

# **NERC SPCTF Assessment of Standard PRC-001-0 – System Protection Coordination**

---

**December 7, 2006**

A Technical Review of Standards

Prepared by the  
System Protection and Controls Task Force  
of the  
NERC Planning Committee

# TABLE OF CONTENTS

<b>Introduction .....</b>	<b>2</b>
<b>Executive Summary.....</b>	<b>2</b>
<b>Assessment of PRC-001-0.....</b>	<b>2</b>
<i>General Comments</i> .....	2
<i>Applicability</i> .....	3
<i>R1</i> .....	3
<i>R2</i> .....	3
<i>R3</i> .....	4
<i>R4</i> .....	4
<i>R5</i> .....	5
<i>R6</i> .....	5
<b>Related Standard MOD-011-0 — Regional Steady-State Data Requirements and Reporting Procedures.....</b>	<b>5</b>
<b>FERC Assessment of PRC-001-0.....</b>	<b>6</b>
<b>Other Activities related to PRC-001-0.....</b>	<b>6</b>
<b>Conclusion and Recommendation.....</b>	<b>7</b>
<b>Appendices .....</b>	<b>8</b>
<b>Appendix B — SYSTEM PROTECTION AND CONTROL TASK FORCE.....</b>	<b>9</b>

---

This report was approved by the Planning Committee on December 7, 2006, for forwarding to the Standards Committee.

## **INTRODUCTION**

When the original scope for the System Protection and Control Task Force was developed, one of the assigned items was to review all of the existing PRC-series Reliability Standards, to advise the Planning Committee of our assessment, and to develop Standards Authorization Requests, as appropriate, to address any perceived deficiencies.

This report presents the SPCTF's assessment of PRC-001-0 – System Protection Coordination. The report includes the SPCTF's understanding of the intent of this standard and contains specific observations relative to the existing standard.

This standard was developed by translating the requirements of an earlier Phase I Planning Standard; thus it has not been previously subjected to a critical review of the Requirements.

---

## **EXECUTIVE SUMMARY**

This reliability standard is intended to assure that system protection is coordinated between multiple transmission entities and between generation entities and transmission entities. It appears that this standard is intended to address coordination of protection functions and capabilities in both the operating time frame and the planning time frame. These time frames, as they apply to protective functions, are discussed, as are the various responsibilities to assure the related coordination.

The SPCTF concludes that the list of applicable entities in the existing standard is incomplete and that the assigned responsibilities do not reflect the activities of the identified functions. Significantly, the existing standard disregards the significant responsibilities and roles of the equipment owners; specifically, the Transmission Owners and Generator Owners.

The SPCTF also concludes that the Requirements of the existing standard are vague and ambiguous, and that, while Measures and Levels of Non-Compliance are defined, these are essentially unenforceable because of fundamental flaws within the requirements.

---

## **ASSESSMENT OF PRC-001-0**

### **General Comments**

The SPCTF offers the following general comments:

1. None of the requirements within PRC-001-0 specifically indicate what protective systems are being addressed.
2. The phrase “protective relay or equipment” is a recurring phrase, and generally should be revised to “protective system” or “protective system equipment.”
3. The phrase “If a protective relay or equipment failure reduces system reliability” is ambiguous, and needs additional clarification. This phrase does not clearly state when failures must be reported.
4. Many of the requirements list the Balancing Authority as an applicable entity. It does not seem that the Balancing Authority has the direct responsibility for any of these activities, and only needs to respond to the various issues when directed by the Transmission Operator and/or Generator Operator.

## Applicability

- 4.1. Balancing Authorities
- 4.2. Transmission Operators
- 4.3. Generator Operators

The remainder of the PRC-series standards rarely assigns any responsibility for protection systems to any of the above entities. Specifically, the responsibilities for disturbance monitoring (which includes some monitoring of protective systems) and for protective system maintenance apply to the equipment owners, specifically Transmission Owners and Generator Owners. The current applicable entities do, however, have a role in the functions of this standard. The SPCTF asserts that Transmission Owner, Generator Owner, and Distribution Provider should be added to the list of Applicable Entities.

