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NPCC
Regional Reliability Reference Directory # 4
Bulk Power System Protection Criteria

Task Force on System Protection Revision Review Record:
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Revision History

Version	Date	Action	Change Tracking (New, Errata or Revisions)
0	12/01/2009		New
1	3/31/2015	Inserted Applicability of NPCC Criteria	
2	9/30/2015	TFSP Revisions	Revisions
3	1/30/2020	TFSP Revisions	Revisions
4	11/08/2020		Hyper Link to SP8 Report Section 2.2.4

Table of Content

Title Page	i
Revision History	ii
Table of Content	1
1.0 Introduction	2
2.0 Terms Defined in This Directory	4
3.0 NERC ERO Reliability Standard Requirements	6
4.0 NPCC Regional Reliability Requirements	6
5.0 NPCC Full Member More Stringent Requirements	6
5.1 General Criteria	6
5.2 Criteria for Dependability	7
5.3 Criteria for Security	8
5.4 Criteria for Dependability and Security	8
5.5 Operating Time Criteria	8
5.6 Current Transformer Criteria	9
5.7 Voltage Transformer and Potential Devices Criteria	9
5.8 Batteries and Direct Current (DC) Supply Criteria	10
5.9 Station Service ac Supply Criteria	11
5.10 Circuit Breaker	11
5.11 Teleprotection Criteria	11
5.12 Environment	12
5.13 Grounding Criteria	13
5.14 Transmission Line Protection Criteria	14
5.15 Breaker Failure Protection Criteria	14
5.16 Design to Facilitate Testing and Maintenance	14
5.17 Design to Facilitate Analysis of Protection System Performance	15
5.18 Commissioning Testing	15
5.19 HVdc System Protection Criteria	15
5.20 Criteria for Protection Systems Utilizing IEC 61850 Protocol	15
6.0 Compliance Requirements	16
7.0 Compliance Monitoring Process	17
Appendix A: Guideline for Bulk Power System Protection	
Appendix B: Procedure for Reporting to TFSP New and Modified Protection Systems	

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1.0 Introduction

1.1 Title Bulk Power System Protection Criteria

1.2 Directory Number 4

1.3 Objective

The purpose of this Directory is to provide the **protection** criteria for **protection** of the **Bulk Power System** in NPCC Inc. member **Areas**. It is not a design specification.

1.4 Effective Date December 1st, 2009.

Compliance Guidance Statement- **Protection system** designs submitted to the TFSP prior to September 30th, 2015 are not subject to the submittal requirements described in Section 6, Compliance Requirements R1, R2, and R3.

1.5 Background

This Directory establishes the basic **protection system** design criteria and review process for **protection systems** for the **Bulk Power System**.

Guidance for consideration in the implementation of these criteria is provided in Appendix A, and the procedure for reviewing new and modified **protection systems** is provided in Appendix B.

1.6 Applicability

The requirements of NPCC Directory #4 apply only to those facilities defined as NPCC **bulk power system elements** as identified through the performance based methodology of NPCC Document A-10, "*Classification of Bulk Power System Elements*," the list of which is maintained by the NPCC Task Force on System Studies and approved by the NPCC Reliability Coordinating Committee.

Requirements to abide by an NPCC Directory may also reside in external tariff requirements, bilateral contracts and other agreements between facility owners and/or operators and their assigned Reliability Coordinator, Planning Coordinator, Transmission Operator, Balancing Authority and/or Transmission Owner as applicable and may be enforceable through those external tariff requirements, bilateral contracts and other agreements. NPCC will not enforce compliance to the NPCC Directory requirements in this document on any entity that is not an NPCC Full Member.

1.6.1 Functional Entities

Transmission Owners
Generator Owners
Distribution Providers

1.6.2 Facilities

1.6.2.1 New Facilities

These criteria shall apply to all new **Bulk Power System (BPS)** facilities.

1.6.2.2 Existing Facilities

It is the responsibility of individual companies to assess the **protection systems** at existing facilities and to make modifications which are required to meet the intent of these criteria as follows.

1.6.2.2.1 Facilities found lacking two batteries or **elements** lacking two independent sets of **protective relays**

If an entity becomes aware of an existing facility that lacks an independent battery for each **protection group**, or an **element** that lacks two independent sets of **protective relays**, a mitigation plan to meet the requirements of this Directory must be submitted to TFSP within six months. The mitigation plan shall correct these deficiencies within three years. Justification for a longer timeframe must be approved by TFSP.¹

1.6.2.2.2 Planned Renewal or Upgrade to Existing BPS Facilities

It is recognized that there may be portions of the **bulk power system**, which existed prior to each

¹ A BPS Risk Mitigation Plan was put in place in 2010 based on a recommendation by the Task Force on System Protection following an extensive survey by NPCC member entities of their BPS protection system conformance to Directory No. 4 (Criteria A5 at the time). The purpose of this plan was to provide direction to separately mitigate the two attributes identified by TFSP as the highest risk to reliability namely the lack of two independent sets of protective relays or two batteries. At the time, members who owned protection systems that were subject to these high risk items were directed to provide a schedule to mitigate the identified deficiencies based on their original survey which occurred in 2009.

member's adoption of the *Bulk Power System Protection Criteria* (Directory 4 and its predecessor Document A-5) that do not meet these criteria. If **protection systems** or sub-systems of these facilities are replaced as part of a planned renewal or upgrade to the facility and do not meet all of these criteria, then an assessment shall be conducted for those criteria that are not met. The result of this assessment shall be reported to TFSP. It is recommended this reporting be in accordance with the procedure stipulated in Appendix B of this Directory and using the appropriate portion of the “**Protection System Review forms**”, for review and disposition by the TFSP, or in a form consistent with the intent of the procedure.

1.6.2.2.3 Facility Classification Upgraded to **Bulk Power System**.

These criteria apply to all existing facilities which become classified as **bulk power system**. A mitigation plan shall be submitted to TFSP for review to bring such a facility into compliance with these criteria.

Where the owner of the **protection system** has determined that the cost and risks involved to implement physical separation, as per Section 5.12, cannot be justified, the reason for this determination and an assessment shall be reported to the TFSP. It is recommended this reporting be in accordance with the procedure stipulated in Appendix B of this Directory and using the appropriate portion of the “**Protection System Review forms**”, for review and disposition by the TFSP, or in a form consistent with the intent of the procedure.

1.6.2.2.4 Additions to **Bulk Power System** Facilities

If a **bulk power system element** is added to an existing **bulk power system** facility that is recognized under Section 1.6.2.2.2, Planned Renewal or Upgrade to Existing Facilities, these criteria apply to the **protection systems** for the

new **element**. The new bulk power system element shall be reported to the TFSP. If protection systems or sub-systems of these facilities are added as part of a planned renewal or upgrade to the facility and do not meet all of these criteria, then an assessment shall be conducted for those criteria that are not met. It is recommended this reporting be in accordance with the procedure stipulated in Appendix B of this Directory and using the appropriate portion of the “**Protection System Review forms**”, for review and disposition by the TFSP, or in a form consistent with the intent of the procedure.

