PSCAD Model Requirements Rev. 12

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This document includes the following attachments:
Attachment #1: PSCAD Model Test Checklist for Reviewing Model Submissions
Attachment #2: PSCAD Model Requirements Supplier Checklist

Revision 12 notes (Changes from rev. 11):

Entire document	Editorial changes for clarity
PMR sections A,B	Model Accuracy Requirement: "Real Code" model now required, not recommended
PMR section X	New requirement to compile models using Intel Fortran 15 and Microsoft Visual Studio version 2015 or higher
PMTC (App. A)	Significant updates based on industry feedback in partial alignment with IEEE 2800 std. Now includes more clear requirements for documentation, generator owner attestation of compliance, and additional performance tests.

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Introduction

Specific model requirements for a PSCAD study depend on the type of study being done. A study with a scope covering weak system interconnections, ride-through evaluation, Sub-Synchronous Control Interactions (SSCI), short term[1] event response, and fast control interaction with nearby devices (for example) would require a model which has the following characteristics. Some specialty studies may require other features. Refer to "Attachment #1: PSCAD Model Test Checklist for Reviewing Model Submissions" and "Attachment #2: PSCAD Model Requirements Supplier Checklist", appended to this document, for additional information on how these requirements may applied.

Validation of models against recorded equipment behaviour and benchmarking against other models are important tools for assuring accuracy. This document does not address how this validation or benchmarking should be done, but it is recommended that inverter and plant level validation be done to the extent practical and possible.

Model Accuracy Features

For the model to be sufficiently accurate, it must:

A. *Represent the full detailed inner control loops of the power electronics.* The model cannot use the same approximations classically used in transient stability modeling, and must fully represent all fast inner controls, as implemented in the real equipment. Models which embed the actual hardware code into a PSCAD component are currently wide-spread, and this is the required type of model.[2,3]

B. *Represent all control features pertinent to the type of study being done.* Examples include external voltage controllers, customized PLLs, ride-through controllers, SSCI damping controllers and others. As in point A, actual hardware code is required to be used for most control and protection features. Operating modes that require system specific adjustment must be user accessible.

C. *Represent plant level control.* Power Plant Control (PPC) representation must be included which represents the specific controllers used in the plant. Plant controllers must be represented in sufficient detail to accurately represent short term performance, including specific measurement methods, communication time delays, transitions into and out of ride-through modes, settable control parameters or options, and any other specific implementation details which may impact plant behaviour. Generic PPC representations are not acceptable unless the final PPC controls are designed to exactly match the generic PPC model. If multiple plants are controlled by a common

[1] Example analysis periods could be 2 to 10 seconds following fault inception. Some studies could require longer periods.

[2] The model must be a full power transistor (eg. IGBT) representation (preferred), or use an average source representation that approximates the switching but maintains full detail in the inner controls, and maintains DC side protection features. Models manually translated block-by-block from MATLAB or control block diagrams may be unacceptable because the method used to model the electrical network and interface to the controls may not be accurate, or portions of the controls such as PLL circuits or protection circuits may be approximated or omitted. Note that firmware code should be directly used to create an extremely accurate PSCAD model of the controls. The controller source code may be compiled into DLLs or binaries if the source code is unavailable due to confidentiality restrictions.

[3] Model standards are under development which define appropriate ways to wrap .dll based control code into PSCAD models. Model writers are directed to this IEEE/Cigre WG to assist in developing a DLL standard for controller models.

controller, or if the plant includes multiple types of IBRs (eg. Hybrid BESS/PV) this functionality must be included in the plant control model. If supplementary or multiple voltage control devices (eg. STATCOM) are included in the plant, these should be coordinated with the PPC.

D. *Represent all pertinent electrical and mechanical configurations*. This includes any filters and specialized transformers. There may be other mechanical features such as gearboxes, pitch controllers, or others which must be modelled if they impact electrical performance within the timeframe and electrical purview of the study. Any control or dynamic features of the actual equipment which may influence behaviour in the simulation period which are not represented or which are approximated must be clearly identified.

