

System Restoration Manual

November 2019

1. OVERVIEW

This Manual addresses the restoration plan for the New York Reliability Coordinator Area, including the procedures, documentation, training, and testing for the New York Independent System Operator (NYISO) and its Market Participants, to ensure the NYISO Reliability Coordinator Area capability for reliable system restoration following a major or total blackout.

1.1 References

This Manual was written to adhere to and support the following standards:

- NERC Standard EOP-005-3 – System Restoration Plans (available from <https://www.nerc.com/pa/Stand/Reliability%20Standards/EOP-005-3.pdf>)
- NERC Standard EOP-006-3 – Reliability Coordination - System Restoration (available from <https://www.nerc.com/pa/Stand/Reliability%20Standards/EOP-006-3.pdf>)
- NERC Standard EOP-007-0 – Establish, Maintain, and Document a Regional Black Start Capability Plan (available from <http://www.nerc.com/files/EOP-007-0.pdf>)
- NERC Standard EOP-009-0 – Documentation of Black Start Generating Unit Test Results (available from <http://www.nerc.com/files/EOP-009-0.pdf>)
- NPCC Directory 8 – System Restoration (available from https://www.npcc.org/Standards/Directories/Directory%208%20Revised_20180925.pdf)
- NPCC Document– Glossary of Terms (available from <https://www.npcc.org/Standards/Directories/Glossary%2020171103.pdf>)
- NYSRC Reliability Rules - Section F – System Restoration & Section G – Local Area Operation (available from <http://www.nysrc.org/pdf/Reliability%20Rules%20Manuals/RRC%20Manual%20V44.pdf>)

1.2 Strategy

The strategy for prompt restoration of the NYISO’s Reliability Coordinator Area rests on three main principles:

1. Restoration procedures are based on restoration of a backbone of high voltage lines, but allowing operators flexibility to adjust the restoration path for actual system conditions;
2. Periodic training on restoration concepts and procedures; and
3. Periodic drills on restoration procedures to exercise details of procedures and reinforce restoration concepts and strategy.

The objective of the New York Control Area (NYCA) restoration plan is to energize the 345-KV transmission backbone from Black Start Facilities. This transmission backbone consists of four paths: Albany into New York City; Massena to Utica; Buffalo to Utica to Albany, and Buffalo to Binghamton to Albany. From this backbone there are a multitude of

options to restore transmission, access available generation, and coordinate the restoration efforts with the New York Transmission Owners (TOs) and neighboring areas.

Since the exact extent or nature of a disturbance cannot be predicted, procedures are prepared as general guidelines. The NYISO restoration procedure has been developed in conjunction with the NYISO Restoration Diagram and supporting documents. These common references provide the operator with guidelines for bulk power system restoration within the NYISO. These guidelines also provide the basis for alternative restoration actions if normal restoration procedures cannot be executed due to system conditions.

Prompt restoration of the NYISO total customer load is best accomplished by the restoration of the NYS Power System. Although some customer load may be picked up during this procedure in order to maintain stability and voltage levels, priority must be assigned to the restoration of the major transmission ties. Each TO may restore load within its area in accordance with its own restoration procedure, but load restoration must not delay the NYISO-coordinated restoration of the NYS Power System.

Throughout the restoration process, the restored facilities shall be operated in accordance with the operating procedures and criteria in the *NYISO Emergency Operations Manual* and *NYISO Transmission and Dispatching Operations Manual*, both of which are posted as Operations manuals on the NYISO Web site at the following URL: (<https://www.nyiso.com/manuals-tech-bulletins-user-guides>).

1.3 Priorities

The following operations shall have the highest restoration priority:

- Energizing the backbone of the New York State (NYS) Power System. (Priority shall be given to energizing the Albany to Staten Island and Long Island path, while simultaneously restoring from Buffalo and Massena Black Start Facilities.)
- Synchronizing the NYS Power System with the interconnection.
- Restoring off-site power supplies to nuclear power plants.

The next priority shall be load restoration. If there is limited energy available within the NYCA, preference shall be given to generating station start-up, followed by the restoration of the high-density load portions of the system.

1.4 Coordination

Under normal circumstances, the NYISO will coordinate system restoration among neighboring Reliability Coordinators and Transmission Owners (TOs).

2. RESTORATION PROCEDURES

System restoration will take place at two levels: restoration of the NYISO Reliability Coordinator Area's backbone system in accordance with a NYISO restoration procedure and restoration of local areas in accordance with TO restoration procedures. These procedures shall be designed to restore the NYCA system in a safe, orderly, and prompt manner following a

major or total blackout. Since the exact extent or nature of a disturbance cannot be predicted, the procedures are prepared as general guidelines.

