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WECC Modeling and Validation Work Group
Criteria for Acceptance of New Dynamic Models in WECC

March 4, 2009

I. DOCUMENTATION

Brief description on why a new model is required; such as existing models inadequately represent the dynamic behavior. Confidential and proprietary information are not acceptable.

The documentation of the model must include the following:

a) Description of the equipment that is modeled at a level that reveals the aspects of the equipment that are and are not described by the model.
b) Description on how the model reasonably represents the behavior of the equipment over the frequency range from DC to 3 Hz including voltage and frequency oscillations
c) Description of the model in mathematical and logical detail including, as appropriate, items such as Laplace transfer functions, block diagrams, description of physical and logical limits, control logic, interlock, supervisory and permissive actions.
d) The relationship of all parameters to the physical and logical characteristics of the equipment. The documentation of the model must be sufficient to permit the implementation of the model in all of the simulation programs used by WECC. This may require that part of the documentation of the model be in the form of 'code snippets', however it is not anticipated that complete code of a model should be included in its documentation.
e) Description of any behavior not represented by the model.

II. VALIDATION

The model must be validated by strong evidence that it effectively reproduces the behavior of the equipment being modeled. With regard to validation it is recognized that dynamic modeling falls into two clear categories:

a) Models of equipment that can be described explicitly and tested directly either in laboratory conditions or in specially managed operating conditions. Generators, generator controls, electrical protection elements, and most transmission system elements are in this category.
b) Models of aspects of the power system that cannot be described in explicit detail and cannot be tested directly. Most aspects of the modeling of load behavior are in this category.

Validation of models in the first category should include comparisons of simulations made with the model with test results or responses produced by other authoritative sources. (Authoritative sources may include, for example, results from manufacturer's detailed physical design simulations, results from factory acceptance tests, on-line recorder response of the equipment to system disturbances, or performance guarantee documents.)

Where possible validation of models in the second category should include comparisons of simulations made with the model to records of events that have occurred on the transmission system. Where comparison with actual grid behavior is not practical the characteristics of models in the second category should be demonstrated by simulations of small scale operational situations and disturbances chosen so that the proposed model is the predominant factor in the response. Validation must cover the behavior of the model in the broad range of operational situations that the equipment is expected to encounter. Validation must cover steady state behavior of the equipment over its full operational range. It should cover dynamic behavior in response to dynamic events such as:

a) Sudden step changes of voltage and frequency at pertinent point of interconnection with the grid
b) Undervoltage fast transients typical to fault clearing and delay fault clearing times
c) Step changes of control references and set-points
d) Ramps of voltage, frequency, references and set-points
e) Oscillatory behavior in the frequency range from 0.1 to 3 Hz

Changes of voltage and frequency considered in validation should cover the range of amplitude that will be produced by transmission disturbances from faults to persistent small oscillations.

III. INDEPENDENCE

For the purpose of model validation, the equipment model should be validated through comparison of simulated and expected behavior (whether based on tests or other means as discussed above) focusing on the behavior of the modeled equipment. Thus the intent is to emulate the test conditions (injected signals, etc.) and compare the simulated behavior of the developed model with the recorded field, factory or other test/results for validation. That is, full scale power system simulations with proposed models in the simulation set-up should not be used for model validation, since the purpose is to focus on dynamics of the equipment independent of its impact on the system study results.

IV. NUMERIC STABILITY

Evidence shall be provided that a model is numerically stable for simulations of faults with normal clearing in weak systems (Short Circuit Ratio less than 5).