E. *Have all pertinent protections modeled in detail for both balanced and unbalanced fault conditions.* Typically this includes various OV and UV protections (individual phase and RMS), frequency protections, DC bus voltage protections, converter overcurrent protections, and often other inverter specific protections. Any protections which can influence dynamic behaviour or plant ride-through in the simulation period must be included. Actual hardware code is recommended to be used for these protection features.

F. *Be configured to match expected site-specific equipment settings.* Any user-tunable parameters or options must be set in the model to match the equipment at the specific site being evaluated, as far as they are known. Default parameters are not appropriate unless these will match the configuration in the installed equipment.

Model Usability Features

In order to allow study engineers to perform system analysis using the model, the PSCAD model must:

G. *Have control or hardware options which are pertinent to the study accessible to the user.* Although plant must be configured to match site specific settings as far as they are known (see point F above), parameters pertinent to the study must be accessible for use by the model user. Examples of this could include protection thresholds, real power recovery ramp rates, frequency or voltage droop settings, voltage control response times, or SSCI damping controllers.[4] Diagnostic flags (eg. flags to show control mode changes or which protection has been activated) should be visible to aid in analysis.

H. *Be accurate when running at a simulation time step of 10 µs or higher*. Often, requiring a smaller time step means that the control implementation has not used the interpolation features of PSCAD, or is using inappropriate interfacing between the model and the larger network. Lack of interpolation support introduces inaccuracies into the model at larger simulation time-steps. In cases where the power transistor (eg. IGBT) switching frequency is so high that even interpolation does not allow accurate switching representation at 10 µs (eg. switching frequency greater than 40 kHz), an average source approximation of the inverter switching may be used to allow a larger simulation time step[2].

[4] Care must be taken to ensure that any user-settable options are not changed in a way that is not implementable in the real hardware, and that any selectable options are actually available at the specific site being considered. Discussion is recommended with the manufacturer prior to any changes being made in model configuration.

I. *Operate at a range of simulation time* steps. The model must not be restricted to operating at a single time step, but must be able to operate within a range (eg. 10 µs – 20 µs)

J. *Include documentation and a sample implementation test case.* Test case models must be configured according to the site-specific real equipment configuration up to the Point of Interconnection. This would include (for example): aggregated generator model, aggregated generator transformer, equivalent collector branch, main plant transformers, gen tie line, power plant controller, and any other static or dynamic reactive resources. Test case must use a single machine infinite bus representation of the system, configured with an appropriate representative SCR[5]. Access to technical support engineers is desirable. Additional detail on required documentation and test case is described in PSCAD Model Test Checklist (Appendix A).

K. *Have an identification mechanism for configuration.* The model documentation must provide a clear way to identify the specific settings and equipment configuration which will be used in any study, such that during commissioning the settings used in the studies can be checked. This may be control revision codes, settings files, or a combination of these and other identification measures.

L. *Accept external reference variables.* This includes real and reactive power ordered values for Q control modes, or voltage reference values for voltage control modes. Model must accept these reference variables for initialization, and be capable of changing these reference variables mid-simulation, ie. dynamic signal references.

M. *Be capable of initializing itself.* Once provided with initial condition variables, the model must initialize and ramp to the ordered output without external input from simulation engineers. Any slower control functions which are included (such as switched shunt controllers or power plant controllers) must also accept initial condition variables if required. Note that during the first few seconds of simulation (eg. 0-2 seconds), the system voltage and corresponding terminal conditions may deviate from nominal values due to other system devices initializing, and the model must be able to tolerate these deviations or provide a variable initialization time.

N. *Have the ability to scale plant capacity.* The active power capacity of the model must be scalable in some way, either internally or through an external scaling component[6]. This is distinct from a dispatchable power order, and is used for modeling different capacities of plant or breaking a lumped equivalent plant into smaller composite models.

O. *Have the ability to dispatch its output to values less than nameplate.* This is distinct from scaling a plant from one unit to more than one, and is used for testing plant behaviour at various operating points.

