REQUIREMENTS FOR GENERATING FACILITY INTERCONNECTION TO THE LIPA TRANSMISSION SYSTEM

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1. Introduction

This document has been prepared to identify the technical requirements for connecting Power Producing or Energy Storage Resources (hereinafter referred to as Resources) to the LIPA transmission system. It applies to new connections or substantial modifications of existing Resources including but not limited to synchronous generation, inverter based, and battery storage types. An entity proposing a Resource interconnection, a substantial modification of an existing Resource, or operating a Resource is referred to in this document as "Producer".

This document is written to comply with NERC Standard FAC-001, (most recent) Facility Interconnection Requirements, which requires Transmission Owners responsible for the reliability of the interconnected transmission systems to maintain and make available a Facility Interconnection Requirements document. The NERC standards require those entities seeking to add facilities, seeking to make a qualified change to existing interconnections as defined by the Planning Coordinator or connect to the interconnected transmission system to comply with the Facility Interconnection Requirements document. The NERC Planning Standards are posted on NERC's web site (www.nerc.com/standards).

This document provides the following:

- Design practices applicable to LIPA system modifications and upgrades necessary for interconnection of Resources.
- Specific substation and protection design practices applicable to all Resources.
- Performance requirements applicable to synchronous generator and synchronous condenser Resources (performance requirements applicable to inverter-based resources, inclusive of doubly-fed generators, are specified separately in LIPA's Performance Requirements for Transmission Connected Resources Using Non-Synchronous Generation document).

Rather than give detailed technical specifications this document provides a general overview of the functional objectives and requirements to be met in the design of facility connections. These requirements are written to establish a basis for maintaining reliability, power quality, and a safe environment for the general public, power consumers, maintenance personnel and LIPA equipment. This Facility Interconnection Requirements document is revised from time to time to reflect changes or clarifications in planning, operating, or interconnection policies.

The Producer should also refer to the following LIPA documents for information concerning the functional objectives and requirements when designing interconnections:

- Bulk Electric System Facility and End User Interconnection Requirements to the LIPA Transmission System
- PSEG Long Island Transmission Planning Criteria
- LIPA Revenue Metering Requirements for Generating Facilities Interconnecting to the LIPA Transmission System
- Performance Requirements for Transmission Connected Resources Using Non-

Synchronous Generation
- NYISO Interconnection Guide/ TEI Manual (Will potentially change due to ongoing Queue Reform)
- LIPA Welcome Package for Producers

The Interconnection process and the procedures for coordinated studies and procedures for notification regarding new interconnections or existing interconnections seeking to make a qualified change are provided by the NYISO as the Planning Authority within the New York Control Area.

Applicable sections of the NYISO OATT summarize the procedures for confirming that new Facilities or existing Facilities seeking to make a qualified change are within the NYISO's (i.e., Balancing Authority) Area.

Any Producer seeking to connect to the Bulk Electric System in New York should review the NYISO Interconnection documents and Tariffs, as well as the NYISO Transmission Expansion and Interconnection Manual. All Resources connecting to the New York Transmission System must follow the NYISO Generator Interconnection Procedures.

Nothing in this document is intended to supersede the PSEG Long Island Transmission Planning Criteria or the Performance Requirements for Transmission Connected Resources Using Non-Synchronous Generation document. If there is a conflict, the NYISO Large Facility Interconnection Procedures and any documents referenced in this Agreement, as applicable, will control.

All Producers operating Resources rated 10 MVA or greater must adhere to the requirements outlined in this document.

Protection and Control requirements as well as specific electrical requirements for parallel operation with the LIPA system are provided for transmission interconnections of Resources.

2. General Requirements

Producer Resources shall be connected to the transmission system rated 23 kV and above. This connection can be made at the LIPA substation or at a point on a transmission line. Direct connection to existing LIPA Substations is the preferred method for connecting new Resources.

Interconnection of Resources at the 23 kV and 33kV transmission levels are not preferred as this voltage level may eventually be upgraded to a higher nominal voltage. Producers interconnecting at 23 kV and 33kV shall be prepared to replace their interconnection equipment, including transformers, switchgear, lines and cables, if the particular LIPA 23 kV and 33kV lines or buses are upgraded to a higher nominal voltage. Replacement of equipment necessary for voltage upgrade, and all associated construction, shall be solely at the expense of the Producer.

The following are LIPA system configuration practices used to accommodate Resource

interconnections:

- A substation connection shall require a dedicated circuit breaker at the point of interconnection for Resources to allow for isolation from the LIPA system. A system or bus configuration could require more than one dedicated circuit breaker. All dedicated circuit breakers shall be sized to meet the voltage, load current, and short circuit interrupting requirements at the substation.
- A connection to a point on a transmission line shall require the installation of a substation at the point of connection and be located on land provided by Producer. A minimum three breaker substation, including a dedicated breaker for the producer, and a breaker for each side of the transmission line will be required. Three terminal lines, including those created by parallel individual producers, are not acceptable. Reliable station and breaker arrangements will be used when there are new or substantial modifications to existing LIPA switching stations affecting transmission lines rated at or above 69kV. Please see additional requirements below in Section 3.

LIPA shall evaluate and analyze each proposed installation prior to accepting any interconnection configuration through NYISO Transmission interconnection process. That includes but not limited to, NYISO study processes, Interconnection Agreements, Material Modifications, Commissioning tests etc., Each Producer facility which is to be operated in parallel with the LIPA system shall submit its protection and Control designs to LIPA for review and acceptance. The specific design requirements of the protection system depend on the Resource type, size, and other site-specific considerations. Resource tie-line interconnections into the LIPA transmission system or substation must be submitted with a proposed route, construction methodology, permitting needs, discussion of environmental impact on the overall site including potential effects on wildlife, land use, nearby communities and address mitigation measures to address existing or newly created environmental issues and identification of any need for property acquisition for proper evaluation.

If the Producer installs equipment without prior written acceptance of the equipment by LIPA, it shall be done at the Producer's own risk. The Producer shall be solely responsible for all costs associated with the replacement of any equipment that has not been accepted by LIPA. Final acceptance of the interconnection by LIPA will be contingent upon LIPA's acceptance of all the facility's interconnection equipment.

If the Producer makes changes in the design of the project, any previous information furnished by LIPA shall be subject to review and possible changes.

