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Independent System Operator

Manual 33

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Version	Effective Date	Revisions
1.0	10/29/2009	Initial Release
1.1	8/4/2011	Section 1 ➢ Multiple edits reflecting change in scope of NERC/NPCC requirements Section 2.2 ➢ Clarifying edit Section 3.4.4.1 ➢ Additional reporting requirements listed Section 3.4.4.5 ➢ UTC contact information updated Section 4.2 ➢ NPCC D-12 email schedule modification Section 4.6 ➢ Reference to NPCC B-7 removed Appendix B.2 ➢ clarification
2.0	12/31/2013	Section 2 ➢ Multiple additions and revisions on DME and DDR specifications for NYCA Section 3 ➢ Multiple edits reflecting clear abbreviations and reclosing statements clarifications Section 4 ➢ Updated Table 1 for UFLS as per latest NPCC D-12 Section 5 ➢ Multiple edits reflecting dates of data collection Appendix B.2 ➢ Clarification Appendix D ➢ Addition
3.0	04/01/2016	Section 1 ➢ Revised to Bulk Electric System Section 1.1 ➢ Revision in the Scope Section 1.4

		➢ Multiple additions and revisions to reflect the Information Collected and data format changed to NPCC Misoperations reporting template Section 1.4.2 ➢ Deletion of this section and merged with section 1.4.1 Section 1.5.2 ➢ Deletion of this section and merged with section 1.5.1 Section 1.6 ➢ Multiple revisions to clear the reporting and review process of quarterly reports Section 1.7 ➢ Revision to include the non-reportable events Section 2.1 ➢ Definitions changed to Acronyms Section 2.6 ➢ NYSRC Rule C-R5 changed to NYSRC Rule I-R5 with the revised NYSRC Rule Section 2.7 ➢ Revisions made to reflect the current applicable standards Section 3.6 ➢ Deletion of this section Section 3.3.1 ➢ Updated the assumptions for calculating the fault clearing times Section 4 ➢ Multiple edits in Scope Section 4.1 ➢ Multiple additions and revisions to include the applicable entities Section 4.2 ➢ Deletion of old section ➢ Addition of Applicable NERC,NPCC and NYSRC standards Section 4.3 ➢ Deletion of old section ➢ Addition of UFLS program Section 4.4 ➢ Deletion of old section ➢ Addition of Applicable entities actions to conform the UFLS program Section 4.5 ➢ Deletion of old section ➢ Addition of Methodology Section 4.6

		➢ Deletion of old section ➢ Addition of UFLS program Performance requirements Section 4.7 ➢ Addition of Criteria to meet the UFLS program design performance characteristics Section 4.8 ➢ Addition of UFLS program assessment requirements Section 4.9 ➢ Addition of Format for UFLS data submittal Section 4.10 ➢ Addition of UFLS Schedule Section 4.11 ➢ Multiple edits to reflect the updated applicable standards Section 5 ➢ Deletion of this section as Maintenance reporting is no longer under the scope of SPAS Appendix A ➢ Renamed to Attachment A Appendix B ➢ Renamed to Attachment B ➢ Deletion of the old format instructions ➢ Addition of the NPCC Misoperations reporting Template Appendix C ➢ Renamed to Attachment C Appendix D ➢ Renamed to Attachment D ➢ Updated Table D.1 as per the revised scope
3.1	06/30/2017	Section 1.2 ➢ Updated Data collection and Reporting Timeline Section 1.3.1 ➢ Updated reporting format as per NERC standard Section 1.3.2 ➢ Updated reporting format as per NERC standard Section 1.5.1 ➢ Updated reporting format as per NERC standard Section 1.6 ➢ Updated reporting format as per NERC standard Section 2.7 ➢ Updated references to NERC and NPCC standards Section 4.11 ➢ Updated references to NERC and NPCC standards

		Attachment B removed and Attachment C and D updated to be new Attachment B and C. All the references to these are updated in the Manual.
3.2	08/26/2019	Section 1.2 ➢ Revised SPAS practice to review PSP reports for the two prior quarters Section 2.7 ➢ Deletion of reference to retired NYSRC Rule I.5 "Disturbance Reporting" Section 3.5 ➢ Updated references to "Utilities Telecommunications Council" to its current name of "Utilities Technology Council" ➢ Updated UTC contact Section 4.2 ➢ Deletion of reference to retired NYSRC Rule D.2 "Underfrequency Load Shedding" Section 4.7 ➢ Updated diagram to reflect changes in PRC-006-3 Section 4.11 ➢ Updated references and links Section A.4 ➢ Updated PES-PSRC link
3.3	06/07/2022	Recertified Section 2.2 ➢ Removed list of DDR locations Section 2.7 ➢ Removed references to NYISO Dynamic Disturbance Recorder Location Study Section 3.4 ➢ Updated references of SPS to RAS in accordance with NERC definitions ➢ Added step for RAS facility owner review process to comply with PRC-012 Section 3.5 ➢ Shifted PLC Frequency collection process to quarterly reports through SPAS, instead of an as-needed basis Section 4 ➢ Updated references reflecting the retirement of NPCC D-12 and updates to NERC standards ➢ Updated figures reflecting updates to NERC standards ➢ Changed frequency of inhibit threshold reviews from annual to once every five years ➢ Format of UFLS Data Submittal Attachment C ➢ Updated PLC Frequency data collection schedule
3.4	12/15/2022	Recertified ➢ Updated broken hyperlinks

		➢ Corrected page numbering
3.5	12/12/2023	Recertified

1. Reporting Transmission and Generation Protection System Operations and Protection System Performance

The processes outlined below are intended to fulfill information sharing for Bulk Electric System (BES) protection system operations as assigned to the New York Independent System Operator (NYISO) System Protection Advisory Subcommittee (SPAS).

1.1. Scope

The NYISO SPAS has the responsibility to exchange information on the design, operation, maintenance, and testing of BES protection equipment and associated communication channels as needed. SPAS reviews BES Protection System Performance (PSP) and maintains a record of all BES protection system misoperations.

1.2. Data Collection and Reporting

NYISO staff facilitates the data collection and review of PSP reports and protection system misoperations with the New York Control Area (NYCA) Transmission and Generation Owners on a quarterly basis. This report is exactly the same as the report submitted on a quarterly basis to NERC via Misoperation Information Data Analysis System (MIDAS).

During each quarter's SPAS meeting, the misoperations reports from the two quarters prior will be reviewed. On or about the 20th day of the last month of each quarter, NYISO staff shall initiate a reminder via e-mail to those individuals identified by each BES Transmission Owner and Generation Owner as their PSP contact. The reminder shall set forth the collection schedule. The collection schedule is normally as outlined in the following two subsections.

1.2.1. Transmission Owner Collection Schedule

PSP data for each quarter shall be transmitted to NYISO staff by e-mail on or before the 20th of the month that follows each quarter.

1.2.2. Generation Owner Collection Schedule

Generation Operations data for each quarter shall be transmitted to NYISO staff by e-mail on or before the 20th of the month that follows each quarter.

1.3. Transmission of Data and Discussion of Results

The quarterly data is then tabulated and distributed to SPAS for review at the next regularly scheduled SPAS meeting. For this reason, SPAS meetings are normally scheduled shortly after the PSP data is due. This schedule may be adjusted in some quarters due to constraints such as conflicting meetings.

1.3.1. Transmission Owners

Each Transmission owner representative shall submit all reportable misoperations for two quarters prior to the current quarter in the section 1600 NERC MIDAS format. At the SPAS meeting, misoperations of particular interest may be discussed within the group.

1.3.2. Generation Owners

Generation Owner representatives are encouraged to attend the SPAS meetings to discuss their operations; however, due to the relatively few generation-related protective system operations, it is acceptable for the Generation Owners to simply submit the section 1600 NERC MIDAS format and be available by phone to discuss the operations, if deemed necessary by NYISO staff and/or the SPAS. NYISO staff shall summarize the results from the two quarters prior to the current quarter and provide a verbal report on any operation judged to be incorrect.

1.4. Information Collected and Data Format

1.4.1. Transmission Owners and Generation Owners

As a minimum, the following information shall be reported:

- Resubmittal check
- Regional Entity
- Entity Name
- NERC ID
- Misoperation Date
- Misoperation Time
- Time Zone
- Facility Name
- Equipment Name
- Equipment Type
- Facility Voltage
- Equipment removed from Service
- Event Description
- Misoperation Category
- Causes of Misoperation
- Incorrect setting/logic/Design Errors and Relay failures / Malfunctions sub-cause code
- Protection Systems/Components that Misoperated
- Relay Technology
- TADS reportable event and its Event IDs, if applicable
- Generator Forced outage, if any
- Analysis and Corrective Action Status
- Corrective Action Plan

- Target Completion Date
- Actual Completion Date
- Name of Individual Making Report
- Phone
- Email
- Date of Report

Collection methods are subject to updates and revisions as required.

1.5. Data Collection

1.5.1. Transmission Owners and Generation Owners

New York State Transmission Owners shall use the section 1600 NERC MIDAS reporting template to transmit the PSP data to the NYISO. Collection methods are subject to updates and revisions as required.

1.6. Follow-Up Actions

NYISO staff will archive the PSP reports as they are received in advance of each SPAS meeting and shall present the summarized PSP reports for discussion during the SPAS meetings.

Any items that are incomplete or remaining under investigation should be included in the next quarter's template as per the section 1600 NERC MIDAS format.

1.7. Non-NPCC Reportable Events

Any other event that would be of interest to the NYISO or SPAS could be reported as supplemental, outside of the reporting as described above.

2. Application of Disturbance Monitoring Equipment (DME)

Disturbance Monitoring Equipment (DME) as used in this document includes, but is not necessarily limited to, dynamic disturbance recorders, digital fault recorders, and Phasor Measurement units.

The NYCA has long been a pioneer in the effective application of DME and continues to be exemplary in its ability to effectively use DME to accomplish the three main purposes: (1) model validation, (2) disturbance investigation, and (3) assessment of system protection performance.