## R1

**R1.** Each Transmission Operator, Balancing Authority, and Generator Operator shall be familiar with the purpose and limitations of protective system schemes applied in its area.

This requirement is a statement of a highly laudable goal, but this is not specific and enforceable. In fact, the drafting team that was providing missing Measures and Compliance Elements was unable to assign either to this requirement.

It may be possible to restate this requirement in such a way to be measurable and enforceable. The protective system equipment owners (Transmission Owners, Generator Owners, and Distribution Providers) should be responsible to provide the necessary information to the Transmission Operator and Generator Operator to facilitate their familiarity with the relevant protective systems.

## R2

**R2.** Each Generator Operator and Transmission Operator shall notify reliability entities of relay or equipment failures as follows:

**R2.1.** If a protective relay or equipment failure reduces system reliability, the Generator Operator shall notify its Transmission Operator and Host Balancing Authority. The Generator Operator shall take corrective action as soon as possible.

**R2.2.** If a protective relay or equipment failure reduces system reliability, the Transmission Operator shall notify its Reliability Coordinator and affected Transmission Operators and Balancing Authorities. The Transmission Operator shall take corrective action as soon as possible.

Requirement R2 addresses the operating horizon, but the equipment owner entities will be familiar with the condition of their protective system equipment.

Therefore, the responsibility for this requirement must originate with the owner entities: the Transmission Owner, Generator Owner, and Distribution Provider. These entities should inform the Transmission Operator, Generator Operator, and Balancing Authorities of equipment failures pertinent to this requirement. The Transmission Operators may need to have to coordinate with each other, similar to the existing requirement R4.

The requirement for corrective action, “as soon as possible”, is vague and ambiguous, and needs modification to be specific.

As evidenced by the lack of a related Measure (via the drafting team for missing Measures and Compliance Elements), this requirement is currently not measurable.

### **R3**

**R3.** A Generator Operator or Transmission Operator shall coordinate new protective systems and changes as follows.

**R3.1.** Each Generator Operator shall coordinate all new protective systems and all protective system changes with its Transmission Operator and Host Balancing Authority.

**R3.2.** Each Transmission Operator shall coordinate all new protective systems and all protective system changes with neighboring Transmission Operators and Balancing Authorities.

Not only new protective systems and changes to protective systems should be coordinated. A requirement should be added to require coordination of all existing protective systems. Then, requirement R3 should require the coordination of new protective systems and changes to protective systems with existing protective systems.

Requirement R3 addresses the planning horizon; therefore, this responsibility should be assigned to the Transmission Owner, Generator Owner, and Distribution Provider.

In addition, R3.1 should be bi-directional; the Transmission entity should provide similar coordination with the Generator entity.

### **R4**

**R4.** Each Transmission Operator shall coordinate protection systems on major transmission lines and interconnections with neighboring Generator Operators, Transmission Operators, and Balancing Authorities.

It’s unclear whether this requirement addresses the operations planning horizon or the planning horizon.

If Requirement R4 addresses the planning horizon, the responsibilities should be assigned similarly to the recommendations for R3, to the Transmission Owner, Generator Owner, and Distribution Provider. If Requirement R4 addresses the operations planning horizon, it seems to be redundant with R3 to some extent.

## R5

- R5.** A Generator Operator or Transmission Operator shall coordinate changes in generation, transmission, load or operating conditions that could require changes in the protection systems of others:
- R5.1.** Each Generator Operator shall notify its Transmission Operator in advance of changes in generation or operating conditions that could require changes in the Transmission Operator’s protection systems.
  - R5.2.** Each Transmission Operator shall notify neighboring Transmission Operators in advance of changes in generation, transmission, load, or operating conditions that could require changes in the other Transmission Operators’ protection systems.

Requirement R5 addresses both the planning horizon and operating planning horizon. It is essential to the reliability of the system that this activity occurs, and it must occur in advance of any changes to the system.

