

**A. Introduction**

**1. Title: Power System Stabilizer Requirement**

**2. Number: MPRC-018-0**

**3. Purpose:**

To ensure that power system stabilizers are designed, installed and tuned as required to dampen power system oscillations in the Midwest Reliability Organization (MRO).

**4. Applicability**

**4.1.** Planning Authority

**4.2.** Transmission Planner

**4.3.** Generator Owner

**5. (Proposed) Effective Date: January 1, 2007**

**B. Requirements**

**R1.** The Generator Owner shall install power system stabilizers on all new<sup>1</sup> generator units 100 MVA or larger, prior to the generator's in-service date or as required by changes in system conditions, when all of the following conditions given in R1.1 through R1.3 exist:

**R1.1.** Small signal stability assessments periodically conducted by the Transmission Planner or Planning Authority, as applicable, as required in Reliability Standard MPRC-018-0\_R2, provide evidence of high generator relative participation (relative participation factors greater than 10%) in a range of local, inter-plant and inter-area modes (i.e. 0.1 to 2.0 Hz) that show instability or inadequate damping. The minimum damping ratio standard is defined in the MRO System Performance Table in Reliability Standard MTPL-001-0.

**R1.2.** System performance assessments performed by the Transmission Planner or Planning Authority, as applicable, for disturbances defined in Categories A, B, and C of Table 1 in Reliability Standard TPL-001-0, TPL-002-0, TPL-003-0 and MTPL-001-0 show instability or inadequate damping. The minimum damping ratio standard is defined in the MRO System Performance Table in Reliability Standard MTPL-001-0.

**R1.3.** The generator is equipped with a suitable exciter that is able to enhance the effectiveness of the PSS in providing positive damping to local, inter-plant and inter-area modes. The Transmission Planner or Planning Authority, as applicable, shall determine whether the Generator Owner's exciter is suitable for a PSS installation. The exciter assessment shall consider the measured or calculated closed-loop phase response of the generator, exciter and power system and the ability of the PSS to overcome the combined phase lag.

When conditions R1.1 and R1.2 do not exist but R1.3 does exist, the Generator Owner, at minimum, shall make provisions to allow for the future addition of a power system stabilizer on all generator units 100 MVA or larger, prior to the generator's in-service date. The automatic voltage regulator shall be designed capable of accepting a power

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<sup>1</sup> A new generator is a generator that has not received Planning Authority approval to interconnect to the Bulk Electric System prior to the effective date of this standard.

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system stabilizer input signal and the appropriate PSS input signal transducers shall be installed (e.g. speed, frequency, accelerating power).

- R2.** The Transmission Planner shall perform a small signal stability assessment. The Transmission Planner may delegate this responsibility to the Planning Authority. The assessments shall be conducted at least every five years unless it can be demonstrated that significant system changes have not occurred that would require a small signal stability assessment since the last assessment. In the event a study is not conducted after five years, system conditions shall be reviewed annually until a new small signal stability assessment is conducted. The initial system conditions for small signal stability assessments shall include:
- R2.1.** The effect of different system loading conditions (light load and peak load).
  - R2.2.** The effect of transmission contingencies (defined in Categories B and C of Table 1 in Reliability Standard TPL-002-0 and TPL-003-0) prior to the implementation of any post-contingency system adjustments that may be manually implemented by the System Operator.
  - R2.3.** The effect of increasing the power transfer to the TTC on stability constrained Flowgates.
- R3.** When a small signal stability assessment study, as prescribed in Reliability Standard MPRC-018-0\_R2, indicates instability or inadequate damping, the Transmission Planner or Planning Authority, as applicable, shall determine corrective plan(s) to achieve the required system performance, such as installing or retuning a power system stabilizer(s).
- R4.** The Transmission Planner or Planning Authority, as applicable, shall demonstrate through valid assessment that any power system stabilizer required in accordance with MPRC-018-0\_R1 has been designed and tuned to have a positive damping effect on local generator oscillations as well as inter-plant and inter-area oscillations without deteriorating turbine-generator shaft torsional oscillation damping. To be valid, the Planning Authority or Transmission Planner assessments shall:
- R4.1.** Be made prior to the in-service date of the generator and as required by changes in system conditions.
  - R4.2.** Demonstrate that machine rotor angle oscillations are within damping limits as defined in the MRO System Performance Table of MTPL-001-0 for the contingency conditions defined in Categories B and C of Table I of NERC TPL-002-0 and NERC TPL-003-0.
  - R4.3.** Include results from small signal stability model data verification tests as prescribed in Reliability Standard MPRC-018-0\_R6 and other dynamic model data verification tests prescribed by NERC and the MRO.
  - R4.4.** Include results from small signal stability assessments done in accordance with Reliability Standard MPRC-018-0\_R2 that are required in the design of the power system stabilizer.
- R5.** The Transmission Planner or Planning Authority, as applicable, shall, within thirty (30) calendar days of a request or completion of an assessment or plan, provide to the Midwest Reliability Organization and any impacted Transmission Planner(s), Planning Authority(ies), and Generator Owner(s) the results of its latest small signal stability and system performance assessments, power system stabilizer plans and corrective plans.

