

Rationale for Revising the Definition of System Operating Limit (SOL)

Project 2015-03 Periodic Review of SOL Standards

The NERC defined term System Operating Limit (SOL) is used extensively in the NERC Reliability Standards; however, there is much confusion with – and many widely varied interpretations and applications of – the SOL term. Accordingly, the Periodic Review Team (PRT) for project 2015-03 is recommending a FAC standards project include development of revised and new definitions. These definitions would benefit reliability by promoting consistency among functional entities responsible for the reliable operation of the Bulk Electric System (BES).

Background in Project 2014-03 Revisions to TOP and IRO Standards

During the development of the new TOP/IRO standards under Project 2014-03, the Standard Drafting Team (SDT) issued a white paper¹ describing the SDT's conceptual understanding of establishing SOLs, exceeding SOLs, and implementing Operating Plans to mitigate SOL exceedances. While this white paper, entitled *System Operating Limit Definition and Exceedance Clarification*, was vetted through the NERC stakeholder process, the PRT believes that reliability would be further enhanced by modifying the actual SOL definition in the NERC Glossary of Terms to better fit the SOL White Paper itself.

NERC Glossary of Terms Definitions

The NERC Glossary of Terms defines System Operating Limit (SOL) as the following:

System Operating Limit (SOL) – The value (such as MW, MVar, Amperes, Frequency or Volts) that satisfies the most limiting of the prescribed operating criteria for a specified system configuration to ensure operation within acceptable reliability criteria. System Operating Limits are based upon certain operating criteria. These include, but are not limited to:

- *Facility Ratings (Applicable pre- and post-Contingency equipment or facility ratings)*
- *Transient Stability Ratings (Applicable pre- and post-Contingency Stability Limits)*
- *Voltage Stability Ratings (Applicable pre- and post-Contingency Voltage Stability)*
- *System Voltage Limits (Applicable pre- and post-Contingency Voltage Limits)*

The PRT proposes a revised definition of SOL and a new definition for SOL Exceedance:

System Operating Limit (proposed) – Any applicable limit among the following types of reliability limits:

- *Facility Ratings*

¹ See *System Operating Limit Definition and Exceedance Clarification* White Paper
http://www.nerc.com/pa/Stand/Prjct201403RvsnstoTOPandIROStndrds/2014_03_fifth_posting_white_paper_sol_exceedance_20150108_clean.pdf

- *Voltage Limits*
- *Transient Stability Limits*
- *Voltage Stability Limits*

System Operating Limit Exceedance or SOL Exceedance (Proposed):

When any of the following occur or are observed as part of Real-time monitoring or a Real-time Assessment:

- *Actual flow on a Facility is above the Facility Rating for an unacceptable time duration*
- *Calculated Post-Contingency flow on a Facility is above the highest available Facility Rating*
- *Actual bus voltage is outside acceptable pre-Contingency (normal) bus voltage limits*
- *Calculated Post-Contingency bus voltage is outside acceptable post-Contingency (emergency) bus voltage limits*
- *The pre or post-Contingency System exhibits either transient or voltage instability (techniques for determining and observing Stability Limits can vary)*

Rationale for Proposed Glossary Changes

The current definition of SOL contains five key concepts as described below. The first four of these five concepts are addressed by other mechanisms in the new TOP and IRO standards, in other revised NERC definitions, and in the proposed revisions of the FAC standards. The remaining fifth concept captures the essence of the proposed revision of the SOL definition. The newly proposed definition of SOL Exceedance works hand-in-hand with the proposed revision to the definition of SOL. Together, these two definitions clearly portray what an SOL is and what it means to exceed one.

1. "Most Limiting Criteria"

There is no longer a need for the definition to contain this concept. The new proposed definition of SOL Exceedance clarifies exceedance for any of the four types of limitations – not just the most limiting. This concept of SOL Exceedance is described in the NERC SOL White Paper and formed the basis for the development of the new TOP and IRO standards under Project 2014-03.

2. "Specified System Configuration"

The PRT believes that a “specified system configuration” is inherent to the definition of some SOLs, and yet may not be applicable to others. Including it in the definition could create confusion to the industry. Many SOLs are not dependent upon system configuration, such as the majority of Facility Ratings and voltage limits, while other SOLs such as transient and voltage Stability Limits are dependent on system configuration. For this reason, the PRT recommends a definition that does not include “specified system configuration” or similar language.

3. "Pre- and Post-Contingency" for Each Type of Limit

The NERC SOL White Paper describes that the intent of the SOL concept is to both:

1. *Know the Facility Ratings, voltage limits, transient Stability Limits, and voltage Stability Limits, and*

2. *Ensure that they are all observed in both the pre- and post-Contingency state by performing a Real-time Assessment.*

Project 2014-03 revised the definition of Operational Planning Analysis (OPA) and Real-time Assessment (RTA) to include pre- and post-Contingency analysis.

Real-time Assessment – An evaluation of system conditions using Real-time data to assess existing (pre-Contingency) and potential (post-Contingency) operating conditions...

Operational Planning Analysis – An evaluation of projected system conditions to assess anticipated (pre-Contingency) and potential (post-Contingency) conditions for next-day operations...

Because of the stated intent above and the revised definitions, there is no need to duplicate “pre- and post-Contingency” in the definition of SOL. Additionally, the pre- and post-Contingency concept can also be inherent in the definition of some SOLs. For example, voltage Stability Limits and transient Stability Limits are typically defined to prevent instability for specified Contingency events. This concept may not directly apply to the determination of Facility Ratings and voltage limits. Furthermore, the pre- and post-Contingency concepts are addressed in the proposed definition of SOL Exceedance. Leaving the pre- and post-Contingency language in the definition of SOL could lead to further confusion within the industry.

4. "Operation within Acceptable Reliability Criteria"

The PRT recommends that revisions to FAC-011 are necessary and has provided the following recommendation in the Periodic Review Recommendation (PRR) for FAC-011:

The PRT believes a standards project should consider writing system performance requirements directly into the continent-wide Reliability Standards instead of requiring the RC's methodology to specify acceptable system performance as done in FAC-011-3. To improve consistency, the PRT recommends that Requirement R2 and subparts be revised to define acceptable system performance requirements for the operating horizon similar to the way TPL-001-4 Table 1 defines acceptable performance requirements for the planning horizon

5. List of Types of Reliability Limits

The list of the four primary types of reliability limitations (Facility Ratings, voltage limits, transient Stability Limits, and voltage Stability Limits) and their applicability is reflected in the revised definition of SOL.

Summary

The PRT believes that the industry needs a clear understanding of what SOLs are and what it means to exceed them. Accordingly, the PRT recommends that a FAC standards project develop revisions to the SOL definition and develop a new defined term for SOL Exceedance. The proposed change in the definition of SOL discussed in this white paper would improve clarity and eliminate industry confusion with regards to SOLs. The fundamentals of the new proposed SOL definition are consistent with new TOP and IRO standards, the new OPA and RTA definitions, and the NERC SOL White Paper.