3. Transmission Interconnection Technical Design Requirements

A. General Technical Requirements

a. Storm Hardening for the LIPA transmission system (Outside Substation):
As applied to Long Island, IEEE's, National Electric Safety Code (most recent and/or as per utility's guidance) is interpreted for Extreme Wind requirement is 120 mph for all of Long Island. In 2006, due to the storm impact of hurricanes along

other similar coastal areas of the United States, LIPA adopted a storm hardening standard called the "LIPA Extreme Wind" rule that requires calculation of transmission pole loadings for 130 miles per hour ("mph") using the NESC Extreme Wind loading test. This standard is consistent with Category 3 hurricanes, which have wind speeds ranging from 111 to 130 mph. Accordingly, installation of any new utility poles on Long Island must take into account these criteria.

b. Wetlands
Developer is responsible for mitigating any impacts to wetlands and wetland adjacent areas where it is proposing infrastructure upgrades that are located in or near sensitive wetland areas. .Mitigations include all environmental, permitting, community impact factors that affect construction. Alternate routes including conversion of Overhead to Underground may be necessary and may include other routing of facilities.

c. Community Impact/Assessment
Developers would be required to perform all public outreach to elected officials, customers, and community groups. There should be a drafted detailed outreach plan that accounts for outreach to the above groups. The Community impact assessment should address short and long term visual impacts, sound, impacts to adjacent property owners, and construction impacts. There should be a plan to mitigate any of these concerns. Final pre-construction outreach should include notifications to local municipalities and customers. All outreach should be documented for review.
Additionally, developers would be required to seek all necessary zoning or site plan approvals that may be required.

d. Property use limitations
   i. Landfills – The building of LIPA owned infrastructure on or within a landfill property is prohibited. LIPA owned infrastructure must be suitably located to avoid the need for explosive gas monitoring and emergency procedures and be engineered, designed and constructed on subsurface soils with known and appropriate geotechnical characteristics.

   ii. Contamination - Developer is required to address any site contamination that exists on property that the developer needs either itself or on properties PSEGLI/LIPA is asked to erect any necessary infrastructure to support its projects. Contamination may be addressed through developer performing site remediation in accordance with any state and federal requirements or through compensation to PSEGLI/LIPA in order to perform necessary site remediation.

e. Stormwater Design
Site stormwater design shall be for 100 year 24-hour duration storm as per the latest revision of NYS Stormwater Design Manual.

B. Substation Requirements

a. Substation Structural Design Criteria
   i. Prepare in accordance with the requirements of the New York State Building Code, ASCE Standard No. 7, latest edition, and ASCE Manual and Reports on Engineering Practice 113.

ii. Wind loads shall be for a basic wind speed of 150 mph as defined by ASCE Standard No. 7, latest edition.

iii. Buildings and substation structures are considered Risk Category IV for engineering and design, with the potential to cause mass disruption of day to day civilian life in the event of failure.

iv. Exposure Category shall be Exposure D.

Perform an independent Geotechnical Investigation, to include, but not necessarily be limited to, subsurface soil borings, soil resistivity testing and laboratory testing to identify subsurface stratigraphy, locate groundwater, evaluate for and recommend foundation types and support, assign soil criteria for design, discuss seismic considerations, earthwork and subgrade preparation. Prepare a geotechnical investigation report in accordance with the NYS Building Code and other local, state or federal codes that may apply. The Producer's analysis is subject to LIPA review and approval.

b. Storm Surge

Equipment, enclosures, elevated platforms and stairs etc. shall be designed per the latest codes that apply including the ACI, ASCE, OSHA, IEEE, AISC, etc. For LIPA facilities that are to be built in support of an interconnection the required elevation will be determined by LIPA based on storm surge modeling using the worst of 1/100yrs + Sea Level Rise(8 in) + 3ft of Freeboard or 1/500yrs + Sea Level Rise (8 in) as projected for a 50 year equipment life cycle.

c. Advanced Configurations

i. Substation Layouts

In general, the preference is that Producer's request interconnections at existing substations to minimize impacts to individual circuits/paths.
Additionally, substation configurations, including new or modification to existing, shall be designed such that consequential load loss under N-1-1 conditions is reduced.

1. Ring Bus

Preferred ring size is six (6) breakers or less. Maximum number of breakers is eight (8). Special circumstances requiring justification, review and analysis of load flow and protection may allow for consideration of up to ten (10) breakers (subject to LIPA approval). Additional review and analysis is required to identify/determine risks associated with the increased chance of the ring being broken into two or more segments. Where ring bus designs exceed six (6) breakers, breaker and a half designs should be considered for increased reliability in alignment with good utility practices.

2. Breaker and a Half

Maximum number of rungs is five (5). Additional rungs can be added with the inclusion of bus tie breakers. Additional review and analysis of load flow (including rung pairs and buses) and protection will be required for configurations greater than five rungs. Bus tie breakers reduce risk of entire bus outage for either contingency or maintenance.

3. I-Bus

Preferred I-Bus design is three (3) breakers or less. Maximum number of

breakers is four (4). Larger designs shall consider ring or breaker and a half for reliability in alignment with good utility practice.

4. Three Breaker Configuration
   i. Required for POI's on a line.
   ii. Open air design requirements
      1. 138kv- Approximate space required for open air construction is 180 x 200'
      2. 69kv and 33kV- Approximate space required for open air construction is 123 x 145'
   iii. GIS Design Requirements
      1. For a 69kV GIS design in a building enclosure, with UG transmission cable entries, will require a minimum of 75' x 75'. For OH transmission lines terminations, it will be considerably larger. Also to be noted that the requirement for two separate sources of AC station service power will have to be supplied from the distribution system and may require extensive feeder extensions.
      2. For 138kV and 345kV GIS design property requirements will be determined at the time of the evaluation of the project.
   iv. Limitations
      If an electrically short transmission line(s) is created due to tapping of existing transmission line, it may be subject additional system upgrades to protection systems at affected LIPA substations, which may include addition of second fiber for high speed current differential scheme

5. Other
   Consideration of configurations to reduce Consequential Load loss under N-1-1 contingencies may be required.

ii. Bus Designs
   1.Typical 138KV Amp Rating: 3000A
   2.Typical 69kV and 33 kV Amp Rating: 2000A
   3.Increased equipment ratings subject to LIPA review and approval

iii. Fault Duty

1.Typical 138KV Fault Rating: 63 kA

2.Typical 69 kV Fault Rating: 43kA

3.Typical 33 kV Fault Rating: up to 43 kA

4.Increased equipment ratings:

For 138 kV not to exceed 80kA

For 69 kV not to exceed 63 kA

iv. Gas Insulated Substations

1. GIS design shall be in an equipment enclosure, with UG transmission cable entries.
2. GIS designs shall be created in such a way to allow future expansions.

v. LIPA Policy on Efficient Land Use

Substation designs and considerations for efficient land use shall be in accordance with "Long Island Power Authority ("LIPA") Substation Design Criteria"

vi. Modification of Existing Stations

Complete rebuilds: To the extent possible, design should not consider decommissioning of the active substation or prolonged outages.

vii. Other Requirements:

1. For LIPA facilities located on the Producer's property will be required to provide a full Geotechnical report (including recommendations for foundations and deep foundations) and a full Environmental report.

2. LIPA shall install, own, control, operate and maintain (at the Producer's expense) a visible manual load break or motor-operated disconnecting device on LIPA's side of the point(s) of interconnection. Devices shall be capable of being padlocked.

3. A visible disconnect is required at the Producer's equipment on the generator side of the interconnection breaker.

d. Maintenance and Operations

i. Substations proposed must show all entrance/exit gates for the facilities.

ii. Details must include all internal roadways to fully maintain and replace all types of substation equipment. The internal roadways must allow for the safe, reliable, access and turning radius of construction vehicles and trailers that would remove or install equipment. Substations must have full LIPA-only access that is available 24 hours a day.

iii. A replacement methodology must be submitted for approval for the replacement of heavy substation equipment. The methodology must allow for the proper over-the-road routing for transportation of the equipment from a proposed storage location. This methodology must be aligned with local permitting agency requirements and guidelines.

e. Fencing

i. Separation requirements

For interconnection where the Producer is providing property for the LIPA interconnection station located on their site adjacent to their facilities, a common fence separating the LIPA station from the Producer is acceptable. Fencing must be located a minimum of 5 ft. inside site property lines, subject to LIPA review and approval.

f. Grounding

Grounding of LIPA interconnect stations located on Producer's property adjacent to Producer's facilities is required. For interconnection where the Producer is providing property for the LIPA interconnection station, located on their site adjacent to their facilities, the ground grids of the LIPA substation and Producer's facilities shall be bonded. The Producer shall perform soil resistivity tests, model and design the grounding grid requirements for the entire site, with the LIPA station and Producer's facilities included.

g. Control Houses

Where existing control houses cannot accommodate panels required for substation expansion/protection, the following requirements shall apply for new control houses.