1.6.2.2.5 Unplanned In-kind Replacement of **Bulk Power System** Equipment

If a **bulk power system element** (e.g., breaker, transformer, capacitor bank, reactor, etc.) or a **protective relay** is replaced “in kind” as a result of an unplanned event, then it is not required to upgrade the associated **protection system** to comply with these criteria. Reporting to the TFSP in accordance with the procedure stipulated in Appendix B of this Directory is not required.

1.6.2.2.6 Change in **Bulk Power System** Facility Status

When a facility was originally on the **BPS** list of April 2007 and has been shown to be non-**BPS** but later was determined to be **BPS** again, Section 1.6.2.2.2 would apply.

2.0 Terms Defined in this Directory

The definitions of terms found in this Directory appearing in bold typeface, can be found in NPCC *Glossary of Terms*.

3.0 NERC ERO Reliability Standard Requirements

The NERC ERO Reliability Standards containing requirements that are associated

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with this Directory include, but may not be limited to:

- 3.1 PRC-001
- 3.2 PRC-002
- 3.3 PRC-004
- 3.4 PRC-005
- 3.5 PRC-006
- 3.6 PRC-010
- 3.7 PRC-012
- 3.8 PRC-018
- 3.9 PRC-019
- 3.10 PRC-023
- 3.11 PRC-024
- 3.12 PRC-025
- 3.13 PRC-026
- 3.14 PRC-027
- 3.15 FAC-008

- 4.0 NPCC Regional Reliability Standard, Directory, Criteria Requirements that are associated with this Directory include, but may not be limited to:

Directory #11 Disturbance Monitoring Equipment Criteria
PRC-006-NPCC– Automatic Underfrequency Load Shedding

- 5.0 NPCC Full Member, More Stringent Criteria

These Criteria are in addition, more stringent or more specific than the NERC continent-wide reliability standards.

- 5.1 General Criteria

The intent of the criteria established in this Directory is to ensure dependable and secure operation of the **protection systems** for **bulk power system**. For those **protective relays** intended for removal of **faults** from the **bulk power system**, dependability is paramount, and the redundancy provisions of the criteria shall apply. For **protective relays** installed for reasons other than **fault** sensing such as overload, etc., security is paramount, and the redundancy provisions of the criteria do not apply. The relative effect on the **bulk power system** of a failure of a **protection system** to operate when desired versus an unintended operation shall be weighed carefully in selecting design parameters as follows.

5.2 Criteria for Dependability

5.2.1 Except as identified otherwise in these criteria, all **elements** of the **bulk power system** shall be protected by two **protection groups**, each of which is independently capable of performing the specified protective function for that **element**. This requirement also applies during energization of the **element**.

5.2.1.1 The failure of a **merging unit** shall not lead to the momentary or permanent loss of more than one **protection group** per **element**.

5.2.2 Except as identified otherwise in these criteria, the two **protection groups** shall not share the same **component**. If the two **protection groups** share a redundant **component** in order to achieve improved reliability, the **galvanic isolation** and physical separation of the two **protection groups** shall not be compromised. This is to ensure that a single **component** failure or malfunction will not prevent both **protection groups** from performing their **protective** functions.

5.2.2.1 Each **protection group** shall be supplied from its own DC circuit and that DC circuit shall not be used in any other **protection group** protecting the same **element**. Any non-**protection** control or monitoring circuits shall be supplied from a separately protected DC circuit. **Non-protection** control or monitoring circuits include but are not limited to closing, reclosing, SCADA, and **DME** functions.

5.2.3 Means shall be provided to trip all necessary local and remote breakers in the event that a breaker fails to clear a fault. This **protection** need not be duplicated. If **breaker failure protection** is duplicated, the exceptions as allowed in 5.12.3 and 5.15.1 for single **breaker failure protection** do not apply.

5.2.4 On installations where free-standing or column-type current transformers are provided on one side of the breaker only, resulting in a **protection** blind spot, **protection** shall be provided locally to detect **faults** to ground occurring in the **protections'** blind spot area.

5.2.5 When frame ground **protection** is used, then frame ground and **breaker failure protections** are two local independent **protections** for the blind spot between the current transformer and the circuit breaker. Neither of these **protections** need be duplicated. Both of these **protections** shall be designed so as to not be disabled by the same failure. The frame ground protection and breaker failure protection will in fact provide independent **protections** for the blind spot.

5.3 Criteria for Security

Protection systems shall be designed to isolate only the **faulted element**, except in those circumstances where additional **elements** are tripped intentionally to preserve system integrity, or where isolating additional **elements** has no impact outside the **local area**

5.4 Criteria for Dependability and Security

- 5.4.1 The thermal capability of all **protection system** components shall be adequate to withstand rated maximum short time and continuous loading of the associated **protected elements**.
- 5.4.2 Position or state of control devices that can disable **protections** shall be monitored and annunciated to allow prompt attention by appropriate operating authorities. These devices include but are not limited to communication cutoff switches, relay test mode switch, and protection scheme cutoff switches.
- 5.4.3 When a Local Area Network (LAN) is used as part of the **protection system, relay** hardware, network paths, network hardware and **merging unit** shall be continuously monitored and annunciated for software failure, hardware failure and/or communication failure in order to allow prompt attention by the appropriate operating authorities.
- 5.4.4 Short Circuit Models used to assess **protection** scheme design and to develop **protection** settings shall take into account minimum and maximum **fault** levels and mutual effects of parallel transmission lines. Details of neighboring systems shall be modeled wherever they can affect results significantly.
- 5.4.5 **Protection system components** with redundant power supplies shall be powered from the same DC battery system.
- 5.4.6 Contact outputs used for tripping interrupting devices shall be properly rated to make and carry the DC current for the tripping circuits that they are applied to.
- 5.4.7 **Protection system components** with self-monitoring capability shall be annunciated in order to allow prompt attention by the appropriate operating authorities.

5.5 Operating Time Criteria

Bulk power system protection shall take corrective action within times determined by studies in accordance with Directory #1 Design and Operation of the Bulk Power System and if applicable, the planning assessment performed to exclude BPS elements from Directory #1 applicability..,

5.6 Current Transformer Criteria

Current transformers (CTs) associated with **protection systems** shall have adequate steady-state and transient characteristics for their intended function as follows:

- 5.6.1 The output of each current transformer secondary winding shall be designed to remain within acceptable limits for the connected burdens under all anticipated **fault** currents to ensure correct operation of the **protection system**.
- 5.6.2 The thermal and mechanical capabilities of the current transformer at the operating tap shall be adequate to prevent damage under maximum **fault** conditions and normal or **emergency** system loading conditions.
- 5.6.3 For **protection groups** to be independent, they shall be supplied from separate current transformer secondary windings.
- 5.6.4 Interconnected current transformer secondary wiring shall be **grounded** at only one point.
- 5.6.5 Current transformers shall be connected so that adjacent **protection** zones overlap.

