

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Electric Reliability Organization (ERO) Compliance Analysis Report

Reliability Standard PER-002 — Operating
Personnel Training

September 2010

to ensure
the reliability of the
bulk power system

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Table of Contents

ERO Compliance Analysis Reports.....	3
Summary of Practical Information and Suggestions	4
Analysis of PER-002 Violations.....	5
Background.....	5
Analysis	6
Noncompliance Analysis	10
Regional Entity Analysis	11
Key Reasons for Noncompliance	11
Common Violation Descriptions for Frequently Violated Requirements	11
Conclusion	16
Contact Information.....	16

ERO Compliance Analysis Reports

The ERO is comprised of NERC and Regional Entities. Their compliance staffs are collaborating on analysis of the Top 10 Violated Standards. This is the sixth report wherein NERC and the Regional Entity compliance staffs have publicly provided information and guidance on the most violated standards in order to facilitate compliance. This document further serves as a formal mechanism to provide feedback to the standards developers.

The next compliance analysis report for the ERO is expected to be submitted in the fourth quarter of 2010 to the NERC Board of Trustees Compliance Committee, and will cover a dual analysis involving CIP-006 and CIP-007.

Summary of Practical Information and Suggestions

This summary is intended to capture the analysis detailed below, by providing some essential elements of the requirements, and by offering some suggestions for consideration. It is not a complete list of all possible elements or actions. Evaluation or undertaking such actions or suggestions does not guarantee compliance and does not replace the NERC Reliability Standards language.

After thorough review of violation descriptions and potential impact statements submitted to NERC via the Regional Entities, the following recommendations can be made:

1. Entities need to effectively identify objectives based on standards, procedures, and applicable regulatory requirements.
2. Entities should clearly and accurately present the core knowledge and skills required for reliable operations in their training plans.
3. Proper documentation needs to be employed by entities. Organization of records prior to an audit should be stressed for inclusion in the execution of the program.
4. With regard to training programs, it should be clarified that the essential goal of training programs is not simply providing system operators with a set of skills or competencies, but training them how to conduct their daily work; to gain critical experience and then exercise judgment appropriately.

Analysis of PER-002 Violations

Background

Since the beginning of the mandatory and enforceable standards on June 18, 2007, PER-002 has been ranked as one of the top ten most violated reliability standards committed by Registered Entities. This standard plays an important educational role as it instructs Transmission Operators and Balancing Authorities to provide their personnel with a coordinated training program to ensure reliable system operation. Given the nature of these violations, NERC has performed an initial analysis of active and closed violations of this reliability standard to define prevailing trends. As of July 31, 2010, there are 91 violations of PER-002 that are closed or active, with another 22 dismissed at the Regional Entity level. This reliability standard is in revision level 0 (FERC-approved) and has four top-level requirements and six sub-level requirements.

NERC focuses on developing the following metrics for PER-002:

1. The requirement numbers and sub-requirement numbers give a high-level view of the violations and their severity.
2. Violations by region show how the violations are distributed throughout the ERO regions.
3. The dispersion of violations across North America by region is an interesting fact, but relating it to the proportion of Registered Entities whose functions directly relate to the applicable standard is a more intriguing statistic.
4. The violations separated by functional registration of the Registered Entity.
5. The method of discovery provides insight as to how the violations are found or reported.
6. The date of violation will aid in seeing if there are particular months, quarters, or years of interest to see if there are noticeable trends.
7. Key reasons for noncompliance cited by the Regional Entities, classified by a bucket structure that includes trained personnel deficiencies, program deficiencies, and emergency training deficiencies.

Top-level requirements 1, 2, 3, and 4 have Violation Risk Factors of “High”, while sub-level requirements have Violation Risk Factors that range from “Lower” to “High”.

Analysis

The first way to view the 91 violations is by requirement number and sub-requirement number. By simple inspection, the 11 violations of requirement 2 and zero violations to the sub-requirements of this requirement show that both of the sub-requirements were violated. The opposite is evident with regard to the 31 violations to requirement 3, and only 11 violations to the sub-requirement.