1. Control Power Requirements and Station service requirements are subject to LIPA review and approval.
2. Regardless of the voltage, two separate sources of station service are required:
   i. For open air design, the two sources can be one station-service voltage transformer connected to the common bus, and a primary distribution feed with a pad mount control power transformer (CPT).
   ii. For GIS designs the two sources will need to be supplied from two separate primary distribution feeds with two pad mount CPTs. The two distribution feeds must be supplied from either separate LIPA substations, or at a minimum from separate LIPA substation transformers/switchgear buses.
   iii. Diversified combination distribution feed and distribution CPT are an acceptable alternative.
3. Fiber specification shall be provided.
4. Bulk Power System (BPS) Facility Design.
   The protection and control and Disturbance Monitoring Equipment (DME) design for BPS facility shall be as per requirement of NPCC Directory #4 and Directory #11. Additional LIPA specific design requirements for BPS facilities will be provided upon request.

C. Transmission Lines

a. Overhead Line Requirements

i. Design Requirements

1. All facilities shall be designed following the guidelines of the National Electric Safety Code (NESC), including, but limited to, clearances, structural loadings, and strength requirements.

2. All facilities shall meet the requirements of NESC Grade B Construction
3. All facilities shall be designed to the requirements of NESC Heavy Loading 250B
4. All facilities shall be designed to the requirements of NESC Extreme Wind 250C. A wind speed of 120 mph shall be used for all facilities on Long Island.
5. Utilizing the requirements from NESC Extreme Wind 250C, all facilities shall be designed utilizing a wind speed of 130 mph as per LIPA Storm Hardening Standards.
6. All facilities shall be designed to the requirements of NESC Extreme Ice and Wind 250D
7. All overhead transmission facilities located inside of LIPA Substations shall be designed to the requirements of NESC Extreme Wind 250C utilizing the wind speed from ASCE 7 Risk Category IV of 150 mph as well as following the guidelines of the NYS Building Code
8. All facilities shall be designed utilizing LIPA construction standards as well as standard conductors and materials as much as practical

ii. Crossing of overhead circuits will not be permitted for connecting to a facility

iii. Connections to the overhead transmission circuit in the right of way shall only be to the outside circuit closest to the facility.

iv. LIPA policy on Overhead Transmission Circuits
1. Increases in pole height are limited to no greater than 10 feet from the existing pole. Pole height increases greater than 10 feet will be subject to approval by LIPA.
2. Pole materials are limited to treated wood and steel depending on location and aesthetic analysis. Wood poles shall be direct buried. Steel poles may be either direct embedded or foundation supported. Steel poles inside substation shall be foundation supported.
3. Steel poles may require a special finish or color to minimize aesthetic impacts. Steel poles may be either direct buried or foundation supported.
4. Community and stakeholder input of proposed design may be required.
5. Designs for special situations shall be subject to review and approval by LIPA. Special situations may include, but not be limited to, larger steel or wood poles, underground transition poles, and roadway and vehicle protection.
6. Introducing underground transmission segments is strongly discouraged. Dedicated Overhead circuits on the LIPA system will remain overhead.
7. Circuits shall run from substation to substation. "Tapping" of circuits on the LIPA system is prohibited.

v. Ampacity
1. Thermal ampacity ratings as per FAC-008 for Bulk electric must be detailed by a circuit ampacity drawing.

2. Thermal ampacity ratings for non-Bulk electric system circuits must be provided as per LIPA specifications and is subject to LIPA's approval.

b. Underground Line Requirements
   i. Underground transmission construction is the preferred method of interconnection for the Producer's generator tie line.
   ii. Installation of infrastructure that affects the thermal ampacity of existing circuits is not permitted.
   iii. Consultation with LIPA will be required if any existing pipe-type cable system is proposed to be modified.
      a. New construction must be pipe-type cable if connecting to pipe type cable.
      b. Transition joints from pipe-type cable to solid dielectric are not permitted.
      c. Pump house requirements – tapping into an existing pipe-type circuit will require the installation of a pump house with adequate storage capability for dielectric fluid. The pump house must maintain pressure and circulation (as required). Other conditions apply.
   iv. Cable routing must be within public franchise area or LIPA right-of-way.
   v. Cable routes requiring LIPA to purchase property or acquire property rights acquisition will not be permitted.
   vi. LIPA must be consulted if a LIRR crossing is proposed.
   vii. New underground lines must maintain a fifteen (15) foot separation from existing underground transmission circuits.
   viii. Cable entrance into substations shall be submitted for review and comment as early in the process as required and it is subject to LIPA review and approval.
   ix. Adequate thermal spacing to enter/exit a substation is not guaranteed.
   x. Cable rating calculations shall use a 25 degree Celsius summer ambient and 17 degree Celsius winter ambient temperature.
   xi. Soil borings shall be performed to determine thermal resistivity.
   xii. Ampacity
      a. Thermal ampacity ratings as per FAC-008 for Bulk electric must be detailed by a circuit ampacity drawing.
      b. Thermal ampacity ratings for non-Bulk electric system circuits must be provided as per LIPA specifications.
      c. Thermal ampacity ratings are to be calculated using a 1.0 load factor.

c. Right of Ways (ROWs)
   Producer's use of utilizing or using ROWs is not preferred and is subject to LIPA's review and approval

D. Relay Protection Requirements
   a. Producer Submittal Requirements for their Facility.

   The following must be submitted by the Producer through email:

   i. Substation one-line drawing.

ii. Relay functional diagram showing all current transformer (CT) and potential transformer (PT) circuits, relay connections, and protective control circuits. All interconnections with LIPA's circuits shall be clearly labeled (See Appendix **A** for an example of an acceptable relay functional).

iii. Three-line AC schematic diagrams of transmission lines, transformers and bus relay protection.

iv. Producer's interconnection breaker AC and DC schematics. Interconnecting line protection, transformer protection and breaker failure protection DC schematics. Any other drawings or documents necessary to understand protective relaying and controls schemes within Producer's facility.

v. If IEC-61850 or other methods of protection over LAN are used then detailed logic diagrams of protection scheme shall be provided. A communication diagram showing general overview of relay connections shall be provided.

vi. Protective relay equipment list including manufacturer model number, relay firmware, manufacturer's bulletins, curves and proposed settings.

vii. Length, positive sequence impedance and zero sequence impedance of the circuit that interconnects LIPA substation with Producer's site.

viii. MVAR rating of Resource at rated power factor.

ix. Protection scheme of the Resource.

x. Producer's interconnection breaker speed curve.

xi. All drawings should incorporate LIPA's requirements for name and number description of the major equipment (switches, breakers, etc.).