In the operations planning horizon, the Operator entities should coordinate these changes with the Owner entities, since the Owners have the tools to analyze the effects of these system changes on the protective systems and the access to the protective systems to make any needed changes to the protective system.

In the planning horizon, the owner entities should be responsible for this requirement, similarly to Requirement R3.

## R6

- R6.** Each Transmission Operator and Balancing Authority shall monitor the status of each Special Protection System in their area, and shall notify affected Transmission Operators and Balancing Authorities of each change in status.

Requirement R6 addresses the operating horizon. The Owners have to monitor the status of Special Protection Systems and provide the status to the Operators. The Operators then should coordinate the availability of Special Protection Systems between each other, and take any necessary operating actions to address issues with Special Protection Systems.

This requirement needs to better define “status of ... Special Protection System...”

This requirement may be better moved to one of the PRC-series standards specifically addressing Special Protection Systems.

---

## RELATED STANDARD

### MOD-011-0 — REGIONAL STEADY-STATE DATA REQUIREMENTS AND REPORTING PROCEDURES

Also, while reviewing PRC-001, the SPCTF noted that no existing NERC Standard requires that a consistent model be maintained for protection studies, such as that required by MOD-011-0 — Regional Steady-State Data Requirements and Reporting Procedures, for other steady-state studies. Without such a

model, various Transmission Owners, Generator Owners, and Distribution Providers cannot accurately apply the protective relaying. To address this deficiency, the SPCTF recommends that MOD-011, Maintenance and Distribution of Steady-State Data Requirements and Reporting Procedures, be modified to include the essential data for wide-area fault studies. The specific MOD-011 requirements are listed below, together with suggested modifications.

### **R1.2 – Generators**

Recommend including direct-axis synchronous reactance ( $X_d$ ), transient reactance ( $X_d'$ ), sub transient reactance ( $X_d''$ ), and the associated time constants ( $T_{do}$ ,  $T_{do}'$ , and  $T_{do}''$ ) for synchronous generators. For induction and inverter generators, generically include the data necessary to model the equipment in short circuit models in the positive, negative, and zero sequence domains.

### **R1.3 – Transmission Lines**

Recommend specifying the positive and zero sequence impedance, including mutual impedances

### **R1.5 – Transformers**

Recommend specifying positive sequence and zero sequence impedance, including all grounding effects.

---

## FERC ASSESSMENT OF PRC-001-0

On October 20, 2006, the Notice of Proposed Rulemaking for adoption of NERC Standards (Docket Number RM06-16-000), the Federal Energy Regulatory Commission, for the most part, considered the operating horizon impacts of PRC-001. FERC proposed that PRC-001-0 be approved as mandatory and enforceable. They did, however, propose that NERC be directed to make modifications to PRC-001. The modifications proposed in the NOPR are excerpted from the NOPR and repeated below:

“The Commission proposes to direct that NERC submit a modification to PRC-001-0 that: (1) includes Measures and Levels of Non-Compliance; (2) includes a requirement that relevant transmission operators and generator operators must be informed immediately upon the detection of failures in relays or protection system elements on the Bulk-Power System that would threaten reliable operation, so that these entities can carry out the appropriate corrective control actions consistent with those used in mitigating IROL violations; and (3) clarifies that, after being informed of failures in relays or protection system elements on the Bulk-Power System, transmission operators or generator operators shall carry out corrective control actions, i.e., returning the system to a stable state that respects system requirements as soon as possible and no longer than 30 minutes.”

---

## OTHER ACTIVITIES RELATED TO PRC-001-0

The Standard Drafting Team on Missing Measures and Compliance Elements modified PRC-001-0 as a part of their work, but the requirements were not changed. As this report is being prepared, the modified Standard is being balloted.

A draft SAR for the revision of PRC-001-0 is included in the “Draft Reliability Standards Development Plan: 2007–2009”, which was presented to the NERC Board of Trustees for their approval on November 1, 2006. This draft SAR is entitled, “System Protection Project (2009-01)”, and discusses many of the same deficiencies in PRC-001-1 that were identified by the SPCTF.