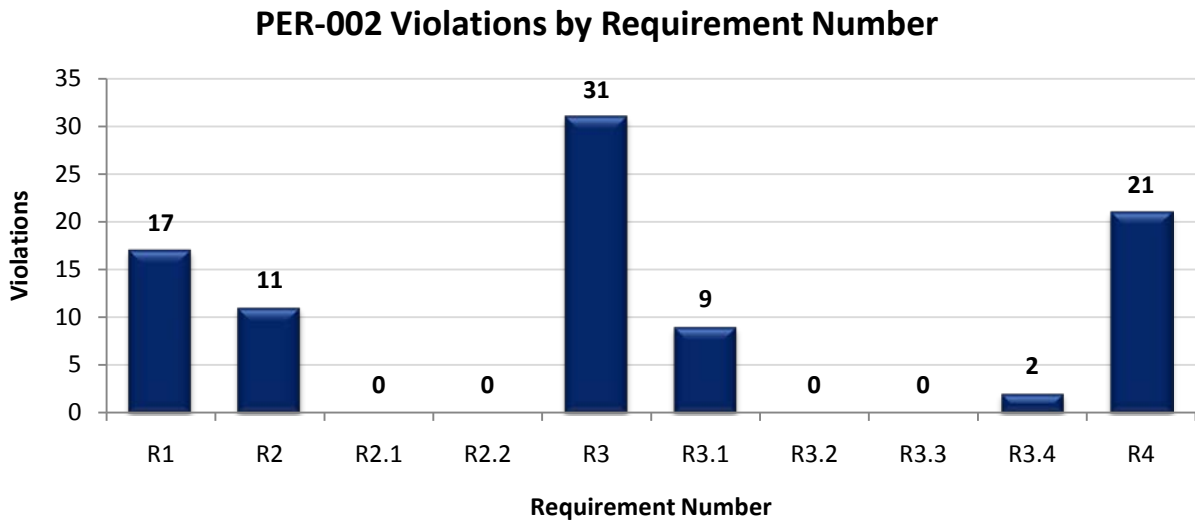
Table 1 below shows the distribution of the 91 violations of the PER-002 reliability standard.

Table 1

PER-002 Requirements	Violations	Percentage
R1 – Each TOP and BA shall be staffed with adequately trained operating personnel	17	18.7%
R2 – Each TOP and BA shall have a training program for all operating personnel in:	11	12.1%
R2.1 – Positions that have the primary responsibility for the real-time operation of the bulk power system	0	0.0%
R2.2 – Positions directly responsible for complying with NERC standards	0	0.0%
R3 – For personnel identified in R2, the TOP and BA shall provide a training program meeting the following:	31	34.0%
R3.1 – A set of training program objectives must be defined based on NERC and Regional Reliability Organization standards, entity operating procedures, and applicable regulatory requirements	9	9.9%
R3.2 – The training program must include a plan of initial and continuing training of TOP and BA operating personnel	0	0.0%
R3.3 – The training program must include training time for all TOP and BA operating personnel to ensure their operating proficiency	0	0.0%
R3.4 – Training staff must be identified, and the staff must be competent in both knowledge of system operators and instructional capabilities	2	2.2%
R4 – For personnel identified in R2, each TOP and BA shall provide its operating personnel at least five days per year of training, drills, and simulations of emergencies, in addition to the other training required	21	23.1%
Totals	91	100%

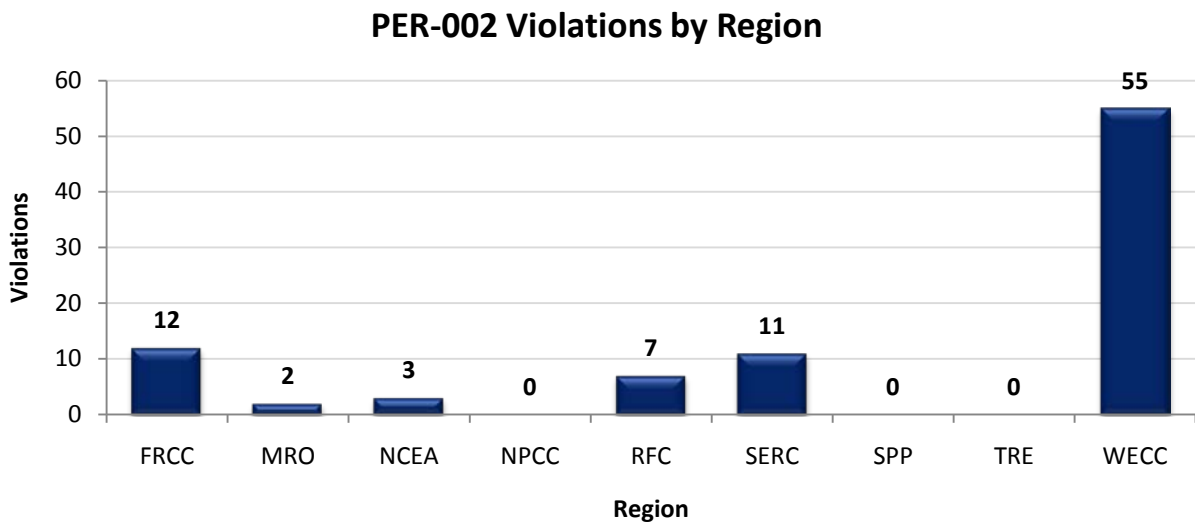
This table shows that the percentage of violations by requirement varies from 12% to 34%, which shows a dispersion of the violations with no clear trend. A more visual representation of this analysis is shown in Figure 1.