5.7 Voltage Transformer and Potential Devices Criteria

Voltage transformers and potential devices associated with **protection systems** shall have adequate steady-state and transient characteristics for their intended functions as follows:

- 5.7.1 Voltage transformers and potential devices shall have adequate volt-ampere capacity to supply the connected burden while maintaining their rated accuracy over their specified primary voltage range.
- 5.7.2 The two **protection groups** protecting an **element** shall be supplied from separate voltage sources. The two **protection groups** may be supplied from separate secondary windings on one transformer or potential device, provided all of the following requirements are met:

- 5.7.2.1 Complete loss of one or more phase voltages does not prevent all tripping of the protected **element**;
- 5.7.2.2 Each secondary winding has sufficient capacity to permit fuse **protection** of the circuit;
- 5.7.2.3 Each secondary winding circuit is adequately fuse protected.
- 5.7.3 The wiring from each voltage transformer secondary winding shall not be **grounded** at more than one point.

5.8 Batteries and Direct Current (DC) Supply Criteria

DC supplies associated with **protection** shall be designed to have a high degree of dependability as follows:

- 5.8.1 No single battery or DC power supply failure shall prevent both independent **protection groups** from performing the intended function. Each battery shall be provided with its own charger. Physical separation shall be maintained between the two station batteries or DC power supplies used to supply the independent **protection groups**.
- 5.8.2 Each station battery shall have sufficient capacity to permit operation of the station, in the event of a loss of its battery charger or the ac supply source, for the period of time necessary to transfer the **load** to the other station battery or re-establish the supply source. Each station battery and its associated charger shall have sufficient capacity to supply the total DC **load** of the station.
- 5.8.3 A transfer arrangement shall be provided to permit connecting the total **load** to either station battery without creating areas where, prior to failure of either a station battery or a charger, a single event can disable both DC supplies.
- 5.8.4 The battery chargers and all DC circuits shall be protected against short circuits. All protective devices shall be coordinated to minimize the number of DC circuits interrupted.
- 5.8.5 DC systems shall be continuously monitored and annunciated to detect abnormal voltage levels (both high and low), DC grounds, and loss of ac to the battery chargers, in order to allow prompt attention by the appropriate operating authorities.
- 5.8.6 **Protection group** DC sources shall be continuously monitored and

annunciated to detect loss of voltage in order to allow prompt attention by the appropriate operating authorities.

5.9 Station Service ac Supply Criteria

On **bulk power system** facilities there shall be two sources of station service ac supply, each capable of carrying at least all the critical **loads** associated with **protection systems**.

5.10 Circuit Breaker

5.10.1 No single trip coil failure shall prevent both independent **protection groups** from performing the intended function. The design of a breaker with two trip coils shall be such that the breaker will operate if both trip coils are energized simultaneously. The correct operation of this design shall be verified by tests.

5.10.2 Each trip coil shall be monitored in a fail-safe manner for continuity and presence of corresponding DC voltage and annunciated to allow prompt attention by appropriate operating authorities.

5.10.2.1 The design for trip coils monitoring shall not introduce a single point of failure in the trip circuits. The design shall meet Requirement 5.2.2.1.

5.11 Teleprotection Criteria

5.11.1 Communication facilities required for **teleprotection** shall be designed to have a level of performance consistent with that required of the **protection system**, and shall meet the following:

5.11.1.1 Where each of the two **protection groups** protecting the same **bulk power system element** requires a communication channel:

5.11.1.1.1 The equipment for each **protection group** shall be separated physically on non-adjacent panels and designed to minimize the risk of both **protection groups** being disabled simultaneously by a single event or condition.

5.11.1.1.2 The communication medium outside the substation physical perimeter for each **protection group** shall be designed to minimize the risk of both **protection groups** being disabled

simultaneously by a single event or condition. In addition, physical separation of the communication media shall be three feet at a minimum. In cases where constraints do not allow three feet separation, this distance may be reduced if a proposed alternative design can achieve comparable physical protection of the communication medium.

- 5.11.1.2 **Teleprotection** equipment shall be monitored to detect loss of equipment to allow prompt attention by the appropriate operating authorities.
- 5.11.1.3 **Teleprotection** communication channels shall be designed with continuous monitoring and alarming for loss of function to allow prompt attention by appropriate operating authorities. For **teleprotection** communication channels that utilize ON/OFF signaling that cannot be continuously monitored, the design shall provide daily automated testing for the presence of the channel health and alarming for loss of function to allow prompt attention by appropriate operating authorities.
- 5.11.1.4. **Teleprotection** equipment shall be provided with means to test for proper signal adequacy where provisions for automated testing are not provided.
- 5.11.1.5 **Teleprotection** equipment shall be powered by the substation batteries or other sources independent from the power system.
- 5.11.1.6 Except as identified otherwise in these criteria, the two **teleprotection** groups shall not share the same **component**.
 - 5.11.1.6.1 The use of a single communication tower for the radio communication systems used by two **protection groups** protecting a single **element** is permitted as long as directional diversity of the communication signals is achieved.
 - 5.11.1.7 Teleprotection design for DCB schemes shall not allow for over tripping of more than one element for a single component failure other than battery failure.

5.12 Environment

- 5.12.1 Each separate **protection group** and **teleprotection** protecting the same system **element** shall be on different non-adjacent vertical mounting assemblies or enclosures, except as noted in 5.12.7.
- 5.12.2 **Protection group** LAN devices for redundant **protection groups** shall be on different non-adjacent vertical mounting assemblies or enclosures, except as noted in 5.12.7.
- 5.12.3 Wiring for separate protection groups and teleprotections protecting the same system element shall not be in the same cable or terminated in the same panel.
- 5.12.4 The use of fiber optics for separate **protection groups** and **teleprotections** protecting the same system **element** shall not result in a common mode failure.
- 5.12.5 Cabling for separate **protection groups** and **teleprotections** protecting the same system **element** shall be physically separated. This can be accomplished by being in different raceways, trays, trenches, etc. Cable separation shall be achieved up to the breaker control cabinet or equipment control cabinet.
 - 5.12.5.1 In the event a common raceway is used, cabling for separate protection groups protecting the same element shall be separated by a non-flammable barrier.
- 5.12.6 This section was left as blank.
- 5.12.7 Electronic devices physically located outdoor in the substation yard which serve as **components** of separate **protection groups**, protecting the same **element**, shall be physically separated. This can be accomplished by separate enclosures, or by a non-flammable barrier.
- 5.12.8 An electronic device, which serves as a **component** of a **protection group**, and is physically located near the primary equipment and outside of the control house, may be subject to more severe environmental conditions than if it was located inside of a building. These environmental conditions may include extreme temperatures, corrosive atmosphere, and electromagnetic interference (EMI). Electronic device selection and secondary enclosure design (“cabinets”) shall ensure that environmental conditions do not reduce **protection group reliability** and availability and that the electronic devices contained therein are not subject to the environmental

conditions above the accepted limits specified by the IEEE or IEC.
Any outdoor enclosure shall have as a minimum a NEMA 4X rating for non-EMI related environmental conditions.