## CONCLUSION AND RECOMMENDATION

As it exists today, enforcement of PRC-001-0 will be very difficult. The applicable entities in the existing Standard are incorrect for many of the requirements, and the requirements themselves are vague and not measurable. In addressing the “operating horizon,” “operations planning horizon,” and “planning horizon” protection coordination issues, the deficiencies in the current standard are magnified.

The SPCTF recommends that the existing draft Standards Authorization Request that is included in the “Draft Reliability Standards Development Plan: 2007–2009” be modified to include the observations from the SPCTF assessment of PRC-001-0 and also include the modifications directed in the FERC NOPR on RM06-16-000. The SPCTF also recommends that the requirements for the operating horizon and planning horizon be clearly delineated and warrants consideration of dividing this standard into two standards.

In addition, it is not possible to effectively coordinate protective systems without having accurate short circuit models of neighboring systems. To address these modeling issues related to data for short circuit calculations, the SPCTF recommends that a Standards Authorization Request be developed to modify Standard MOD-013-1 — RRO Dynamics Data Requirements and Reporting Procedures, to address these issues. Data for short circuit calculations, as noted in this report, should be considered as additional requirements within MOD-013-1.



# APPENDICES

## APPENDIX B — SYSTEM PROTECTION AND CONTROL TASK FORCE

**Charles W. Rogers**

*Chairman / RFC-ECAR Representative*  
Principal Engineer  
Consumers Energy Co.

**W. Mark Carpenter**

*Vice Chairman / ERCOT Representative*  
System Protection Manager  
TXU Electric Delivery

**John Mulhausen**

*FRCC Representative*  
Manager, Design and Standards  
Florida Power & Light Co.

**Joseph M. Burdis**

*ISO/RTO Representative*  
Senior Consultant / Engineer, Transmission  
and Interconnection Planning  
PJM Interconnection, L.L.C.

**William J. Miller**

*RFC-MAIN Representative*  
Consulting Engineer  
Exelon Corporation

**Deven Bhan**

*MRO Representative*  
Electrical Engineer, System Protection  
Western Area Power Administration

**Philip Tatro**

*NPCC Representative*  
Consulting Engineer  
National Grid USA

**Philip B. Winston**

*SERC Representative*  
Manager, Protection and Control  
Georgia Power Company

**Fred Ipock**

*SPP Representative*  
Senior Engineer - Substations & Protection  
City Utilities of Springfield, Missouri

**David Angell**

*WECC Representative*  
T&D Planning Engineering Leader  
Idaho Power Company

**John L. Ciuffo**

*Canada Member-at-Large*  
Manager Reliability Standards (P&C/Telecom)  
Hydro One, Inc.

**Jim Ingleson**

*ISO/RTO Representative*  
Senior Electric System Planning Engineer  
New York Independent System Operator

**Evan T. Sage**

*Investor Owned Utility*  
Senior Engineer  
Potomac Electric Power Company

**James D. Roberts**

*Federal*  
Transmission Planning  
Tennessee Valley Authority

**Tom Wiedman**

*NERC Consultant*  
Wiedman Power System Consulting Ltd.

**Henry (Hank) Miller**

*RFC-ECAR Alternate*  
Principal Electrical Engineer  
American Electric Power

**Baj Agrawal**

*WECC Alternate*  
Principal Engineer  
Arizona Public Service Company

**Michael J. McDonald**

Senior Principal Engineer, System Protection  
Ameren Services Company

**Jonathan Sykes**

Senior Principal Engineer, System Protection  
Salt River Project

**W. O. (Bill) Kennedy**

*Canada Member-at-Large*  
Principal  
b7kennedy & Associates Inc.

**Bob Stuart**

*NERC Blackout Investigation Team*

Director of Business Development, Principal

T&D Consultant

Elequant, Inc.