Figure 1



The next metric that NERC focuses on is to look at the violations by region.

Figure 2



What stands out is how entities in the WECC region have committed 55 of the total 91 violations of the PER-002 reliability standard (60%). NPCC, SPP, and TRE are the three regions where no entities have committed a violation with regard to PER-002 as of yet.

An interesting approach in looking at this issue is to take into account the functions that are applicable to this reliability standard. With this reliability standard dealing with only Transmission Operator and Balancing Authorities, we can look at the percentage of Registered

Entities who perform these functions, and how they are distributed by region. In the NERC Compliance Registry, which was last updated on July 26, 2010, there are 176 entities registered as Transmission Operators and 134 entities registered as Balancing Authorities. To go a little further, there are 47 entities registered as Balancing Authorities and not Transmission Operators, 89 entities registered as Transmission Operators and not Balancing Authorities, and 87 entities that are registered as both Balancing Authorities and Transmission Operators.

Below is a table that shows how many of the applicable registered functions each region has pertaining to PER-002, as well as the violations count for the region. For instance, MRO has 13 entities registered as Balancing Authorities only. With one violation to a BA in the MRO region since June 2007, we can see how well those entities registered as Balancing Authorities are complying with the PER-002 reliability standard.

Table 2: Registered Function and Violations Count Relationship

Registered Functions				Violations Count			
Region	BA	TOP	BA/TOP	Region	BA	TOP	BA/TOP
FRCC	2	7	9	FRCC	0	8	4
MRO	13	13	7	MRO	1	1	0
NCEA	0	0	1	NCEA	0	1	0
NPCC	0	8	6	NPCC	0	0	0
RFC	10	12	3	RFC	3	2	2
SERC	15	9	17	SERC	7	1	3
SPP	2	4	14	SPP	0	0	0
ERCOT	1	14	0	ERCOT	0	0	0
WECC	4	22	30	WECC	2	40	13
Total	47	89	87	Total	13	55	23

The visual representation of the violations separated by functional registration of the Registered Entity is shown in Figure 3.