xii. All final relay setting (in .RDB format) and setting calculations for the Producer's interconnection breaker/line shall be submitted for review and comment by LIPA to assure proper coordination, protection of LIPA equipment and reliability of service to the adjacent LIPA customers. The Producer shall be required to change relay settings, if necessary, to accommodate changes in the LIPA system.

b. System Modeling Data for Producer's Facility

The following must be submitted by the Producer through email:

i. An ASPEN Oneliner short circuit model of their facility and supporting documentation from the manufacturer. For inverter based Resources, provide data on type of inverters and generating technology, including any spec sheets. For inverter based Resources, the short circuit characteristics of the

system, including graphs showing behavior during short circuit and maximum fault current contribution by their inverter system for LG, 2LG, L-L and 3LG faults shall be provided. If fault current varies based on bus voltage, then a table with values of fault current at different voltages should be provided. Additional information specific to interconnecting equipment may be requested to understand impact and behavior of Producer's equipment.

ii. For synchronous generation, generator nameplate information including generator transient, subtransient, and synchronous impedances with time constants and transformer positive and zero sequence impedances.

iii. Transformer and breaker nameplate information. Transformer test reports with positive and zero sequence impedances.

c. Protection and Control Design Requirements for Producer's Facility

These are Protection and Control requirements for Producer's facility. The requirements for facilities that will be owned and operated by LIPA will be provided upon request. All additions or changes to Producer's relay and control equipment shall be paid for and installed by the Producer.

The following requirements apply to the interconnection equipment of all Resources operating in parallel with the LIPA transmission system:

1. All Producers shall provide an interconnection breaker on LIPA's side of their interconnecting transformer. The breaker shall be located in the Producer's substation and shall be installed at the Producer's expense.

2. All breakers shall be D.C. trip and close. Trip and close circuits of the interconnection breaker shall be separately fused. A loss of D.C. alarm shall be wired to the RTU.

3. The Producer shall be responsible for isolating faults within their facility in a coordinated manner by tripping appropriate breakers.

4. Faults occurring on the interconnection equipment at the interconnecting voltage level shall be cleared as follows: Resources interconnecting at 69kV and below shall be cleared within 6 cycles and Resources interconnecting at 138kV and above shall be cleared within 4 cycles after occurrence of the fault.

5. All installations shall have an interconnecting transformer between LIPA system and Producer's Resource and be a ground source to LIPA system. All synchronous generation Resources shall be isolated from the LIPA system by means of an interconnecting transformer that creates zero sequence discontinuity between primary and secondary of the transformer (isolating transformer). All synchronous generation Resources shall have a wye grounded (LIPA side) /delta (Resource side) or a wye grounded (LIPA

side) /delta (tertiary) /wye (Resource side) interconnecting transformer. All inverter based Resources shall have a wye grounded (LIPA side) /delta (Resource side) or a wye grounded (LIPA side) /delta (tertiary) /wye (Resource side) or wye grounded (LIPA side) /delta (tertiary) /wye grounded (Resource side) interconnecting transformer.
See Appendix B for the technical explanation of this requirement. A ground fault current limiting neutral reactor shall be installed if required by LIPA.

6. For synchronous generation, whenever the LIPA supply is de-energized, the Producer's interconnection breaker shall be tripped by voltage and/or frequency relays. The Producer's interconnection breaker shall be automatically locked out and prevented from closing into a de-energized or partially de-energized (loss of one phase) LIPA system.

7. The following are the minimum relay requirements for the Producer's interconnection breaker.

   i. Dual protective relaying systems shall be provided for all transmission interconnections. For all interconnections at 100kV and above, the protective relaying for system #1 and #2 shall be physically and electrically separated to avoid single point of failure. The relay systems shall be installed on separate panels and supplied by separate dc battery systems. The relay panels shall be non-adjacent or separated by minimum of 6ft. For all interconnections below 100kV, the protective relaying systems #1 and #2 shall be installed on separate panels. However, they do not need to be supplied from separate DC batteries. All interconnections to existing or future BPS substations shall be designed with electrical and physical separation in accordance with NPCC Directory #4 and Directory #11.

   ii. The interconnecting transmission line shall be protected by dual transmission line relaying systems using fiber optic cables as the communication channels. Each transmission line relaying system shall include line current differential (87L), phase distance (21P) and ground distance (21G) elements. The SEL-311L and SEL-411L relays shall be utilized for the two line protection relaying systems. Each relay will utilize a single independent communication channel for both 87L and DTT communication. CTs for this relaying shall be on the Resource side of the Producer's interconnection breaker. LIPA shall specify the CT ratios. Back-up directional ground overcurrent elements (67N) with instantaneous and time delay functions shall be provided. Phase overcurrent with instantaneous and time delay functions may be required.

   iii. The Producer's interconnection transformer shall be protected by dual current differential protection systems with electrical and physical separation outlined above. Any transformer that is a ground source to LIPA system shall have a ground overcurrent element at the transformer to provide backup overcurrent protection.

iv. Over/under frequency protection may be required for synchronous generation based interconnection.

v. Over/under voltage protective functions may be required.

vi. Directional power relays may be required to limit power flow to contractual agreements, except if it's needed to provide required frequency response.

vii. Directional phase overcurrent relays shall be required at sites where the Producer's load requirements from LIPA exceed the Producers simultaneous generating capability. Any exceptions to this requirement must be approved by LIPA.

viii. Breaker failure protection is required for Producer's interconnection breaker and all breakers adjacent to Producer's interconnection breaker. Breaker failure relaying is required to trip all adjacent breakers including keying DTT to trip remote breakers. The Producer may utilize the line current differential relays for direct transfer trip or may provide separate transfer trip equipment.

ix. Additional protection functions and modification to these protection functions may be required as deemed necessary by LIPA to protect LIPA system or to improve dependency and/or security of the protection systems.

x. All interconnection breaker relays and required relays within Producer's facility relays must be utility grade. Producer's interconnection breaker relays will require Flexi-test Switches for current, voltage, output and input connections to facilitate maintenance, inspection, testing, and adjustments.

8. The Producer shall specify, order and install the 87L and transfer trip communications channels.

9. A separate fiber optic cable shall be utilized for each line relaying system and they shall be routed in separate conduits. For all interconnection 100kV and above, fiber route for primary and secondary relaying systems shall be separate and diverse. For interconnections 100kV and below if line is short and instantaneous settings cannot be set, fiber route for primary and secondary relaying systems shall be separate and diverse.
A leased T1 channel may be used as a second channel for current differential protection.

The Producer will install/own/maintain fiber between LIPA substation and the Producer's facility and Producer's fiber would terminate at a Producer owned/maintained fiber patch panel in the LIPA control house.

The Producer shall terminate fibers adjacent to the transfer trip equipment in a wall mounted fiber patch panel. The Resource shall not be allowed on line if the transfer trip or associated communication

medium is out of service.

10. If IEC-61850 or other methods of protection over LAN are used then failure of single network device or single path shall not disable both protection systems.

11. Control, CT, and telemetering leads which interconnect to LIPA shall have a minimum size and stranding of 19/25, 19/22, and #18 STP, respectively. All control, CT and telemetering leads shall be terminated using ring type connectors.

12. A cut-off switch logic shall be implemented by the Producer in their line protection scheme. Physical cut-off switches shall be installed. Programmed logic simulating the switches is not acceptable. The purpose of the logic is to disable current differential (87L) scheme and DTT tripping at local and remote relays. A cut-off switch and a test switch associated with DTT and 87L scheme shall be installed on panel with each line protection relay.

