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## **NPCC Regional Reliability Reference Directory # 8 System Restoration**

Task Force on Coordination of Operations Revision Review Record:
<b>October 22, 2008</b>
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Adopted by the Members of the Northeast Power Coordinating Council, Inc. this October 6<sup>th</sup>, 2017 based on recommendation by the Reliability Coordinating Committee, in accordance with Section VIII of the NPCC Amended and Restated Bylaws dated January 1, 2012 as amended to date.

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### Version History

<b>Version</b>	<b>Date</b>	<b>Action</b>	<b>Change Tracking (New, Errata or Revisions)</b>
<b>1</b>	<b>10/22/2010</b>	<b>Revised Sections 5.7.4.4 and 5.7.5.2 Battery Testing</b>	<b>Revision</b>
<b>2</b>	<b>10/06/2017</b>	<b>Phase 2 format</b>	<b>Revision</b>
<b>3</b>	<b>2/16/2018</b>	<b>Revised R8.3 &amp; R12.2</b>	<b>Errata Revision</b>
<b>4</b>	<b>9/25/2018</b>	<b>Revised Section 1.7 Battery Testing</b>	<b>Revision</b>

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## 1.0 Introduction

1.1 Title System Restoration

1.2 Directory Number 8

1.3 Objective

The objective of this Directory is to present the requirements that each functional entity shall follow in order to perform **bulk power system** restoration.

Note that the terms in **bold** used in this Directory are defined in the NPCC Glossary of Terms.

1.4 Effective Date: October 22, 2008.

1.5 Background

This Directory was developed from the draft NPCC A-12 System Restoration Criteria document (January 10, 2008 version). Test procedures for consideration in the implementation of this Directory are provided in Appendix A. Individual functional entity restoration plans may specify more stringent requirements than presented in this Directory. In all cases, the more stringent requirements shall apply.

1.6 Applicability

1.6.1 Functional Entities

- Reliability Coordinators
- Transmission Operators
- Balancing Authorities
- Transmission Owners
- Generator Owners
- Generator Operators

1.6.2 Applicability of NPCC Criteria:

The requirements of a NPCC Directory apply 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.

The requirements of NPCC Directory #8 *System Restoration* also apply to those additional **key facilities** identified by a Reliability Coordinator as being required to establish a **basic minimum power system (BMPS)** in the Reliability Coordinator Area.

Requirements to abide by a NPCC Directory may also reside in external tariff requirements, bilateral contracts and other agreements between facility owners and/or operators and their assigned Reliability Coordinators, Planning Coordinators, Transmission Operators, Balancing Authorities and/or Transmission Owners 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 a NPCC Full Member.

## 2.0 NPCC Regional Reliability Standard Requirements

None.

## 3.0 NPCC “Full Member” More Stringent Criteria Requirements

### 1. Requirements

#### 1.1 System Restoration Plan Requirements

**R1.** Each Reliability Coordinator shall develop and maintain a restoration plan for its Reliability Coordinator **Area** that shall:

**R1.1** Identify the Reliability Coordinator **Area’s basic minimum power system(s)**.

**R1.2** Address the priority of restoring off-site power to nuclear plants;

**R1.3** Identify interconnection points with adjacent Reliability Coordinator areas;

**R1.4** Identify parameters to **synchronize** adjacent **basic minimum power systems**;

**R1.5** Address coordination of system restoration with neighboring Reliability Coordinator areas;

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**R1.6** Provide for the re-energization of transmission systems to major generating stations, including inter-area tie points;

**R1.7** Address electrical **island** stabilization;

**R1.8** Identify provisions for fuel resources to support operation of any supplementary generators (e.g., a diesel generator) necessary for operating **key facilities** consistent with the expected requirements of the Restoration Plan.

## 1.2 Basic Minimum Power System Determination Requirements

**R2.** In determining the **basic minimum power system, the Reliability Coordinator** shall involve all affected parties or functional entities.

**R3.** The Reliability Coordinator shall ensure that the **basic minimum power system** includes the ability to:

**R3.1** Utilize generator **blackstart capability**;

**R3.2** Form an electrical **island(s)**;

**R3.3** Synchronize electrical **islands**; and

**R3.4** Permit the continuation of the system restoration plan.

## 1.3 Identification of Key Facilities and Associated Critical Components Requirements

**R4.** Each Reliability Coordinator shall identify **key facilities** and shall inform each functional entity of its identified **key facilities**.