Figure 3

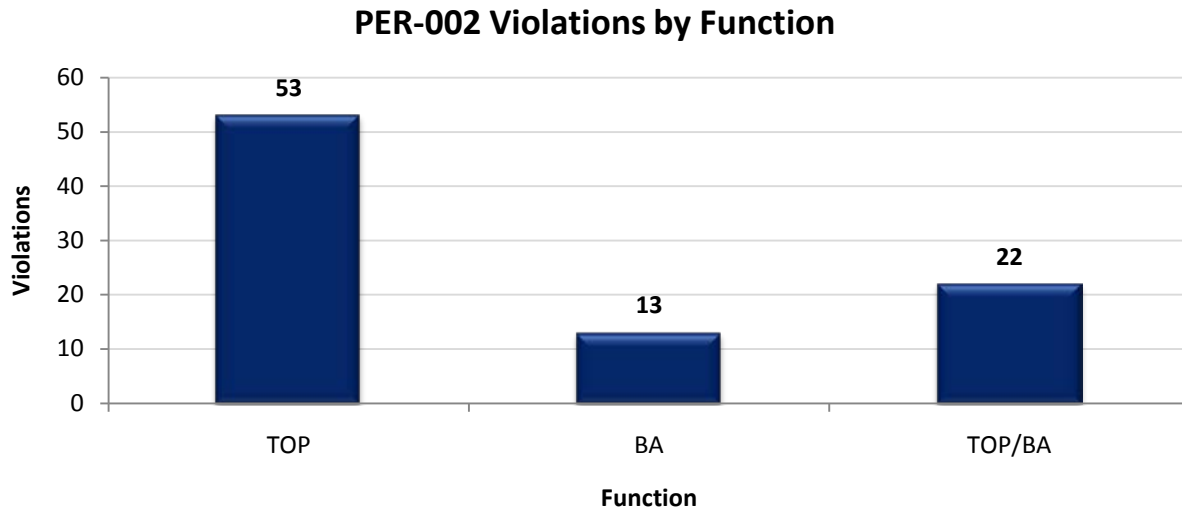
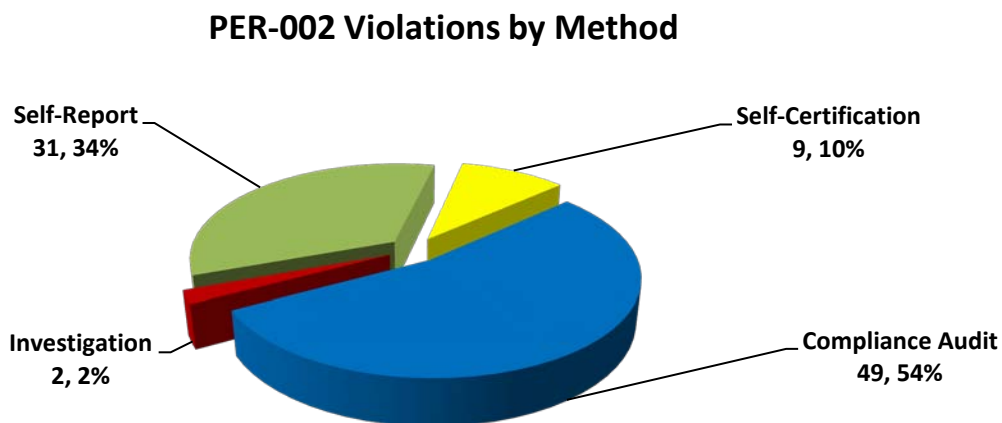


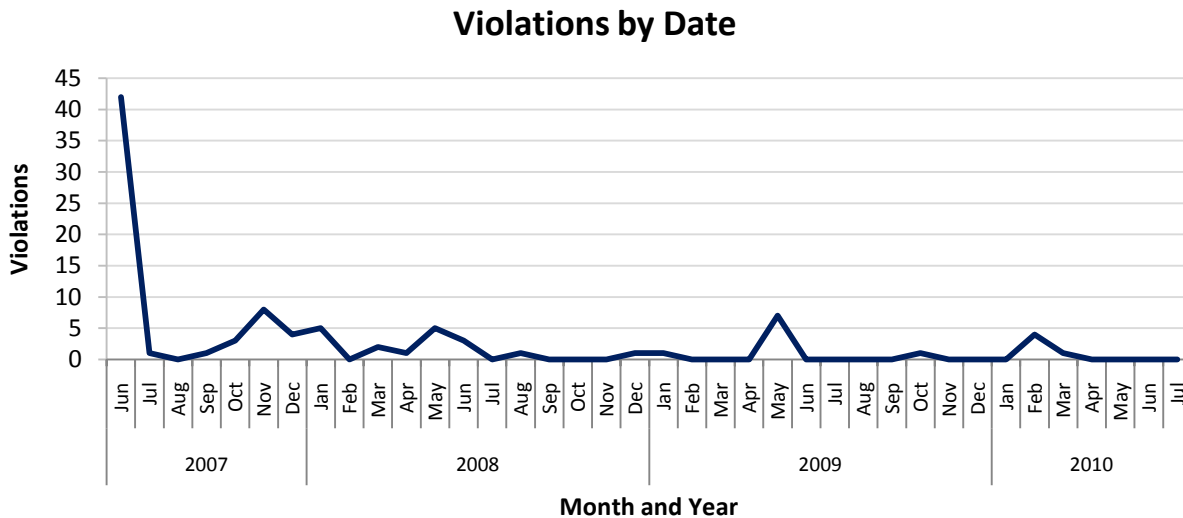
Figure 4 shows how the methods of discovery are divided among self-reports, investigations, self-certifications and compliance audits. For the reliability standard PER-002, we see that a 54% of the violations are coming from compliance audits. This is the highest percentage of violations from audits of the previous Top Ten Violated Standards Compliance Analyses conducted to date. The violations from compliance audits for the previous compliance analysis reports are; VAR-002, 10%; CIP-001, 22%; FAC-008, 40%; FAC-009, 31%; CIP-004, 0%; and PRC-005, 25%. This may be indicative of the complexity of developing and articulating a training and education program where it is often difficult to quantify the levels of experience and judgment expected of systems operators. It is essential that each of the requirements are considered in detail in developing a training program. More detail on this aspect is provided in the Regional Entity analysis section below. For this standard, a critical reassessment of training programs are in order. Reviewing the previous compliance analysis reports indicates the Registered Entities are encouraged to self-report their violations as soon as they are found to their respective Regional Entity.

