PSCAD model requirements

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Specific model requirements for a PSCAD study depends on the type of study being done. A study with a scope covering weak system interconnection, ride-through, voltage control and event response, and islanding performance (for example) would require a model which has the following characteristics. Some specialty studies may require other features.

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 should fully represent all fast inner controls, as implemented in the real equipment. It is possible to create models which embed the actual hardware code into a PSCAD component, and this is the best type of model.[1]

B. Represent all pertinent control features (e.g., external voltage controllers, plant level controllers, PLLs, etc). Operating modes that require system specific adjustment should be user accessible. In particular, plant level voltage control should be represented along with adjustable droop characteristics. If the plant level controllers are very slow (>5 second time constant), these may be approximated using constant Q modes.

C. Represent all pertinent electrical and mechanical configurations, such as filters and specialized transformers. There may be other mechanical features (such as gearboxes, pitch controllers, etc.) which should be modelled if they impact electrical performance.

D. 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, and overcurrent protection. There may be others.

Model Usability Features

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

E. Have control or hardware options which are pertinent to the study accessible to the user. (For example, adjustable protection thresholds or real power recovery ramp rates) Diagnostic flags (eg. flags to show control mode changes or which protection has been activated) should be accessible to aid in analysis.

F. Be capable of running at a minimum time step of 20 us, unless specific control parameters require smaller. The smallest we have seen in terms of genuine control limits are 10 us. Most of the time, 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 higher time-steps.

[1] The model must be a full IGBT representation (preferred), or may use a voltage source interface that mimics IGBT switching (ie. A firing pulse based model). A three phase sinusoidal source representation is not acceptable. Models manually (ie. block-by-block) translated from MATLAB are often unacceptable because the method used to model the electrical network and interface to the controls may not be accurate. Note, however, that Matlab may be used to generate C code which is used in the real control hardware, and if this approach is used by the developer, the same C code may be directly used to create an extremely accurate PSCAD model of the controls. The controller source code may be compiled into DLLs if the source code is unavailable due to confidentiality restrictions.

G. Include documentation and a sample implementation test case should be provided. Access to technical support engineers is desirable.

Model Efficiency Features

In addition, the following elements are required to improve study efficiency and enable other studies which include the model to be run as efficient as possible. If these features are not supported, additional discussion is required:

a. Initializes as quickly as possible (<1-3 seconds) to user supplied terminal conditions.
b. Support multiple instances of the model in the same simulation.
c. Support the PSCAD “snapshot” feature.
d. Support the PSCAD “multiple run” feature.