**R5.** Each functional entity identified as the owner of a newly identified or proposed **key facility**:

**R5.1** Shall identify the associated **critical components** for that **key facility** prior to implementation of the proposed facility as a **key facility**.

**R5.2** Shall provide a list of **critical components** associated with the proposed **key facility** upon request of the Reliability Coordinator within the timeframe requested.

**R5.3** Shall ensure that all applicable testing outlined in Appendix A has been successfully completed prior to implementation, or

within the timeframe requested by the Reliability Coordinator, of the proposed **key facility**.

**R6.** Each functional entity identified as the owner of an existing **key facility**:

**R6.1** Shall provide any updates, additions or deletions to the list of **critical components** for each identified **key facility** upon request of the Reliability Coordinator within the timeframe requested.

**R6.2** Shall ensure that all applicable testing outlined in Appendix A has been successfully completed for any updated or additional **critical components** associated with each identified **key facility**.

#### 1.4 Power System Restoration Event Analysis Requirements

**R7.** Following the occurrence of an event that required implementation of a system restoration plan and upon request of the Task Force on Coordination of Operation (TFCO):

**R7.1** The Reliability Coordinator shall report on the performance of its plan within the timeframe requested by the TFCO.

**R7.2** The Transmission Operator shall report on the performance of its plan within the timeframe requested by the TFCO.

#### 1.5 Critical Components Associated with Key Facilities Testing Requirements

**Note:** The occurrence of an actual event can be considered as a completed test for individual facilities provided it can be demonstrated that the operation of the facilities during the event met the test objectives and performance of the criteria for a successful test listed in Table 1.

**Note:** In the event that the owner of the **critical component** is different than the owner of the associated **key facility**, then the owners of the associated **key facility** and the **critical component** shall coordinate to ensure that the requirements of this Directory are met.

**Note:** All **critical components** not addressed in Appendix A shall be tested in accordance with accepted industry practice as agreed to by the

Reliability Coordinator.

- R8.** Each functional entity which has been identified as owning a **key facility** shall:
- R8.1** Perform the tests outlined in Appendix A - Table 1
  - R8.2** Maintain records of the test results
  - R8.3** Provide evidence, upon request, to the Reliability Coordinator and Transmission Operator within the timeframe requested that the tests specified in sub-Requirement R8.1 have been met.

1.6 Cable Backup Pressurization System Test at a Key Facility (Reference: Table 1; Test No. UG-1)

- R9.** Each functional entity that owns a **cable** pressurization system at a **key facility** shall test for satisfactory operation of both the primary pressurization system and/or the backup pressurization system (if applicable) ability(s) to maintain pressure upon loss of power to the **key facility**.

This capability is required during a blackout to maintain the availability of **cables** for service and to preclude any damage to the **cables** as a result of the loss of dielectric strength. This test shall be conducted every six (6) calendar months by demonstrating that the required pressures can be maintained for a minimum of thirty (30) minutes.

1.7 Battery Chargers, Batteries and Backup Power Supply Tests at Transmission, Generation Telecommunication Facilities and Control Centers identified as a Key Facility - (Reference: Appendix A-Table 1; Test Nos. KF-1 to KF-6)

- R10.** Each functional entity shall test its backup power supplies identified as **critical components** as specified below. Where there are separate backup power arrangements at a **key facility** for transmission or generating station equipment and telecommunication equipment, they shall be separately identified in the **critical components** list and shall be inspected and tested individually.