2.1 NYISO System Restoration Procedure

The NYISO's procedures for system restoration are contained in the Restoration State section of the *NYISO Emergency Operations Manual* (posted as an Operations manual on the NYISO Web site at the following URL: <https://www.nyiso.com/manuals-tech-bulletins-user-guides>).

The NYISO Restoration Procedure has been developed by the NYISO and TOs and is contained in Attachment B of the *NYISO Emergency Operations Manual*. The contents of Attachment B constitute Critical Electric Infrastructure Information, therefore distribution is limited. The restoration procedure includes reference documents, which shall be employed by system operators during a restoration event. These include the following:

- a. A Restoration Diagram, which provides a common network configuration reference for all NYCA transmission and substations stations 230 kV and above, identifies available synchronization points on the system, and identifies the preferred energization path to establish the transmission backbone.
- b. A Restoration Procedure, which identifies the Black Start Facilities, the switching operations required to establish the transmission backbone, preferred synchronization points between the Black Start Facilities, guidance on voltage levels to be maintained, locations and magnitudes of load to be restored to maintain system voltage, and brief notes addressing procedure implementation.
- c. A Black Start Facilities List, identifying their location, capabilities, and fuel sources
- d. A Line Charging List associated with all lines 230 kV and above identified in the Restoration Diagram.
- e. A set of Restoration Guidelines, which provides detailed guidance beyond that included in the Restoration Procedure.
- f. An Inter-Area Restoration Coordination table, which provides the elements of coordination in restoring the Interconnection with the neighboring Reliability Coordinators.

2.2 Transmission Owner System Restoration Procedures

Transmission Owners within the NYISO's Reliability Coordinator Area shall maintain local system restoration plans (SRPs) for their transmission districts consistent with NYSRC, NPCC, and NERC standards. These restoration procedures shall be coordinated with the restoration procedures of neighboring TOs. The TOs must maintain current copies of these procedures at the NYISO.

Procedures and protocols for off-site power requirements of nuclear power plants, including priority of restoration, are described in Nuclear Plant Interface Requirement (NPIR)

documents maintained by the local transmission owners and the interconnected nuclear power plant.

2.3 Black Start Resource Restoration Procedures

Each Generator Operator with a Black Start Resource shall have documented procedures for starting each Black Start Resource and fulfilling its requirements in the SRP without the availability of an outside electric supply.

3. RESTORATION-RELATED FACILITIES

The NYISO and the TOs within the NYISO's Reliability Coordinator Area shall secure adequate Black Start Facilities to meet the requirements of the NYISO's System Restoration Procedure. Black Start Resources are individual units that have the capability, following a system-wide blackout, to start up and energize a bus without the availability of an outside electric supply. Black Start Facilities are multi-unit plants, containing at least one Black Start Resource, where the entire plant can be restarted without the availability of an outside electric supply. All Black Start Facilities must incorporate at least one Black Start Resource. It is not required that all units at a Black Start Facility be Black Start Resources.

3.1 Black Start Resources

3.1.1 NYISO Black Start Service Resources

The NYISO determines the need and adequacy of Black Start Facilities for the NYISO's restoration procedure through operating studies and simulation. The NYISO restoration procedure shall include identification of any Black Start Facility and the characteristics of such units, including but not limited to the following: the name of the Black Start Facility, location, megawatt and megavar capacity, and type of unit. Procedures for acquiring the necessary Black Start Resources as identified in NYISO studies are in Section 7, Black Start Capability Service, of the *NYISO Ancillary Services Manual* (posted as an Operations manual on the NYISO Web site at the following URL: <https://www.nyiso.com/manuals-tech-bulletins-user-guides>).

3.1.2 Transmission Owner Black Start Service Resources

Transmission Owners within the NYISO's Reliability Coordinator Area are responsible for determining the need and adequacy of Black Start Facilities to meet the requirements of their local restoration procedure. The TO restoration procedure shall include identification of any Black Start Facilities and the characteristics of such units, including but not limited to the following: the name of the Black Start Facility, location, megawatt and megavar capacity, and type of unit. The identity of TO Black Start Facilities shall be made available to the NYISO and to affected TOs. Transmission Owners are responsible for procuring any required local Black Start Resources.

3.1.3 Black Start Testing Procedures

Black Start Testing procedure requirements shall be designed by the Transmission Operator to ensure Black Start Facilities are able to perform their intended function in the SRP. The number of units to be included in the Black Start Resource test procedures shall be determined by the SRP requirements to control voltage and frequency.

Each Generator Operator with a Black Start Resource shall prepare Black Start Resource specific testing procedures, perform Black Start Resource tests, and maintain records of such testing, in accordance with the testing requirements set by the Transmission Owner to

verify the unit's ability to, following a system-wide blackout, start up and fulfill its requirements in the SRP without the availability of an outside electric supply.