5.12.9 DC distribution panels used to supply **system protection groups** shall be separated physically and non-adjacent.

5.13 Grounding Criteria

An entity shall have established as part of its substation design procedures or specifications, a mandatory method of designing the substation ground grid, which:

5.13.1 Can be traced to a recognized calculation methodology

5.13.2 Considers cable shielding

5.13.3 Considers equipment grounding and its impact on the operation of the live tank frame ground protection.

5.14 Transmission Line **Protection** Criteria

5.14.1 **Protection system** settings shall not constitute a loading limitation as per NERC continent-wide PRC standards. In cases where NERC approved exceptions are used the limits thus imposed shall be adhered to as system operating constraints.

5.14.2 A **pilot protection** shall be so designed that its failure or misoperation will not affect the operation of any other **pilot protection** on that same **element**.

5.15 Breaker Failure **Protection** Criteria

Means shall be provided to trip all necessary local and remote breakers in the event that a breaker fails to clear a **fault**, as follows.

5.15.1 For non-redundant breaker failure **protection**, initiation by each **protection group** which trips the breaker, is required with the optional exception of a breaker failure **protection** for an adjacent breaker. Tripping both System 1 and System 2 trip coils of adjacent breakers is not required; however, if desired, specific design provisions shall be used to ensure a single point of failure of the trip circuits is not introduced.

5.15.2 For redundant breaker failure protection, each breaker failure protection shall be initiated only by its respective **protection groups** which trip the breaker (i.e.: System 1 line protection initiates System 1 breaker failure protection), with the optional exception of a breaker

failure protection for an adjacent breaker.

5.15.3 For redundant breaker failure protections, system 1 breaker failure protection shall only operate system 1 trip coil of the associated backup breakers needed to clear the fault and system 2 breaker failure protection shall only operate system 2 trip coil of the associated backup breakers needed to clear the fault.

5.15.4 **Fault** current detectors shall be used to determine if a breaker has failed to interrupt a **fault** current.

5.15.5 A series breaker can be an acceptable means of providing **fault** clearing for a failed circuit breaker, in lieu of breaker-failure **protection**. This requires both series breakers be in the same overlapping zones of relay **protection**, and both series breakers are tripped by these same **protection** zones.

5.16 Design to Facilitate Testing and Maintenance

5.16.1 The design of **protection systems** both in terms of circuitry and physical arrangement shall facilitate periodic testing and maintenance.

5.16.2 When a Local Area Network (LAN) is used as part of the **protection system**, the design shall provide the ability to isolate the operation of **protective relaying**, while maintaining a network communication path to give personnel the ability to view **relay** response while under test.

5.16.3 When a Local Area Network (LAN) is used as part of the **protection system**, the network architecture shall provide a dedicated and secure means for personnel to connect to the LAN for testing, troubleshooting and operational purposes.

5.16.4 Test facilities or test procedures shall be designed such that they do not compromise the independence of the redundant design aspects of the **protection systems**.

5.16.5 If a segmented testing approach is used, test procedures and test facilities shall be designed to ensure that related tests properly overlap. Proper overlap is ensured if each portion of circuitry is seen to perform its intended function, such as operating a relay from either a real or test stimulus, while observing some common reliable downstream indicator.

5.16.6 When a Local Area Network (LAN) is used as part of the **protection system**, network monitoring tools shall be deployed to facilitate troubleshooting/corrective maintenance.

- 5.17 Design to Facilitate Analysis of **Protection System** Performance
 - 5.17.1 Event recording capability shall be provided to permit analysis of the **protection systems'** performance.
- 5.18 Commissioning Testing
 - 5.18.1 Each **protection group** shall be functionally tested to verify the dependability and security aspects of the design, when initially placed in service and when modifications are made.
- 5.19 HVdc **System Protection** Criteria
 - 5.19.1 LCC-type (Line Commutated Converter)
 - 5.19.1.1 The ac portion of a HVdc converter station, up to the valve – side terminals of the converter transformers, shall be protected in accordance with these criteria.
 - 5.19.1.2 Multiple commutation failures, unordered power reversals, and faults in the converter bridges and the dc portion of the HVdc link which are severe enough to disturb the **bulk power system** shall be detected by more than one independent control or **protection group** and appropriate corrective action shall be taken, in accordance with the considerations of these criteria.
 - 5.19.2 VSC-type (Voltage Source Converter)
 - 5.19.2.1 The ac portion of a HVdc converter station, up to the converter arms terminals, shall be protected in accordance with these criteria.
 - 5.19.2.2 Abnormal ac condition (voltage, current, frequency, or harmonic distortion) and faults in the converter arms and the dc portion of the HVdc link which are severe enough to disturb the **bulk power system** shall be detected by more than one independent control or **protection groups** and appropriate corrective action shall be taken, in accordance with the considerations in these criteria.

- 5.20 Criteria for **protection systems** utilizing IEC 61850 protocol
- 5.20.1 Loss of one **protection group's** sampled value data stream shall not momentarily or permanently compromise the redundant **protection group's** sampled value data stream, unless studies demonstrate that the total clearing time including momentary interruption is acceptable.
 - 5.20.2 If process bus is employed for both **protection groups** protecting the same **element**, a single device failure shall not lead to momentary or permanent loss of time synchronization for both **protection groups**.
 - 5.20.3 **Protection** related data shall take priority over other types of data that are transported over the same LAN. LANs used for **protection** shall be designed such that the **protection** response shall not be adversely impacted during stressed network conditions. Due to the possibilities for non-**protection** network traffic such as DME record retrieval, security video streaming, phasor measurements, etc., **protection** message response time shall meet the critical clearing time requirements in all network loading conditions.
 - 5.20.4 The actual propagation times through LANs used for **protection** during stressed network conditions shall be included in the calculation of clearing times of protected **element**. Network congestion occurs when a link or node is carrying so much data that its quality of service deteriorates. Typical effects include queuing delay, packet loss or the blocking of new connections.
 - 5.20.5 The failure of a single network device shall not momentarily or permanently disable both **protection groups**, unless studies demonstrate that the total clearing time including momentary interruption² is acceptable.
 - 5.20.6 The network topology shall be designed in a way that will ensure that a single broken path does not momentarily or permanently disable both **protection groups**, unless studies demonstrate that the total clearing time including momentary interruption is acceptable.
 - 5.20.7 Analog to digital conversion, processing and communication latency shall maintain a level of speed and accuracy that, at a minimum, meets current utility **protection** performance.