Figure 4



Another analysis that can be done of this reliability standard is to look at the date at which the violation occurred. Figure 5 below shows the distribution of the violations. Most of the violations are dated in June 2007 and this is not an unexpected result with the initial wave of self-reported violations as audits, self-certifications, and spot checks would identify these violations.

Figure 5



While there is some clustering of violations by the Date of Violation analysis, there is no discernable pattern when viewing the violations by their submission date to NERC, as Figure 6 shows.

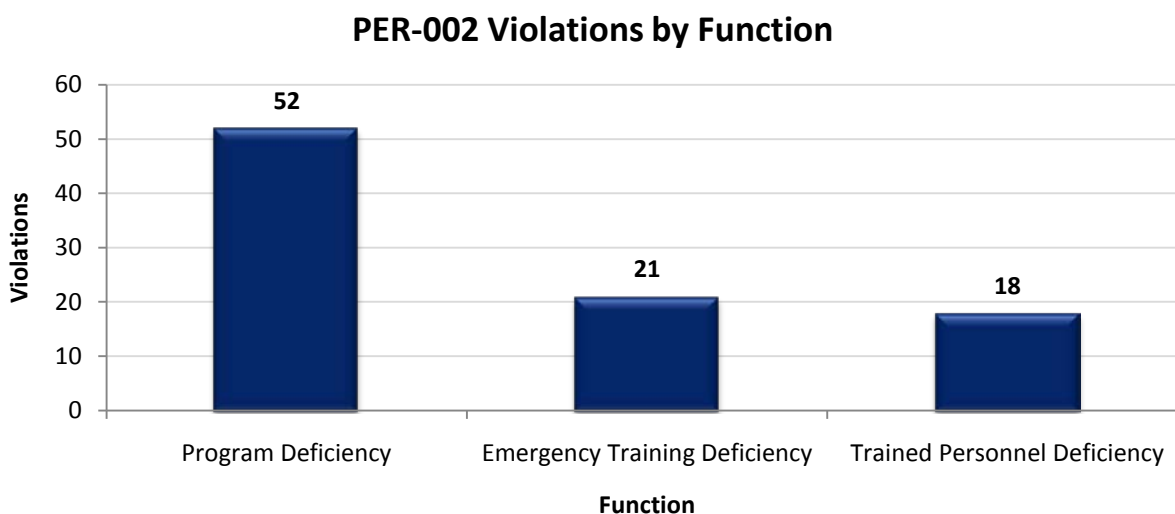
Noncompliance Analysis

The classification scheme defined by NERC in the Violation Description and Potential Impact fields of the Regional Workbooks provide further insight into this standard. Three different types of classifications for the 91 violations of PER-002 are explained below:

1. **Trained Personnel Deficiency** – Staffing key positions that have direct impact on the real-time operation of the bulk power system with inadequately trained or unqualified individuals
2. **Program Deficiency** – A training program which does not meet the specific program objectives in requirements 2 and 3.1 through 3.4
3. **Emergency Training Deficiency** – A training program offered by the Registered Entity which does not satisfy the emergency training component as fully described in requirement 4

Figure 6 represents the results of the classification scheme of PER-002.

Figure 6



The biggest classification bucket is the “program deficiency” bucket, with 52 of the 91 violations falling into this category (57%). The second largest classification bucket is the “emergency training deficiency” bucket, with 21 of the 91 violations falling into this category (23%). Close in the amount of violations to the “emergency training deficiency” bucket lies the “trained personnel deficiency” bucket, with 18 of the 91 violations falling into this category (20%).