The NYCA has also been an active participant in preparation of the various DME-related documents of the IEEE, North American Electric Reliability Corporation (NERC), the Northeast Power Coordinating Council, Inc. (NPCC), and the New York State Reliability Council (NYSRC); several of the most important documents are listed in the Section 2.7, "References," below. This Manual addresses only those items that are not already covered in the applicable documents of NERC, NPCC, and NYSRC.

2.1. Acronyms

DDR – Dynamic Disturbance Recorder

DFR – Digital Fault Recorder

DME – Disturbance Monitoring Equipment

GO – Generation Owner

NYISO – The New York Independent System Operator

PDC – Phasor Data Concentrator

PMU – Phasor Measurement Unit

TO – Transmission Owner

2.2. Specifications of DDR

2.2.1. Location

DDR locations within NYCA are identified to provide a minimum of one DDR per 3,000 MW of peak load and record dynamic disturbance information. The DDR locations were determined considering the NERC PRC-002-2 criteria.

2.2.2. Capabilities

DDRs within NYCA shall have the following dynamic disturbance recording capabilities:

- Function as continuous recorders.

- A minimum recording time of sixty (60) seconds per trigger event.
- A minimum sample rate of 960 samples per second, and a minimum data storage rate for RMS quantities of six (6) data points per second.
- DDRs shall be set to trigger for at least one of the following:
  - Rate of change of frequency (recommended ±30 mHz/s).
  - Rate of change of power (recommended ±5 MW/s).
  - Delta frequency (recommended ±20 mHz).
  - Delta voltage (recommended ±0.05 Vpu).
  - Oscillation of frequency (recommended 0 to 3 Hz).

2.2.3. Monitored or Derived Quantities

DDRs within NYCA shall monitor or derive the following dynamic disturbance quantities:

- Line currents for most lines such that normal line maintenance activities do not interfere with the DDR functionality.
- Bus voltages such that normal bus maintenance activities do not interfere with the DDR functionality.
- As a minimum, one phase current per monitored Element and two phase-to-neutral voltages of different Elements. One of the monitored voltages shall be of the same phase as the monitored current.
- Frequency.
- Real and reactive power.
- If derived, shall be calculated using the appropriate bus voltages and line current pairs.

2.2.4. PMUs within NYISO Network

PMUs within the NYISO network currently providing data to the NYISO PDCs are considered in compliance with the DDR requirements of NERC PRC-002-2 when local storage of monitored or recorded data is provided and if the above DDR specifications are met.

2.3. Time Zone

The NYISO prefers that DDRs and DFRs be set to Universal Time Zone (identified as UTC).

In the event DDRs and/or DFRs are set to local time, records transmitted to the NYISO shall contain the hours offset from UTC in the file name consistent with the IEEE C37.232 Standard.

2.4. Survey of DME Equipment

NYISO staff shall survey the status of DME in the NYCA approximately every two years. This activity shall be coincident with a NPCC survey if a NPCC survey is undertaken. The following DME survey data may be included but not limited to:

- Type of DME
- Recording and triggering capabilities

- Type of data storage (local or remote)
- Equipment owner
- DME recorded data owner
- Make and model of equipment
- Power system location of DME
- Operational Status
- Monitored elements
- All identified channels
- Monitored and derived quantities
- Trigger settings
- Date of last maintenance testing

2.5. Sharing of DME Data

Through applicable NYISO Tariffs and Market Participant agreements, the NYISO has the right to ask for any DME records or data needed to fulfill its functions as Reliability Coordinator. When necessary, the NYISO will request individual DME records or files from TOs and GOs and DME records must be provided within thirty (30) days from receipt of a request, see Attachment C for collection date. DME records shall contain all monitored channels including analog and binary.

Individual records/files furnished as part of a disturbance investigation shall be in IEEE COMTRADE format (IEEE C37.111), and file names shall be in accordance with IEEE C37.232 convention, except by agreement among the parties involved. Depending on the volume of data, the NYISO may request individual records be forwarded electronically or that a group of files or records be placed on a CD or DVD and shipped to the NYISO by express delivery service.

2.6. Other

DFRs shall automatically extend records when a re-trigger occurs while a recording is in progress.

It is recommended that any new DME to be installed at a NYISO-secured Transmission System facility that functions as a DFR or DDR shall have PMU-capability for future use.

DME installed by New York TOs and GOs shall be operated and maintained in accordance with the requirements of NERC Standard PRC-002-2, NPCC Directory 11, NYSRC Rule I-R5 and NERC Standard PRC-018-1. Consideration shall be given to consultation with NYISO staff in regard to DME locations and configuration.

2.7. References

- NPCC Directory 11, “Disturbance Monitoring Equipment Criteria”
- NERC Standard PRC-002-2, " Disturbance Monitoring and Reporting Requirements"

- NERC Standard PRC-018-1, “Disturbance Monitoring Equipment Installation and Data Reporting”
- NPCC Directory 11 Appendix A, “Guide to Time Synchronization of Substation Equipment”
- NPCC Directory 11 Appendix B, “Guide for Application of Disturbance Recording Equipment”
- IEEE C37.111-1999, “IEEE Standard for Common Format for Transient Data Exchange (COMTRADE) for Power Systems”
- IEEE C37.232-2007, “IEEE Recommended Practice for Naming Time Sequence Data Files”

3. System Protection Data

Transmission system protection data is required to develop and maintain functional models of the transmission and generation NYISO-secured Transmission System facilities or Table A1 of NYISO *Outage Scheduling Manual* (https://www.nyiso.com/manuals-tech-bulletins-user-guides) protection devices that can be used for dynamic simulation and for the coordination of protection facilities with the existing and proposed system reinforcements. Some of the data is also required for other aspects of power system operation and operating studies, such as thermal and voltage contingency analysis. This section describes the requirements and procedures for reporting this data to the NYISO.

Facility Equipment owners' system protection engineering staff shall provide data to the NYISO System Protection Data Coordinator upon request. In general, the time period allowed for such data request is 45 days; however, in special circumstances, a shorter time period may be necessary. Characteristics of protection equipment associated with NYISO-secured Transmission System facilities or Table A1 of NYISO *Outage Scheduling Manual* are important for dynamic simulation and other aspects of NYISO planning and operations which will be collected and surveyed annually by the NYISO Planning group.

3.1. Relay Characteristics

Protection systems may be specifically (rather than generically) modeled when they could operate within the scope of system dynamic simulations (power system stability analyses). When the actual relay system characteristics are not available, a generic relay model may be used. When appropriate, over-current or out-of-step protection may also be modeled. A simplified data submission form is included in this manual as the B.1 Relay Characteristics Form, found on page H.

Relay characteristics are required only for relays that could trip for an apparent three-phase fault (e.g., a power swing) to evaluate the possibility of additional trips during the post-transient swing following the clearing of the fault.

Relay characteristics are not used for the purpose of determining clearing times or for the primary clearing of a fault, in the dynamic simulation. Appropriate clearing times are determined by the design of the protection groups on each transmission facility and are reported separately. Please see the B.2 Clearing Times Form, included in this manual on page I.

Margins should not be applied to the relay characteristic data. In the course of the study analyses, margins may be applied to the relay characteristics when relay actions are evaluated as part of a stability simulation.

3.2. Pilot Protection Systems

Pilot protection systems are defined as those systems that utilize a communications channel in comparing fault conditions at the line terminals of a transmission line to determine whether the fault is internal or external to that particular line section.

The procedures described in this manual shall be used by the Transmission Owners to prepare and submit the protection systems relay characteristics data to the NYISO. The relay data shall be furnished on the B.1 Relay Characteristics Form, found on page H. If the relay schemes do not lend themselves to this form (only Mho-distance or reactance-distance relays), separate pages shall be attached. If the Facility Equipment owner is using the Power Technologies, Inc. PSS/E program, then PSS/E input forms may be attached to the B.1 Relay Characteristics Form.

3.3. Clearing and Reclosing Times

Estimated protection system clearing times and automatic reclosing times are required for all NYISO-secured Transmission System facilities or Table A1 of NYISO Outage Scheduling Manual

3.3.1. Clearing Times

Facility Equipment owners shall use the following assumptions when calculating the fault clearing times to be submitted to the NYISO:

- Maximum system short-circuit capacity.
- Faults are solid, three-phase faults.
- Use both near-end and far-end line faults.
- Speed of operation of circuit breakers and relay equipment is the nominal speed quoted by the manufacturer.
- Clearing time is a single value, from fault inception until breaker clearing.
- For pilot systems, communication time is included for far-end faults.
- No margin shall be added to the clearing times.
- Clearing times for single phase to ground faults may be requested by NYISO staff when needed.

3.3.2. Reclosing Times

The following information is required by the NYISO for reclosing relay protection data:

- High speed reclosing times
- Relay reclosing time in seconds
- Breaker reclosing time in cycles
- Delayed reclosing times in seconds
- First Shot: Hot-bus/dead-line reclosing time in seconds
- Second Shot: Hot-bus/dead-line reclosing time in seconds

- Third Shot: Hot-bus/dead-line reclosing time in seconds

A data submission form is included in this manual as the B.3 Reclosing Data Form, found on page K. Reclosing terms are used as defined in the NPCC document, “Guide for the Application of Auto Reclosing to the Bulk Power Systems,” Document B-1.

3.4. Remedial Action Schemes

Protection-based systems that are designed to monitor special system conditions can have an impact on system operation. The NYISO requires that the following protection systems be described and reported to the NYISO according to the guidelines of this section:

- Remedial Action Schemes (NERC definition)
- Special Protection Systems (NPCC definition)
- Other Remedial Action Systems (NYISO definition)

3.4.1. Remedial Action Schemes

A Remedial Action Scheme, or RAS, is defined by NERC as a scheme designed to detect predetermined system conditions and automatically take corrective actions that may include, but are not limited to, adjusting or tripping generation (MW and MVAR), tripping load, or reconfiguring a system(s).

Remedial Action Schemes are also known as Special Protection Systems (SPS). Both definitions are used interchangeably by NERC/NPCC while the SPS nomenclature is in the process of being phased out.

