**Model Specification**

Each model provided shall:

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| Item | Description | Check |
| 1 | Be compatible with PSCAD version 4.5.3. |  |
| 2 | Represent the full detailed inner control loop 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. |  |
| 3 | Represent plant level controllers as they are implemented in the real controls. 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 to help in analyzing voltage control coordination. |  |
| 4 | Represent all pertinent control features as they are implemented in the real controls (e.g. PLLs, etc.) |  |
| 5 | Represent SSR mitigation and/or protection including the ability to enable and disable SSR mitigation/protection, if applicable |  |
| 6 | Represent dynamic reactive devices including automatically controlled capacitor and reactor banks, if applicable. |  |
| 7 | Represent all pertinent electrical and mechanical configurations, such as filters and specialized transformers, gearboxes, torsional models. The model can be either a full IGBT representation, or use a voltage source interface that mimics the IGBT operation (unless harmonic studies require full representation of switching dynamics). Current source interface is not recommended. |  |
| 8 | Have all pertinent protections modeled in detail. Typically this includes various over-voltage and under-voltage protections, frequency protections, DC bus voltage protections, and overcurrent protection. There may be others. |  |
| 8.1 | Include model flags for protection and trip diagnostics that clearly identify why a model trips during simulations. |  |
| 9 | Allow various dispatch levels and accurately reflect behavior throughout the valid MW output range from minimum power through maximum power. |  |
| 10 | Have pertinent control or hardware options accessible to the user. |  |
| 11 | Initialize as quickly as possible (<1-3 seconds) to user supplied terminal conditions. |  |
| 12 | Be capable of running at a minimum time step of 20 us, unless specific control parameters require smaller. 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. |  |
| 13 | Support multiple instances of the model in the same simulation. |  |
| 14 | Support the PSCAD “snapshot” feature. |  |
| 15 | Support the PSCAD “multiple run” feature. |  |
| 16 | Include documentation and a sample implementation test case. |  |