13. The Producer shall be solely responsible for synchronizing its Resource(s) with the LIPA system.

14. Synchronous generators shall be equipped with synchronizing capability across the generator breaker. Synch check is also required across the Producer's interconnection breaker. A total of four potential transformers shall be required on the Producer's interconnection breaker, one on LIPA's side of the breaker and three on the Producer's side. Synch check relays shall be installed for manual synchronizing. Closing into the LIPA system without a functioning synch check relay is not permitted. Automatic synchronizing equipment shall be optional.

15. For all synchronous based generation and Resources capable of generating voltage prior to closing in to LIPA system (grid-forming IBR) the Producer's interconnection breaker close circuit shall include a synch check and an over/under voltage permissive to prevent closing the breaker when unfavorable voltage conditions exist.

16. Voltage and frequency relays are required at the LIPA substation to disconnect the Producer's Resource from the LIPA bus in the event that this bus becomes isolated from the LIPA system and the Producer's Resource continues to carry the connected LIPA load. These relays shall be installed at the Producer's expense.

17. Unless mentioned otherwise LIPA's transmission system's phase rotation is ABC.

18. Protective relay coordination for three phase and line to ground faults on the LIPA system and the Producer's facility shall be performed. The relays

shall be set to operate in a coordinated manner.

19. Nearby LIPA transmission lines may have automatic reclosing enabled. It is the Producer's responsibility to protect its equipment from being reconnected out-of-synchronism with the LIPA system after automatic reclosing of a LIPA circuit breaker.

20. It is Producer's responsibility to meet requirements of all applicable NERC reliability standards for their protective relaying systems.

21. Any Resource interconnecting to LIPA BES substation, the protection at Producer's interconnection breaker shall be designed as per relay protection requirements for 138kV and above in this document.

22. Any Resource interconnecting to LIPA BPS substation, the control, protection and DME design at the Producer's interconnection breaker shall be designed as per NPCC Directory #4 and Directory #11.

d. Instrument Transformers and DC Supplies for Producer's Facility

1. All relaying CTs shall have a minimum ANSI accuracy of C800. The Producer shall provide a CT shorting block for each CT circuit.

2. Three PTs with dual secondary windings shall be installed on the Producer side of the interconnection breaker and shall be connected wye grounded/wye. Each secondary winding shall supply separate line protection relay system. Three red indicating lights, one per phase, connected phase to ground in the PT secondary, shall be installed to provide visual verification of potential on each phase.

3. The station battery shall be sized for an eight hour duty cycle in accordance with current revision of IEEE Standard 485. At the end of the duty cycle the battery shall be capable of tripping and closing all breakers. A low voltage D.C. alarm shall be wired to Producer's local SCADA and/or Annunciator.

4. All microprocessor relays requiring an auxiliary power source shall be powered from the station battery. AC to DC converters are not acceptable.

e. SCADA/RTU and DME Requirements for Producer's Facility
The following are SCADA and RTU requirements applicable to Producer's Facility to provide SCADA to LIPA.

1. A SCADA (Supervisory Control and Data Acquisition) system RTU (Remote Terminal Unit) shall be required at each Producer's facility. The RTU shall provide LIPA with following SCADA monitoring and control points:

i. Status indication of Producer's interconnection breaker(s),

generator/Resource breaker(s), and all other devices that are in series with these breakers.

ii. Status indication of various alarms such as loss of DC to Producer's interconnection breaker(s), relay failure alarm, loss of relaying communication channel for each relay, DTT sent and received for each relay and 87L cut-off switch alarm for each switch.

iii. Trip control of Producer's interconnection breaker for system emergencies.

iv. Controlled Stop/Emergency Stop of Resource for system emergencies.

v. Telemetry of current, voltage, watts, VARS, power factor and frequency at all Producer's interconnection breakers.

vi. Pulse accumulation of MWHR (in/out) and MVARHR (in/out) for the facility.

vii. The RTU shall be equipped with analog output capabilities if it is determined that the Resource's set point is to be transmitted from the NYISO to the Producer via the LIPA Control Room.

viii. Three (3) Analog input points: 5 Min CC set point control (feedback), 6 sec/ CC set point control (feedback), and Curtailment Flag (feedback). Three Analog output control points: 5 Min CC set point control, 6 sec/ CC set point control, and Curtailment Flag

ix. Additional alarms and status points as determined by LIPA dependent on Producer's interconnecting Resource technology and their system configuration.

The Producer shall not be allowed to operate in parallel if the RTU or its associated communications channels are out of service.

All costs for additional hardware and software for LIPA's mainframe supervisory computer that are necessary for its interconnection shall be charged to the Producer.

The supervisory equipment shall be installed and paid for by the Producer. A digital meter or digital relay connected to the CTs and PTs through Flexi-test switches shall be used to provide analog telemetering to the RTU. The make and model number for the device shall be provided to LIPA. SCADA protocol shall be DNP 3.0 Serial.

2. The DME shall be designed when required as per applicable NERC Reliability PRC standards and NPCC Directory #11.

f. System Upgrades at the LIPA substation.

All additions or changes required to protective relay and control equipment on the LIPA system shall be installed by LIPA at the Producer's expense.

Additional Protection and Control equipment that, depending on the parameters of each interconnection, could be required for installation on the LIPA system include, but are not limited to:

i. Digital Monitoring Equipment (SER and FR capabilities).

ii. Additional protective relaying systems and associated communication equipment to existing LIPA transmission line(s) to ensure reliability of protection systems due to changes in magnitude fault current and to ensure fault clearing within "new" stability parameters resulting from the Producer's generation.

iii. Modifications to existing LIPA transmission line protection systems for special cases may be required on a case-by-case basis.

iv. Expansion/addition of SCADA RTUs on the LIPA side of the interconnection.

v. Upgrade of breaker failure relaying protection.

vi. Recloser blocking of transmission line breakers.

vii. Zero sequence voltage relaying

E. Protection Commissioning Testing

The following requirements apply to all Producer-owned installations.

a. At the completion of construction, functional tests, relay acceptance tests and calibration tests of all protective equipment shall be performed by a qualified testing company acceptable to LIPA, and LIPA reserves the right to witness such tests. All test results shall be submitted to LIPA for review prior to energization. If these tests are successful, and the protective relay settings have been correctly applied, LIPA shall permit the interconnection to be energized.

b. All CT circuits supplying interconnection relaying shall be tested via current injection test (primary or secondary) to verify integrity of complete circuit.

c. All CTs shall be tested for ratio and saturation (knee point) and polarity.

d. The PTs used for interconnection relaying shall be tested for ratio. Results from factory test are acceptable. The PTs shall also be tested for insulation.

e. The functional trip test shall verify that all protection related wired outputs perform their intended function. All auxiliary relays in protection scheme must be tested to verify that they are appropriately activated and perform their intended function as per design. All circuit breaker must be tripped at least once via auxiliary or protective relays. All relay functions or logic programmed in the relay intended to perform tripping or breaker re-closing must be verified by performing that function through output contact of the protective relay. Highlighted schematics, diagrams and/or logic diagrams may be submitted for review as evidence of completion of functional trip tests. Alternatively, Producer may prepare and submit forms that capture all the functional trip tests in detail and indicate pass/fail for each test. The forms will need to be reviewed and

approved by LIPA prior to testing. All documentation shall be dated and signed.

f. All communication channels utilized for relay protection shall be tested and any communication channel based protection functions and trip functions shall be verified.

g. The relay calibration tests shall verify pick-up value, reach and/or operating time of the relay based on function provided by the relay. Multiple points on curve of time overcurrent relays shall be tested. Any logic programmed in the relay that affects tripping shall be tested. A complete calibration report with relay serial number and part number shall be submitted to LIPA for review.

h. If IEC-61850 or other methods of protection over LAN are used then additional testing requirements may be provided.

i. As-left relay settings, as-built drawings and any logic diagrams shall be submitted to LIPA after completion of all testing.

