LONG ISLAND POWER AUTHORITY
INTERCONNECTION REQUIREMENTS FOR
NEW DISTRIBUTED GENERATION
GREATER THAN 300 KVA
OPERATING IN PARALLEL WITH
LIPA'S RADIAL DISTRIBUTION SYSTEM

Revised and Issued March 2003

I. Introduction

This document provides the minimum control and protection requirements for safe and effective operation of Distributed Generation Equipment, greater than 300 kVA, interconnecting with the Long Island Power Authority (LIPA) radial distribution system. The term "Distributed Generation Equipment" (DG System) refers to generating systems owned by individuals, companies, or agencies, other than LIPA, within the LIPA service area. It is emphasized that these requirements are general and may not cover all details in specific cases.

A DG System greater than 300 kVA may only interconnect directly to the distribution system through a line designed for radial operation. The customer must be Primary Metered as defined by LIPA's tariffs. Primary Metering requirements are defined elsewhere. Interconnections shall not be made to primary feeders supplying secondary network systems. **Generator size limitations are outlined in Section VI - Classification of DG System Generator Installations.**

LIPA will evaluate applications for interconnections to looped radial primary systems (fused loops). If approved, these interconnections shall be made through a LIPA installed and owned fused disconnect switch installed on the primary side of the customer owned transformer. The installation of the fused switch shall be at the DG System's expense.

Interconnection requirements as well as specific electrical requirements for parallel operation with the LIPA system are provided for substation and distribution interconnections of synchronous generators, induction generators, and D.C. generators with inverters.

Appendix D is an application form to be used by the DG System and LIPA to document the specific characteristics of the installation. This application shall be coordinated by LIPA's Distributed Resource Management group.

Responsibility for protection of the DG System against possible damage resulting from parallel operation with the LIPA Distribution System lies solely with the DG System.

The LIPA transmission lines have automatic instantaneous reclosing and distribution feeders have automatic instantaneous and time delay reclosing with a dead time as short as 12 cycles and as long as 30 seconds. It is the DG System's responsibility to protect its equipment from being reconnected out-of-synchronism with the LIPA system after automatic reclosing of a LIPA circuit breaker. The DG System connected to the distribution system can also be affected by a transmission line breaker reclosure. It is the DG System's responsibility to protect its equipment from these reclosures. The DG System shall provide high speed protective relaying to remove its equipment from the utility circuit prior to the automatic reclosure. This requirement cannot be met by direct transfer trip equipment.

II. Generating Criteria

It is the policy of LIPA to permit any applicant to operate a DG System 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 DG System shall meet the following criteria:

A. Voltage

The DG System shall produce voltages within ± 5% of nominal when operating in parallel with the LIPA system. (Nominal voltages on the LIPA distribution system are 13.8 and 4.5 kV). The DG System shall provide an automatic means of disconnecting its generating equipment from LIPA's facilities as follows:

Voltage Range (% of base voltage)	Clearing Time (seconds)
$V < 50$	0.16
$50 \leq V < 88$	2.0
$110 < V > 120$	1.0
$V \geq 120$	0.16

Base voltages are nominal LIPA system voltages. The clearing time is the time between the start of the abnormal condition and the DG System ceasing to energize the LIPA system. The clearing times indicated are default times and may be adjusted based upon application specific requirements subject to LIPA review and approval.

B. Flicker

The DG System shall not cause voltage variations on the LIPA system exceeding those defined on the Border Line of Visibility in **Appendix E** - Voltage Flicker Curves.

C. Voltage Dip

The voltage dip on a primary circuit due to inrush current should not exceed 2 Volts on a 120 Volt base.

D. Frequency

The DG System shall provide an automatic means of disconnecting its generating equipment from LIPA's facilities for over and under frequency situations. No under frequency tripping shall take place between 59.9 Hz and 58.0 Hz. The final under frequency set point shall be determined to best support the operation of the LIPA system. The equipment must be disconnected within 0.16 seconds for a frequency of 60.5 Hz or more and within 1.0 second for a frequency of less than 58.0 Hz.

E. Harmonics

The total harmonic voltage or current distortion created by a DG System must not exceed 5% of the fundamental 60 Hz voltage or current waveform. The harmonic current injection shall be exclusive of any harmonic currents due to harmonic voltage distortion present on the LIPA system without the DG System connected. Any single harmonic shall not exceed 3% of the fundamental frequency.

$$\% \text{ Total Harmonic Distortion (THD)} = \frac{\sqrt{\sum_{i=2}^{\infty} h_i^2}}{h_1} x100 \quad (1)$$

$$\text{While a Single Component \% Distortion} = \frac{h_i}{h_1} x100 \quad (2)$$

Where:

h_i = The magnitude of the i_{th} harmonic of either voltage or current.
h_1 = the magnitude of the fundamental voltage or current.