P. *Initialize quickly.* Model must reach its ordered initial conditions as quickly as possible (for example <5 seconds) to user supplied terminal conditions.

[5] Representative SCR should reflect approximate N-1 interconnection SCR where possible, especially if the system is expected to be weak. If the system strength is not known, using a relatively low SCR in the test system, such as 2.5, may help to avoid issues during study phases.
[6] A free publicly available scaling transformer suitable for this purpose is available in the E-Tran library.

Study Efficiency Features

The following elements are required to improve study efficiency, model compatibility, and enable other studies which include the model to be run as efficiently as possible. If these features are not supported, additional discussion is required[7]:

Q. Model must be compatible with Intel Fortran compiler versions 15 and higher.[8]
R. Model must be compatible with PSCAD version 4.6.3 and higher.
S. Model must support multiple instances of its own definition in the same simulation case.
T. Model must support the PSCAD “timed snapshot” feature accessible through project settings.
U. Model must support the PSCAD “multiple run” feature.
V. Model must not use or rely upon global variables in the PSCAD environment.
W. Model must not utilize multiple layers in the PSCAD environment, including ‘disabled’ layers.
X. Model must be compiled with Visual Studio 2015 or newer[9]

[7] Electranix has parallelization tools available (E-Tran Plus for PSCAD) which can circumvent compatibility concerns in some cases.

[8] Models compiled using PSCAD with Intel Fortran 12 or 14 will use Visual Studio 2010 or 2013 which may cause compiler conflicts when those models are used in combination with models built with Intel Fortran 15 and newer. If Intel Fortran 12 or 14 support is required, it is recommended to compile both an Intel Fortran 12 to 14 model and an Intel Fortran 15 and newer model for maximum compatibility.

[9] Older models which were compiled using Intel Fortran 12 may not be compatible with Visual Studio versions 2015 or newer. In this case older versions of Visual Studio may be needed.

Attachment #1: PSCAD Model Test Checklist for Reviewing Model Submissions

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Purpose

This document is a test checklist meant to accompany "PSCAD Model Requirements" (PMR) provided above and "Attachment #2: PSCAD Model Requirements Supplier Checklist". The checklist is intended for use by engineers who are reviewing model submissions, and the procedures provided in this document are intended to provide an indication of the core model accuracy, performance, and usability features specified in the model requirements. These procedures cannot ultimately prove that the model is compliant with all requirements, as black box models usually hide the details of the equipment controls and protection. It is recommended that the equipment manufacturer supply additional confirmation that the model meets each individual requirement. The requirements in this document do not necessarily represent interconnection criteria for specific individual systems, and may be supplemented or adjusted based on interconnection region.

The tests outlined here are considered "basic", and may be supplemented by more rigorous testing, as well as more extensive protection testing and benchmarking against phasor models. This document is not intended to be a guide for thorough benchmarking between PSCAD, PSS/E, and actual equipment, and is subject to revision as the state of the art in EMT modeling evolves.

Model test Summary	
Model Test date:	
Reviewer	
Project Name:	
Interconnection Location:	
Rated Capacity at POC:	
Manufacturer:	
Equipment type: (eg. PV, Wind, BESS or Hybrid)	
Equipment version:	
Documentation files (OEM):	
Documentation files (site specific):	
Model Files supplied:	

Model Review Procedure and Checklist

		Yes/No	Comments
Documentation and site specific model verification			
1a	Model documentation states compliance with "Recommended PSCAD model requirements Rev. 12"[10] (PMR), including certification of model accuracy as defined in PMR.		
1b	The Vendor's name and the specific version of the model must be clearly observable in the. pscx PSCAD case.		
1c	OEM Documentation and supporting model filenames must not conflict with model version shown in the. pscx/.pslx file.		
1d	Documentation for how to use the plant model, including key parameters and any required information for configuring the model for the site is available and matches supplied plant model. Documentation should include the recommended range of simulation timesteps and must give a clear description of trip / operation code signals produced by model.		
1e	Model is supplied with a test circuit which is configured for the site-specific application.[11]		
"Real Code" model verification			
2a	Controls are black-boxed, and no PSCAD master library control blocks are visible within control circuits.[12] Model is based on "real code", with firmware version matching the expected installed version.[13]		
Model usability verification			
3a	Model uses a timestep greater than or equal to 10 μs[14]		
3b	Model is not restricted to running at a single defined timestep.		
3c	Model compiles using Intel FORTRAN 15 and Visual studio 2015 requirements in PMR		

