Western Electricity Coordinating Council
Generating Unit Baseline Test Requirements

A great amount of technical information on methods of generator testing is provided in WSCC 1997 Generator Test Request Letter and Guidelines posted on WECC web-site [www.wecc.biz].

1. Synchronous Generators

The following tests shall be done:

a. Open Circuit Saturation: Measurement of the steady state variation of generator field current versus generator stator voltage from the minimum achievable generator stator voltage to at least 105 percent of the rated stator voltage with the generator circuit breaker open. For machines with brushless exciters the field current measurement shall be the field current of the exciter.

b. Inertia: A test that reasonably confirms the inertia constant of the turbine-generator.

For example, recording of the rotor speed following opening of the generator circuit breaker with the generator running at a moderate real power output.

c. Synchronous Machine Impedances and Time Constants: Tests that reasonably confirm the d-axis reactances (Xd, X'd, X"d) and time constants (T'do and T"do) of the synchronous generator.

For example, recording of terminal voltage and field current following opening of the generator circuit breaker with the generator running at near-zero real power and under-excited so as to absorb substantial reactive power with the excitation system in manual field voltage control.

2. Excitation Systems

Tests of the excitation system shall be such that they reasonably confirm the characteristics of the voltage regulator and the exciter from dc to 5 Hz. The test recordings shall include generator terminal voltage, field voltage or exciter field current for brushless excitation systems. These tests shall be done with the excitation system in automatic voltage control.

One or more of the following tests can meet the above requirement:

a. VAR Rejection Test: Recording of stator voltage, field voltage (exciter field current for brushless exciters) following opening of the generator circuit breaker with the generator running at near-zero real power and under-excited so as to absorb substantial reactive power.
b. Open Circuit Voltage Reference Step: Recording of stator voltage, field voltage (exciter field current for brushless exciters) following a clearly identifiable step change of voltage regulator reference with the generator circuit breaker open.
c. On-Line Voltage Reference Step: Recording of stator voltage, field voltage (exciter field current for brushless exciters) following a clearly identifiable step change of voltage regulator reference with the generator circuit breaker closed and the generator at normal real power output.
d. Open Circuit Frequency Response Test: Gain and phase angle measurement of stator voltage / voltage reference using a swept sign input from 0.05 Hz to 10 Hz.

3. Power System Stabilizer (PSS)

Tests of the PSS shall be such that they identify the PSS transfer function up to 10 Hz. Approaches for PSS testing are described in *WECC Power System Stabilizer Tuning Guidelines* and *WECC Power System Stabilizer Design and Performance Criteria.*

4. Over-Excitation Limiter (OEL)

Update OEL model data as necessary. Approaches for OEL testing are described in *Guidelines for Over-Excitation Limiter (OEL) and Over-Excitation Protection (OEP) Testing.*

5. Turbine Control

5.1 Hydro Unit

Tests of the governor and turbine shall be such that they reasonably confirm the characteristics from dc to 1 Hz.

The following test is acceptable:
On-Line Speed Reference Step: Recording of generator speed, generator speed reference, gate (valve) position, blade angle if applicable, and generator power following a clearly identifiable step change in speed reference with the generator circuit breaker closed and the generator at normal real power output.

The following measurements should also be made:

a. Measurement of turbine-governor steady-state droop.
b. Measurement of steady-state generator power versus gate position (and blade angle versus gate position for Kaplan turbines) at typical operating heads.

5.2 Steam Turbine Units and Gas Turbine Units

The turbine-governor model should be representative of the actual behavior of the unit the majority of the time. Provide recordings of generator power (resolution of 0.5% or better and 4 second sampling time or shorter) for events including frequency deviations. Sources of the data include, but not limited to, plant DCS, SCADA, digital event recorders. Simulated behavior should reasonably match the recorded data.

The methodology for thermal governor response validation is described in IEEE papers prepared by the members of WECC Governor Modeling Task Force:

1. Les Pereira, John Undrill, Dmitry Kosterev, Donald Davies and Shawn Patterson, “A New Thermal Governor Modeling in WECC,” *IEEE Transactions on Power Systems*, vol.18, no.2, pp.819-829, May 2003.

2. Les Pereira, Dmitry Kosterev, Donald Davies and Shawn Patterson, “New Thermal Governor Model Selection and Validation in the WECC,” *IEEE Transactions on Power Systems*, vol.19, no.1, pp.517-523, February 2004.