² Certain network protocols (RSTP, ERSTP, etc.), can expose a **protection system** to significant disruptions during the self-healing process known as re-convergence. During this period no traffic is passed by the network switches and results in a momentary loss of **protection**.

6.0 Compliance Requirements

R1. An entity, proposing to install a new **protection system** or a modification to an existing **protection system**, shall submit documentation to TFSP in accordance with Appendix B of this Directory.

R2. An entity, proposing to install a new **protection system** or a modification to an existing **protection system**, shall obtain a letter of acceptance by TFSP of the compliance statement accompanying the submittal in R1 prior to or within twelve months of placing the **protection system** in service.

R3. The entity shall provide within 30 days, upon request from the Regional Entity (Criteria Compliance Enforcement Program) documented evidence of the submittal and acceptance by TFSP, of any new or modified **protection system**.

7.0 Compliance Monitoring Process

Compliance with the requirements set forth in this Directory will be in accordance with the NPCC Criteria Compliance and Enforcement Program (CCEP). Measures and corresponding Levels of Non Compliance for these requirements are contained within the compliance templates associated with this Directory.

Prepared by: Task Force on System Protection

Review and Approval: Revision to any portion of this Directory will be posted by the lead Task Force in the NPCC Open Process for a 45 day review and comment period. Upon satisfactorily addressing all the comments in this forum, the Directory document will be sent to the remaining Task Forces for their recommendation to seek RCC approval.

Upon approval of the RCC, this Directory will be sent to the Full Member Representatives for their final approval if sections pertaining to the Requirements and Criteria portion have been revised. All voting and approvals will be conducted according to the most current "NPCC. Bylaws" in effect at the time the ballots are cast.

Revisions pertaining to the Appendices or any other portion of the document such as Links glossary terms, etc., only RCC Members will need to conduct the final approval ballot of the document.

This Directory will be updated at least once every three years and as often as necessary to keep it current and consistent with NERC, Regional Reliability Standards and other NPCC documents.

Appendix A

Guideline and Recommendations for Bulk Power System Protection

1.0 Introduction

This Appendix provides the guidance for consideration in the implementation of the **bulk power system protection** criteria stipulated in this Directory. It is intended to convey best practices recommendations for the **bulk power system protection** design.

2.0 Design Considerations

2.1 General Considerations

- 2.1.1 In general, the function of a **protection system** is to limit the severity and extent of **system disturbances** and possible damage to system equipment.
- 2.1.2 The Directory's criteria objectives can be met only if **protection systems** have a high degree of dependability and security. In this context dependability relates to the degree of certainty that a **protection system** will operate correctly when required to operate. Security relates to the degree of certainty that a **protection system** will not operate when not required to operate.
- 2.1.3 Often increased security (fewer unintended operations) results in decreased dependability (more failures to operate), and vice versa. As an example, consideration is given to the consequence of applying permissive line protection schemes, which often are more secure, but less dependable, than blocking line protection schemes. The relative effect on the bulk power system of a failure of a protection system to operate when desired versus an unintended operation should be weighed carefully in selecting design parameters. Considerations for specific aspects of protection design are provided below.
- 2.1.4 Whenever changes are anticipated in generating sources, transmission facilities, or operating conditions, Generator Owners, Transmission Owners, and Distribution Providers should review those protection system applications (i.e., settings, ac and dc supplies) which can reasonably be expected to be impacted by those changes.

2.2 Issues Affecting Dependability

- 2.2.1 Some portions of **elements** may not in themselves be part of the **bulk power system** such as terminals of bulk power system elements connected to non-**BPS** buses. The requirements do not apply to the non-BPS bus terminals of that element.
- 2.2.2 Two identical measuring **relays** should not be used in independent **protection groups** due to the risk of simultaneous failure of both groups because of design deficiencies or equipment problems.
- 2.2.3 In addition to the separation requirements in the criteria, areas of common exposure should be kept to a minimum to reduce the possibility of both **protection groups** being disabled by a single event such as fire, excavation, water leakage, and other such incidents.
- 2.2.4 **Merging unit** design should consider the inherent reduction in **protection system reliability** and availability that the use of these devices presents. ([Refer to SP-8 Report, Reliability for IEC 61850, November 20, 2013, Section 2, Page 2](#))

2.3 Issues Affecting Security

- 2.3.1 For **faults** external to the protected zone, each **protection group** should be designed either to not operate, or to operate selectively with other **protection groups** and with breaker failure **protection**.
- 2.3.2 For planned system conditions, **protection systems** should not operate to trip for stable **power swings**.
- 2.3.3 If a **merging unit** failover scheme is used, the loss of sampled value data shall not result in any **protection** Misoperations.
- 2.3.4. For DCB schemes, design considerations should include pertinent alarms to minimize the risk associated with failure of these schemes.

2.4 Issues Affecting Dependability and Security

- 2.4.1 **Protection systems** should be no more complex than required for any given application.
- 2.4.2 The components and software used in **protection systems** should be of proven quality, as demonstrated either by actual experience or by stringent tests under simulated operating conditions.
- 2.4.3 **Protection systems** should be designed to minimize the possibility of

component failure or malfunction due to electrical transients and interference or external effects such as vibration, shock and temperature.

2.4.3.1 Digital relaying and control systems may also be subjected to other signal or noise interference events which may cause transients to be detected as a full contact closure by the **protective relay** digital input boards and/or cause contact outputs to erroneously conduct. The digital inputs/outputs associated with the **protective relays** should be designed or modified as necessary to reduce their sensitivity to voltages from transients, signal noise or high resistance contact bridging.³

- 2.4.4 **Protection system** circuitry and physical arrangements should be designed so as to minimize the possibility of incorrect operations due to personnel error.
- 2.4.5 **Protection system** automatic self-checking facilities should be designed so as to not degrade the performance of the **protection system**.
- 2.4.6 Consideration should be given to the consequences of loss of instrument transformer voltage inputs to **protection systems**.
- 2.4.7 Inputs and Outputs necessary for correct **protection system** operation shall be conditioned for a communication loss or power failure such that upon restoration of communication or power the intended output state is restored.
- 2.4.8 The use of network redundancy protocols and network configurations should be considered to improve LAN availability.
- 2.4.9 **Protection systems**, including intelligent electronic devices (IEDs) and communication systems used for **protection**, should comply with applicable industry standards for utility grade **protection** service. Utility Grade **Protection System** Equipment are equipment that are suitable for protecting **bulk power system elements**, that are required to operate reliably, under harsh environments normally found at substations. Utility grade equipment should meet the applicable sections of all or some of the following types of industry standards, to ensure their suitability for such applications:

³ Reference NERC Lessons Learned 20150201 on Digital Inputs to Protection Systems May Need to be Desensitized to Prevent False Tripping Due to Transient Signals.
https://www.nerc.com/pa/rrm/ea/Lessons%20Learned%20Document%20Library/LL20150201_Digital_inputs_to_protection_systems.pdf