For non-type tested units, as defined in the New York Standardized Interconnection Requirements and listed on the New York Public Service Commission website, the DG System(s) shall provide manufacturer’s harmonic testing reports.

F. Power Factor

DG Systems utilizing synchronous generators shall produce or absorb VARS such that the overall power factor at the delivery point (location of LIPA's revenue metering equipment) is between 0.90 and 1.0 leading or between 0.90 and 1.0 lagging. LIPA's System Operator may request DG System to adjust the power factor at the delivery point, within the above stated limits.

For DG Systems utilizing induction generators with a nameplate power factor below 1.0, LIPA shall provide, at the DG System's expense, VAR capacity from its system to bring such generators' power factor to 1.0.

G. External Fault and Line Clearing

The DG System shall be responsible for disconnecting from the LIPA system within 8 cycles of the occurrence of a fault on the LIPA distribution system using it’s relaying. Backup relaying must coordinate with LIPA's protective relaying.

Note: The maximum available symmetrical short circuit current from LIPA on the 13 kV distribution system is 16,000 amperes and is exclusive of any other DG Systems that may be connected to the same LIPA substation.

H. DC Injection

The DG System shall not inject dc current greater than 0.5% of the full rated output current at the point of interconnection with the LIPA system.

I. Unintentional Islanding

In the event that an unintentional island in which the DG System energizes a portion of the LIPA system across the interconnection point, the DG System shall detect the island and cease to energize the LIPA system within two seconds of the formation of an island.

III. General Requirements

Each DG System operating in parallel with the LIPA system shall have its interconnection control and protection designs reviewed and accepted by LIPA.

The specific design requirements of the protection system depend on the generator type, size, and other site specific considerations. The DG System shall meet LIPA's Specifications and Requirements for Electric Installations (Red Book), latest revision, all applicable sections of the NEC and all local and municipal codes.

It is the intent of these Interconnection Requirements that interconnected DG Systems meet operational requirements outlined in IEEE Standard P1547 and all future companion documents to P1547, as they may be adopted by the IEEE Standards Board in the future. LIPA reserves the right to impose site specific interconnection requirements on a case by case basis.

To eliminate unnecessary costs and delays, a DG System interconnection one line drawing should be submitted to LIPA for acceptance prior to the commencement of construction and ordering of equipment. Seven (7) copies of the following must be submitted before a final acceptance can be given to the DG System's design:

A. DG System Interconnection one-line drawing.

B. 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 should be clearly labeled (See **Appendix F** for an example of an acceptable relay functional).

C. Three line AC schematic diagrams of transformers and bus relay protection.

D. Interconnection breaker AC and DC schematics.

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

F. Generator, transformer, and breaker nameplate information including generator transient, generator harmonic characteristics (non type tested generators), subtransient, and synchronous impedances and transformer positive and zero sequence impedances (Appendix D).

G. Producer generator protection scheme.

H. Interconnection breaker speed curve.

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

No installation of equipment can be completed without written acceptance from LIPA. If the DG System is installed without prior written acceptance of the equipment by LIPA, it shall be done at the DG system's own risk. The DG System 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 of the DG System's interconnection equipment.

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

At the completion of construction, functional 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. If these tests are successful, and the protective relay settings have been correctly applied, LIPA shall permit the interconnection to be energized.

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 DG System prior to interconnecting the facility. The Operating Instructions shall include but not be limited to defining requirements for:

A. Maintaining proper voltage and frequency and for putting into effect voltage changes as required from time to time.

B. Phasing and synchronizing the facility and LIPA's system.

C. Taking feeders out of service for maintenance during a system emergency or system pre-emergency conditions and restoring such feeders to service.

D. Controlling the flow of real and reactive power.

E. Periodic maintenance of the interconnection circuit breaker and related facilities.

F. Procedure for communication between electrical operations personnel of the DG System and LIPA.

The DG System shall also ensure the availability of a dedicated telephone handset, for use by LIPA personnel during testing and maintenance of the DG System's equipment.

The DG System shall be required to have a qualified testing company, acceptable to LIPA, perform maintenance, trip tests, and recalibration tests on its protective relaying devices once every two (2) years. 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.