Facility Equipment owners are required to prepare and submit to the NYISO an SPS description that includes but is not limited to the following information about the SPS:

- Initiating incident (RAS trigger or triggers)
- Resulting action
- Total clearing time
- Reason for use
- Percent of time in service
- NPCC classification

This information shall be provided by the Facility Equipment owner’s System Protection Advisory Subcommittee (SPAS) member or designee to the NYISO System Protection Data Coordinator in accordance with NPCC Criteria.

A RAS description shall be prepared for any RAS that is located within the NYCA or involves any ISO-secured facility or tie line between the NYCA and a neighboring control area.

The NPCC Task Force on System Protection maintains a RAS list that is updated and posted annually by

NPCC.

3.4.2. Other Remedial Action Systems

In addition to NPCC RASs, NYISO TOs, GOs, Load-Serving Entities (LSEs), or other participants may operate other remedial action systems that are similar in concept to RASs and that may have an effect on NYCA operations, even though the scheme does not fit the NERC or NPCC definitions of a RAS. These systems must also be described and reported to the NYISO. Some examples of protection systems could have an effect on NYCA operations are:

- A protection system included in transient stability simulations that effects the results of the simulation
- A protection system that causes a change in operating limits
- A protection system used by a Facility Equipment owner that allows the Transmission Provider to mitigate a transmission security limitation
- A protection system that limits the ability to load a facility to rated Short-Term Emergency (STE) capability

The NYISO System Protection Data Coordinator notifies the SPAS Representative of the Facility Equipment owner when one of the above situations is detected and a NYISO System Impacting Protection Memo report is required.

3.4.3. RAS Data Submission and Updating Procedures

The following procedures apply to all data described in the Sections 3.4.1 and 3.4.2 unless otherwise indicated.

3.4.3.1. Facility Equipment Owner Actions

1. Submit to the NYISO System Protection Data Coordinator updates to the following data for all facilities found to be Bulk Power system facilities by NPCC criteria A-10, upon the implementation of a new System Impacting Protection System, or upon NYISO request:
   a. Relay characteristics using the B.1 Relay Characteristics Form found on page H of this manual.
   b. Clearing times using the B.2 Clearing Times Form, found on page I of this manual.
   c. Reclosing times using the B.3 Reclosing Data Form, found on page K of this manual.
2. Submit to the NYISO System Protection Data Coordinator the RAS report at least three months before placing the RAS in service.
3. Submit RAS data for all new or modified transmission facilities not later than three months prior to the scheduled in-service date of the protection system. If setting changes are made, the data shall be furnished upon implementation.
4. In the case of transmission lines which are interconnections with neighboring control areas, the TO SPAS representative shall submit data for all terminals of the line.

5. Perform an annual review of the RAS to verify that it avoids adverse interactions with other RASs and other protection and control systems.

3.4.3.2. NYISO Actions

1. Once each year the NYISO System Protection Data Coordinator will transmit all data back to each TO SPAS Representative for confirmation or revision.
2. Use the RAS data in the dynamic simulation, thermal, and voltage contingency analysis studies.
3. Inform the Facility Equipment owner SPAS member when RAS conditions are present and a new report is needed.
4. When the review is complete, the NYISO shall issue updates to the NYISO Protection Memo document and distribute to appropriate Facility Equipment owner and NYISO personnel.

3.5. Power Line Carrier Frequencies

This section describes the procedure for coordination of Power Line Carrier (PLC) Frequencies among Facility Equipment owners of NYISO and neighboring systems. As part of the coordination process, information is provided for updating PLC databases maintained by the Utilities Technology Council.

3.5.1. Introduction

Coordination of PLC frequencies within New York State is the responsibility of the NYISO successor group to the System Protection Advisory Subcommittee (SPAS).

In order to carry out these coordination responsibilities, the NYISO participates as part of a working group known as the Power Line Carrier Task Force, or PLC Task Force. This task force comprises designated Utilities Technology Council PLC Data Base Contacts and the NYISO System Protection Data Coordinator.

The PLC Task Force originally collected and supplied information on New York PLC facilities to NERC, which later turned over to UTC the responsibility of maintaining the PLC Database.

3.5.2. Utilities Technology Council PLC Task Force Contacts

Each Facility Equipment owner designates a PLC Task Force contact to represent it. A list of the New York PLC Task Force contacts is maintained by the NYISO.

This list is distributed annually to all PLC Task Force contacts and to SPAS. Changes to this list must be reported by the Equipment owner contact to the NYISO contact and System Protection Data Coordinator as soon as possible. The NYISO will report such changes to the SPAS and all PLC Task Force contacts.

3.5.3. Utilities Technology Council PLC Frequencies Database Reports

Two Utilities Technology Council PLC Frequencies Database reports are available by contacting the

Utilities Technology Council. Turnaround time for receipt of any of the reports is approximately three working days.

- ***Individual Organization Report*** — Details an individual organization's PLC frequencies. The PLC Frequency data is sorted by substation, transmitter and associated receiver(s), and frequencies.
- ***Interference Report*** — Details any PLC or licensed user frequencies that are within potential interference distance or frequency range of a proposed or in-use PLC frequency. The criteria used for interference distance is 50 miles.

3.5.4. PLC Frequency Coordination Procedures

Any changes to PLC frequencies will be presented and discussed as part of the quarterly SPAS meetings. The PLC frequency coordination procedure applies in the following cases:

- To request addition of a new PLC frequency for immediate or future use
- To request a current frequency change

In all these cases, both the NYISO PLC Frequency Data Report form and an updated URC PLC Frequency Database must be completed and sent to the NYISO no later than two weeks prior to the quarterly SPAS meeting. During the SPAS meeting, as part of the regular agenda, the Facility Equipment Owner who is proposing the change (or a PLC Task Force member speaking on their behalf) will bring them up for discussion. The instructions and templates for creating and filling a PLC database file are available on the Utilities Technology Council Web site at this address: https://utc.org/plc-forms-instructions/

All the information in the NYISO PLC Frequency Data Report form must be completed, and the applicable Utilities Technology Council Transaction Code for this form must be specified. All transmitter information entered for the first time shall be designated as transaction code A or P.

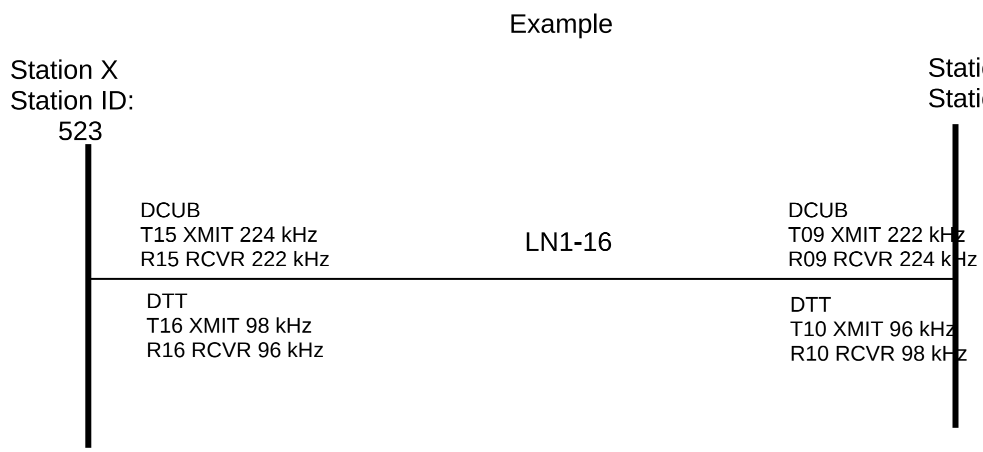
Add in service	A
Add in proposed	P
Correction	C
Delete	D

3.5.4.1. PLC Task Force Contact Actions

The Facility Equipment owner PLC Task Force contact shall initiate the process by submitting a completed UTC PLC Frequency Database and the NYISO PLC Frequency Data Report and forwarding both to the NYISO. The forms shall be completed to indicate each new frequency or change. Additionally, as part of the NYISO PLC Frequency Data Report, a Single-Line Sketch shall be submitted that identifies:

- Station and Station ID
- Line Number

- Transmitter/Receiver ID and its associated frequency
- Associated Communication Scheme (DCB, DCUB, DTT, Etc.) to be added or deleted



3.5.4.2. NYISO Actions

Upon receiving a completed NYISO PLC Frequency Data Report, the NYISO shall send copies of the report to the PLC Task Force Contacts. The NYISO PLC Frequency Data Report will then be added to the agenda of the next quarterly SPAS meeting for discussion.

3.5.4.3. PLC Task Force Contact Actions

5. Within four weeks of discussion of a new NYISO PLC Frequency Data Report at a quarterly SPAS meeting, each PLC Task Force contact shall advise the NYISO by written memorandum of the concurrence or objection with the proposed PLC frequency or frequencies.
6. If there is a conflict, the involved parties shall attempt to work out the difficulty by holding meetings, where necessary, to negotiate solutions to PLC frequency coordination problems.
7. If the approved frequencies resulting from these discussions are different than those originally submitted, the appropriate PLC Task Force contact shall resubmit a revised NYISO PLC Frequency Data Report to the NYISO for redistribution to the PLC Task Force Contacts.

3.5.4.4. NYISO Actions

When frequencies are found satisfactory by all PLC Task Force contacts, the NYISO shall notify the Facility Equipment owner of this result.

3.5.4.5. PLC Task Force Contact Actions

The Facility Equipment owner PLC Task Force contact that originated the Frequency Report shall send an updated version of their UTC PLC Frequency Database to the current designated contact at the Utilities Technology Council. At this time, the address is as follows:

Mike Etzel
Frequency Coordinator

Utilities Technology Council
2511 Richmond Hwy, Suite 960
Arlington, VA 22202
mike.etzel@utc.org
Tel. No.: 202-833-6839

3.5.4.6. Utilities Technology Council Actions

Upon receiving the UTC PLC Frequency Database, the Utilities Technology Council will report other potential conflicts to the affected Facility Equipment owner PLC Task Force contacts.