**R10.1** Equipment Inspection



A battery and/or battery charger identified as a **critical component** shall be inspected in accordance with maintenance activities and maintenance intervals specified in PRC-005- Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance. (Reference: Table 1; Test KF-1)

#### **R10.2** Equipment Verification

A battery and battery charger identified as **critical components** shall be verified in accordance with maintenance activities and maintenance intervals specified in PRC-005 Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance. (Reference: Table 1; Test KF-2)

#### **R10.3.** Confirm that all Critical Component Loads can be Supplied

The owner of batteries or battery chargers identified as **critical components** shall confirm that all **critical component loads** are connected to and can be supplied by the batteries and battery chargers. At least every sixty (60) calendar months, or when modifications are made to the **key facility**, the functional entity owner shall confirm through its design review or through testing that all **critical component** loads are connected to and can be sufficiently supplied by the batteries and battery chargers. (Reference: Table 1; Test KF-3)

#### **R10.4** Startup and Run Test

The owner of a backup power generator identified as a **critical component** of a **key facility**, shall perform a monthly startup and run test on that backup power generator for a minimum run time of fifteen (15) minutes. (Reference: Table 1; Test KF-5).

**Note:** This test also applies to supplemental generation required for **blackstart capability** and to a control center and telecommunication center backup power generator.

#### **R10.5** Startup, Transfer and Load Test

The owner of a backup power generator identified as a **critical component** of a **key facility** shall verify that the backup power generator will pick up the **critical component load** following the loss of station service.

**Note:** This test also applies to a control center and telecommunication center backup power generator.

For automatically started backup power generators, a startup, transfer and run test simulating the loss of station service will be performed every twelve (12) calendar months for a duration of at least thirty (30) minutes. (Reference: Table 1; Test KF-6)

For manually started backup power generators, the asset owner shall every twelve (12) calendar months start the generator and verify stable operation for thirty (30) minutes while supplying **critical component loads**. (Reference: Table 1; Test KF-6)

**Note:** Power sources used to start blackstart units will be excluded from test KF-6.

1.8 AC Supply and Computer Redundancy at Control Centers or Telecommunication Centers Identified as a **Key Facility** (Reference: Appendix A-Table 1; Test Nos. CC-1 and CC-2.)

- R11.** Each functional entity identified as owning **key facilities** shall test its **critical components** in the control centers and the telecommunication centers identified as **key facilities** to demonstrate that the computer systems will be functional when required for system restoration, without dependencies on power sources that may be unavailable during a partial or complete system blackout.

**R11.1** AC Supply Interruption Test

The uninterruptible power supply (UPS) systems in control centers and telecommunication centers shall be tested every twelve (12) calendar months by interrupting AC supply and verifying that all **critical component loads** are supplied for a time that is sufficient for backup power sources to restore the AC input to the UPS. (Reference: Table 1; Test CC-1)

**R11.2** Computer Redundancy (SCADA/EMS) Test

Each functional entity identified as owning a **key facility** shall test its computer redundancy (SCADA/EMS) features every six (6) calendar months to ensure computer systems

(SCADA/EMS) continue to function adequately. (Reference: Table 1; Test CC--2)

1.9 Blackstart Capability Generator Testing (Reference: Appendix A-Table 1; Test No. BS-1)

- R12.** Each functional entity owning a generating station with **blackstart capability** shall verify such capability as follows:
- R12.1.** Operations voice communications and auxiliary systems such as Supervisory Control and Data Acquisition (SCADA) that are required for blackstart shall be verified at least every twelve (12) calendar months to operate adequately without dependency on the interconnected system or other unrelated unit for any source of station service.
  - R12.2.** A generating station with **blackstart capability** shall be tested every twelve (12) calendar months for successful equipment startup and **energize** a transmission element or a generating station switchyard **element** if that doesn't involve the disconnection of **load** that is not dedicated generating station **load** to conduct the test. Verify stable operation while isolated from the **bulk power system** for a minimum of ten minutes. (Reference: Table 1; Test BS-1). (Reference: Appendix A-Table 1; Test No. BS-1)
- R13.** Reliability Coordinators shall determine the number of units within a generating station that are to be tested for **blackstart capability** as required by their respective system restoration plans, and shall notify the applicable functional entity.
- R14.** Each Reliability Coordinator shall confirm that the functional entity owning a generating station with **blackstart capability** that is part of the **basic minimum power system** has completed a successful blackstart test consistent with the objectives of the Reliability Coordinator's system restoration plan.

