

Definitions of Terms Used in Standard

This section includes all newly defined or revised terms used in the proposed standard. Terms already defined in the NERC Reliability Standards Glossary of Terms or the MRO Reliability Standards Glossary of Terms are not repeated here. New or revised definitions listed below become approved when the proposed standard is approved. When the standard becomes effective, these defined terms will be removed from the individual standard and added to the Midwest Reliability Organization (MRO) Glossary. NERC and MRO defined terms are capitalized in the standard.

A. Introduction

1. **Title:** Subsynchronous Resonance (SSR) Assessment
2. **Number:** TPL-504-MRO-02
3. **Purpose:** To ensure subsynchronous resonance with series compensated lines, torsional interaction with power system controls and generator shaft damage or excessive torsional fatigue due to network switching does not occur in the Midwest Reliability Organization (MRO).
4. **Applicability**
 - 4.1. Transmission Planner
 - 4.2. Generator Owner
 - 4.3. Transmission Owner
 - 4.4. Generator Operator
5. **Effective Date:** 1st day of the 1st quarter following all appropriate Regulatory Authority approvals, financial sanctions will become effective

B. Requirements

- R1.** Each Transmission Planner shall demonstrate through a valid subsynchronous resonance assessment that all new¹ system additions or new network switching practices that are added to its portion of the Bulk Electric System that have potential to excite sustained subsynchronous torsional oscillations are planned to avoid causing generating unit shaft damage. [*Violation Risk Factor: Medium*] [*Time Horizon: Long-Term Planning*]

To be valid, the assessment shall:

- R1.1** Be performed prior to the in-service date of the new system additions or network switching practices that are potential scenarios to excite torsional oscillations in the subsynchronous range. System additions or network switching practices include the following:
- R1.1.1** Transmission system equipment such as a series capacitor, HVdc rectifier terminal, or static var compensator (SVC) system that is connected to a transmission line 200kV or higher and that is electrically close to a turbine-generator.
 - R1.1.2** Large fluctuating load greater than 100MW such as an ac electric arc furnace, rolling mill, cyclo-converter, or industrial drive, that is electrically close to a turbine-generator.
 - R1.1.3** Network switching practice such as high-speed auto-reclosing (e.g. reclosing after a delay of less than two seconds) and single-

¹ A new system addition is a system addition that receives Planning Coordinator agreement to interconnect to the Bulk Electric System after the effective date of this standard

pole switching on a transmission line 200kV or higher and that is electrically close to a turbine-generator.

- R1.2** Consist of initial studies, such as frequency scanning, that determine whether there is evidence of a potential subsynchronous resonance (SSR) condition. Estimated or typical turbine-generator data may be used.
- R1.3** Consist of detailed studies, such as frequency scanning, eigenvalue analysis or electromagnetic transient simulation, if results from R1.2 indicate evidence of the potential for a SSR condition. Data available from the generator manufacturer and/or from field tests as per R5 shall be used to confirm the condition.
- R1.4** Consider the effect of contingency conditions under all categories other than extreme events in the currently approved NERC TPL standard(s).
- R1.5** Include a rationale for how the size of the study area was determined for initial studies in R1.2 and detailed studies in R1.3. The study area determines which turbine-generators are electrically close to the new system additions or new network switching practices.
- R2.** Each Transmission Planner shall determine a corrective plan(s) to mitigate the SSR condition when an assessment, performed as prescribed in Requirement R1, confirms sustained subsynchronous torsional oscillations will result and cause generating unit shaft damage or the Generator Operator reports a SSR event to the MRO per Requirement R3 of EOP-004-1. [*Violation Risk Factor: Medium*] [*Time Horizon: Operations Planning*]
- R3.** Each Transmission Planner shall, within thirty (30) calendar days of completion of any corrective plan(s) required by Requirement R2, provide the results of the corrective plan(s) to the MRO, adjacent Transmission Planners, and Transmission Owners(s) or Generator Owner(s) identified in the corrective plan. Each Transmission Planner shall, within thirty (30) calendar days of completion of any assessments required by Requirement R1 that confirm the potential for a SSR condition or upon request by the MRO, provide the results of the assessments to the MRO, adjacent Transmission Planners and Transmission Owners(s) or Generator Owner(s) identified in the assessment. [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*].
- R4.** Each Transmission Owner, Generator Owner and Generator Operator that owns or operates a SSR countermeasure shall provide information to its Transmission Operator on a change in operational status of the SSR countermeasure within thirty (30) minutes. [*Violation Risk Factor: Medium*] [*Time Horizon: Same Day Operations*].
- R5.** Each Generator Owner shall perform field testing to verify the natural torsional mode frequencies when a SSR countermeasure is determined necessary in Requirement R2. Field testing may be used to verify natural torsional mode mechanical damping as a function of generator loading when a SSR countermeasure is determined necessary in Requirement R2. [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*].

