GENERATOR CONNECTION R1 SUBMISSION CHECKLIST

PREPARED BY:	National Connections
DOCUMENT REF:	NC-GDLN-0005
VERSION:	2.0
EFFECTIVE DATE:	3 May 2021
STATUS:	FINAL

Approved for distribution and use by:

APPROVED BY:	Mark Shilliday
TITLE:	Group Manager National Connections

DATE: 3 / 05 / 2021

PURPOSE

This document has been prepared by AEMO to provide guidance to Network Service Providers, Connection Applicants and Generators about the minimum information and documents to be submitted following detailed design of new generation that is proposed to be connected to the power system. This information will enable AEMO to undertake its assessment of those under Chapter 5 of the National Electricity Rules in preparation for receiving an application for registration.

DISCLAIMER

This document may be subsequently updated or amended.

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VERSION RELEASE HISTORY

Version	Effective Date	Summary of Changes
1.0	18 December 2020	First Issue
2.0	3 May 2021	Updated document links and communication system failsafe requirements

CONTENTS

1. INTRODUCTION

1.1. Purpose and scope

This document contains a number of checklists designed to assist *Connection Applicants* in ensuring that their R1 submissions contain all relevant and necessary information to enable AEMO to complete its assessment for the purposes of assessing the material for the purposes of approving the Applicant's application for registration as a *Generator* and to meet the National Electricity Rules (NER) requirements post-commissioning.

The NER and the National Electricity Law (NEL) prevail over this document to the extent of any inconsistency.

1.2. Definitions and interpretation

1.2.1. Glossary

Terms defined in the NEL and the NER have the same meanings in this document unless otherwise specified.

Terms defined in the NER are intended to be identified in this document by italicising them, but failure to italicise a defined term does not affect their meaning.

The words, phrases and abbreviations in the table below have the meanings set out opposite them when used in these Procedures.

Term	Definition
Applicant	Either a *Connection Applicant* submitting an *application to connect* a proposed *generating system* under clause 5.3.4 of the NER, or a *Generator* seeking to alter its *generating plant* under clause 5.3.9 of the NER.
Application	An *application to connect* a proposed *generating system* under clause 5.3.4 of the NER, or a *Generator* seeking to alter its *generating plant* under clause 5.3.9 of the NER.
AVR	Automatic Voltage Regulator.
CUO	*continuous uninterrupted operation.*
ECM	*energy conversion model.*
EMS	AEMO's Energy Management System.
FAT	Factory acceptance testing
FRT	Fault ride-through
GPS	*Performance standards* applicable to a *generating system.*
GPS S5.2.X.X	The *performance standard* applicable to the *generating system* in question. The reference to "S5.2.5.X" refers to the clause in Schedule 5.2 of the NER from which the applicable *performance standard* is drawn.
HVRT	High *voltage* ride-through.
LVRT	Low *voltage* ride-through.
MRFT	Multiple fault ride-through
NEL	*National Electricity Law*
NER	National Electricity Rules
NSP	*Network Service Provider.* Used in this document to denote the *connecting Network Service Provider*.

PFR	*primary frequency response*
PPC	Power plant controller
PSCAD™/EMTDC™	Power Systems Computer Aided Design / Electromagnetic Transient with Direct Current.
PSS®E	Power System Simulator for Engineering.
PQM	Power quality *meter*.
RUG	*releasable user guide*.
SAT	Site acceptance testing
SCADA	Supervisory control and data acquisition.
SCR	Short circuit ratio.
SAT	Site acceptance test.
SLD	Single line diagram.
VDS	VAr Dispatch Scheduler

1.2.2. Interpretation

This document is subject to the principles of interpretation set out in Schedule 2 of the National Electricity Law.

1.3. Related documents

This document does not supersede or replace any other documents published by AEMO in accordance with the NER that relate its subject matter. The table below lists these and other related documents that Applicants should be familiar with when submitting their Applications.