### 1.10 Reporting the Loss of Functionality of Critical Components Associated with Key Facilities

The reporting specified in Requirements R15, R16, R17 and R18 shall identify:

- the name of the **critical component** which has lost its functionality or redundancy;
- the affected **key facility** and how it is impacted;
- the impact to the system restoration plan;
- if possible, how the loss of functionality will be compensated for;
- the date and time of the loss of functionality;

**R15.** A functional entity that has confirmed the loss of functionality of a **critical component** shall report to the Transmission Operator responsible for operating that **critical component of that critical component's** loss of functional availability as soon as possible but no longer than 15 minutes after becoming aware of the condition.

**R15.1** The Transmission Operator shall report to its Reliability Coordinator as soon as possible but no longer than 15 minutes after the functional entity has made the Transmission Operator aware of the loss of functionality of the **critical component**.

Examples of such conditions are but not limited to:

- Loss of control of remote equipment;
- Complete loss of AC or DC service supply;
- Loss of blackstart facilities.

**R16.** A functional entity that has confirmed the loss of redundancy of a **critical component** shall report to the Transmission Operator responsible for that **critical component** as soon as possible but no longer than 12 hours after the functional entity's staff has confirmed the loss of redundancy for the **critical component**.

Examples of such conditions are:

- Loss of a redundant AC or DC service supply;
- Loss of redundant blackstart **critical components**.

**R17.** A functional entity that has scheduled a maintenance condition of a **critical component** that will result in the loss of functionality of that **critical component** shall report that maintenance condition to the

Transmission Operator responsible for the **critical component** at least 24 hours prior to that scheduled loss of functionality.

**R17.1** The functional entity shall report to the Transmission Operator responsible for the **critical component** as soon as possible after the loss of functionality has occurred.

**R17.2** If the scheduled maintenance condition causing the loss of functionality of a **critical component** affects the functionality of a **key facility**, the Transmission Operator responsible for the **critical component** shall report this scheduled maintenance condition to its Reliability Coordinator.

**R18.** A functional entity shall report the actions to be taken to restore a **critical component's** availability or redundancy to the Transmission Operator responsible for the **critical component** as soon as known.

**R18.1** The functional entity shall report to the Transmission Operator responsible for that **critical component** the anticipated time that the **critical components** functionality will be restored.

**R18.2** The functional entity shall report to the Transmission Operator responsible for maintaining redundancy for a **critical component** the anticipated time that the **critical component's** redundancy will be restored.

**R19.** A functional entity shall report the date and time when the functional availability of a **critical component** is restored to the Transmission Operator responsible for the **critical component** as soon as known.

## 4.0 Compliance

### 4.1 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 template associated with this Directory.

Testing of **critical components** shall be in accordance with the duration, testing intervals and criteria for a successful test as specified in PRC-005.

### 4.2 Data Retention

Responsible Entities shall keep evidence of compliance for a minimum of five (5)

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years. A Responsible Entity found non-compliant shall keep information related to the non-compliance until found compliant.

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Prepared by: Task Force on Coordination of Operation

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.

Reference: NPCC Glossary of Terms

**Appendix A--Table 1 - Standard Test Procedures for key facilities and associated critical components required for system restoration**

<b>Table 1 - Standard Test Procedures for key facilities and associated critical components required for system restoration</b>				
<b>Test No.</b>	<b>Critical Component</b>	<b>Test</b>	<b>Test Frequency and Duration</b>	<b>Criteria for Successful Test</b>
<b>BS-1</b>	Blackstart Generating Units	Blackstart Generating Unit Startup Test	<u>Frequency:</u> every twelve (12) calendar months  <u>Duration:</u> 10 minutes of stable operation	Successful startup and 10 minutes of stable operation; all operating aids and auxiliary systems are independent.
<b>UG-1</b>	Pressurization system of underground transmission <b>cables</b>	<b>Cable</b> Backup Pressurization System Test	<u>Frequency:</u> every six (6) calendar months  <u>Duration:</u> minimum of 30 minutes	Maintains safe dielectric pressure for the minimum test period