[10] Non-compliance may be waived in systems which do not require compliance with the model requirements document.

[11] The test circuit must model all relevant electrical components of the plant and contain a system equivalent. Parameters will be assumed to be site-specific, unless there are obvious indications otherwise, such as an incorrect grid base frequency.

[12] Black-boxing of controls to a high level does not guarantee that real-code is embedded into the model, however the visibility of PSCAD master-library control blocks in the inner control loops (PLL, inner current controllers, etc.) suggest that the model is generic in nature. Model documentation may contain information on use of real-code in the model.

[13] If models are not "real code" models, all aspects of the controller operation are required to be validated by utilizing a "hardware in loop" platform or other hardware test systems. Model must not be validated against other software models. Validations must include control responses to various types of faults, changes in power and voltage references, changes in system frequency, testing frequency response in sub and super-synchronous ranges, and testing of protection operation. Tests must also be performed under a variety of system strengths, including very weak systems. Other tests may also be required. The validation report is required along with any model updates that result from the more rigorous validation tests.

[14] Models with timesteps less than 10 μs may be acceptable in situations where a small timestep does not significantly increase the runtime of the total simulation

3d	Model allows multiple instances of itself to be run together in the same case[15]		
Model electrical configuration verification			
4a	Plant level electrical single line diagram (SLD) is included.		
4b	Generator step-up transformer(s) included, with impedance between 5 and 10% on generator base, and matches SLD.[16]		
4c	Lumped collector equivalent(s) included, with total charging equal to between 0.5 and 5% of plant rating, and matches SLD.[16]		
4d	Substation transformer(s) included which: - Is rated appropriately for plant size - Has impedance between 6 and 12% on transformer base - Includes site specific tap configuration - Includes correct vector group or winding configuration - Matches transformer described in plant SLD[16]		
4e	Model can be scaled to represent any number of inverters/turbines, either using a scaling transformer or internal scaling.		
4f	All supplementary devices included in the plant (such as STATCOMs) include appropriate models.		
Plant controller verification			
5a	Model includes a power plant controller (PPC) with sufficient detail as described in PMR.		
5b	PPC accepts an external active power setpoint.		
5c	PPC accepts a voltage/reactive power/power factor setpoint.		
5d	PPC has a mechanism to implement a settable voltage droop.		
5e	If supplementary voltage control devices (eg. STATCOM/DVAR, SVC, MSCs) are included in the plant, ensure that the voltage control of these devices is effectively coordinated with the PPC, with no potential for VAR looping or oscillations.		
Basic performance verification[17]			
6a	Initialization Tests: Model meet the success criteria in tests outlined in Table 1		
6b	Balanced Fault Ride-through tests: Model meet the success criteria in tests outlined in Table 2		
6c	Unbalanced Fault Ride-through tests:		

[15] Depending on specific application and whether E-Tran Plus for PSCAD is allowed to be used to overcome the limitation, this requirement may be waived.
[16] Impedance range is for sanity checking only. Impedances outside this range may be allowed.
[17] Performance testing is recommended with a POI level SCR of 2.5 and X/R of 5 as this is a representative system condition seen during weak system studies. Testing may be performed at higher SCRs if the stable operating SCR of a model is known to be above 2.5 and the interconnection POC system strength is known.