- R6.** Each Generator Owner shall provide to the Transmission Planner, generator manufacturer data, if available, and/or results from field tests when results from Requirement R1 indicate evidence of the potential for a SSR condition.

The minimum data to be provided by the Generator Owner shall include:

- R6.1** Resistance and reactance as a function of frequency for the generator as viewed from the generator terminals. Armature and rotor circuits shall be included.
- R6.2** The inertia constant for each turbine element, generator and exciter.
- R6.3** The spring constants for each shaft connecting turbine elements, generator and exciter.
- R6.4** Estimated turbine-generator natural torsional mode mechanical damping for all subsynchronous modes as a function of generator loading, ranging from no load to full load.
- R6.5** Fatigue life expenditure data for each shaft connecting the turbine elements, generator and exciter. Assumptions made in the preparation of this data shall also be provided.

C. Measures

- M1.** The Transmission Planner shall have documented evidence of a valid SSR assessment that has been conducted as specified in R1.
- M2.** The Transmission Planner shall have documented evidence that it has determined a corrective plan(s) to mitigate an identified or observed, SSR condition as specified in R2.
- M3.** The Transmission Planner shall have evidence it reported documentation of results of its SSR assessment(s) and corrective plan(s) to the MRO and adjacent Transmission Planners, and Transmission Owners(s) or Generator Owner(s) as specified in R3.
- M4.** The Transmission Owner, Generator Owner and Generator Operator, as applicable shall have evidence it reported changes in operational status of SSR countermeasures to its Transmission Operator as specified in R4.
- M5.** The Generator Owner shall have evidence it reported to the Transmission Planner the generator manufacturer data and results from field tests as specified in R5 and R6.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Monitoring Responsibility.

ERO delegated to Midwest Reliability Organization.

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 shall retain assessments from last finding of full compliance until the next assessment is completed.

The Generator Owner shall retain detailed manufacturer turbine-generator data for the life of the plant.

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

The Compliance Monitor shall retain any audit data for three years.

1.4. Additional Compliance Information.

The Transmission Planner, Transmission Owner, Generator Owner and Generator Operator shall demonstrate compliance through the following methods, as determined by the compliance monitor: (1) Self certification or (2) Audits (periodic, as part of targeted monitoring or initiated by complaint or event).

Violation Severity Levels

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	Not applicable	Transmission Planner performed a SSR assessment that was incomplete prior to in-service date.	Transmission Planner performed a SSR assessment after in-service date.	Transmission Planner did not perform a SSR assessment per R1
R2	Not applicable	Not applicable	Transmission Planner did not determine a corrective plan(s) where a SSR assessment indicated a need for a corrective plan.	Transmission Planner did not determine a corrective plan(s) where a SSR event was reported.
R3	Not applicable	Documentation was provided to one or more of these entities identified in the corrective plan after 30 calendar days: MRO, adjacent Transmission Planners and Transmission Owners(s) or Generator Owner(s)	Documentation was not provided to one or more of these entities identified in the corrective plan: MRO, adjacent Transmission Planners and Transmission Owners(s) or Generator Owner(s)	Documentation was not provided to the MRO, adjacent Transmission Planners and Transmission Owners(s) or Generator Owner(s) identified in the corrective plan per R3.
R4	Transmission Owner, Generator Owner or Generator Operator, did not report operational status changes of SSR countermeasures within sixty (60) minutes to the Transmission Operator	Transmission Owner, Generator Owner or Generator Operator, did not report operational status changes of SSR countermeasures within six (6) hours to the Transmission Operator	Transmission Owner, Generator Owner or Generator Operator, did not report operational status changes of SSR countermeasures within twelve (12) hours to the Transmission Operator	Transmission Owner, Generator Owner or Generator Operator, reported operational status changes of SSR countermeasures to the Transmission Operator next day

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R5	Not applicable	Not applicable	Not applicable	Generator Owner did not perform field tests per R5
R6	Not applicable	Generator Owner did not provide data for R6.4 and/or R6.5 to the Transmission Planner per R6	Generator Owner did not provide the data for R6.1 and/or R6.2 and/or R6.3 Transmission Planner per R6	Generator Owner did not provide any data to the Transmission Planner per R6

Version History

Version	Date	Action	Change Tracking