The most current test procedure shall be provided to the NYISO, and in the case of local Black Start Resources, to the appropriate TO, upon request.

3.1.4 Black Start Resource Testing Requirements

The annual test requirements for each Black Start Resource shall include the ability to:

1. Start with no support from the Bulk Electric System.
2. Energize a transmission bus or a generating station switchyard element
3. Operate in a stable condition while isolated from the Bulk Electric System for a minimum of ten minutes.

The Transmission Owner may specify additional testing requirements

3.1.5 Black Start Testing Frequency

At least once each capability year each Black Start Facility in the NYISO's Reliability Coordinator Area must successfully test or demonstrate the ability of their Black Start unit(s) to perform their intended function as required by the NYISO's or local TO's SRP.

The NYISO shall determine the time within the capability year that the testing shall be completed.

Tests must be coordinated with the NYISO and the TO in whose service territory the unit is located.

3.1.6 Documentation of Black Start Testing

Generator Operators of Black Start Resources shall document the date, start-time, and duration of all tests, and indicate if the tests meet the criteria in the unit's Black Start test procedure. Testing will be certified to the NYISO through the form found in the *Services Tariff*, Rate Schedule 5, Appendix I (available from the NYISO Web site at the following URL: <https://www.nyiso.com/regulatory-viewer>). This documentation must be provided to the NYISO within 30 calendar days following a request from the NYISO.

Each Generator Operator, for each Black Start unit, shall annually provide a letter to the NYISO confirming that it identifies and maintains a list of critical components in its facilities (i.e., batteries, diesel back-up generators, inverters, etc.) to verify the condition of these critical components in accordance with good industry practice.

The NYISO shall maintain a database of all units identified as Black Start Resources for use in the SRP. This database shall include the name, location, megawatt capacity, megavar capacity, type of unit, latest date of test, and starting method for each unit.

4. COMMUNICATIONS DURING RESTORATION

4.1 Normal and Emergency Communications Procedures

Normal and emergency communications procedures and protocols for use during Restoration State recovery actions are found in the Communications section of the *NYISO Emergency Operations Manual* (posted as an Operations manual on the NYISO Web site at the following URL: (<https://www.nyiso.com/manuals-tech-bulletins-user-guides>))

4.2 Loss of Communications with the NYISO

If all communication is lost between the Power Control Center and TOs, the TOs shall proceed to restore the NYS Power System using inter-company communication facilities to coordinate all aspects of the restoration according to the procedures in the Restoration State section of the *NYISO Emergency Operations Manual* (posted as an Operations manual on the NYISO Web site at the following URL: (<https://www.nyiso.com/manuals-tech-bulletins-user-guides>)).

4.3 Incident Command Structure Protocol

The NYISO has developed an internal procedure for establishing an Incident Command Structure (ICS) protocol in order to manage and prioritize off-floor communications during bulk power disturbances. Key elements of this protocol have been shared with appropriate entities for coordination of communication during system recovery.

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5. REVIEWING AND UPDATING THE SYSTEM RESTORATION PROCEDURE

5.1 NYISO Procedure Review, Verification, Update, and Distribution

5.1.1 NYISO Procedure Review

NYISO's SRP review is conducted annually by the NYISO and TOs. This review will incorporate feedback from simulation exercises, restoration training, and an annual NYISO Restoration Drill. The simulation exercises and restoration training shall exercise the coordination between the NYISO restoration procedure and the procedures of the TOs and the neighboring Reliability Coordinators. The annual restoration drill will also include testing telecommunication facilities and protocols, as well as confirming the specific procedures identified in the plan are adequate to implement the restoration strategy.

Additional reviews of the NYISO's procedure should be performed if the NYISO or TOs deem it necessary due to significant changes to the power system network or modeling. Review of the restoration procedures of the TOs and neighboring Reliability Coordinators shall be incorporated into the annual review of the NYISO SRP. Following the review, the NYISO and TOs will update the procedure, if required.

Feedback and recommended updates to the NYISO procedure should be documented.

5.1.2 NYISO Procedure Verification

The NYISO shall verify through analysis of actual events, steady state and dynamic simulations, or testing that its restoration procedure accomplishes its intended function. This shall be completed every five years at a minimum. Such analysis, simulations, or testing shall verify:

- The capability of Black Start Facilities to meet the Real and Reactive Power requirements of the Cranking Paths and the dynamic capability to supply initial Loads,
- The location and magnitude of Loads required to control voltages and frequency within acceptable operating limits, and
- The capability of generating resources required to control voltages and frequency within acceptable operating limits.