- IEEE C37.90.1-2012 (oscillatory surge and fast transient)
- IEEE C37.90.1-2012 (service conditions)
- IEC 60255-22-1, 2007 (1 MHz burst, i.e. oscillatory)
- IEC 61000-4-12, 2017 (oscillatory surge)
- IEC 61000-4-4, 2004 (EFT)
- IEC 60255-22-4, 2008 (EFT)
- IEEE C37.90.2-2004 (narrow-band radiation)
- IEC 60255-22-3, 2007 (narrow-band radiation)
- IEC 61000-4-3, 2010 (narrow-band radiation)
- IEEE 1613a, 2011 (communications networking devices in Electric Power Substations)

2.5 Issues Affecting Performance

- 2.5.1 Control cables and wiring and ancillary control devices should be highly dependable and secure. Due consideration should be given to published codes and standards, fire hazards, current-carrying capacity, voltage drop, insulation level, mechanical strength, routing, shielding, grounding, and environment.
- 2.5.2 **Protection** performance should be evaluated under stressed network and failover conditions to ensure that protection coordination and performance is within the acceptable design limits.
- 2.5.3 Continuous streaming of sampled values may consume a large amount of LAN bandwidth. The network architecture should account for bandwidth-intensive applications and **protection system** response, as required by planning standards, should not be impacted by increased traffic during any scenario.
- 2.5.4 Redundant communications within a **protection group** can significantly increase **protection** availability and reliability.
- 2.5.5 Sampled values and Generic Object Oriented Substation Events (GOOSE) messages should have the highest priority among all traffic in the network and network interfaces of end-devices.

2.6 Operating Time

Adequate time margin should be provided taking into account study inaccuracies, differences in equipment, and **protection** operating times. In cases where clearing times are deliberately extended, consideration should be given to the following:

- Effect on system **stability** or reduction of **stability** margins.
- Possibility of causing or increasing damage to equipment and subsequent extended repair and/or outage time.
- Effect of **disturbances** on service to customers.
- Network configurations that impact the delivery or latency of GOOSE messages in one **protection group** should not momentarily or permanently affect the delivery or latency of GOOSE messages in the redundant **protection group** for the same **element**, unless studies demonstrate that the total clearing time including momentary interruption is acceptable.
- The reception and processing of a GOOSE message is time critical, specifically during events and relaying operations. The use of GOOSE messages for **protection** should be configured (dataset priority, how messages are published, VLANS, network configuration, etc.) such that the maximum clearing times as specified by Planning Studies are met.

2.6 Current Transformer

None.

2.7 Voltage Transformers and Potential Devices

2.7.1 Voltage transformer installations should be designed with due regard to ferroresonance.

2.7.2 Special attention should be given to the physical properties (e.g. resistance to corrosion, moisture, fatigue) of the fuses used in **protection** voltage circuits.

2.7.3 Relay systems utilizing capacitive voltage transformer should be designed with due regard for transient response

2.8 Batteries and Direct Current (dc) Supply

2.8.1 The circuitry between each battery and its first protective device cannot be protected and therefore should be designed so as to minimize the possibility of electrical **short circuit**.

2.8.2 The design for the regulation of the dc voltage should be such that, under all anticipated charging and loading conditions, voltage within

acceptable limits will be supplied to all devices, while minimizing ac ripple and voltage transients.

2.9 Station Service ac Supply

None.

2.10 Circuit Breakers

2.10.1 The indication of the circuit breaker position in **protection systems** should be designed to reliably mimic the main contact position.

2.10.2 Consideration should be given to DC trip circuits monitoring in addition to trip coil monitoring.

2.11 **Teleprotection**

2.11.1 **Teleprotection** systems should be designed to prevent unwanted operations such as those caused by equipment or personnel.

2.11.2 Two identical **teleprotection** equipments should not be used in independent **protection groups**, due to the risk of simultaneous failure of both **protection groups** because of design deficiencies or equipment problems.

2.11.3 Areas of common exposure should be kept to a minimum to reduce the possibility of both **protection groups** being disabled by a single event such as fire, excavation, water leakage, and other such incidents.

2.11.4 For applications where each of the two protection groups protecting the same bulk power system element requires a communication channel, and telecommunication route diversity cannot be achieved, proper selection of protection scheme can be used to achieve required performance, for example, a DCB scheme and a POTT scheme could be used over the same communication medium. In the case of a single communication path, due consideration should be given to any operational concerns that may arise as result of the loss of that communication path.

2.11.5 **Teleprotection** systems should be designed to mitigate the effects of signal interference from other communication sources and to assure adequate signal transmission during **bulk power system disturbances**.

2.11.6 The directional diversity for microwave signals for the two independent **protection groups** protecting the same **element** should

be designed to establish an angle difference of at least 60 degrees between the two communication paths. This is to minimize the possibility of a storm cell preventing transmission of both communication channels.

2.12 Environment

2.12.1 Means should be employed to maintain environmental conditions that are favorable to the correct performance of a **protection system**.

2.12.2 Non-flammable barrier used to separate the cabling of the two **protection groups** protecting the same **element** in a common raceway should be sufficiently rated to allow enough time to isolate the affected facility while maintaining operation of one **protection group**.

2.12.3 Raceways containing the cabling of the two **protection groups** protecting the same **element** should be sufficiently separated, in both horizontal and vertical planes, to allow enough time to isolate the affected facility subsequent to a failure in one raceway while maintaining operation of one **protection group**.

2.13 Grounding

2.13.1 Station grounding is critical to the correct operation of **protection systems**. The design of the ground grid directly impacts proper **protection system** operation and the probability of false operation from **fault** currents or transient voltages.

2.13.2 When frame ground **protection** is used, the design must ensure that the current passing through the frame ground CT will be adequate to operate for a primary equipment ground **fault** and that the scheme is secure enough to not operate for a **fault** external to the intended zone of **protection**.⁴

2.14 Transmission Lines **Protection**

⁴ Reference July 1, 2013 NERC Lesson Learned reviewed by TFSP at the May 2014 Meeting on Current Transformer Ground Relay.

2.14.1 For planned system conditions, line **protection systems** associated with transmission facilities should not operate to trip for stable **power swings**.

2.15 Transformer **Protection**

2.15.1 Fault pressure or Buchholz **relays** used on transformers, phase shifters or regulators should be applied so as to minimize the likelihood of their misoperation due to through **faults**.

2.15.2 The transformer differential relays have the tendency to misoperate during energization of the transformer. The high inrush current flowing into the transformer from the energizing terminal may cause the **protective relay** to mistakenly sense an internal **fault**. This effect has traditionally been mitigated by utilizing the high harmonic content of the inrush current as a restraining quantity but this may be insufficient for modern transformers due to their low second harmonic inrush characteristic. Due regard should be given to the possibility of incorrect blocking for an internal transformer **fault** when mitigating the above issue.⁵

2.16 Breaker Failure **Protection**

2.16.1 It is not necessary to duplicate the breaker failure **protection** itself.

2.16.2 Auxiliary switches may also be required in instances where the **fault** currents are not large enough to operate the **fault** current detectors. In addition, auxiliary switches may be necessary for high-speed detection of a breaker failure condition.