- If the transaction code was to add a proposed new frequency (P), Utilities Technology Council will report on potential conflicts to the affected Transmission Provider Contact only and not to other users of the low-frequency radio spectrum.
- If the transaction code was to add a frequency already in service, Utilities Technology Council will report the potential conflict to all the PLC Task Force contacts and users of the low-frequency radio spectrum.

3.5.5. Procedures for Retiring PLC Frequencies

When Facility Equipment owners decide to retire a PLC frequency from the Utilities Technology Council PLC database, the same PLC Frequency Data Report is submitted to the NYISO. In this case the applicable Utilities Technology Council Transaction Code is:

- Code D, standing for "deletion of an existing PLC frequency."

Retired PLC frequencies will be announced at the following SPAS meeting. It is not necessary for the Facility Equipment owner's PLC Task Force contact to respond to the NYISO in the case of retired frequencies.

3.5.5.1. PLC Task Force Contact Action

Initiate the process by submitting a completed NYISO PLC Frequency Data Report to the NYISO. This form shall be completed to indicate each frequency retired. A copy of this form shall be sent to the Utilities Telecommunications Council at the address above.

3.5.5.2. NYISO Action

Upon receiving a completed NYISO PLC Frequency Data Report, the NYISO shall send copies of the report to the PLC Task Force contacts.

3.5.6. Annual Review of the PLC Frequencies Database

In addition to the coordination and database update procedures defined, an annual review is required of the Utilities Technology Council database for accuracy.

3.5.6.1. Utilities Technology Council Action

Annually, Utilities Technology Council initiates the review of the PLC Frequencies Database by sending to each PLC Task Force contact a copy of their respective Utilities Technology Council data for review.

3.5.6.2. PLC Task Force Contact Actions

1. Review and revise the Utilities Technology Council database and send it directly to the Utilities Technology Council.
2. Send copies of the PLC Database revisions to the NYISO.

3.5.6.3. NYISO Action

Send copies of received PLC Frequencies Database updates to all of the other PLC Task Force contacts.

4. Automatic Underfrequency Load Shedding Reporting and Compliance

The NYISO Underfrequency Load Shedding (UFLS) program is developed as per the NERC Standard PRC-006-5 Automatic Underfrequency Load Shedding objective to establish design and documentation requirements for automatic UFLS programs to arrest declining frequency, assist recovery of frequency following underfrequency events and provide last resort system preservation measures.

4.1. Applicability

4.1.1. Planning Coordinator

The NYISO is the Planning Coordinator for the NYCA.

4.1.2. UFLS Entities

- NYCA Generator Owners
- NYCA Transmission Owners
- NYCA Distribution Providers or Municipals.

4.2. Applicable Standards

- NERC Standard PRC-006-5 – "Automatic Underfrequency Load Shedding"
- NERC Standard PRC-006-NPCC-2- "Automatic Underfrequency Load Shedding"
- NPCC Directory -2 – "Emergency Operations"

4.3. UFLS Program

The intent of the NYISO Automatic Under Frequency Load Shedding program is to ensure that declining frequency is arrested and recovered in accordance with established performance requirements.

4.3.1. Underfrequency Load Shedding Program Requirements

The UFLS entities shall implement an automatic UFLS program reflecting normal operating conditions excluding outages for its Facilities based on frequency thresholds, total nominal operating time and amounts specified as per Table 4-1 through Table 4-3 as shown below. [Ref :NPCC Standard PRC-006-NPCC-2 Attachment C]

Figure 1: UFLS Program Requirements

UFLS Table 1: Eastern Interconnection **Distribution Providers and Transmission Owners with 100 MW2 or more of peak net Load shall implement a UFLS program with the following attributes:**					
UFLS Stage	**Frequency Threshold (Hz)**	**Minimum Relay Time Delay (s)**	**Total Nominal Operating Time (s)**[1]	**Load Shed at Stage as % of TO or DP Load**	**Cumulative Load Shed as % of TO or DP Load**

1	59.5	0.10	0.30	6.5 – 7.5	6.5 – 7.5
2	59.3	0.10	0.30	6.5 – 7.5	13.5 – 14.5
3	59.1	0.10	0.30	6.5 – 7.5	20.5 – 21.5
4	58.9	0.10	0.30	6.5 – 7.5	27.5 – 28.5
5	59.5	0.10	10.0	2 – 3	29.5 –31.5
1. The total nominal operating time includes the underfrequency relay operating time plus any interposing auxiliary relay operating times, communication times, and the rated breaker interrupting time. The underfrequency relay operating time is measured from the time when frequency passes through the frequency threshold setpoint, using a test rate of frequency decay of 0.2 Hz per second. If the relay operating time is dependent on the rate of frequency decay, the underfrequency relay operating time and any subsequent testing of the UFLS relays shall utilize a test rate of linear frequency decay of 0.2 Hz per second. 2. Peak net load shall be calculated as an average of the peak net load from the previous 3 years, excluding the current year.					

Figure 2: UFLS Program Requirements

UFLS Table 2: Eastern Interconnection **Distribution Providers and Transmission Owners with 50 MW2 or more and less than 100 MW2 of peak net Load shall implement a UFLS program with the following attributes:**					
UFLS Stage	**Frequency Threshold (Hz)**	**Minimum Relay Time Delay (s)**	**Total Nominal Operating Time(s)[1]**	**Load Shed at Stage as % of TO or DP Load**	**Cumulative Load Shed as % of TO or DP Load**
1	59.5	0.10	0.30	14-25	14-25
2	59.1	0.10	0.30	14-25	28-50
1. The total nominal operating time includes the underfrequency relay operating time plus any interposing auxiliary relay operating times, communication times, and the rated breaker interrupting time. The underfrequency relay operating time is measured from the time when frequency passes through the frequency threshold setpoint, using a test rate of frequency decay of 0.2 Hz per second. If the relay operating time is dependent on the rate of frequency decay, the underfrequency relay operating time and any subsequent testing of the UFLS relays shall utilize a test rate of linear frequency decay of 0.2 Hz per second. 2. Peak net load shall be calculated as an average of the peak net load from the previous 3 years, excluding the current year.					

Figure 3: UFLS Program Requirements

UFLS Table 3: Eastern Interconnection Distribution Providers and Transmission Owners with 25 MW[2] or more and less than 50 MW[2] of peak net Load shall implement a UFLS program with the following attributes:					
UFLS Stage	**Frequency Threshold (Hz)**	**Minimum Relay Time Delay (s)**	**Total Nominal Operating Time (s[1]**	**Load Shed at Stage as % of TO or DP Load**	**Cumulative Load Shed as % of TO or DP Load**
1	59.5	**0.10**	0.30	28-50	28-50
1. The total nominal operating time includes the underfrequency relay operating time plus any interposing auxiliary relay operating times, communication times, and the rated breaker interrupting time. The underfrequency relay operating time is measured from the time when frequency passes through the frequency threshold setpoint, using a test rate of frequency decay of 0.2 Hz per second. If the relay operating time is dependent on the rate of frequency decay, the underfrequency relay operating time and any subsequent testing of the UFLS relays shall utilize a test rate of linear frequency decay of 0.2 Hz per second. 2. Peak net load shall be calculated as an average of the peak net load from the previous 3 years, excluding the current year.					

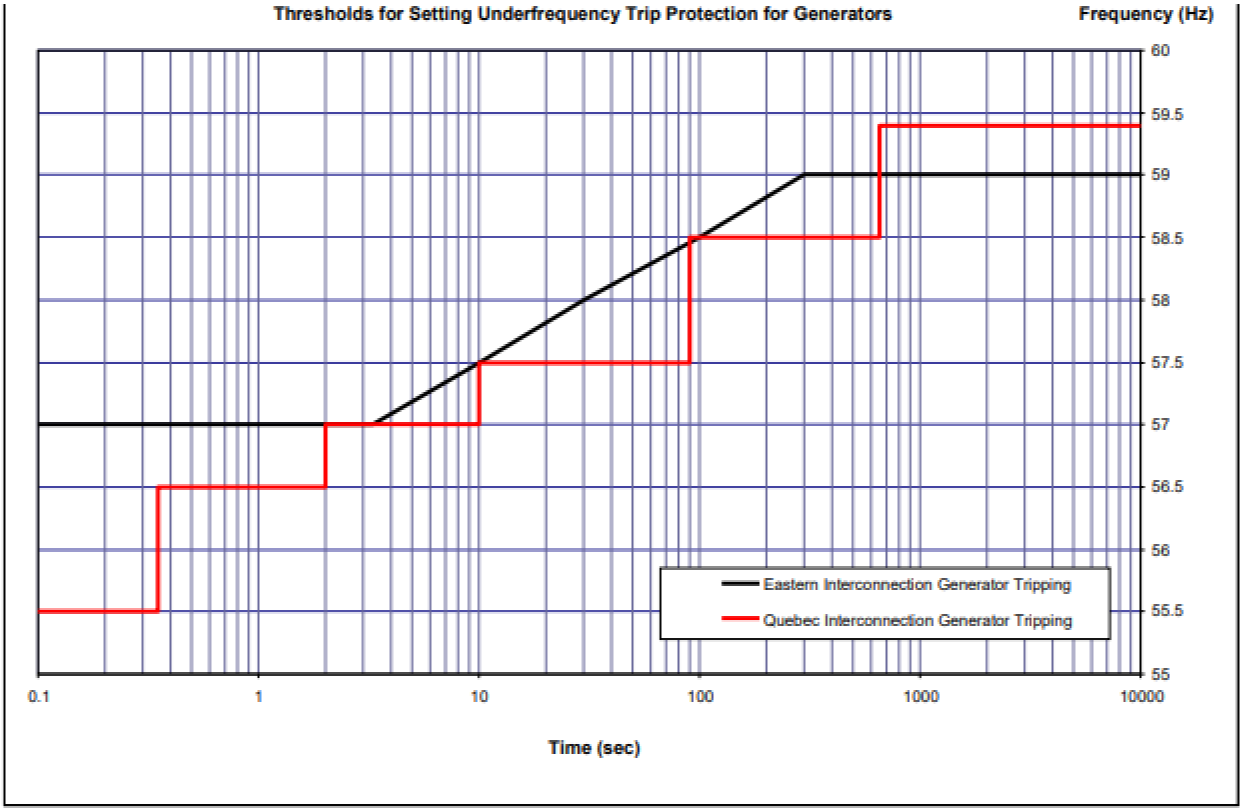
4.3.2. Generator Underfrequency Protection Requirements

Generators shall not be tripped for under frequency conditions in the area above the curve in Figure 1, except for the following:

In special cases, requirements may dictate a generator to trip in the region above the curve in Figure 1. In those cases, the Generator Owners shall notify NYISO and shall ensure through alternate arrangements, that automatic load shedding additional to the amount equivalent to +/- 5% to the amount of generation to be tripped is provided and shall be reviewed by the Task Force on Coordination of Operation.