	Model meet the success criteria in tests outlined in Table 3		
6d	Over-Voltage Ride-through Tests: Model meet the success criteria in tests outlined in Table 4		
6e	Voltage Reference Step Change Tests: Model meet the success criteria in tests outlined in Table 5		
6f	Active Power Reference Step Change Tests: Model meet the success criteria in tests outlined in Table 6		
6g	Grid Frequency Response and Ride-Through Tests: Model meet the success criteria in tests outlined in Table 7		
6h	Grid Voltage Phase Angle Change Ride-Through Tests: Model meet the success criteria in tests outlined in Table 9		
6i	POI SCR Change Tests (informational): Model meet the success criteria in tests outlined in Table 10		
Basic protection verification			
7b	Voltage Protection Inclusion Tests: Model meet the success criteria in tests outlined in Table 12		

Basic performance and protection verification tests

Note on test system: Unless otherwise indicated, tests should be performed in a moderately weak grid (eg. SCR = 2.5), or if the interconnection location system strength is known, that SCR may be used. The plant must ultimately comply with applicable ride-through standards within the context of the actual system, normally determined in a more complete study.

Note on OLTC: Tests should be performed with plant operating in a reasonable nominal state prior to the test. If an OLTC is used, tap should be set to produce an appropriate powerflow condition prior to the test.

Table 1: Initialization Tests

Test #	Test Description				Success Criteria
	Test duration [s]	Test Type	Active Power at POI	Initial Approx. Reactive Power at POI	
1-1	20	Flat Run	Pmax	0	Reach steady state in less than 10, remains flat for run duration
1-2	20	Flat Run	Pmin	0	Reach steady state in less than 10, remains flat for run duration

Table 2: Balanced Fault Ride-through Tests

Test #	Test Description					Success Criteria
	Fault duration [s]	**Fault type**	**Fault impedance Zf**	**Active Power at POI**	**Initial Approx. Reactive Power at POI**	
2-1	0.16	3PHG	Zf=0	Pmax	0	Ride Through
2-4	2.50	3PHG	Zf=Zs[18]	Pmax	0	Ride Through

Table 3: Unbalanced Fault Ride-Through Tests

Test #	Test Description					Success Criteria
	Fault duration [s]	**Fault type**	**Fault impedance Zf**	**Active Power at POI**	**Initial Approx. Reactive Power at POI**	
3-1	0.16	2PHG	Zf=0	Pmax	0	Ride Through
3-4	0.16	1PHG	Zf=0	Pmax	0	Ride Through
3-7	2.5	2PH	Zf=0	Pmax	0	Ride Through

Table 4: Over-Voltage Ride-Through Tests

Test #	Test Description				Success Criteria
	Duration [s]	**Grid Voltage at POI (use infinite source at POI)**	**Active Power at POI**	**Initial Approx. Reactive Power at POI**	
4-1	1	1.2 pu	Pmax	0	Ride Through
4-3	1	1.2 pu	Pmax	Qmax	Ride Through

[18] The intention of setting the fault impedance equal to the source impedance is to create a voltage at the POI of approximately 50%.

Table 5: Voltage Reference Step Change Tests

Test #	Test Description			Success Criteria
	Event	**Active Power at POI**	**Initial Approx. Reactive Power at POI**	
5-1	Relative V (or Q or PF)[1] reference change as per Figure 1	Pmax	0	Step Response < 10s
5-2	Relative V (or Q or PF)[1] reference change as per Figure 1	Pmin	0	Step Response < 10s

[1] Will be based on reactive power control method

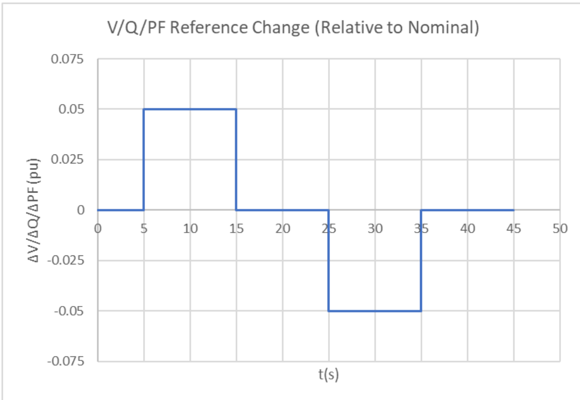

Figure 1: Relative voltage reference step change

Table 6: Active Power Reference Step Change Tests

Test #	Test Description			Success Criteria
	Event	**Active Power at POI**	**Initial Approx. Reactive Power at POI**	
6-1	Active Power controller reference change as per Figure 2	Pmax	0	Plant Responds Appropriately