Title	Location
Dispatch Procedure SO_OP_3705	https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3705---Dispatch.pdf
ECM Guidelines	https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/dispatch-information/policy-and-process-documentation
GPS Compliance Assessment and R2 Model Validation Test Plan Template - For Power Electronic Interfaced Nonsynchronous Generation Technologies	https://www.aemo.com.au/-/media/Files/Electricity/NEM/Network_Connections/Transmission-and-Distribution/Generating-System-Test-Template-for-Non-Synchronous-Generation.pdf
GPS Compliance Assessment and R2 Model Validation Test Plan Template - For Conventional Synchronous Machines	https://www.aemo.com.au/-/media/Files/Electricity/NEM/Network_Connections/Transmission-and-Distribution/Generating-System-Test-Plan-Template-for-Conventional-Synchronous-Machines.pdf
Interim Primary Frequency Response Requirements	https://aemo.com.au/-/media/files/initiatives/primary-frequency-response/2020/interim-pfrr.pdf
Power System Design and Setting Data Sheets	https://aemo.com.au/en/consultations/current-and-closed-consultations/power-system-model-guidelines-and-system-strength-impact-assessment-guidelines

Power System Model Guidelines	https://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/System-Security-Market-Frameworks-Review/2018/Power_Systems_Model_Guidelines_PUBLISHED.pdf
Communication System Failure Guidelines	https://aemo.com.au/-/media/files/electricity/nem/network_connections/stage-6/communication-system-failure-guidelines.pdf

2. USING THIS DOCUMENT

Each Appendix contains a checklist for the use of Applicants when submitting the R1 package for their application for registration as a *Generator*.

The purpose of the checklists is to ensure that all necessary and relevant information and data is submitted to AEMO and the NSP to facilitate the timely assessment of the application.

3. THE CHECKLISTS

Applicants should complete all relevant checklists and submit them at the appropriate time with the information specified in the checklists, as stipulated in each checklist.

The listed documents and other information to be submitted is the minimum that must be submitted. Where an Applicant considers that more information would assist in the assessment of their application, they should provide it.

Applicants should copy each checklist they wish to complete into a new document, complete it and submit it to AEMO when they submit the relevant information.

3.1. Pre-Connection (R1 package) Documentation Completeness

R1 information must be submitted to AEMO after the proposed *generating system's* detailed design is complete and major equipment has been procured by the Applicant. There will be delays to AEMO's ability to process an application for registration if the R1 information package is not provided to AEMO in a timely manner.

This checklist is in Appendix A and is designed to ensure that the R1 package submission is complete.

3.2. Information Consistency and Quality Check

It is incumbent on the Applicant to ensure that high quality information and documents are submitted and that the results and conclusions included with reports are appropriate.

This checklist is included in Appendix B and is designed to assist Applicants in determining whether these quality standards are met.

4. CONFIDENTIALITY

AEMO will manage the model, data and information provided by Applicants for AEMO in accordance with the confidentiality requirements in clauses 5.3.8, 3.13.3 and 4.6.6 of the NER.

5. ADDITIONAL INFORMATION REQUESTS

Either AEMO, or the NSP, may request further or additional information at any time during the assessment of an *application to connect* or request to alter *generating plant*, and the Applicant is required to respond within the time specified by the request.

6. TRANSMITTAL

Applicants must accompany any models, data or other information submitted to AEMO with a transmittal describing the model, data or other information submitted and include a date, model number or version number, as applicable.

APPENDIX A. PRE-CONNECTION (R1)

Requirement		Comment / file name / reference
Updates to all documentation (see Generator Connection Application Checklist) and models previously provided with the connection application are consistent with NER requirements for R1 data. R1 model should: 1. be based on final detailed design of the proposed *generating system*. 2. resolve any outstanding modelling issues identified by AEMO, or the NSP, during assessment of the proposed GPS. 3. Include additional models, controls or details requested by AEMO, or the NSP, prior to detailed design and during assessment of the proposed GPS.		
Details of any alteration to the proposed *generation system* that could impact its ability to meet the GPS. For example, changes to the number of *generating units*, *generating unit* model, maximum capacity, control modes and settings, *generating system* design, significant changes to main *transformer* and reticulation *network* impedance. Any alteration that impacts the performance of the *generating system* should be assessed under the process under clause 5.3.9 of the NER, in conjunction with the R1 assessment.		
In addition to simulation assessments, evidence of compliance with the GPS in the form of design reports, test reports, assessment reports. For example:		
S5.2.5.1	• Evidence for applied *plant* level and inverter level *active power* and *reactive power* limits. • Design of *active power* local limit controls. • *Reactive power* at night, or wind-free mode control and operational details. (This information should also be included in the VCS.)	
S5.2.5.2	Harmonic filter design reports. Power quality assessment reports	
S5.2.5.3	• Protection design reports to confirm applied settings consistent with GPS requirements. • Simulation evidence to demonstrate compliance with GPS requirements.	
S5.2.5.4	• Protection design reports to confirm applied settings consistent with GPS requirements. • Detailed design evidence that furthest inverters can maintain CUO for voltage ranges under this GPS with current VCS. • Online Tap Changer failure. • Plant ramp down logic. • Partial clouding algorithm	
S5.2.5.5	• Statement and test reports from the OEM or Applicant indicating capability to sustain successive fault ride-through (FRT) events substantiated by technical evidence, e.g. FAT or	