Regional Entity Analysis

In addition to the Regional Entity contributions identified throughout the document, the following specific items warrant further discussion, with a summary of practical compliance information and suggestions provided at the end of this assessment.

Key Reasons for Noncompliance

After reviewing the results of the information gathered, the following key reasons are identified by the RCIG as the primary reasons that Registered Entities are found to be noncompliant with PER-002:

Common Violation Descriptions for Frequently Violated Requirements

1. Failure to contain objectives that cover all elements required by R3.1 in personnel training programs.

Among all requirements and sub-requirements in PER-002, R3.1, which requires training programs to contain a set of objectives based on standards, procedures, and applicable regulatory requirements that apply to normal, emergency, and restoration conditions is most frequently violated. The reasons cited by the regions for violations of R3.1 include lack of understanding of this sub-requirement or lack of awareness of the desired functions and importance of personnel training programs identified in the sub-requirement. Some violators did not have objective

sections in their training programs at all, while others had objectives that did not meet one or more of the elements specified in R3.1. Namely, objectives should:

- be based on NERC and Regional Reliability Organization Standards, entity operating procedures, and applicable regulatory requirements,
- reference the knowledge and competencies needed to apply these standards, procedures and requirements,
- and consider normal, emergency, and restoration conditions.

Many training programs did not effectively identify objectives, but merely provided a list of skills. For instance, an objective such as “the operator will be able to restore the system from a blackout condition” might be missing. Instead, the program identified skill sets or competencies required to accomplish an actual objective, such as “the operator will be able to demonstrate competency in the ability to issue switching orders to properly align system configuration” or “establish blackstart and/or emergency power to a nuclear facility”. The objective regarding blackstart to a nuclear facility will need to have many enabling objectives to be considered a good objective set. For example, enabling objectives for this set would include identifying units and their capacities, the ability to get start-up power to the nuclear facility, and to find and implement restoration plans. The training material must be designed to meet all of the enabling objectives.

Suggested Enhancements

A well-designed training program must start with the identification of job tasks. From this identification of the tasks required, learning objectives must be developed to give operators the abilities to perform the tasks. The knowledge, skills, and abilities are identified as required to meet the objectives, both general and enabling as mentioned above. Training is then designed to the objectives and the related knowledge, skills, and abilities that are associated with them.

It should be clarified that the essential goal of training programs is not simply to provide system operators with a set of knowledge, skills, or abilities, but to train them on how to conduct their daily work. As per the sub-requirement, the program will provide explicit mention of how to respond in emergency and restoration conditions properly in compliance with NERC and regional standards, applicable regulatory requirements, and entity operating procedures.

2. Failure to address knowledge, skills, or competencies for an operator to be able to operate the system reliably in training plan, which violates R3.2.

Some non-compliance was the result of the training plan’s failure to identify the necessary knowledge, skills, or competencies for system operators to conduct reliable operations. In the violations observed, the training plan was not well-designed and left this out entirely or the program developers did not have a clear idea of what knowledge, skills, or competencies are required for reliable operations. Often the plans identified a list of training activities without mentioning the knowledge, skills or abilities necessary to achieve the stated learning objectives for that activity. For example, a plan included a checklist with items such as “perform operations under the supervision of the switching desk operator for X hours” without relating this in any way to the learning objective the training activity is striving to meet, or its associated

knowledge/skills/abilities. R3.2 also stipulates that these be addressed for both initial and recurring personnel training; entities should not limit their plan to qualifying new staff only.

Suggested Enhancements

In their training plans, entities should clearly and accurately present the core knowledge, skills, and abilities required for reliable operations. This calls for thorough and comprehensive investigation of the responsibilities and the work to be performed by operators (i.e., the job tasks), along with identification of learning objectives and analysis of specific knowledge, skills, and abilities required for each job task and its associated objectives. Successful training plans show the marks of careful design and are performed in accordance with desired outcomes. An entity may choose to create detailed checklists and measures of knowledge and skills for each position, which can also provide documented evidence. It is essential to carry out training according to plans for all operators to whom this reliability standard is applicable and to document the records of all trained operators as evidence for compliance audits.

3. Failure to prove the competencies of training staff in both knowledge of system operations and instructional capabilities, in violation of R3.4.