2.17 Generating Station **Protection**

2.17.1 Each **protection system** should be designed to minimize the effects to **the bulk power system** of **faults** and **disturbances**, while itself experiencing a single failure.

2.17.2 Generators should be protected to limit possible damage to the equipment. The following are some of the abnormal (not necessarily **fault**) conditions that should be detected:

⁵ Reference NERC Lesson Learned reviewed by TFSP dated July 15, 2014 on Power Transformer Differential Relay during Transformer Energization prepared by SP-7 Working Group.

- Unbalanced phase currents, loss of excitation
- overexcitation, generator out of step, field ground
- inadvertent energization.

- 2.17.2.1 **Protections** for the above conditions, which are applied for equipment **protection**, need not be duplicated.
- 2.17.2.2 When a directional overcurrent or distance **relay** is applied to remove the generator for slowly cleared **faults** on the external system, such **protection** is a backup and need not be duplicated.
- 2.17.2.3 The apparatus should be protected when the generator is starting up or shutting down as well as running at normal speed; this may require additional **relays** as the normal **relays** may not function satisfactorily at low frequencies.
- 2.17.2.4 Generator **protection systems** should not operate for stable **power swings** except when that particular generator is out of step with the remainder of the system. This does not apply to **Special Protection Systems** designed to trip the generator as part of an overall plan to maintain **stability** of the **power** system.
- 2.17.2.5 Loss of excitation and out of step **relays** should be set with due regard to the performance of the excitation system.
- 2.17.2.6 It is recognized that the overall **protection** of a generator involves non-electrical considerations that have not been included as a part of the criteria in this Directory.
- 2.17.2.7 All overfrequency, overvoltage and undervoltage **protection systems** designed to disconnect generators from the **power** system should be coordinated with automatic underfrequency **load shedding** programs.

2.18 Automatic Underfrequency Load Shedding **Protection Systems**

- 2.18.1 Automatic underfrequency **load shedding protection systems** are not generally located at **bulk power system** stations; however, they have a direct effect on the operation of the **bulk power system** during major **emergencies**.

- 2.18.2 Automatic underfrequency **load shedding protection** need not be duplicated.
- 2.18.3 Underfrequency **relays** which operate at a discrete frequency value are called “underfrequency threshold **relays**.” Selection of underfrequency sensing devices should be on a threshold basis. Alternatively, rate of change of frequency **load shedding** may be used when the requirements of the Balancing Authority indicate that this method will achieve the intent of the **load shedding** program. Appropriate studies are necessary to determine the application and settings of the rate of change of frequency **relays** for a particular Balancing Authority area.
- 2.18.4 In order for each Balancing Authority within NPCC to **shed** approximately the same proportion of **load**, given the same frequency condition, all styles and manufacture of underfrequency **relays** should trip at essentially the same time. For electromechanical **relays**, time delay depends on rate of frequency decline, and it is not possible to achieve uniform response for different rates of decline. The recommendations in this guideline are based on the goal of a uniform response at a rate of frequency decline of 0.2 Hz per second.
- 2.18.5 Additional Application Considerations
- 2.18.5.1 Where undesired underfrequency **relay** operation can be caused by decaying frequency due to isolated generation or motor load, additional supervising undercurrent or voltage **relays** may be used to prevent misoperation.
- 2.18.5.2 Where the AC voltage source for an underfrequency **relay** is derived from a potential device connected to a cable circuit, care should be taken to estimate the voltage present during deenergization of the circuit. The natural frequency of the decaying cable voltage may be less than 60 Hz, and thus cause an incorrect **relay** operation.
- 2.18.5.3 The AC Voltage Inhibit feature available on some relays may be useful as a security tool to restrain operation during cable deenergization, depending on the voltage decay time constant
- 2.18.5.4 Due regard should be given to the expected **power** system voltage during events for which the underfrequency **relays** are expected to operate. The **relay’s** minimum AC voltage operating characteristic should not inhibit proper **relay**

operation, nor should the Voltage Inhibit feature, where it exists, be set to prevent proper operation.

2.18.6 Settings and Maintenance Recommendations

2.18.6.1 Pickup Time Delay Settings

Pickup and time delay settings of underfrequency threshold **relays** should be applied in accordance with the requirements specified in Directory #12 until its retirement and PRC-006-NPCC Automatic Underfrequency Load Shedding upon its approval.

2.18.6.2 Relay Performance Considerations

Any underfrequency **relay** which has been found to have drifted more than ± 0.2 Hz from its set point or ± 0.1 seconds from its time delay should be recalibrated and then retested in six months. If, at that time, the **relay** has drifted ± 0.2 Hz or more from its set point or ± 0.1 seconds or more from its fixed time delay, the cause of the drift should be corrected or the **relay** should be replaced.

2.19 Commissioning Testing

2.19.1 Firmware upgrades, automation software updates shall be tested and documented in a controlled, off-line environment prior to being placed into service to determine if there are any adverse impacts which could prevent proper **protection system** operation.
Reference IEEE C37.231-2012

2.19.2 Pre-commissioning testing specific to the entity's design shall be performed to ensure interoperability of IEC 61850 devices. The fact that an Intelligent Electronic Device (IED) has a conformance certificate will not guarantee it will inter-operate with other conformance certified IEDs in the same substations.

2.20 HVdc Systems Protection

2.20.1 Converter terminals should be protected to avoid excessive equipment stresses and to minimize equipment damage and outage time. These **protections** are usually specific to the design of the converter station(s) and are determined by the manufacturer to comply with availability guarantees. The followings are some conditions which should be detected:

- ac and dc undervoltage,
- ac and dc overvoltage,
- valve misfire,
- excessive **harmonics** on the dc,
- dc ground **faults** and open circuits,
- dc switching device failures,
- thyristor failures,
- valve and snubber circuit overloads.

2.20.2 The overall **protection** and control of an **HVdc link** may also involve the initiation of actions in response to abnormal conditions on the ac interconnected system. The control and **protection systems** associated with such conditions are not considered part of the HVdc systems **protection**.

2.21 **Protection System** Testing and Maintenance

2.21.1 Test facilities and test procedures should be designed such that they do not compromise the independence of **protection groups** protecting the same **bulk power system element**. Test devices or switches should be used to eliminate the necessity for removing or disconnecting wires during testing.

2.21.2 The configuration of IEC 61850 **protection system** should remain as simple as possible to minimize the risks associated with test and maintenance.

2.21.3 All GOOSE messages should contain information to uniquely identify its publishing device. GOOSE message identifiers should provide descriptive nomenclature to aid maintenance and troubleshooting activities.

