

WEM Rules – Generator Model Submission & Maintenance

WEM Reform Implementation Group (WRIG)
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Background and Purpose

- The Generator Model Procedure as contemplated under section 3A.14 of WEM Rules, applies to all Market participants with Transmission connected generators (including inverter and converter coupled generating units), and to both new connections and modifications to existing facilities (including settings and configuration changes).
- Procedure Specify the processes:
 - (a) In providing the Computer Model to be taken into account [Appendix 12];
 - (b) In maintaining the Generator Register [Clause 3A.7].

Power System Modelling

- Power system modelling consists of a computer rendition of the electric grid, detailing the characteristics and parameters of individual units.
- It is critical to accurately incorporate into the model not only the various devices but also their parameters. Once the model has been developed, then it is possible to analyse what is happening or might happen in the real grid.
- WP will use these computer models for:
 - Load Flow & Contingency Analysis;
 - Harmonic analysis and;
 - Transient Stability & Electromagnetic transient(EMT) analysis.



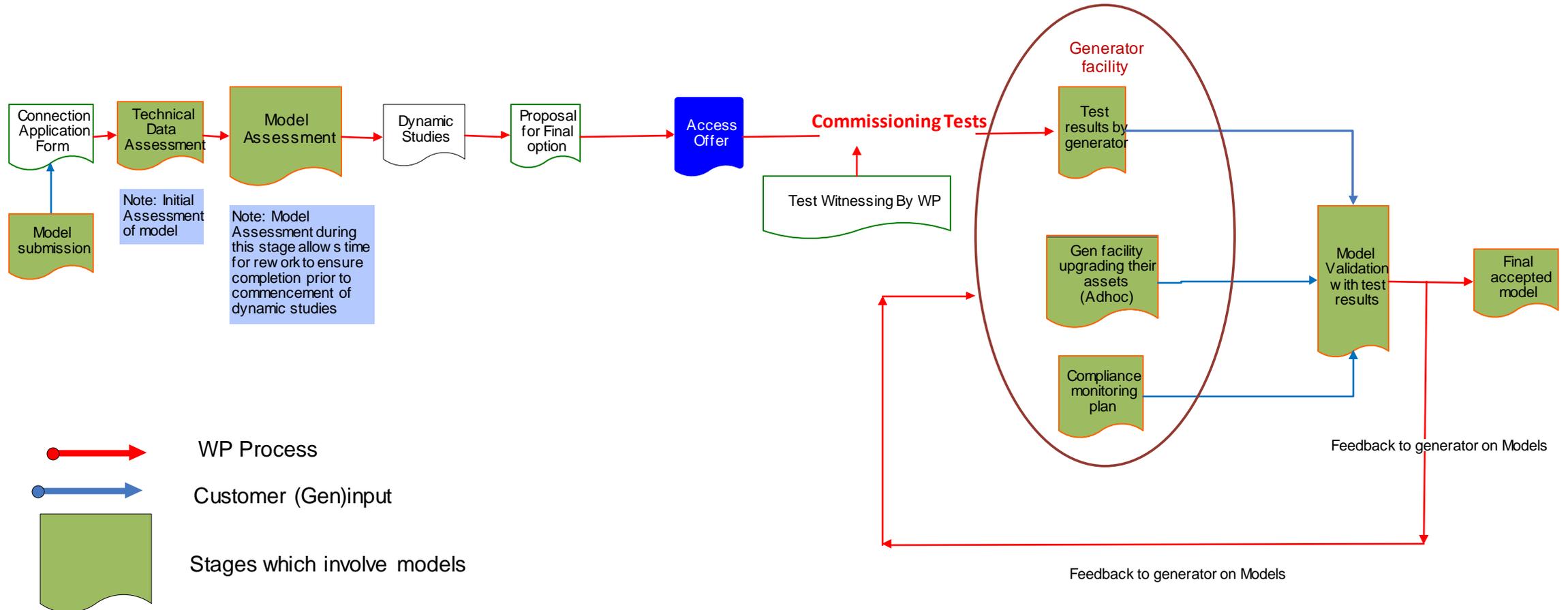
Objectives of Procedure

- Western Power needs to ensure that computer modelling data used for planning, design and operational purposes is complete and accurate. This is fundamental to the safe and reliable operation of the power system within its' technical envelope.
- Procedure describes:
 - Requirements for provision of computer models for facilities connected or proposed to connect to the Western Power Network, including:
 - Model functional requirements;
 - Model acceptance test and model performance requirements;
 - Model documentation and user manual requirements and;
 - Model validation, registered data and model accuracy requirements.
 - Details of Western Power's methodology for assessing compliance with the above requirements to assist Market Participants with providing the required models and associated model information.