- R6.** Where a power system stabilizer is required on a generating unit(s) in accordance with MPRC-018-0\_R1, the Generator Owner shall perform small signal stability model and performance verification tests for excitation systems (including automatic voltage regulator controls and power system stabilizers) on the unit(s) that require the power system stabilizer in accordance with Midwest Reliability Organization requirements. The Generator Owner shall, within thirty (30) calendar days of a request, provide to the Midwest Reliability Organization and applicable Planning Authority(s) and Transmission Planner(s) the results of its most recent excitation system small signal stability model and performance verification tests for excitation systems (including automatic voltage regulator controls and power system stabilizers) in accordance with Midwest Reliability Organization requirements. The excitation system small signal stability model and performance verification tests shall include at minimum:
- R6.1.** Frequency-response test to verify the closed-loop automatic voltage regulator (AVR) transfer function without the PSS in-service. The generator is disconnected from the grid and operating at rated speed.
  - R6.2.** Frequency-response test of the power system stabilizer (PSS) to verify the PSS open-loop transfer function. The PSS output is disconnected from the AVR summing junction.
  - R6.3.** Step-response test with the generator synchronized to the grid to verify that the gains and time constants of excitation systems (including automatic voltage regulator controls and power system stabilizers) provide damping improvement to local mode frequencies. A 2% and/or 5% step-change in the terminal voltage of the AVR is performed with and without the PSS in-service.
  - R6.4.** Load-ramping test at the typical generating unit ramp rate to ensure that the PSS does not produce undesirable modulation of the generating unit's terminal voltage.
  - R6.5.** The tests shall be conducted during commissioning and repeated every five years thereafter or as specified by MRO testing requirements.
- R7.** Where a power system stabilizer is required on a generating unit(s) in accordance with MPRC-018-0\_R1, the Generator Owner shall keep the power system stabilizer operational except for the following reasons:
- R7.1.** Maintenance and testing
  - R7.2.** PSS does not operate properly due to a failed component
  - R7.3.** Generator unit is operating in synchronous condenser mode (near zero power level)
  - R7.4.** A hydro unit is passing through a range of output that causes undesirable terminal voltage variations "rough zone"
- The Generator Owner shall maintain a log that specifies the date, duration and reason for not keeping the power system stabilizer operational and shall, within thirty (30) calendar days of a request, provide the log to the Midwest Reliability Organization.
- R8.** The Transmission Planner shall determine whether existing generators greater than 100 MVA may be exempted from requiring a power system stabilizer. The Transmission Planner may delegate this responsibility to the Planning Authority. The Transmission Planner or Planning Authority, as applicable, shall document their exemption criteria and shall, within thirty (30) calendar days of a request, provide the documentation to the

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Midwest Reliability Organization. The exemption criteria shall at minimum consider the following:

- R8.1.** type of generating unit (peaking vs. base load, capacity factors)
- R8.2.** size of generating unit
- R8.3.** age of generating unit
- R8.4.** type of excitation system
- R8.5.** outage time required to install PSS
- R8.6.** location
- R8.7.** whether generating unit provides station service
- R8.8.** cost of retrofitting
- R8.9.** signed agreement that provides the ability for the Transmission Planner or Planning Authority, as applicable, to require the installation of a power system stabilizer.