F. Metering Requirements

a. Location
   i. Metering shall be located in LIPA substation
   ii. Where metering cannot be accommodated in existing substations due to space constraints, Metering shall be permitted to be located on Producer's property in dedicated LIPA area with 24/7 Access and arrangement of double key provision which can be accessible by LIPA at all times.
   iii. Metering requirements are described in LIPA's Revenue Metering Requirements for Generating Facilities Interconnecting to the LIPA Transmission System.

G. Maintenance and Operating Requirements

The following requirements apply to all Producer-owned installations.

a. The protective devices (relays, circuit breakers, etc.) required to disconnect the Producer's generation shall be owned, operated, and maintained by the Producer at its expense.

b. Maintenance testing requirements and test intervals must follow the latest version of PRC-005 whether or not the facility is BES. Copies of these test results shall be submitted to LIPA no later than five working days after completion of tests. All the testing and calibration shall be performed by a qualified independent testing organization acceptable to LIPA, in accordance with industry standards. Interconnection breaker speed curves shall be verified using a Cincinnati Analyzer or an equivalent. Battery tests shall meet the requirements of IEEE Standard 450-1987. LIPA reserves the right to witness and accept or reject the result of all tests. LIPA shall be notified of the date of testing two (2) weeks in advance.

c. After the Producer's equipment is in service, LIPA reserves the right to test or review on request the calibration and operation of all protective equipment

including relays, circuit breakers, batteries, etc. at the interconnection as well as review the Producer's complete maintenance records. A review of the calibration and operation of protective equipment may include LIPA-witnessed trip testing of the interconnection breaker from its associated protective relays.
The failure of the Producer to maintain its equipment in a manner acceptable to LIPA or to furnish maintenance records on demand shall result in the Producer being prevented from operating in parallel with the LIPA system.

d. If LIPA is requested to work at the Producer's generating site, LIPA operating and maintenance personnel shall inspect the site to insure that all LIPA safety requirements have been met. If not, commencement of the requested work will be delayed until conditions are deemed safe by LIPA.

e. LIPA reserves the right to test for or to request the Producer to supply certified test reports for harmonic content at the point of interconnection. The % Total Harmonic Distortion (THD) measurements shall be taken with a spectrum analyzer.

   If at any time during parallel operation harmonic distortion problems affecting other customers' equipment can be traced to the Producer's Resource, LIPA reserves the right to disconnect the equipment from the LIPA system until solution is developed and all impacts are resolved.

f. The Producer shall close the interconnection circuit breaker only after obtaining approved switching orders from the responsible LIPA operator as defined in the Operating Agreement. LIPA reserves the right to open the disconnecting device to the Producer for any of the following reasons:

   i. System Emergency or System Pre-Emergency
   ii. Substandard conditions existing with the Producer's generating and/or protective equipment.
   iii. Failure of the Producer to maintain its equipment in accordance with the agreed upon schedule.
   iv. Failure of Producer to make maintenance records available to LIPA on request.
   v. Interference by the Producer's generation system with the quality of service rendered by LIPA to its customers.
   vi. Personnel safety.
   vii. To eliminate conditions that constitute a potential hazard to the general public.
   viii. Loss of communications medium for Direct Transfer Trip or SCADA.
   ix. Loss of communications medium that results in loss of high speed protection for the entire interconnecting transmission line.

g. To accomplish the interconnection and to provide for continuing operations in a safe, economical and efficient manner, LIPA shall prepare and deliver Operating Instructions to the Producer prior to interconnecting the facility. The Operating Instructions shall include but not be limited to, defining requirements for:

i. Maintaining proper voltage and frequency and for putting into effect voltage changes as required from time to time.
ii. Phasing and synchronizing the facility and LIPA's system (if a synchronous generator).
iii. Taking transmission lines out of service for maintenance during a system emergency or system pre-emergency conditions and restoring such lines to service.
iv. Controlling the flow of real and reactive power.
v. Periodic maintenance of the interconnection circuit breaker and related facilities.
vi. Procedure for communication between electrical operations personnel of the Producer and LIPA.

i. The Producer shall be required to have a qualified testing company acceptable to LIPA, perform maintenance, trip tests, and recalibration tests on its protective relaying devices to meet the latest version of PRC-005 (whether or not this is a BES facility or not). A copy of the test results shall be sent to LIPA for review, comment, and acceptance, no later than five (5) working days after completion of tests.

j. The Producer will notify LIPA whenever equipment modifications are made that change ratings or performance characteristics of the Producer's equipment.

4. Generating Criteria

It is the policy of LIPA to permit any applicant to operate Resources in parallel with the LIPA electric system whenever such operation can take place without adversely affecting other LIPA customers, the general public, LIPA equipment and LIPA personnel. To minimize this interference, the Producer's Resources shall meet the following criteria:

A. Voltage

Nominal voltages on the LIPA transmission system are 345, 138, 69, 34.5 and 23.38 kV.

B. Frequency

The Resource shall meet all applicable NERC and NPCC under frequency requirements / guidelines. The over-frequency trip setting of the Protective Functions shall be 60.5 Hertz. The final time delay will be determined by LIPA based on review of the Project design.

C. Power Factor

Resources shall have the capability to produce or absorb VARS such that the power factor at the delivery point (location of LIPA's revenue metering equipment) is controllable over the range between 0.90 and 1.0 leading or 0.90 and 1.0 lagging. LIPA's system operator may request the Resource to adjust the power factor at the delivery point, within the above stated limits. Developer should not rely on LIPA system as a source or sink for

VAR requirements of the site. Site should be able to produce or absorb at request of LIPA system operator

D. External and Internal Fault Clearing

For interconnections at voltages up to and including 69 kV, the Resource shall be responsible for disconnecting its equipment from the LIPA system within 7 cycles of the occurrence of a fault on a LIPA transmission line connected directly to the interconnection breaker using its dual high speed relaying systems. A similar type fault with a 138 kV connection shall also be cleared by dual high speed relaying systems in 5 cycles. The backup relaying must clear these faults within times specified by LIPA based on coordination studies. The short circuit currents on the transmission system are available from LIPA on request.