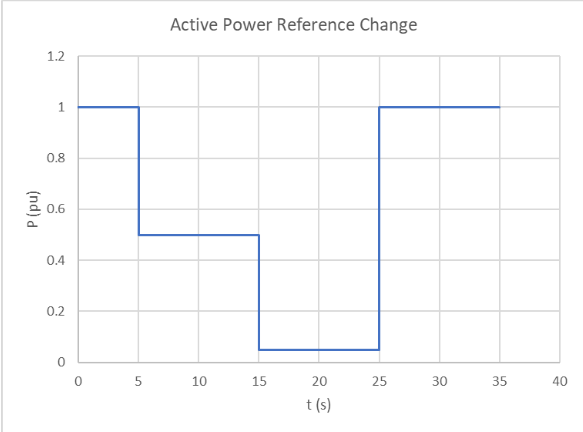

Figure 2: Active power reference step change

Table 7: Grid Frequency Response and Ride-through Tests

Test #	Test Description			Success Criteria
	Event	**Active Power at POI**	**Initial Approx. Reactive Power at POI**	
7-1	Grid Frequency Change as per Figure 3	Pmax	0	Ride-through, Appropriate response per IEEE 2800 Table 8
7-2	Grid Frequency Change as per Figure 3	Pmin	0	Ride-through, Appropriate response per IEEE 2800 Table 8
7-3	Grid Frequency Change as per Figure 4	Pmax	0	Ride-through, Appropriate response per IEEE 2800 Table 8
7-4	Grid Frequency Change as per Figure 4	Pmin	0	Ride-through, Appropriate response per IEEE 2800 Table 8

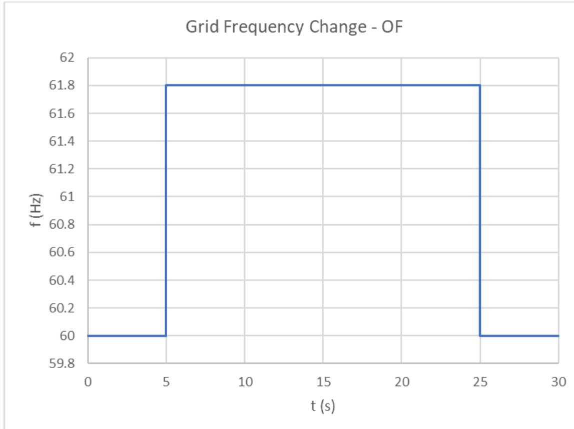

Figure 3: Grid frequency change (>60 Hz) – for inverter performance evaluation

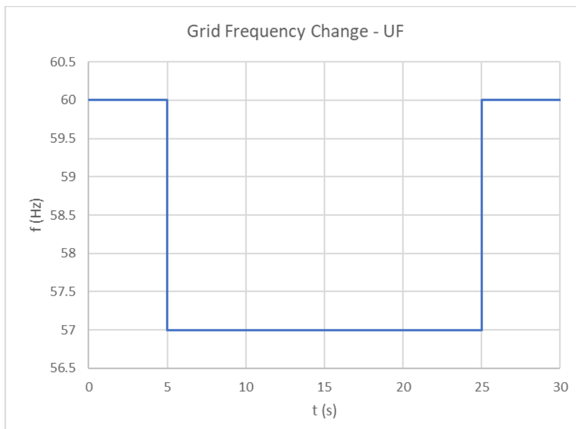

Figure 4: Grid frequency change (<60 Hz) - for inverter performance evaluation

Table 8: Grid Voltage Phase Angle Change Ride-through Tests

Test #	Test Description			Success Criteria
	Event	Active Power at POI	Initial Approx. Reactive Power at POI	
9-1	Grid voltage angle change equal to +25°	Pmax	0	Ride Through
9-2	Grid voltage angle change equal to -25°	Pmax	0	Ride Through
9-3	Grid voltage angle change equal to +25°	Pmin	0	Ride Through
9-4	Grid voltage angle change equal to -25°	Pmin	0	Ride Through

