and switchgear, or withstood by system assets.
Reactive power capability and power factor correction (iii)	NER Chapter 5 S5.2.5.1 Reactive power capability
Power quality and how limits are allocated (iv)	Ausgrid Network Standard 238 Power Quality NER Chapter 5 S5.2.5.2 Quality of electricity generated
Responses to frequency and voltage disturbance (v)	NER Chapter 5 S5.2.5.3 Generating unit response to frequency disturbances and S5.2.5.4 Generating system response to voltage disturbances
Voltage control and regulation (vi)	Ausgrid Network Standard NS194 Embedded Generation NER Chapter 5 S5.2.5.13 Voltage and reactive power control
Remote monitoring equipment control and communication requirements (vii)	Ausgrid Network Standard 178 Secondary system Requirements for Major Substations NER Chapter 5 S5.2.6.1 and S5.2.6.2
Earthing requirements and other relevant safety requirements (viii)	Ausgrid Network Standard NS194 Embedded Generation
Circumstances in which augmentation may be required to facilitate integration of an embedded generating unit into the network (ix)	Described in this document
Commissioning and testing requirements (x)	Ausgrid Network Standard NS194 Embedded Generation AEMO GPS Compliance Assessment and R2 Model Validation Test Plan Template

Appendix E: End-to-End Connection Process Overview