### **C. Measures**

- M1.** The Generator Owner shall have evidence it has installed or made provisions to install a power system stabilizer as specified in Reliability Standard MPRC-018-0\_R1.
- M2.** The Transmission Planner or Planning Authority, as applicable, shall have a valid small signal stability assessment and corrective plan as specified in Reliability Standard MPRC-018-0\_R2 and MPRC-018-0\_R3.
- M3.** The Transmission Planner or Planning Authority, as applicable, shall have a valid power system stabilizer assessment as specified in Reliability Standard MPRC-018-0\_R4.
- M4.** The Transmission Planner or Planning Authority, as applicable, shall have evidence it reported documentation of results of its assessments and power system stabilizer and corrective plans per Reliability Standard MPRC-018-0\_R5.
- M5.** The Generator Owner shall have evidence it provided the Midwest Reliability Organization and applicable Planning Authority(ies) and Transmission Planner(s) with small signal stability model and performance verification test results for excitation systems (including automatic voltage regulator controls and power system stabilizers) per Reliability Standard MPRC-018\_R6.
- M6.** The Generator Owner shall maintain an operational log of the power system stabilizer and have evidence it reported the log per MPRC-018\_R7.
- M7.** The Transmission Planner or Planning Authority, as applicable, shall document their power system stabilizer exemption criteria and have evidence it reported the documentation per Reliability Standard MPRC-018\_R8.

### **D. Compliance**

#### **1. Compliance Monitoring Process**

##### **1.1. Compliance Monitoring Responsibility**

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##### **1.2. Compliance Monitoring Period and Reset Timeframe**

The Performance-Reset period shall be one calendar year from the last finding of non-compliance.

**1.3. Data Retention**

The Transmission Planner or Planning Authority, as applicable, shall retain assessments for five years.

The Generator Owner shall retain information from the most current and prior small signal stability model data verification tests.

In addition, entities found non-compliant shall keep information related to the non-compliance until found compliant.

The Compliance Monitor shall retain the last audit and all subsequent compliance records.

**1.4. Additional Compliance Information**

The Planning Authority, Transmission Planner and Generator Owner shall demonstrate compliance through the following methods, as determined by the compliance monitor: Self certification or Audit (periodic, as part of targeted monitoring or initiated by complaint or event).

**2. Levels of Non-Compliance**

**2.1. Level 1:** Transmission Planner or Planning Authority, as applicable, assessment(s) and/or corrective plan(s) was supplied to the MRO but was incomplete in one or more areas.

**2.2. Level 2:** Transmission Planner or Planning Authority, as applicable did perform a valid small signal stability assessment and corrective plan but did not provide to the MRO.

Transmission Planner or Planning Authority, as applicable, did perform a valid power system stabilizer assessment but did not provide to the MRO.

Generator Owner did not make provisions for the future addition of a power system stabilizer.

**2.3. Level 3:** Transmission Planner or Planning Authority, as applicable did not perform a valid small signal stability assessment and corrective plan. Transmission Planner or Planning Authority, as applicable, did not perform a valid power system stabilizer assessment to the MRO.

Generator Owner did not verify the small signal model data for the excitation systems (including automatic voltage regulator controls and power system stabilizers) and performance of the excitation systems.

Generator Owner did not maintain a power system stabilizer operational log.

**2.4. Level 4:** Generator Owner did not install a power system stabilizer or keep the power system stabilizer in-service under normal conditions in accordance with a corrective plan.

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**Version History**

Version	Date	Action	Change Tracking