Table 9: POC SCR Change Informational Tests

Test #	Test Description			Success Criteria
	Event	**Active Power at POI**	**Initial Approx. Reactive Power at POI**	
10-1	Short Circuit Ratio (SCR) of the plant at POC is changed as per Figure 6. 3LG Z=0 fault is applied at each SCR transition. Time between transitions may be extended to allow stabilization.	Pmax	0	For informational purposes only (not pass/fail) Plant should show stable operation until SCR = 2.5 and is unlikely to show stable operation as SCR approaches 1[1]

[1] valid only for grid following inverters

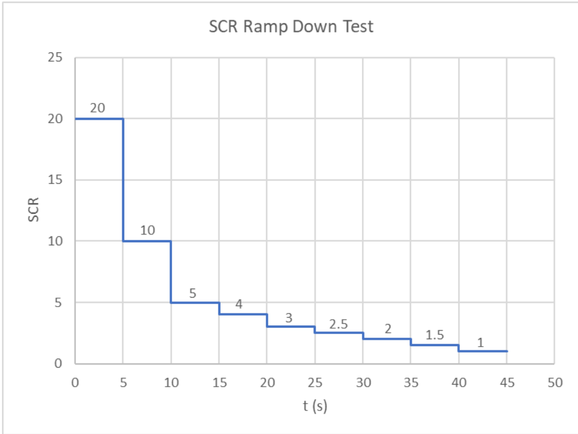

Figure 5: POC SCR change

Basic protection verification tests (test to see whether protection exists)

Table 10: Voltage Protection Inclusion Tests (Note that these tests only indicate that the model has protection included, and may vary according to equipment capability)

Test #	Test Description			Success Criteria
	Event	**Active Power at POI**	**Initial Approx. Reactive Power at POI**	
12-1	Grid Voltage step as per Figure 9	Pmax	0	Inverter Trips
12-2	Grid Voltage step as per Figure 10	Pmax	0	Inverter Trips