Generator Owners shall not increase the underfrequency trip settings or make other modifications to the existing exempt generators (that trip above the curve in Figure 1) that may cause these generators to, directly or indirectly, trip at a higher frequency.

Figure 4: Underfrequency Curve for Generators



4.4. Actions to conform to the UFLS Program

NYISO Actions

The NYISO shall perform the following:

1. The requirements for entities aggregating their UFLS programs for each anticipated island and requirements for compensatory load shedding based on islanding criteria are described within this section. The specific sections would include, but not be limited to, the “Transmission Owners and Distribution Providers Actions”, “Generator Owners Actions”, “Transmission Owners, Distribution Owners and Generator Owners Actions”, Section 4.5.1, 4.5.2, 4.5.5, 4.6, 4.8, 4.9, and 4.10.
2. Within 30 days of completion of its system studies required by the NERC PRC Standard on UFLS, identify to the Regional Entity the generation facilities within its area necessary to support the UFLS program performance characteristics.
3. Provide to the Transmission Owner, Distribution Provider, and Generator Owner within 30 days upon written request the requirements for entities aggregating the UFLS programs and requirements for compensatory load shedding program derived from system studies as determined by 1.

4. Develop and review once per calendar year settings for inhibit thresholds (such as but not limited to voltage, current and time) to be utilized within its region's UFLS program.
5. Provide each Transmission Owner and Distribution Provider the applicable inhibit thresholds within 30 days of the initial determination of those inhibit thresholds and within 30 days of any changes to those thresholds.
6. Maintain a UFLS database containing data necessary to model its UFLS program for use in event analyses and assessments of the UFLS program at least once each calendar year.
7. Provide its UFLS database containing data necessary to model its UFLS program to other Planning Coordinators within its Interconnection within 30 calendar days of request.
8. Update its UFLS program database as specified by the NERC PRC Standard on UFLS. This database shall include the following information:
    - Amount and location of load shed at peak, the corresponding frequency threshold and time delay settings for each UFLS relay, including those used for compensatory load shedding.
    - Buses at which the Load is modeled in the NPCC library power flow case.
    - List of all generating units that may be tripped for underfrequency conditions above the appropriate generator underfrequency trip protection settings threshold curve in Figure 1, including the frequency trip threshold and time delay for each protection system.
    - Location and amount of additional elements to be switched for voltage control that are coordinated with UFLS program tripping.
    - List of all UFLS relay inhibit functions along with the corresponding settings and locations of these relays.
9. Notify each Distribution Provider, Transmission Owner, and Generator Owner of changes to load distribution needed to satisfy UFLS program performance characteristics as specified by the NERC PRC Standard on UFLS.
10. Conduct and document an assessment of BES islanding event in its area that results in frequency excursions below the initializing set points of the UFLS program within one year of event actuation to evaluate the performance and effectiveness of the UFLS program.
11. Conduct and document a UFLS design assessment to consider the deficiencies identified during the event assessment performed in (10) above within two years of event actuation.
12. Coordinate with the respective Planning Coordinators the event assessment in (10) above if the BES islanding event included areas or portions of area(s) of other Planning Coordinator(s) through one of the following:
    - Conduct a joint event assessment per (10) above among the Planning Coordinators whose areas or portions of areas were included in the same islanding event, or
    - Conduct an independent event assessment per (10) above that reaches conclusions and recommendations consistent with those of the event assessments of the other Planning Coordinators whose areas or portions of whose areas were included in the same islanding event, or
    - Conduct an independent event assessment per (10) above and where the assessment fails to reach conclusions and recommendations consistent with those of the event assessments of the other Planning Coordinators whose areas or portions of areas were included in the same islanding event, identify differences in the assessments that likely resulted in the differences in the conclusions and recommendations and report these

differences to the other Planning Coordinators whose areas or portions of areas were included in the same islanding event and the ERO.

13. Respond to the written comments submitted by UFLS entities following comment period and before finalizing its UFLS Program, indicating in the written response to comments whether changes will be made or reasons why changes will not be made to the following:
    - UFLS Program, including a schedule for Implementation
    - UFLS design assessment
    - Format and schedule of UFLS data submittal

Transmission Owners and Distribution Providers Actions

The TOs and DPs shall perform the following:

1. Implement an automatic UFLS program reflecting normal operating conditions excluding outages for its Facilities based on frequency thresholds, total nominal operating time and amounts specified in Tables 1 through 3, or shall collectively implement by mutual agreement with one or more Distribution Providers and Transmission Owners within the same island identified and acting as a single entity, provide an aggregated automatic UFLS program that sheds their coincident peak aggregated net Load, based on frequency thresholds, total nominal operating time and amounts specified in Figure 1 through Figure 3.
2. Distribution Provider or Transmission Owner that must arm its load to trip on Underfrequency in order to meet its requirements as specified and by doing so exceeds the tolerances and/or deviates from the number of stages and frequency set points of the UFLS program as specified in the Figure 1 through Figure 3 as shown above, as applicable depending on its total peak net Load shall:
    - Inform NYISO of the need to exceed the stated tolerances or the number of stages as shown in UFLS Figure 1 if applicable, and
    - Provide NYISO with a technical study that demonstrates that the Distribution Providers or Transmission Owners specific deviations from the requirements of UFLS Figure 1 will not have a significant adverse impact on the bulk power system, and
    - Inform NYISO of the need to exceed the stated tolerances of UFLS in Figure 2or Figure 3, and in the case of Figure 2 only, the need to deviate from providing two stages of UFLS, if applicable, and
    - Provide NYISO with an analysis demonstrating that no alternative load shedding solution is available that would allow the Distribution Provider or Transmission Owner to comply with UFLS Figure 2 or Figure 3.
3. Set each underfrequency relay with 100ms as minimum time delay.
4. Implement the inhibit threshold settings based on the notification provided by the NYISO.
5. Develop and submit an implementation plan within 90 days of the request from the NYISO for approval by the NYISO.
6. Provide annually the actual net Load that would have been shed by the UFLS relays at each UFLS stage coincident with their integrated hourly peak net load during the previous year, as determined by measuring actual metered loads through switches that would be opened by the UFLS relays.

7. Transmission Owners shall provide automatic switching of its existing capacitor banks, Transmission Lines, and reactors to control over-voltage as a result of underfrequency load shedding if required by the UFLS program and schedule for application determined by NYISO.

Generator Owners Actions

The Generator Owners shall perform the following:

1. Set each generator underfrequency trip relay, if so equipped, below the appropriate generator underfrequency trip protection settings threshold curve in Figure 1, except as otherwise exempted.
2. Transmit the generator underfrequency trip setting and time delay to the NYISO within 45 days of the request.
3. For a new generating unit, scheduled to be in service or an existing generator increasing its net capability by greater than 10% shall:
   - Design measures to prevent the generating unit from tripping directly or indirectly for underfrequency conditions above the appropriate generator tripping threshold curve in Figure 1.
   - Design auxiliary system(s) or devices used for the control and protection of auxiliary system(s), necessary for the generating unit operation such that they will not trip the generating unit during underfrequency conditions above the appropriate generator underfrequency trip protection settings threshold curve in Figure 1.
4. For existing non-nuclear units in service that have underfrequency protections set to trip above the appropriate curve in Figure 1 shall:
   - Set the underfrequency protection to operate at the lowest frequency allowed by the plant design and licensing limitations.
   - Transmit the existing underfrequency settings and any changes to the underfrequency settings along with the technical basis for the settings to the NYISO.
   - Transmit the existing underfrequency settings and any changes to the underfrequency settings along with the technical basis for the settings to the NYISO.
   - Have compensatory load shedding, as provided by a Distribution Provider or Transmission Owner that is adequate to compensate for the loss of their generator due to early tripping as per Compensatory Load Shedding Criteria.
5. For the existing nuclear generating plants with units that have underfrequency relay threshold settings above the Eastern Interconnection generator tripping curve in Figure 1, based on their licensing design basis, shall:
   - Set the underfrequency protection to operate at as low a frequency as possible in accordance with the plant design and licensing limitations but not greater than 57.8Hz.
   - Set the frequency trip setting upper tolerance to no greater than + 0.1 Hz.
   - Transmit the initial frequency trip setting and any changes to the setting and the technical basis for the settings to the NYISO.

Transmission Owners, Distribution Owners and Generator Owners Actions

The Transmission Owners, Distribution Providers and Generator Owners shall perform the following:

- Provide data to NYISO according to the format and schedule specified by NYISO to support maintenance of UFLS database.

- Provide automatic tripping of load in accordance with the UFLS program design and schedule for application determined by NYISO.
- Apply the Compensatory Load Shedding Criteria within its area to determine the compensatory load shedding that is required for existing non–nuclear generating units in service that have underfrequency protections set to trip above the appropriate curve as shown in Figure 1 that is adequate to compensate for the loss of the generator due to early tripping.
- Implement the load distribution changes based on the notification provided by NYISO.