High Level Process Map

Model Procedure Flowchart



Software Requirements of Model

- Computer models must be in native unencrypted DlgSILENT Power Factory format.
- Where Western Power intends to perform an upgrade of its PowerFactory software, it will advise Market Participants of any requirements to provide updated models and agree with each Market Participant on a reasonable timeframe for delivery, which must not be longer than 6 months.
- EMT models provided to Western Power must be compatible with PSCAD™/ EMTDC™ version 4.6.3 and Intel Parallel Studio XE Composer Edition for Fortran 2015.
- EMT models should not have dependencies on additional external commercial software, however dependencies on free, commonly available redistributable libraries (such as E-TRAN) may be acceptable.

General Model Requirements

- The model and its associated data and parameters must be consistent with the information provided as part of an access application, or otherwise the User's request for modification to an existing facility.
- The generator active and reactive power ranges must be defined in the model according to the generator capability.
- For a synchronous generator, the control system models are to be included e.g; Excitation system/Speed-control droops etc.
- For a non-synchronous generator, the control systems would include Reticulation network including other relevant equipment such as static or dynamic reactive equipment and harmonic filters, Farm-level control system with measurement points/control points (including Phase Locked Loops) appropriately configured.
- For non-synchronous generators, harmonic current and flicker emissions must be included in the model.



Aggregation of Models

For some detailed load models and for generating systems comprising a large number of generating units, there may be a requirement for the model to be aggregated.

- The methodology for aggregating generating units, loads, other generating equipment and the reticulation system and studies demonstrating the equivalence between the detailed and aggregated models must be provided.
- As a minimum this must illustrate the alignment of time-domain simulation overlays for voltage, active power and reactive power for the nearest and farthest generating unit and the aggregated generating unit, for:
 - Zero impedance balanced three-phase to earth and zero impedance two-phase to earth faults at the connection point and;
 - Voltage, reactive power, power factor and active power step response.



Model Documentation Requirements

- User manual:
 - The user manual must contain sufficient information to enable Western Power to use the computer model to carry out power system studies for planning, design and operational purposes;
 - A description of the model components and parameters, and data category of each parameter;
 - Any special control or protection schemes that are relevant to load flow or dynamic simulation studies (e.g. runback schemes, low voltage ride-through schemes, active power reduction schemes) and;
 - How the model is to be set up for power system analysis.
- Equipment data sheets associated with the computer model.
- If available, a report describing how the model was developed (model development report).
- Protection settings and model tuning report (design report).
- For inverter connected generators, fault ride-through performance and model validation report.
- Other relevant documentation, such as model validation reports or type test reports.

Model Acceptance Tests

- In cases where a Market Participant seeks to develop a facility with a particular technology type, but where a site and/or connection point has not yet been selected (e.g. as part of an Enquiry), the Market Participant may seek to have Western Power provide an initial assessment of the computer model and associated information against the requirements of the WEM Rules and the Generator and Load Model Guidelines published on Western Power's website.
- This assessment would be conducted using an infinite bus model for a range of system strengths to emulate different connection locations. This assessment would therefore not assess electromechanical interactions with generators, which could later be assessed using the complete model of the SWIS once the connection point is known.



Model Assessment

Western Power undertakes a due diligence assessment (model assessment) of the computer model submitted by market participant to assess its performance against the requirements of the WEM Rules.

Before submitting the model the Market Participant is encouraged to:

- Seek details of the characteristics of Western Power Network at the nominated connection point and tune the model to best meet the performance requirements of the WEM Rules Appendix 12;
- Prepare design report to document the tuning methodology and results;
- Western Power can provide a model of the SWIS and other technical information to support the Market Participant tuning of the model upon request;
- Should the model assessment identify the need for retuning or augmentation (such as additional voltage control devices) the proponent should address the deficiencies, after which time Western Power will repeat or update the model assessment.

Generator Test Witnessing

- In accordance with WEM test procedure, Western Power will witness performance testing. During test witnessing, Western Power assesses whether:
 1. Tests are conducted in accordance with the approved test procedure.
 2. Tests pose any risk to power system security or stability, safety or to other Users, in which case there may be a requirement to omit particular tests (for example, for a synchronous generator, omit some tests with the Power System Stabilizer out of service) or cease testing.
- In lieu of attending site for test witnessing Western Power may request the User submit test results and plots with relevant performance analysis to Western Power.
- For commissioning tests there may be a requirement for results to be provided before Western Power provides approval for generating units to be synchronised and before they can operate at progressively higher active power output levels.
- Test results should be provided within 10 days after the conducting of tests.