R3.4 requires that trainers must have competencies not only in the knowledge of system operations, but also in giving effective instructions to the trainees. The first competencies are easier to meet, since in many entities the designated training staff is composed of those who operated the system for many years and have abundant knowledge and experience. With documentation, this generally satisfies the first part of the requirement. However, some entities were not able to prove that their training staff also has capabilities to instruct others effectively. They could not produce proof of formal training or other evidence of instructional skill competencies and thus were found in violation of this sub-requirement.

Suggested Enhancements

To comply with R3.4, entities should not only identify training staff with knowledge and skills in their positions, but also provide them with training programs for instructional methods. A variety of means to satisfy this exist, including educational coursework, workshops, and certificate programs, among others. Entities are also encouraged to make certain that the training records for instructors are also well documented.

4. Failure to conduct annual training and drills using realistic simulations of system emergencies at least five days per year which violates R4.

In addition to normal operations training required to maintain qualified operating personnel, R4 requires each entity registered as a Transmission Operator or Balancing Authority to provide its operating personnel with training and drills using realistic simulations of emergencies at least five days per year (32 contact hours, as noted in the Reliability Standard Auditor Worksheet for PER-002-0). Evidence of compliance with this requirement was sometimes missing in entity documentation, or the entity could not identify sufficient emergency training hours separately from other training. Entities at times did not demonstrate their use of realistic simulations in the program or failed to include this into their evidence.

Suggested Enhancements

This annual practice should be added into the entity's system operations personnel training program and documented separately as emergency training. Efforts should be made to assure that the practice sessions use simulations of real emergency conditions, and records should be logged with exact date, participants, and events to prove that such training is conducted according to the entity's training program. Some entities have recreated simulations of actual system events and used these as a component of their training for this requirement. The reference document for the proposed standard PER-005-1 provides additional reference material on simulation¹ that may be of help in preparing such exercises.

5. Failure to demonstrate that the entity is staffed with adequately trained operating personnel, in violation of R1.

Issues noted by the regions in assessing compliance have two common themes. In some instances the program for training met the requirements, but the entity had not been able to implement its own plan during the period of assessment or they put operating personnel in service without training them for their role. It is worth noting that failure to demonstrate requirements for emergency training hours specified in requirement R4 may also lead to a possible violation of requirement R1. The other issue was lack of organized records for the completion of training to support the evidence requested by auditors. If the records were not produced to support implementation of a training program for personnel in operating positions for the period of assessment, violations resulted even if the program appeared solidly crafted.

Suggested Enhancements

Purely and simply, organization of records prior to an audit should be stressed for inclusion in the execution of the program. Successful execution of the training program itself has to be supported by an entity's budget and schedules. Ongoing maintenance of documentation to demonstrate the completion of operating personnel training should be recognized as an important part of a successful training program's implementation.

6. Failure to demonstrate that the training program addresses appropriate operating personnel, in violation of R2, or that it fails to include training time for these personnel in violation of R3.3.

This requirement had the least number of violations. An example violation reads "training program lacked specificity with respect to the training of operating personnel". An entity under audit must produce evidence that its training programs cover and allot time for the operating personnel who have primary responsibility for real-time operations, or who are directly responsible for complying with NERC standards.

Suggested Enhancements

The BA and TOP should have an underlying job and task analysis or other suitable framework that determines to which of their operating personnel this requirement applies. The same

¹ PER-005 System Personnel Training Reference Document, June 18, 2008
http://www.nerc.com/docs/standards/sar/Project2006-01_PER-005_Reference_Document_2008Dec11.pdf
Electric Reliability Organization Compliance Analysis Report
Reliability Standard PER-002
September 2010

analysis is used in the requirement in PER-003 for determining which personnel need to be NERC certified. Documenting a list of these personnel over the assessment period, along with the evidence for successful execution of the training program per the other requirements of this standard, will provide support when audited.

Conclusion

Compliance with the PER-002 reliability standard means establishing and executing training programs for system operating personnel. It is imperative that the registered entities have clear understanding of the details in the sub-level requirements in the standard and be prepared to provide evidence for the various elements described therein. Even as this standard will ultimately be superseded by PER-005-1 (currently pending regulatory approval at FERC and Canadian provincial authorities), the underlying expectations are similar. The new standard will improve the specificity of requirements with its emphasis on systemic approach to training, but the need to address all aspects of the requirements, execute them and provide evidence is unchanged. As highlighted in the 2003 Blackout Recommendations, entities should recognize the importance of a set of well-defined training programs as part of their responsibilities of keeping the bulk power system reliable.

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