4.5. Methodology

4.5.1. Potential Island Identification

- UFLS design and assessment is based on simulations performed by the working group SS 38 of the Task Force on System Studies anticipated electrical island formation.
- Island formation is identified by applying extreme or beyond extreme contingency disturbances to force a loss of synchronism within the system. The island formation analysis confirms that forcing a loss of synchronism between coherent generation groups for an all lines in service condition requires simulation of at least an extreme contingency event.
- Simulated disturbances include application of three-phase delayed clearing faults using typical breaker failure clearing times or longer (12 cycles or more). They also include loss of a right-of-way (R-O-W), loss of substation, or loss of a generating station following application and clearing of an initiating fault.
- Three-phase faults are placed at several different locations across the New York 345 kV system. The faults were applied for a duration exceeding the critical clearing time resulting in a loss of synchronism of a portion of the system.
- Additionally, islands can be identified by simultaneously tripping the ties between the identified coherent generation groups, islanding the entire NYISO system, or reproducing a historical event.
- The NYISO system is not designed to form any islands as the result of the operation of a relay scheme or a Remedial Action Scheme.

4.5.2. Identification of Generation facilities

The SS-38 working group obtains the Governor Modeling information from the NERC survey of unit governing response for the Assessment of Underfrequency Load Shedding Adequacy study. In addition to this, the group shall coordinate with their counterparts on the NPCC CO-1 Control Performance Working Group to incorporate the accurate governor information into the system models. Also, the information with respect to individual unit response during frequency deviations, along with the NPCC SS-38 Governor Response Calibration Procedure for Dynamics Simulations, is used for Generator modeling with better modeling tools.

4.5.2.1. Generation facilities necessary for UFLS program performance

For each Area, SS-38 members consult their counterparts on the NPCC CO-1 Control Performance

Working Group to identify any units that are observed to be unresponsive to system off-nominal frequency events. After disabling the governor models for these units, the governor droop is adjusted on the remaining non-hydraulic units to match the system frequency response in the study model to the observed system frequency response. Hence, the list of generator facilities which are necessary for the UFLS program are identified from the UFLS assessment study.

4.5.2.2. Generation facilities with restrained performance

Similarly, the generator units those generator output starts to increase as the frequency drops in proportion to frequency deviation, but overriding "outer loop" controls restrains it to return to its initial value (more or less), even though the frequency deviation persists are identified in the UFLS assessment study.

4.5.3. Computation of Load

The amounts of load shedding shall be reported coincident with the individual UFLS Entity's integrated hourly peak from the previous summer. That is, the individual UFLS Entity shall total its UFLS circuit loads at the time of the Entity's previous year's integrated hourly summer peak, and report the amount of load that would have been shed at each UFLS step, in both megawatts and as a percentage of the peak. The calculations shall be retained for a period of two years after making this report.

Aggregation

Entities with less than 100 MW of end-use load connected to its facilities may collectively implement, by mutual agreement with one or more entities within the same NYISO identified island, an aggregated automatic UFLS program that sheds load based on the frequency thresholds in Figure 1 section as an alternative to implementing the applicable program in Figure 2 or Figure 3.

Exemptions

Entities with less than 25 MW of end-use load connected to its facilities are exempt from providing UFLS.

Activation Times

Underfrequency threshold relays shall be set to a nominal total operating time of 300 ms, from the time when frequency passes through the set point to the time of circuit breaker contact opening (including any communications time delay), with a minimum relay operating time to be no less than 100 ms when the rate of frequency decay is 0.2 Hz per second.

4.5.4. Inhibits settings

The settings for inhibits thresholds include, but are not limited to, voltage, current, and time. These settings are utilized by the UFLS entities for the UFLS program and are reviewed once every five years.

The UFLS Assessment study provides the UFLS requirements for the region from which the UFLS entities determine inhibits settings. This may require the TOs planning group and relay group to work together to collect the required data.

4.5.5. Compensatory Load Shedding Criteria

The Generator Owners in the New York State are responsible for establishing a compensatory load shedding program for all existing non-nuclear units with underfrequency protection, set to trip above the appropriate curve in Figure 1 of this standard.

The Generator Owner shall follow the methodology below to determine compensatory load shedding requirements:

1. The Generator Owner shall identify and compile a list of all existing non-nuclear generating units in service, prior to the effective date of this standard, that has underfrequency protection set to trip above the appropriate curve in Figure 1. The list shall include the following information associated with each unit:
    - Generator name and generating capacity
    - Underfrequency protection trip settings, including frequency trip set points and time delays
    - Physical and electrical location of the unit
    - Smallest island within which the unit may operate as identified by the NYISO
2. For each generating unit identified in (1) above, the Generator Owner shall establish the requirements for compensatory load shedding based on criteria outlined below:
    - In cases where a Distribution Provider or Transmission Owner has coordinated protection settings with the Generator Owner to cause the generator to trip above the appropriate curve in Figure 1, the Distribution Provider or Transmission Owner is responsible to provide the appropriate amount of compensatory load to be shed within the smallest island identified by the NYISO.
    - In cases where a Generator Owner has a generator that cannot physically meet the set points defined by the appropriate curve in Figure 1, the Generator Owner shall arrange for a Distribution Provider or Transmission Owner to provide the appropriate amount of compensatory load to be shed within the smallest island identified by the NYISO.
    - The compensatory load shedding that is provided by the Distribution Provider or Transmission Owner shall be in addition to the amount that the Distribution Provider or Transmission Owner is required to shed as specified in Figure 1.
    - The compensatory load shedding shall be provided at the UFLS program stage with the frequency threshold setting at or closest to but above the frequency at which the subject generator will trip.
    - The amount of compensatory load shedding shall be equivalent (±5%) to the average net generator megawatt output for the prior two calendar years, as specified by the NYISO, plus expected station loads to be transferred to the system upon loss of the

facility. The net generation output should only include those hours when the unit was a net generator to the electric system.

- In the specific instance of a generating unit that has been interconnected to the electric system for less than two calendar years, the amount of compensatory load shedding shall be equivalent (±5%) to the maximum claimed seasonal capability of the generator over two calendar years, plus expected station loads to be transferred to the system upon loss of the facility.

4.6. UFLS Program Performance Requirements

The UFLS program shall meet the following performance characteristics in simulations of underfrequency conditions resulting from an imbalance scenario, where an imbalance = [(load — actual generation output) / (load)], of up to 25 percent within the identified island(s).

- Frequency shall remain above the Underfrequency Performance Characteristic curve as shown in Figure 2, either for 60 seconds or until a steady-state condition between 59.3 Hz and 60.7 Hz is reached, and
- Frequency shall remain below the Overfrequency Performance Characteristic curve as shown in Figure 2, either for 60 seconds or until a steady-state condition between 59.3 Hz and 60.7 Hz is reached, and
- Volts per Hz (V/Hz) shall not exceed 1.18 per unit for longer than two seconds cumulatively per simulated event, and shall not exceed 1.10 per unit for longer than 45 seconds cumulatively per simulated event at each generator bus and generator step-up transformer high-side bus associated with each of the following:
  - Individual generating units greater than 20 MVA (gross nameplate rating) directly connected to the BES.
  - Generating plants/facilities greater than 75 MVA (gross aggregate nameplate rating) directly connected to the BES.
  - Facilities consisting of one or more units connected to the BES at a common bus with total generation above 75 MVA gross nameplate rating.

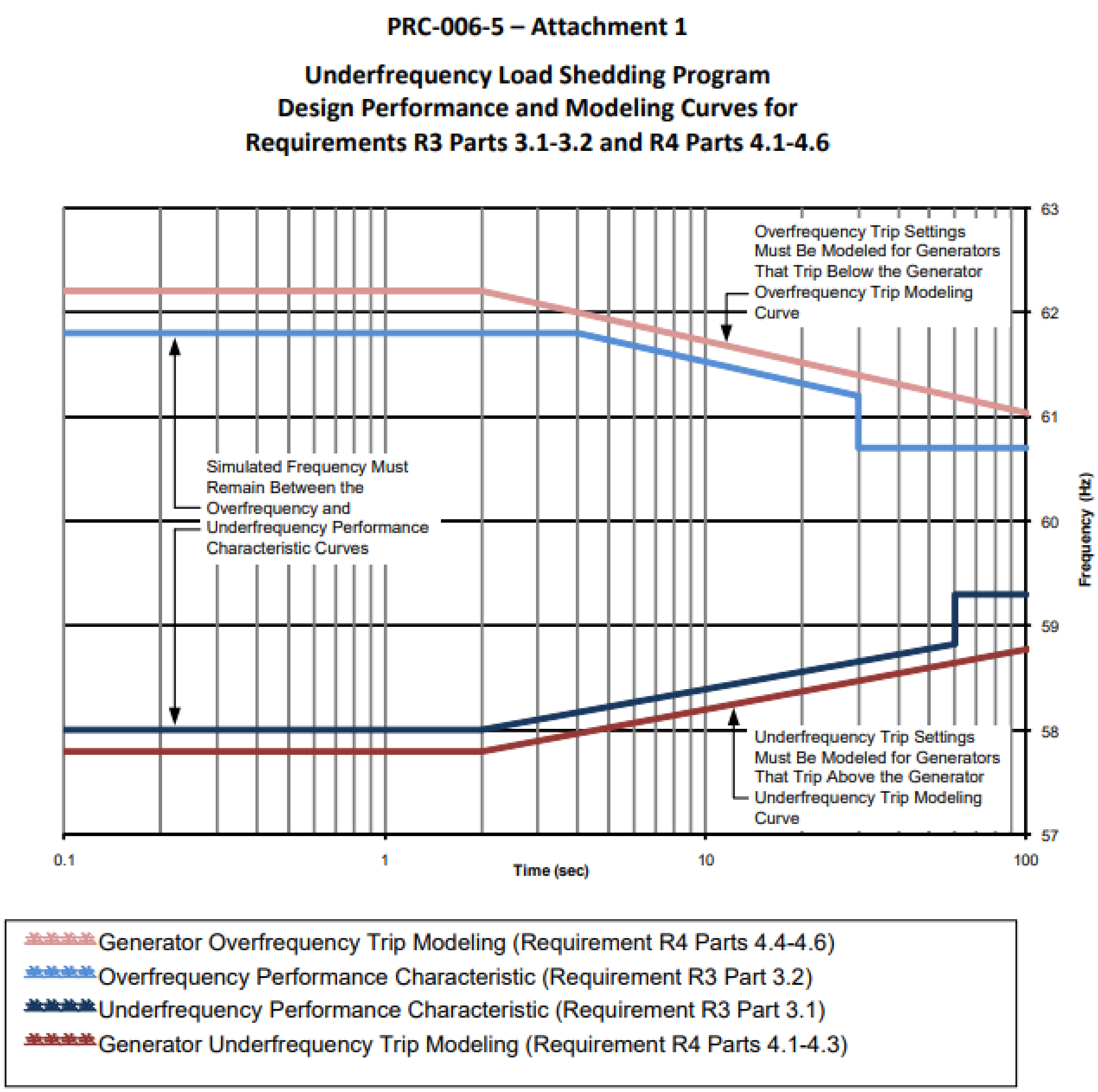
4.7. Criteria to Meet the UFLS Program Design Performance Characteristics