Model Validation and Performance (post-testing)

- WEM Rules Section 3A.8 identifies that data associated with the relevant access application must be validated and submitted to Western Power following generator tests. The data to be validated includes, but is not limited to, the computer model, generator and control system parameters.
- The schedule of tests for performance verification and model validation for synchronous and non synchronous generating units will be provided in WEM Procedure by AEMO, which also includes details of the requirements for test equipment and measurement signals.



Model Validation Documentation

- Details of the tests undertaken and any discrepancies between the tests conducted and the agreed test procedures.
- Results, measurements, analysis techniques used and any relevant information to assist Western Power with performing a due diligence assessment.
- Specific assessments of the performance against Registered performance Standards with relevant clauses of the WEM Rules should be documented, and illustrated on results plots.
- Test report(s) including:
 - R2 data, model validation and performance report (with R2 data and performance standards attachments);
 - Parameters, other than those designated as "R2" that contribute most significantly to the accuracy of the model for fault, voltage and frequency disturbances in the power system, must be derived from on-site tests, where possible and;
 - Model tuning report (design report).
- Final computer model and block diagrams within three months after testing.
- For demonstrated performance with respect to the relevant technical requirements prior to the Technical Rules (1 July 2007), it is necessary for the existing proponent to show evidence there has been no degradation in performance over previous agreed performance standards.
- Any special conditions specified in the connection agreement.
- Completion and submission of the Market Participant generator register.
- Updated access application with registered (R2) data. For upgrades or modifications this should be the updated R2 data relevant to the upgrade.

Review of Test Reports

- Within three months of receiving complete test reports and associated supporting information, Western Power will advise one of the following outcomes:
 - Acceptance of the test report, associated data, parameters, model(s) and performance assessment;
 - Request for further information, further testing and/or model changes.
- If an R2 data, model validation and performance report is not accepted, Western Power will inform the Market Participant of the reason(s) and work collaboratively with the user to expedite resolution of any issues preventing acceptance of the test report.
- Sufficient evidence has to be provided by Western Power if it requires the Market Participant to carry out additional tests. Western Power and the Market Participant must co-operate to reach agreement on the scope to address any deficiencies within a reasonable period.

Non compliance with WEM Rules

- Western Power may accept the R2 data, model validation and performance report as an accurate reflection of the facility. This does not necessarily mean the facility is compliant with the WEM Rules. Should the final performance not comply with the requirements of the WEM Rules there is a requirement for this to be addressed. Options may include:
 - Provide Interim Approval to Generate notification with conditions (i.e. directing to operate at a particular output until matter is resolved);
 - Require generator to rectify non-compliance before providing Interim Approval to Generate notification; Generator, Western Power and AEMO agree that the Generator performance standards can be renegotiated (including potential for trigger events).
- Section 3A.9 enables AEMO to request a Market Participant to undertake testing in accordance with the WEM Procedure should AEMO or the relevant Network Operator reasonably consider that a Market Participant may not be compliant with the applicable Registered Generator Performance Standards. This can occur where the performance of the facility was observed to not correlate to the model. In which case a test (or tests) could be required to demonstrate model compliance.



Variation / Negotiation Requests

- In response to a variation request, Western Power will assess the impact on the ability of the User to meet the requirements of this Procedure. The Variation Request should summarise:
 - The specific sections of the Procedure(s) that cannot be met;
 - Documentary evidence (including options considered) of the reasons for being unable to meet a Procedure, sufficient to satisfy Western Power that meeting the guideline is technically unachievable;
 - If the discrepancy between a Procedure and what can be achieved could be reduced at a later date, an undertaking as to when and how this would be provided and;
 - The extent to which that Procedure might affect the ability to assess the compliance of the Market Participant under WEM Rules.
- Western Power would consider a Variation Request in terms of its impact on:
 - The computer model (to which the Variation Request is related), and how it should be used;
 - Western Power's certainty over its ability to accurately model the facility and conduct power system studies, including determination of power transfer limits and providing advice to AEMO when requested;
 - Quality or security of supply to other Users;
 - The extent of changes to the operation of the generating system and;
 - AEMO's ability to ensure secure operation of the power system.
- Following consideration of the Variation Request, Western Power must:
 - **Accept** or **Reject** it;
 - Propose alternatives or options for the Market Participant to consider;
 - Request further information.



Available Resources

- Further information on model requirements are given in:

<https://westernpower.com.au/media/1888/generator-and-load-model-guidelines-20160511.pdf>

- Further queries can be sent to:

RegulatoryReforms@westernpower.com.au
system.analysis@westernpower.com.au



Questions?