E. Other Applicable Resource Documents
Information above shall apply to all Resources unless explicitly superseded by LIPA NSR

5. Project Modeling Requirements

A. Onelines:

a. All onelines shall be in alignment with description in Interconnection Request, Study Scope and all fields on NYISO Modeling Data Request Form as well as LIPA Modeling data requirements below
b. Onelines shall include legend and clearly labeled equipment specifications.
c. Onelines shall clearly identify suggested POI (or alternatives) and number of requested terminals/ gentie lines required.
d. In addition to oneline, map of Producer facility shall be provided.
e. Transformer Winding notation / vector group and order shall be defined on diagram (i.e. Primary/secondary/tertiary, etc)

B. Modeling Data

a. Sections 2 and 3 from the NYISO Reliability Analysis Data Manual (Manual 24; i.e., RAD Manual) should be referenced to review the annual process, procedures and illustrative schedule followed by the NYISO, Transmission Owners, and Generator Owners to collect the required steady state, dynamic, GIC and short circuit base case data for the New York Control Area. Generator owners are responsible for complying with the procedures and responsibilities for their facilities.
b. New York State Reliability Council Reliability Rule B.5 outlines minimum interconnection standards and modeling requirements for Large Inverter Based Resource (IBR) Generating Facilities based on IEEE Standard 2800-2022.
c. Modeling Data shall be checked for accuracy. All equivalent models shall be provided with documentation identifying intent and supplied with supporting calculations or manufacturer documents. Explicit modeling of facility load is required. The addition of producing facility load is impactful to LIPA system when Resource is not producing and the facility is energized. Please note that load impacts the requested withdrawal and production value at the POI and shall be appropriately identified in the NYISO Interconnection Process.

C. IEEE 2800 Compliance

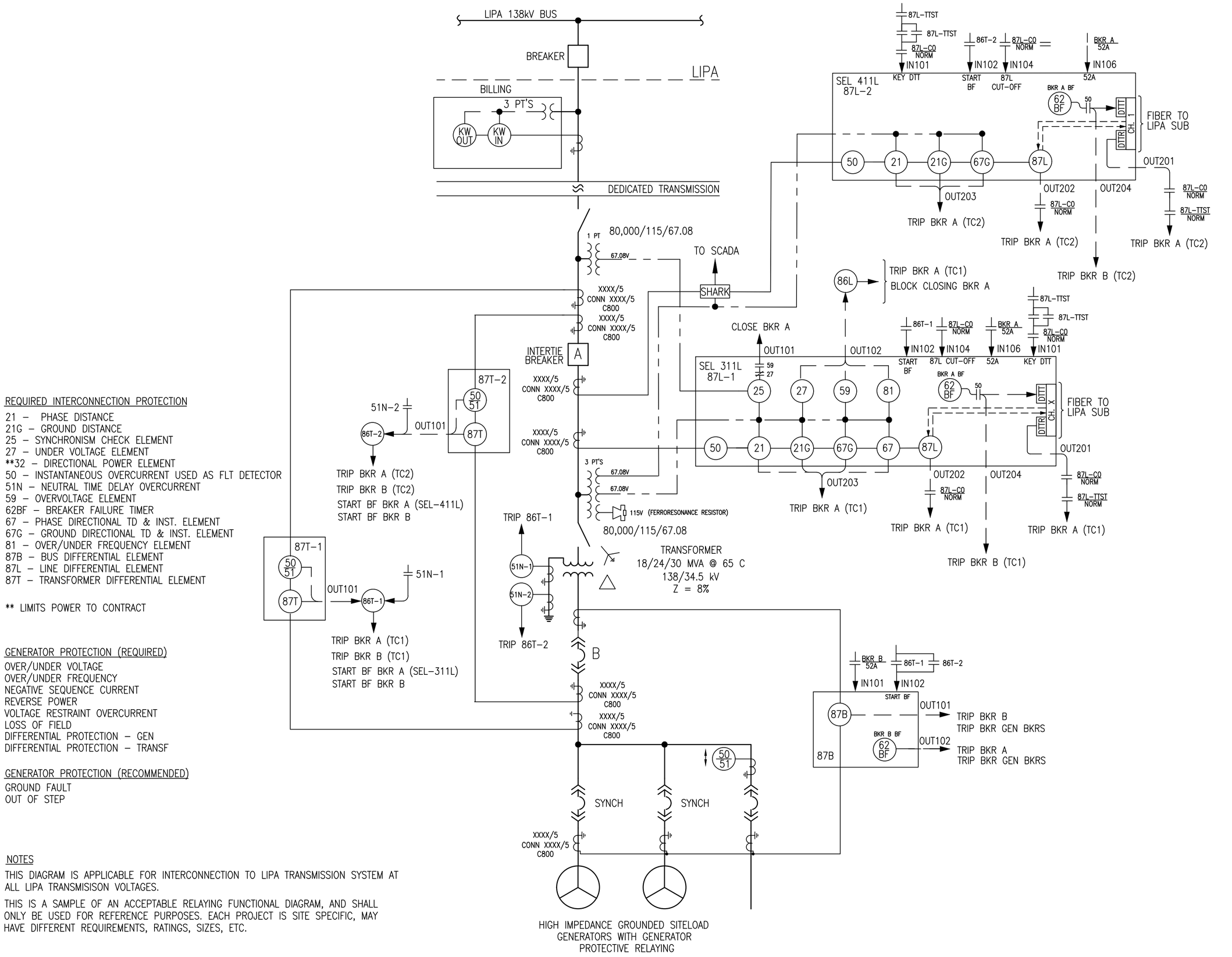
Project shall identify if it complies with or plans to comply with IEEE 2800

Appendix A

Drawing List

1. Relay Functional for Interconnection with Synchronous Generation
2. Relay Functional for Interconnection with Inverter Based Resources

These drawings are examples of typical interconnections. Each project is site specific and may have different requirements.



REQUIRED INTERCONNECTION PROTECTION

21 – PHASE DISTANCE
21G – GROUND DISTANCE
25 – SYNCHRONISM CHECK ELEMENT
27 – UNDER VOLTAGE ELEMENT
**32 – DIRECTIONAL POWER ELEMENT
50 – INSTANTANEOUS OVERCURRENT USED AS FLT DETECTOR
51N – NEUTRAL TIME DELAY OVERCURRENT
59 – OVERVOLTAGE ELEMENT
62BF – BREAKER FAILURE TIMER
67 – PHASE DIRECTIONAL TD & INST. ELEMENT
67G – GROUND DIRECTIONAL TD & INST. ELEMENT
81 – OVER/UNDER FREQUENCY ELEMENT
87B – BUS DIFFERENTIAL ELEMENT
87L – LINE DIFFERENTIAL ELEMENT
87T – TRANSFORMER DIFFERENTIAL ELEMENT

** LIMITS POWER TO CONTRACT

GENERATOR PROTECTION (REQUIRED)

OVER/UNDER VOLTAGE
OVER/UNDER FREQUENCY
NEGATIVE SEQUENCE CURRENT
REVERSE POWER
VOLTAGE RESTRAINT OVERCURRENT
LOSS OF FIELD
DIFFERENTIAL PROTECTION – GEN
DIFFERENTIAL PROTECTION – TRANSF

GENERATOR PROTECTION (RECOMMENDED)