NYISO shall conduct and document a UFLS design assessment at least once every five years to determine through dynamic simulation whether the UFLS program design meets the performance characteristics for the identified islands. The simulation shall model each of the following:

- Underfrequency trip settings of individual generating units greater than 20 MVA (gross nameplate rating) directly connected to the BES that trip above the Generator Underfrequency Trip Modeling curve as shown in Figure 2.
- Underfrequency trip settings of generating plants/facilities greater than 75 MVA (gross aggregate nameplate rating) directly connected to the BES that trip above the Generator Underfrequency Trip Modeling curve as shown in Figure 2.
- Underfrequency trip settings of any facility consisting of one or more units connected to the BES at a common bus with total generation above 75 MVA (gross nameplate rating) that trip above the Generator Underfrequency Trip Modeling curve as shown in Figure 2.

- Overfrequency trip settings of individual generating units greater than 20 MVA (gross nameplate rating) directly connected to the BES that trip below the Generator Overfrequency Trip Modeling curve as shown in Figure 2.
- Overfrequency trip settings of generating plants/facilities greater than 75 MVA (gross aggregate nameplate rating) directly connected to the BES that trip below the Generator Overfrequency Trip Modeling curve as shown in Figure 2.
- Overfrequency trip settings of any facility consisting of one or more units connected to the BES at a common bus with total generation above 75 MVA (gross nameplate rating) that trip below the Generator Overfrequency Trip Modeling curve as shown in Figure 2.
- Any automatic Load restoration that impacts frequency stabilization and operates within the duration of the simulations run for the assessment.

Figure 5: Underfrequency Load Shedding Program



4.8. UFLS Program Assessment Requirements

Studies shall be performed by the associated Transmission Operator to ensure satisfactory voltage and loading conditions after automatic load shedding.

The Task Force on System Studies shall conduct a study every five years to coordinate the Automatic Underfrequency Load Shedding Program among the NPCC Balancing Authorities in accordance with the

NERC standard PRC-006-5 timeline.

4.9. Format of UFLS data submittal

A format for reporting compliance will be distributed with the e-mail inquiry. The following information will be reported on this form:

- Name of UFLS Entity
- Date of report
- Details of the individual making the report on behalf of the Entity
- Name
- Title
- Email address

For UFLS Form A – R9 of PRC-006-NPCC-2:

- Previous year's summer integrated hourly peak load
- UFLS at each step, expressed as both megawatts and percentage of Entity's peak, including those steps provided that are beyond the NPCC-mandated steps

For UFLS Form B – R10, R13, R16 of PRC-006-NPCC-2:

- List of generators that do not conform with PRC-006-NPCC-2 R10.
- For each such non-conforming generator, the generator megawatt rating, trip setting in Hertz, and time delay in seconds.
- Compensatory load shedding for each such non-conforming generator, with the megawatts load shedding and trip setting in Hertz.
- Non-conforming generators with a rating below 20 MW may be reported in groups with other generators of the same settings.
- Compensatory load shedding for generators that have been reported in groups may also be grouped.
- The load-shedding amounts reported for UFLS Form A must not include load shedding provided as compensation for non-conforming generators, in UFLS Form B. That is, the same loading shedding may not be reported for purposes of both UFLS Forms A and B.

For UFLS Form C – R8 of PRC-006-5:

- List of buses at which the load is modeled in the NPCC library FERC-715 power flow case with PSS/E Bus number, Bus name and Zone number
- For each relay, including those used for compensatory load shedding, the amount and location of load shed at peak, the corresponding frequency threshold and time delay settings.
- The location and amount of additional elements to be switched for voltage control that are coordinated with UFLS program tripping.
- List of all UFLS relay inhibit functions along with the settings and locations of these relays.

Overall Compliance:

- A statement of compliance with NERC PRC-006-5 and NERC PRC-006-NPCC-2

4.10. Schedule of UFLS Data Submittal

NYISO shall initiate the request and collect the data and compliance statements as per formats specified in section 4.9 once each calendar year.

4.11. References

PRC-006-NPCC-2, "Automatic Underfrequency Load Shedding," July 1,2015, availableat: https://www.nerc.com/pa/stand/Pages/ReliabilityStandardsUnitedStates.aspx?jurisdiction=United%20States

NERC Standard PRC-006-5 "Automatic Underfrequency Load Shedding Requirements," April 1, 2021, available at: https://www.nerc.com/pa/Stand/Reliability%20Standards/PRC-006-5.pdf

NPCC Underfrequency Load Shedding Assessment Studies

Attachment A. Guide for the Selection of Power Line Carrier Frequencies

This attachment establishes minimum guidelines to provide a uniform method of selecting power line carrier (PLC) frequencies within the New York Control Area (NYCA). Procedures used by the Transmission owners to notify necessary parties of PLC frequency changes and additions and to keep the Utilities Telecommunications Council PLC database current can be found in the Section 3.5.4 of this manual.

PLC spectrum conservation has been a major concern within the power utility business for many years. These guidelines have been developed to conserve spectrum while staying within industry-established frequency separation limits to minimize interference between channels.

It is assumed that the user of this manual is familiar with the application of power line carrier systems.

A periodic review of these guidelines may be necessary, however, as dictated by changes in equipment technology.

A.1. PLC Modulation Techniques

Three types of modulation techniques that utilize the PLC frequency spectrum of 10 to 490 kHz are in general use, namely Amplitude Modulated Keyed Systems, Frequent Shift Keyed Systems, and Single Side Band Systems, described in further detail in the following three subsections.

A.1.1. Amplitude Modulated Keyed Systems

On-Off amplitude modulated (AM) keyed PLC systems are usually used for blocking relay schemes. This type of system may also serve a second function of transmitting voice over the power lines via AM. The PLC frequency is usually off (no PLC signal transmitted).

A.1.2. Frequent Shift Keyed Systems

Frequency shift keyed (FSK) power line carrier systems are used for unblocking and transfer-tripping relay schemes. This type of PLC system always transmits at least one signal, sometimes at reduced levels to avoid possible interference. During tripping operations, full transmitter power (exalted signal level) is used. FSK – PLC systems are generally preferred over AM – PLC systems, as they allow the system to be continuously monitored.

A.1.3. Single Side Band Systems

Single side band (SSB) suppressed AM carrier is used for multi-function PLC communications. SSB systems are typically four-channel systems (4-kHz Bandwidth channels). This is done by the “upshifting” of audio tone and/or baseband frequencies to line frequencies. The channels can be used for various functions including relaying (audio tone and/or baseband), voice, telemetry, and SCADA communications.

When considering frequency separation guidelines, the requirements of both the SSB – PLC system as well as the specific needs of the communications systems utilizing SSB – PLC should be considered.

A.2. General PLC Application Criteria

A.2.1. Trapping and Coupling

If a single frequency is to be used, a single-frequency high Q trap is recommended, as wideband traps do not provide as much isolation.

When using a two-frequency line trap, maintain a minimum frequency separation of 25 kHz or 25% of the higher frequency, whichever is greater.

If two or more closely spaced frequencies are employed, locate the entire group on the upper (higher-frequency) trap skirt of a single-frequency trap if a high Q trap is used. As an alternate, use a low Q single frequency trap ($Q \approx 10$) or a wideband trap of 1,000 ohms, minimum.

In general, use the center phase for single-phase coupling when there are no transpositions and modal analysis permits.

When trapping a relatively long line, the use of three traps is recommended at the tap point if the trapped line is ¼ wavelength of the operating frequency or if the tap is a transformer bank resulting in high PLC attenuation.

Line traps in all three phases may be treated as the equivalent of one line section of PLC separation within the operating frequency range of the traps.

Use of multiple series and parallel L/C tuner combinations (via line tuning units or high power filters) is recommended to provide isolation between widely separated transmitter/receiver groups and also to reduce bandwidth of outgoing and incoming RF energy.

Use reactive/skewed hybrids to isolate closely spaced transmitter/receiver combinations. Use resistive hybrids to isolate two closely spaced transmitters.

A.2.2. Factors Affecting Frequency Selection

A tap point of a line should not be considered as a bus when determining the number of line sections.

An auto-transformer may be treated as the equivalent of one line section.

Avoid second harmonic frequencies on the same bus and for at least two line sections.

Use lower frequencies on longer lines and higher frequencies on shorter lines. A "short line" is one with an attenuation (line and coupling losses) less than 10 dB or a physical length of approximately 20 miles or less. A "long line" is one with an attenuation more than 10 dB or a physical length in excess of 20 miles. Use the highest frequency possible while maintaining adequate operating margins to save the lower frequency spectrum for use on long lines.

Avoid PLC frequencies that correspond to low multiples of $\lambda/2$ or $\lambda/4$ (half or quarter wavelength of PLC frequencies, respectively) on short overhead lines.

Use frequencies that correspond to an odd multiple of $\lambda/8$ on overhead lines with low attenuation.

Use narrow band equipment where speed is not a constraint.

Use power below 10 W where possible (i.e., 1-W guard, 10-W trip) to minimize interference taking into account "bad" weather requirements (i.e., increasing noise and attenuation) of the PLC system.

Unless otherwise noted, parallel lines not terminating on the same bus will be treated as though they were, for PLC frequency selection purposes.

When PLC frequencies are to be applied to power cables, great care should be taken to minimize PLC losses due to the low characteristic impedance of the cable, series impedance mismatch at the coupling point, and standing wave reflections. This can often be done by using lower PLC frequencies, using PLC frequencies at $\lambda/2$ or multiples thereof, and by using extra-hi C coupling capacitors.