	type test verification of FRT and multiple fault ride-through (MFRT). • Confirmation that RMS and EMT models include reactive current limitations as per plant firmware for FRT and MFRT events. • Inclusion of limits or limiting functions in RMS and EMT R1 models and perform FRT and MFRT assessments to confirm CUO and other compliance requirements.	
S5.2.5.8	• Protection design reports to confirm applied protection and settings consistent with GPS requirements. • Anti-*islanding* protection scheme details. • Special protection scheme or runback scheme details. • Automatic *active power* reduction facilities details for *frequency*.	
S5.2.5.9	Protection design reports to confirm applied protection and settings consistent with GPS requirements.	
S5.2.5.10	• Instability *protection system* details • Confirmation whether the instability protection has been included in the model. If not, please confirm that these protections will have no impact on capability meet other GPS, including MFRT. • Communication failsafe mechanism information.	
S5.2.5.11	Confirmation on deadband and droop meet the Interim Primary Frequency Response Requirements.	
S5.2.5.12	Details of controls and operational arrangements sufficient to ensure inter- and intra-area transfer capability.	
S5.2.5.13	• Details of disturbance monitoring and testing, permanently installed and operational, monitoring and recording facilities. • Details of measurement equipment. • triggered data or continuous data (or both). • Location of stored triggered event data. • How long triggered and continuous data are kept. • How triggered event data and continuous data are to be provided to AEMO/NSP on request. • Details of availability of uninterrupted auxiliary supply to monitoring equipment.	
S5.2.5.14	• *Active power control system* capable of meeting GPS S5.2.5.14 and Dispatch Procedure SO_OP 3705 requirements: - Ramp up and ramp down capability (in MW/min), including maximum and minimum possible achievable ramp rates;	

		- a control block diagram of the overall *active power* control scheme (including PI control parameters where used); and - a qualitative description of the a*ctive power control system* and its *dispatch* logic with sufficient detail to allow AEMO to understand how the generating system will respond to dispatch instructions. • Unless the generating system is on AGC, it will require a dynamic ramp rate algorithm to ramp at the end of a *dispatch interval* considering instruction delay and communication delays.	
	S5.2.6.2	• Details of operational communication facilities. • Details of battery backup for remote monitoring equipment.	
As-built SLD of the proposed: • Revenue meters and power quality meters. • Protection relays and CT/VT connections. • SCADA and communications. • Auxiliary supply arrangement.			
If any filter banks are installed to meet power quality requirements, filter bank design reports.			
Generating system's start-up and shutdown procedure, detailing how it is energised or de-energised (switching sequence) from the *connection point* and each *generating unit's* start-up/shutdown and ramp up/down steps. Details of any other conditions in which units shutdown /idle (e.g. temperature or active power setpoint below a certain level)			
Communication failsafe mechanism details in the Communication design report consistent with Communication System Failure Guidelines.			
Protection and control scheme details, including those required to be modelled to assess the impact of the proposed *generating system*, including: • All protection design reports. • Runback or trip scheme design reports. • Updates to any existing special protection schemes , *control systems* and operational arrangements. • Level of duplication applied to communication, measurement CT/VT and relays. • Failsafe mechanisms if protection scheme communication fails or protection scheme disabled.			
Frequency-dependent *active power* controls information consistent with GPS S5.2.5.8(b), GPS S5.2.5.11 and Interim Primary Frequency Response Requirements.			
Confirmation that completed Appendix B of the Interim Primary Frequency Response Requirements submitted to PFR@aemo.com.au.			
Type test, FAT and SAT and any relevant off-site test reports covering *transformer* tests, inverter/turbine tests, and hardware in the loop tests.			