Following an event where the system restoration procedure was invoked, both the NYISO and the TOs shall analyze and report on the performance of their restoration procedures.

5.1.3 NYISO Procedure Update

Following the annual review addressed in Section [5.1.1](#), the NYISO and TOs will update the NYISO restoration procedure, if required. The NYISO shall update its restoration

procedure within 90 calendar days after identifying any unplanned permanent System modifications, or prior to implementing a planned BES modification that would change the implementation of its restoration procedure.

5.1.4 NYISO Procedure Distribution

The NYISO shall distribute its most recent restoration procedure to the TOs within 30 calendar days of creation or revision. The NYISO shall provide the entities identified in its approved restoration procedure with a description of any changes to their roles and specific tasks prior to the implementation date of the procedure.

5.2 Transmission Owner Procedure Review, Verification, Update, and Distribution

5.2.1 Transmission Owner Procedure Review

The TOs shall review their local restoration procedures annually and prior to implementing any planned system modification that could affect the coordination of the NYISO and TO restoration procedures. These reviews shall evaluate the impact of procedure changes, system expansion, or system reconfiguration.

5.2.2 Transmission Owner Procedure Verification

Each TO shall verify through analysis of actual events, steady state and dynamic simulations, or testing that its restoration procedure accomplishes its intended function. This shall be completed every five years at a minimum. Such analysis, simulations, or testing shall verify:

- The capability of Black Start Facilities or ties from neighboring systems to meet the Real and Reactive Power requirements of the Cranking Paths and the dynamic capability to supply initial Loads,
- The location and magnitude of Loads required to control voltages and frequency within acceptable operating limits, and
- The capability of generating resources required to control voltages and frequency within acceptable operating limits.

Following an event where the system restoration procedure was invoked, TOs shall analyze and report on the performance of their restoration procedures.

5.2.3 Transmission Owner Procedure Update

The TOs shall update their restoration procedures within 90 calendar days after identifying any unplanned permanent System modifications. The TOs shall update their restoration procedures prior to implementing a planned BES modification that would change the implementation of their restoration procedures. In the event of any proposed changes to TO facilities or procedures that could affect the coordination of the NYISO and TO restoration procedures, the TOs shall provide notification at least two months prior to implementation.

5.2.4 Transmission Owner Procedure Distribution

Each TO shall distribute its most recent restoration procedure to the NYISO within 30 calendar days of creation or revision. The TO shall provide the entities identified in its approved restoration procedure with a description of any changes to their roles and specific tasks prior to the implementation date of the procedure.

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6. RESTORATION TRAINING

6.1 NYISO Restoration Training

The NYISO shall provide for training NYISO and Market Participant operating personnel for the effective implementation of the NYCA SRP in the following area:

- Annual coordinated restoration training for NYISO and TO system operators, including:
 - Energization paths and initial switching requirements exiting the Black Start Facilities
 - Identification of acceptable voltage and frequency limits during restoration,
 - Operating Processes to reestablish connections between restored systems,
 - Simulation exercises that include modeling of each transmission owner's SRP, and
 - Annual simulations of full or partial system shutdowns and restoration, including the issuance of critique as input to the annual review of the restoration procedure.

Black Start Providers and other generator owners shall be invited to participate in training sessions and exercises as appropriate.

The NYISO shall maintain training program records showing that operating personnel have been trained in the implementation of the NYCA SRP and participated in restoration exercises.

6.2 Transmission Owner Restoration Training

Each TO shall provide for training of operating personnel for the effective implementation of the NYCA SRP in the following areas:

- Annual restoration training for its operating personnel on the local system restoration procedure
- A minimum of two hours of System restoration training every two calendar years to its field switching personnel identified as performing unique tasks associated with the TO's restoration procedure that are outside of their normal tasks.

Each TO shall participate in NYISO restoration drills, exercises, or simulations as requested by the NYISO.

The TOs shall maintain training program records showing that operating personnel have been trained in the implementation of the local system restoration procedure. These records shall be made available to the NYISO upon request.

6.3 Generator Operator Restoration Training

Each Generator Operator shall participate in NYISO restoration drills, exercises, or simulations as requested by the NYISO.

Each Generator Operator with a Black Start Resource shall provide a minimum of two hours of training every two calendar years to each of its operating personnel responsible for the startup of its Black start Resource generation units and energizing a bus. The training program shall include training on the following:

- System restoration procedure elements requiring coordination with the TO
- Procedures for starting each Black Start Resource and energizing a bus

Each Generator Operator with a Black Start Resource shall maintain training program records showing that operating personnel have been trained in the implementation of Black Start procedures. These records shall be made available to the NYISO upon request.