2.21.4 While isolated testing of a device is acceptable for some commissioning tests, end-to-end secondary injection testing should be conducted to ensure that all interfacing protections perform as designed under dynamic/fault conditions.

2.22 Analysis of **Protection System**

2.22.1 Insofar as possible, each active protective function within a **protective relay** should provide separate target information.

2.23 Transmission Station **Protection**

- 2.23.1 The **protection systems** should operate properly for the anticipated range of currents.
- 2.23.2 For planned system conditions, all station **protection systems** should not operate for **load** current or stable **power swings**.
- 2.23.3 **Load** responsive **protection relays** applied to transmission autotransformers should allow all possible loadability, consistent with equipment **protection** requirements.

2.24 Capacitor Banks

- 2.24.1 Each **protection system** should be designed to minimize the effects to the **bulk power system** of **faults** and **disturbances**, while itself experiencing a single failure.
- 2.24.2 Capacitor bank **protection** should be applied with due consideration for capacitor bank transients, **power** system voltage unbalance, and system **harmonics**.
- 2.24.3 **Protection** may be provided to minimize the impact of failures of individual capacitor units on the remaining capacitor units, however, these types of **protections** do not need to be duplicated:
 - a. Overvoltage **Protection**
 - b. Individual fuses for each capacitor unit
 - c. Overvoltage **Protection** for each capacitor units

2.25 Static Var Compensation (SVC) **Protection**

- 2.25.1 The low voltage branch circuits contain the reactive controlling equipment, filters, etc. These may include all or some of the following:
 - a. Thyristor Controlled Reactors (TCR)
 - b. Thyristor Switched Capacitors (TSC)
 - c. Switched or Fixed Capacitors
 - d. **Harmonic** Filters
- 2.25.2 **Protection** for the branch circuits that are not part of the **bulk power system** need not be duplicated. **Protection** for these branch circuits should be applied with due consideration for capacitor bank transients, power system voltage unbalance, and system **harmonics**.

2.25.3 **Protection** against abnormal non-**fault** conditions within the SVC via control of the TSC and TCR valves should be designed so as to not interfere with the proper operation of the SVC.

2.26 Logic System

2.26.1 The design should recognize the effects of contact races, spurious operation due to battery grounds, dc transients, radio frequency interference or other such influences.

2.26.2 It is recognized that timing is often critical in logic schemes. Operating times of different devices vary. Known timing differences should be accounted for in the overall design.

2.27 Microprocessor-Based Equipment and Software

A **protection system** may incorporate microprocessor-based equipment. Information from this equipment may support other functions such as **power** system operations. In such cases, the software and the interface should be designed so as to not degrade the **protection system** functions.

2.28 Control Cable, Wiring and Ancillary Control Devices

Control cables, wiring and ancillary control devices should be highly dependable and secure. Due consideration should be given to published codes and standards, fire hazards, current-carrying capacity, voltage drop, insulation level, mechanical strength, routing, shielding, grounding and environment.

Appendix B

Procedure for Reporting to TFSP New and Modified Protection Systems

1.0 Introduction

As stated in Section 6.0 of this Directory, “an entity, proposing to install a new **protection system** or a modification to an existing **protection system**, shall submit documentation to TFSP” in accordance with this Appendix. Presentation should be made to the TFSP prior to construction to incorporate any TFSP recommendations. A schedule of the proposed design cutover may be requested by TFSP.

2.0 Additional Requirements for Presentation and Review

2.1 As stated in NPCC Document A-10, Classification of **Bulk Power System Elements**, Paragraph 4.1, “within three months of an element being added to the **Bulk Power System List**, a plan and schedule for achieving compliance shall be provided to TFSP for review and acceptance. TFSP may require modifications to the proposed plan and schedule.”

2.2 A presentation will be made to the TFSP on new facilities or a modification to an existing facility when requested by either a member entity or the TFSP.

2.3 A presentation will be made to the TFSP when the design of the **protection** facility deviates from the criteria set forth in this Directory.

2.4 A presentation will be made to the TFSP when a member entity is in doubt as to whether a design meets the **protection** criteria set forth in this Directory.

2.5 For specific relay replacement programs that largely follow the same design, a presentation will be made to the TFSP for the initial installation in full as described in Section 4.2. For subsequent installations in the program, only a Protection System Review Form and a cover letter referencing the program and initial presentation will be required.

3.0 Data Required for Presentation and Review of Proposed Protection Facilities

3.1 The **protection system** owner will advise the TFSP of the basic design of the proposed system. The data will be supplied on the “Protection System Review Forms” as listed below, accompanied by a geographical map, a one-line diagram of all affected areas, and the associated **protection** and

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control function diagrams as well as network architecture drawings if applicable. A physical layout of **protection** panels and batteries for the purpose of illustrating physical separation will also be included. Physical layout drawings of cabinets located in the substation yard housing protection system IED components will also be included if applicable.

- Protection System Details
- Line Relaying (Phase)
- Line Relaying (Ground)
- Transformer/Reactor Relaying
- Generator Relaying
- Bus Relaying
- Shunt Capacitors and Filters Relaying
- HVdc Converter Relaying
- Special Protection Systems
- Communication links
- Equipment Details
- Current Transformers
- Voltage Transformers
- Station Battery
- Physical Separation
- Breakers
- Disturbance Monitoring Equipment
- Exception Request

The proposed **protection system** will be explained with due emphasis on any special conditions or design restrictions existing on the particular **power** system.

4.0 Procedure for Presentation

- 4.1 The **protection system** owner will arrange to have a technical presentation made to the TFSP
- 4.2 To facilitate scheduling, the chairman of the TFSP will be notified approximately two months prior to the desired date of presentation.
- 4.3 Copies of materials to be presented will be distributed to TFSP members 30 days prior to the date of the presentation.

5.0 TFSP Procedures

5.1 The TFSP will review the material presented and develop a position statement concerning the proposed **protection system**. This statement will indicate one of the following:

5.1.1 The need for additional information to enable the TFSP to reach a decision.

5.1.2 Acceptance of the member statement of conformance to the **Protection Criteria**.

5.1.3 Acceptance of the submitted proposal

5.1.4 Conditional acceptance of the submitted proposal*.

5.1.5 Rejection of the submitted proposal*.

* Position Statements 4.1.4 and 4.1.5 which will include an indication of areas of departure from the intent of the **protection** criteria and suggestions for modifications to bring the **protection system** into conformance with the NPCC criteria.

5.2 The results of the TFSP review will be documented in the following manner in a letter:

5.2.1 A position statement, which will also be included in the minutes of the meeting at which the proposed **protection system** was reviewed.

5.2.2 If necessary, a letter will outline areas of nonconformance with the **protection** criteria stipulated in this Directory and recommendations for correction will be submitted to the **protection system** owner. If necessary, the matter will be brought to the attention of the RCC.

The Task Force will maintain a record of all the reviews it has conducted.