GROUND FAULT
OUT OF STEP

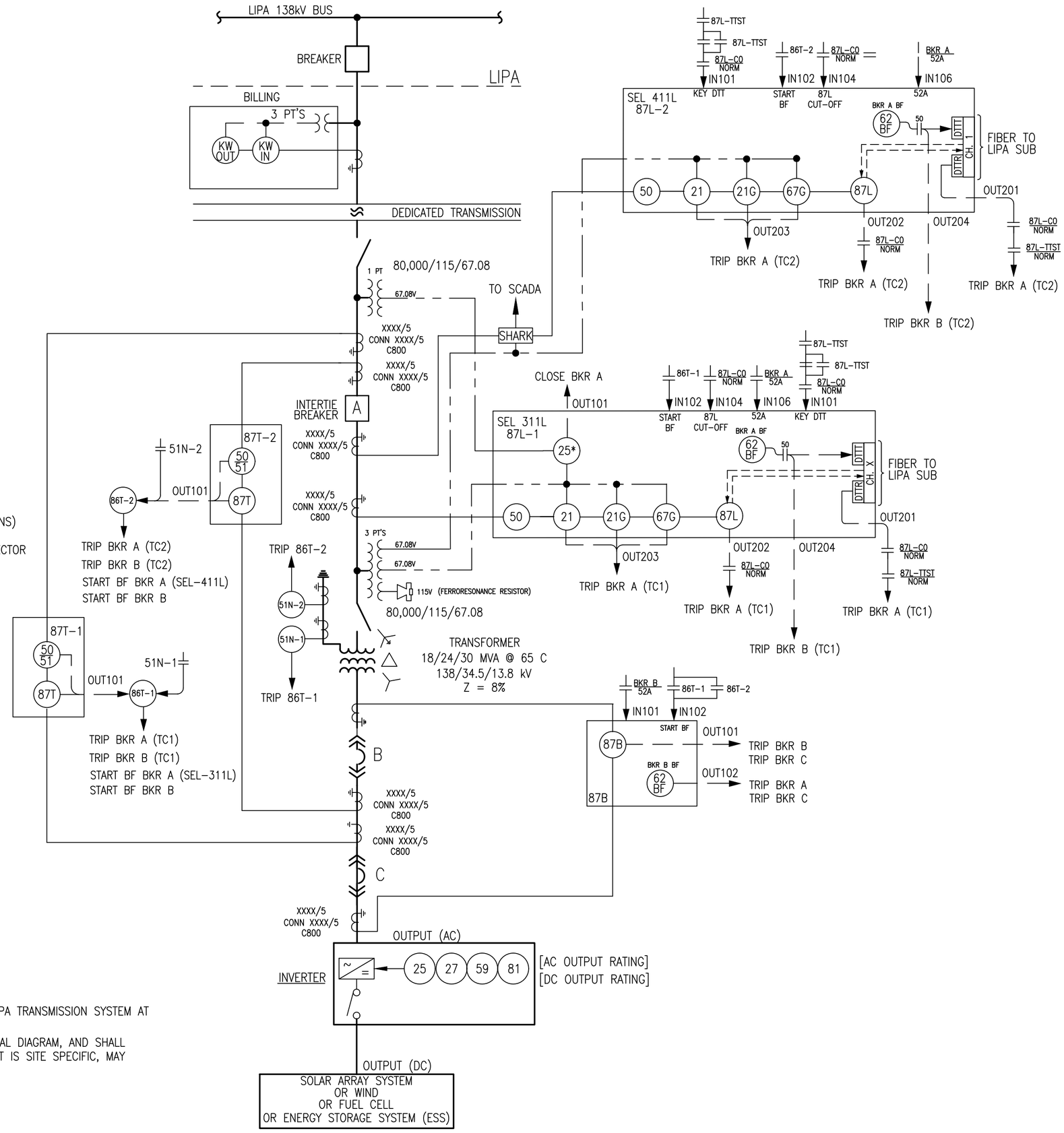
NOTES

THIS DIAGRAM IS APPLICABLE FOR INTERCONNECTION TO LIPA TRANSMISSION SYSTEM AT ALL LIPA TRANSMISISON VOLTAGES.

THIS IS A SAMPLE OF AN ACCEPTABLE RELAYING FUNCTIONAL DIAGRAM, AND SHALL ONLY BE USED FOR REFERENCE PURPOSES. EACH PROJECT IS SITE SPECIFIC, MAY HAVE DIFFERENT REQUIREMENTS, RATINGS, SIZES, ETC.

RELAY FUNCTIONAL FOR INTERCONNECTION WITH SYNCHRONOUS GENERATION

W.O. NUMBER	LIPA	DATE: 4/12/2024
DRAWN BY: JM		DWG NO: APPENDIX A SHEET 1 OF 2
APPROVED BY: MH		



REQUIRED INTERCONNECTION PROTECTION

21 – PHASE DISTANCE
21G – GROUND DISTANCE
*25 – SYNCHRONISM CHECK ELEMENT
(DEPENDENT ON IBR TECHNOLOGY & OTHER CONSIDERATIONS)
**32 – DIRECTIONAL POWER ELEMENT
50 – INSTANTANEOUS OVERCURRENT USED AS FAULT DETECTOR
51N – NEUTRAL TIME DELAY OVERCURRENT
62BF – BREAKER FAILURE TIMER
67G – GROUND DIRECTIONAL TD & INST. ELEMENT
81 – OVER/UNDER FREQUENCY ELEMENT
87B – BUS DIFFERENTIAL ELEMENT
87L – LINE DIFFERENTIAL ELEMENT
87T – TRANSFORMER DIFFERENTIAL ELEMENT
***59 – OVERVOLTAGE ELEMENT
***27 – UNDER VOLTAGE ELEMENT

** LIMITS POWER TO CONTRACT
*** 27/59 REQUIREMENT TO BE DETERMINED BY LIPA PROTECTION ENGINEER

INVERTER BASED RESOURCE PROTECTION (REQUIRED)

OVER/UNDER VOLTAGE
OVER/UNDER FREQUENCY
DIFFERENTIAL PROTECTION – TRANSF

NOTES

THIS DIAGRAM IS APPLICABLE FOR INTERCONNECTION TO LIPA TRANSMISSION SYSTEM AT ALL LIPA TRANSMISISON VOLTAGES.

THIS IS A SAMPLE OF AN ACCEPTABLE RELAYING FUNCTIONAL DIAGRAM, AND SHALL ONLY BE USED FOR REFERENCE PURPOSES. EACH PROJECT IS SITE SPECIFIC, MAY HAVE DIFFERENT REQUIREMENTS, RATINGS, SIZES, ETC.

RELAY FUNCTIONAL FOR INTERCONNECTION WITH INVERTER BASED RESOURCES

W.O. NUMBER	LIPA	DATE: 4/12/24
DRAWN BY: JM		DWG NO: APPENDIX A SHEET 2 OF 2
APPROVED BY: MH		

Appendix B

Explanation of the Requirement for a Wye Grounded Transformer

All Producer generation interconnections with LIPA must be grounded sources. During a phase to ground fault on the LIPA system, the Producer's Resource can be isolated with the phase to ground fault if the LIPA source opens before the Producer's protective equipment detects the fault condition and isolates from the LIPA system. If the Resource is not grounded during the period that it is isolated with the phase to ground fault, the neutral can shift resulting in overvoltage on the two remaining unfaulted phases. This overvoltage can reach 173% of normal and will damage LIPA phase to ground connected load or equipment isolated with the Resource. To avoid the possibility of an overvoltage due to a neutral shift, LIPA requires that the Producer's Resource interconnect into the LIPA system as a grounded source.

The designer of the Resource installation should be aware that the interconnecting transformer provides a path for zero sequence fault current for all phase to ground faults on the interconnecting circuit and LIPA transmission system. In order to limit the ground fault current from the Producer's equipment, LIPA may require that the system be designed to limit the zero sequence current (large zero sequence impedance) and still meet the grounding requirements.