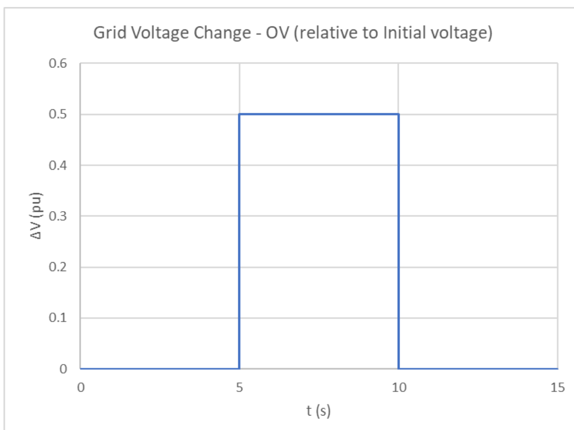

Figure 6: Grid voltage change - OV

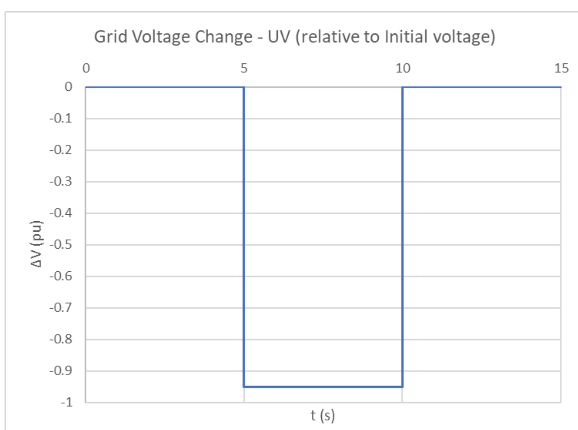

Figure 7: Grid voltage change - UV

Attachment #2: PSCAD Model Requirements Supplier Checklist

Purpose

This document is a model requirements checklist which must be completed by the supplier of the model and submitted alongside each PSCAD model. This document accompanies the "PSCAD model requirements Rev. 12" document above (PMR), which must be used for further reference to describe the requirements associated with each point. Generic testing of the model may be done using "Attachment #1: PSCAD Model Test Checklist for Reviewing Model Submissions" (PMTC), which may be used as a reference.

Model supplier must review every item in the checklist and indicate compliance for each item. If the supplied model does not meet any of the requirements an explanation of the deficiency must be provided in the comments column.

Model Submission Summary (to be completed by model supplier)	
Submission date:	
Project Name:	
Primary contact information for model related questions:	
Secondary contact information for model related questions:	
Manufacturer:	
Equipment type: (eg. PV or Wind)	
Equipment version:	
Documentation file(s):	
Model Files supplied:	

Model Requirements Checklist		PMR Reference	Model Complies? (Yes/No)	Comments
1	*Model Accuracy Features*			
1.1	Power electronic controls are modelled by interfacing with actual firmware code from the inverter ("real code" model)	A,B		
1.2	Operating modes which require system specific adjustment are accessible.	B		
1.3	Plant level controller is included according to PMR.[19]	C		
1.4	Model is capable of controlling frequency[20]	B,C		
1.5	Includes pertinent electrical and mechanical features, such as gearboxes, pitch controllers, or other features which impact the plant performance in the simulation period.[21]	D		
1.6	All protections which could impact ride-through performance are modelled in detail.	E		
1.7	Model is configured for the specific site being evaluated, as far as they are known.	F		
2	*Model and Project Documentation*			
2.1	Model includes documentation.	J		
2.2	Documentation includes instruction for setup and running the model. The Vendor's name and the specific version of the model must be clearly observable in the .pscx PSCAD	J		

[19] If the plant is part of a multi-plant control scheme, a description of the overall scheme must be provided, and corresponding PPC models must be configured to control multiple plants accordingly.
[20] Frequency control model requirements may vary by region. Example response time may be less than 10 seconds.
[21] Simulation period may vary depending on the model use, but 10 seconds of simulation following an event such as a fault is a typical period.

	case. Documentation and supporting model filenames must not conflict with model version shown in the .pscx case file.			
2.3	Model is supplied with a sample test case including site specific plant representation.	J		
2.4	Plant single line diagram is provided, and aligns with model	J		
2.5	Model documentation provides a clear way to identify site-specific settings and equipment configuration.	K		
3	*Model Usability Features*			
3.01	Control or hardware options are accessible to the user as applicable.	G		
3.02	Diagnostic flags are visible to the user.	G		
3.03	Model uses a timestep greater than 10 µs.	H		
3.04	Model allows a range of simulation timesteps (ie. not restricted to a single timestep).	I		
3.06	Model accepts external reference variables for active and reactive power and voltage setpoint, and these may be changed dynamically during the simulation.	L		
3.07	Model is capable of initializing itself.	M		
3.08	Active power capacity is scalable.	N		
3.09	Active power is dispatchable.	O		
3.10	Model reaches setpoint P, Q, and V in 5 seconds or less	P		
3.11	Model compatible with Intel FORTRAN version 15 and higher.	Q		
3.12	Model compiles using PSCAD version 4.5.3 or higher.	R		

3.13	Model supports multiple instances of its own definition in a single PSCAD case.	S		
3.14	Model supports PSCAD "snapshot" feature.	T		
3.15	Model supports the PSCAD "multiple run" feature.	U		
3.16	Model does not use PSCAD global variables.	V		
3.17	Model does not use PSCAD layer functionality	W		
3.18	Model is compiled using MS Visual Studio v.2015 or newer	X		