Although this guide identifies guidelines for PLC frequency selection, the following additional points require consideration to ensure proper PLC system operations:

- Receiver Sensitivity
- Signal-to-Noise Ratio Requirements
- Receiver Selectivity
- Operating Margin, Including Transposition and Other Modal Loses
- Bad Weather Conditions
- Coordination with Adjacent Utilities
- Use of Voice Channels
- Line Tuners and Other Auxiliary Coupling Equipment Losses

A.3. Frequency Spacing by Equipment Type

A.3.1. On-Off (AM) Blocking Carrier

1. In general, minimum frequency separations for all lines terminating at the same bus in the Figure 6, below:

Figure 6: ON – OFF Carrier Frequency Spacing

	Tube Type	Solid State		
		Crystal Controlled	Synthesized	
			Wide Band	Narrow Band
Without Voice Channel	10 Hz	4 kHz	4 Hz	2 kHz
With Voice Channel		6 kHz	4 Hz	4 kHz

The equipment manufacturers' instruction books should be consulted for more detailed information.

2. Repeat frequency no sooner than two buses away.
3. When ON-OFF and frequency-shift equipment is applied on the same bus, the greater minimum separation shall prevail.

A.3.2. Frequency Shift (FSK)

1. In general, minimum frequency separations for non-voice applications are indicated in the Figure 7, below:

Figure 7: FSK Carrier Frequency Spacing

	Extra Wide Band	Wide Band	Narrow Band
Typical Band-Width	1000 Hz	500 Hz	200 Hz
One-Way Channel Spacing	2000 Hz	1000 Hz	500 Hz
Two-Way Channel Spacing	4000 Hz	2000 Hz	1000 Hz

The equipment manufacturers' instruction books should be consulted for more detailed information.

Frequency separations apply between:

a. All lines terminating on the same bus and one bus away;
b. Transmitters and receivers located on lines parallel to the subject line; and
c. Transmitters and receivers one bus away from lines parallel to the subject line.

2. Repeated frequency no sooner than two buses away. A received signal should be at least 40 dB above an interfering signal of the same frequency.

A.3.3. Single Sideband

1. General (SSB) Frequency Selection Guidelines
   a. Transmitters connected to different lines on the same bus, using adjacent frequency bands and transmitting signals of equal power, should have 15 dB of isolation between them to minimize inter-modulation products. If the transmitters have different output power then 15 dB plus the difference in power should be used as the isolation guideline.
   b. Receivers connected to different lines on the same bus, using adjacent frequency bands, and receiving signals of equal power should have at least 3 dB of isolation between them. If receiver levels are different, 3 dB plus the difference in power should be used as the isolation guideline [Adjacent SSB (receivers) channels typically have an inherent 50 dB of isolation due to the SSB modulation / demodulation process.]
   c. Transceiver systems using the same frequency band should have 50 dB of isolation between a transmitter of one system and the receiver of the second system. Typically, a line section and two buses will offer this degree of isolation.
   d. Transceiver systems on different lines on the same bus and using adjacent frequencies should have 25 dB of isolation between the transmitter of one system and the receiver of the second system. In addition, the transmitted level(s) should be 3 dB below the intended receive levels at the input to the local receiver.
   e. A 4-kHz "guard band" between transmitter and/or receiver frequency bands offers approximately 10 dB of isolation.
   f. If two SSB – PLC systems are to be placed on the same line(s), they should be interconnected with high-pass/low-pass filter networks with the crossover occurring at approximately 30 dB below the transmitter signal levels.
   g. In general, it is assumed that there is 10 – 15 dB of isolation across a bus.
   h. Traps with a minimum impedance of 1,000 ohms should be used whenever possible as a frequency conservation measure.
2. SSB – PLC Frequency Selection Guidelines for Various Typical Functions are covered in Figure 8, following. These functions include:
   a. Baseband Relaying
      - Directional Comparison Blocking and Unblocking – AM and FSK
      - Phase Comparison – AM and FSK
      - Transfer Trip – FSK
   b. Audio Tone Functions
      - Relaying
      - SCADA
      - Voice
      - Telemetry

Figure 8: Single-Sideband Equipment Operating Parameters

Equipment Type	Channel Speed	Signal to Noise Ratio Required	Operating Margin	Nominal Spacing (See Note)	Nominal Bandwidth Freq. Shift	Max. Rec. Sens.
On/Off (Baseband)	3 ms	15-20 dB	15 dB			
FSK Transmitter Trip (Baseband)	25-30 ms 7 ms 4 ms	0 dB 5 dB 7 dB	25 dB 25 dB 25 dB	500 Hz 1500 Hz 3000 Hz	200 Hz 500 Hz 1000 Hz	5 mV 15 mV 15 mV
FSK Transmitter Trip (Audio Tones)	6 ms 9 ms 16 ms	5 dB 0 dB -3 dB	10 dB 10 dB 10 dB	1000 Hz 340 Hz 170 Hz	480 Hz 170 Hz 85 Hz	
Tones for Data	15 ms					
Voice w/o Comp.	30 ms					
Voice w/ Comp.	15 ms					
SSB						4.5 dBm

Note: Function of Rec. Bandwidth (Typically 55 dB)

A.4. References

Dowty RFL Industries, Communications Division. *The PLC Handbook (PLC-79-1)*. Boonton, NJ: Dowty RFL Industries, Inc., 1979.

General Electric Company, Power Systems Management Business Dept. *PLC Applications Guide – Protective Relaying Channels (GET-6920)*. Malvern, PA: General Electric Company, 1985.

General Electric Company, Technology Center. *Application Guide Relaying Communications Channels (GET-8034)*. Malvern, PA: General Electric Company, 1993

IEEE: Power Systems Communications Committee. *IEEE Guide for Power-Line Carrier Applications (ANSI/IEEE Std 643-2004)*. New York: IEEE, 2005.

Ray, Roger E. "Channel Considerations for Power Line Carrier (RPL 83-3)." Coral Springs, FL: Westinghouse Electric Corporation, 1983.

IEEE: PSRC H9, "Special Considerations in Applying Power Line Carrier for Protective Relaying," available at:

http://www.pes-psrc.org/kb/published/reports.html

Attachment B. Forms

B.1 Relay Characteristics Form

B.2 Clearing Times Form

B.3 Reclosing Data Form

B.1 Relay Characteristics Form

Line No. ____________________

Line Name ____________________

Terminal ____________________

Base Voltage ____________________

Submitted by ____________________ Date ____________________

	Protection System 1	Protection System 2
Type of Relay Scheme	________	________
CT Ratio	________	________
PT Ratio	________	________
Which Zone initiates Pilot Scheme?	________	________

Zone 1	Protection System 1	Protection System 2
Angle of Max Torque (Enter 0 for reactance relay)	________	________
Setting in Secondary Ohms	________	________
Offset in Secondary Ohms	________	________
Setting in Primary per unit (100 MVA base)	________	________

Zone 2	Protection System 1	Protection System 2
Angle of Max Torque (Enter 0 for reactance relay)	________	________
Setting in Secondary Ohms	________	________
Offset in Secondary Ohms	________	________
Setting in Primary per unit (100 MVA base)	________	________

	Protection System 1	Protection System 2
Zone 3		
Angle of Max Torque (Enter 0 for reactance relay)	______________	______________
Setting in Secondary Ohms	______________	______________
Offset in Secondary Ohms	______________	______________
Setting in Primary per unit (100 MVA base)	______________	______________

Please attach RX plot with notations, or any other information necessary to describe protection systems for modeling.

Number of pages attached ________________________

B.2 Clearing Times Form

Line No. ____

Line Name ____

Terminal ____

Base Voltage ____

Submitted by ____ Date ___________________________

Clearing Times Viewed from the Terminal

Near End Fault (in cycles) _________________________________

Far End Fault (in cycles) _________________________________

B.3 Reclosing Data Form

Line No. ________________________________

Line Name ________________________________

Terminal ________________________________

Base Voltage ________________________________

Submitted by ________________________________ Date ____________________

	NO	YES	IF YES, BREAKER RECLOSING TIME*
HIGH SPEED RECLOSING*	______	______	____________
DELAYED RECLOSING*			
FIRST SHOT – Hot bus dead line	______	______	____________
If there is no hot bus dead line reclosing at this end, i.e., reclosing is by sync check only, or not at all, choose ***NO***.			
SECOND SHOT – Hot bus dead line	______	______	____________
If there is no second shot, choose ***NO***.			
THIRD SHOT – Hot bus dead line	______	______	____________
If there is no third shot, choose ***NO***.			

Definitions of terms are in the NPCC Bulk Power System Reclosing Guide, Document B-1, dated 03/11/2009.

Attachment C. Schedule for System Protection Data Collection

Figure 9: Schedule for System Protection Data Collection

Sr. No.	Task	Applicable Entities	Frequency	Request Date		Submission Date
1	UFLS	TO	Annual	Prior to or on June 1		15-Jul
						31-Aug
		GO				15-Jul
2	DME	TO and GO	Bi-Annual (Odd Years)	Prior to or on July 1		1-Sep
3	PSP Reports	TO and GO	Quarterly	Quarter 1	Prior or on Jan 1	20-Jan
				Quarter 2	Prior or on Apr 1	20-Apr
				Quarter 3	Prior or on Jul 1	20-Jul
				Quarter 4	Prior or on Oct 1	20-Oct
4	Protection Memos / RAS	TO	Annual	Prior to or on March 1		1-Apr
5	New/Revised PLC Frequencies	TO	Quarterly	Quarter 1	Prior or on Jan 1	20-Jan
				Quarter 2	Prior or on Apr 1	20-Apr
				Quarter 3	Prior or on Jul 1	20-Jul
				Quarter 4	Prior or on Oct 1	20-Oct
	PLC Database Review	TO	Annual	Prior to or on Oct 1		Within 31 days
6	Relay Characteristics, Clearing Schemes, Reclosing Schemes	TO	As needed	As needed		Within 45 days