Appendix A--Table 1 - Standard Test Procedures for key facilities and associated critical components required for system restoration				
Test No.	Critical Component	Test	Test Frequency and Duration	Criteria for Successful Test
KF-1	Battery chargers and batteries for <b>Key Facilities*</b>	Equipment <u>Inspection</u>	<u>Frequency:</u> In accordance with maintenance activities and maintenance intervals specified in PRC-005 <i>Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance.</i>	In accordance with maintenance activities and maintenance intervals specified in PRC -005 <i>Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance.</i>
KF-2	Battery chargers and batteries for <b>Key Facilities</b>	Equipment <u>Verification</u>	<u>Frequency:</u> In accordance with maintenance activities and maintenance intervals specified in PRC-005 <i>Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance.</i>	In accordance with maintenance activities and maintenance intervals specified in PRC -005 <i>Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance.</i>
KF-3	Battery chargers and batteries for <b>Key Facilities</b>	Confirm that all <b>Critical Component Loads</b> can be Supplied	<u>Frequency:</u> once every sixty (60) calendar months or when modifications are made	Confirm that all <b>critical component loads</b> are connected to and can be sufficiently supplied from battery chargers and batteries.

\*Refer to standard PRC-005 *Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance*, Table 1-4(f) Exclusions for Protection System Station dc Supply Monitoring Devices and Systems



Appendix A--Table 1 - Standard Test Procedures for key facilities and associated critical components required for system restoration				
Test No.	Critical Component	Test	Test Frequency and Duration	Criteria for Successful Test
KF-4	(Intentionally Left Blank)			
KF-5	Backup power generators at <b>Key Facilities.</b>	Startup and Run Test	<u>Frequency:</u> monthly  <u>Duration:</u> minimum of 15 minutes.	Successful startup followed by 15 minutes of stable operation.
KF-6	Backup power generators at <b>Key Facilities.*</b>	Startup, Transfer and Load Test	<u>Frequency:</u> every twelve (12) calendar months  <u>Duration:</u> minimum of 30 minutes	<ul style="list-style-type: none"> <li>- Successful startup (automatically started type)</li> <li>- Transfer scheme operates correctly (automatically started type)</li> <li>- 30 minutes of stable operation supplying <b>critical component loads</b> (both automatically and manually started backup generators)</li> </ul>

\*Power sources used to start blackstart units will be excluded from test KF-6.

<b>Appendix A--Table 1 - Standard Test Procedures for key facilities and associated critical components required for system restoration</b>				
<b>Test No.</b>	<b>Critical Component</b>	<b>Test</b>	<b>Test Frequency and Duration</b>	<b>Criteria for Successful Test</b>
CC-1	Uninterruptible power supply (UPS) system at all control centers and telecommunication centers that are designated <b>key facilities</b> .	AC Supply Interruption Tests	<p><u>Frequency:</u> every twelve (12) calendar months</p> <p><u>Duration:</u> for a time that is sufficient for backup power sources to restore AC supply to the UPS</p>	No impact on computer or telecommunication functions during testing

<b>Appendix A--Table 1 - Standard Test Procedures for key facilities and associated critical components required for system restoration</b>				
<b>Test No.</b>	<b>Critical Component</b>	<b>Test</b>	<b>Test Frequency and Duration</b>	<b>Criteria for Successful Test</b>
				-
<b>CC-2</b>	Computer systems at all control centers and telecommunication centers that are designated <b>key facilities.</b>	Computer Redundancy Test	Redundancy check every six (6) calendar months	<ul style="list-style-type: none"> <li>- No impact on computer functions during testing.</li> <li>- Successful switching / testing without equipment failure.</li> </ul>

## **Appendix B: NERC ERO Reliability Standards**

The NERC ERO Reliability Standards containing requirements associated with this Directory but not necessarily enforceable in all NPCC areas include but may not be limited to:

- EOP-005 “System Restoration from Blackstart Resources”
- EOP-006 “System Restoration Coordination”
- PRC-005 “Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance”

**Appendix C-Table 2: Comparison of Test Procedures for Critical Components of Key Facilities of the System Restoration Plan**

<b>Comparison of Test Procedures for Critical Components of Key Facilities of the System Restoration Plan</b>	
<b>New D8 Test No.</b>	<b>Equivalent Test No. in Previous D8 Versions</b>
UG-1	UG-1
KF-1	ST-1
KF-2	ST-2, ST-4
KF-3	ST-3, CC-2
KF-4 has been reconstituted into KF-2	
KF-5	ST-5, CC-3
KF-6	ST-6, CC-4
CC-1	CC-1
CC-2	CC-5
BS-1	BS-1