Model source code associated with PSS®E user-written simulation models. The source code must be for the same model used in the assessment of the proposed GPS and its RUG. It must comply with the FORTAN source requirements specified on AEMO's Modelling Requirements webpage.	
Model block diagrams The block diagrams must be for the same model used by AEMO in its assessment of the proposed GPS and RUG.	
ECM complies with the ECM Guidelines. Due dates: • 3 months prior to registration for *transmission connections*. • 1 month prior to registration for *distribution connections*.	
Commissioning program that complies with the GPS Compliance Assessment and R2 Model Validation Test Plan Template - For Conventional Synchronous Machines or GPS Compliance Assessment and R2 Model Validation Test Plan Template - For Power Electronic Interfaced Non-synchronous Generation Technologies, as applicable, provided by the due date. Due dates: • 3 months prior to commissioning for *transmission connections*. • 1 month prior to commissioning for *distribution connections*.	
Following consultation with AEMO and NSP on which signals are required, SCADA signal list provided, including VDS and ECM signals. For more information on VDS, refer to the links below: Guide to Var Dispatch VDS participant interface VDS information Check consistency of the SCADA list with GPS requirements, connection arrangement, VDS, ECM, *AGC*, runback schemes and other auxiliary plant within the *generating system*. Due date is at least 3 months prior to registration.	
For any local limit controls, design details based on temperature, unit availability, transformer status, other auxiliary plant availability. Check local control limit output connected to local limit SCADA signal.	

Voltage control strategy document, including: • *Overall* voltage control philosophy. • Main *transformer* Online Tap Changer AVR logic. • *Generating unit transformer* tap controls. • PPC voltage controls. • *Generating unit* level *voltage* controls. • Coordination of *voltage* control schemes. • *Voltage* control arrangement during night while *generating units* not in operation or under no wind conditions. As the minimum, *generating system* should be able to offset its *reactive power* injection at the *connection point* while *connected* and not *generating active power*. • Operational information about the filter capacitor, such as, *generating system* response in the event of capacitor filter *disconnection* and the expected status of the capacitor filter when it is not *generating*.	
Where applicable, updated studies demonstrating the impact of changes on the *generating system's* ability to meet the GPS, sufficient for AEMO to be satisfied that the Applicant can meet or exceed the GPS, as required by clause 2.2.1(e)(3) of the NER.	(list updated studies provided)
Registration To prevent delays, Applicants must check the requirements on AEMO's Registration webpage and ensure they have all supporting documentation ready for their application for registration as a *Generator*.	
NSP Requirements Confirm additional requirements specified by NSP have been met.	

APPENDIX B. INFORMATION CONSISTENCY AND QUALITY CHECK

Requirement	Comment / file name / reference
PSS®E and PSCAD™/EMTDC™ models are consistent in the physical representation of the proposed *generating system*.	
Details of model aggregation methodology for PSS®E and PSCAD™/EMTDC™ models in relevant RUGs, if applicable.	
PSS®E and PSCAD™/EMTDC™ models comply with the Power System Design and Setting Data Sheets and their representation in the connection studies report(s).	
PSS®E and PSCAD™/EMTDC™ models – a map of parameters is provided including conversion process, where applicable, consistent with the following items: • *Protection systems* – over-*voltage*, over-*frequency*, under-*voltage* and under-*frequency* settings. • Any limitations or *protection systems* that would otherwise limit accuracy of one of the models, e.g. multiple low *voltage* ride-through (LVRT) capability and protection settings for overspeed or oscillatory protection. • Disturbance ride-through logic and performance is consistent for the application of balanced disturbances, where models are consistent during and after the applied disturbance, e.g. look-up tables, gains for active-reactive current injections, activation and deactivation thresholds (depending on the control logic) for LVRT or HVRT etc.	
SLDs align with the model representation of the proposed *generating system*.	
Consistency between *generating system* and modelling, including: • *Generating system*, simulation models and EMS modelling demonstrate consistent aggregation of the GUs. • *Generating units* with separate dispatch unit ID have been modelled separately in the simulation model and EMS. • There are no dummy buses in the PSS®E load flow model.	
Check consistency between SCADA list, SCADA signals required under GPS S5.2.6.1 and *generating system* arrangement.	
Protection settings report does not indicate that any protection settings overrule GPS requirements (a quality check has been carried out to ensure that protection settings design (complete to the extent details are available) does not impede any GPS or stated *generating system* capability).	