IV. Control and Protection Requirements

A. Engineering Studies

Engineering studies shall be performed by LIPA to determine the exact electrical configuration of the interconnection installation and to identify any required additions, changes, or modifications to the LIPA system. Major equipment requirements such as circuit breakers and special protective relaying shall also be studied. Items requiring investigation are as follows:

1. Equipment short circuit duty.

2. Feeder breaker relay protection coordination due to in-feed for three phase and line to ground faults.

3. Branch fusing coordination due to fault current in-feed from DG System's equipment.

4. Breaker Failure requirements.

5. Deadline operating restraints.

6. VAR requirements.

7. MVA limitations of generation because of location on the LIPA feeder.

8. Protective relay coordination for three phase and line to ground faults on the LIPA system and the DG System's generator installation.

9. Protective Relay Alarm Breaker Trip (required for DG Systems utilizing only one microprocessor relay).

B. Equipment Requirements

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

1. All additions or changes required to protective relay and control equipment on the LIPA system shall be installed by LIPA at the DG System's expense. All additions or changes to relay and control equipment required at the point of interconnection shall be paid for and installed by the DG System.

2. The DG System shall be solely responsible for synchronizing its generator(s) with the LIPA system.

3. The DG Systems may provide a primary voltage interconnection breaker or secondary voltage breaker based on the total installed generator nameplate kVA rating. The breaker shall be located in the DG System's substation. If the interconnection breaker is a switchgear breaker, it shall be a drawout type with provisions for installing a ground and test device supplied by the DG system.

4. The interconnection breaker shall be capable of withstanding 220% of the interconnection breaker rated operating voltage.

5. For interconnection breakers rated at 480 Volts or less operating voltage the breaker shall be rated to withstand **the greater** of 220% of the operating voltage or two times the rated operating voltage of the interconnection breaker plus one thousand (1000) volts.

6. An isolation disconnect switch (Utility Disconnect Switch) that is readily accessible to LIPA at all times located within 10 feet of the LIPA metering point or within 10 feet of the LIPA service entrance, lockable with a 3/8 inch shank LIPA lock, visible-break and load break rated shall be installed to isolate the generator from the LIPA system. If the breaker is a drawout type and the DG System provides a ground and test device acceptable to LIPA, LIPA will evaluate allowing the DG System to omit the isolation disconnect switch.

7. DG Systems may be isolated from the LIPA system by means of an isolating transformer. If this option is selected, the DG System shall have a wye grounded/delta or a wye grounded/delta/wye transformer with the wye grounded winding configuration on the LIPA side. See Appendix B for the technical explanation of this requirement. A ground fault current limiting neutral reactor shall be installed if required by LIPA on non-dedicated feeder installations.

8. The DG system can opt not to use the wye-grounded (utility side)/delta (DG side) isolation transformer if all of the following conditions are met:

a) The primary connected transformer must be a wye-grounded/wye-grounded transformer, and the generator must be effectively grounded. The generator neutral reactor is normally used to limit ground fault current and protect the generator windings. The generator neutral reactor must be sized such that it both prevents overvoltages and allows enough ground fault current to be detected by the DG System's relaying for faults on the LIPA distribution feeder.

b) The DG System must provide protective relaying that detects faults on the LIPA system, including ground faults.

c) The DG System must meet the harmonic requirements of the interconnect guide and test data supporting this is provided.

9. A DG System with a total connected primary and/or secondary interconnect generator nameplate rating of greater than 1500 kVA shall require a SCADA (Supervisory Control and Data Acquisition) system RTU (Remote Terminal Unit). LIPA may also require SCADA to be installed on installation smaller than 1500 kVA if deemed necessary for the safe operation of the LIPA system.

The RTU, if required, will be purchased by LIPA and paid for by the DG System or may purchased by the DG System to LIPA's specifications and delivered to LIPA. The RTU shall provide LIPA with supervisory trip control of the interconnection breaker(s). It shall also provide telemetry of key operating parameters of the DG System's facility, which shall include but not be limited to:

a. Status indication of interconnection breaker(s), generator breaker(s), and all other devices that are in series with these breakers.

b. Status indication of various alarms such as loss of DC to interconnection breaker(s), loss of DC to RTU, loss of AC to RTU battery charger, loss of relaying communication channel, microprocessor relay alarm, etc.

c. Digital metering telemetry for current, voltage, watts, VARS, and power factor for all interconnection breaker(s).

d. Pulse accumulation of MWHR (in/out) and MVARHR (in/out) for the facility Access to the pulse metering signal will be made available to LIPA for the installation of additional metering and communications equipment if required.

The location of the RTU shall depend on the proximity of the DG System to the interconnecting LIPA substation. The DG System shall not be allowed to operate in parallel if the RTU or its associated lease line is out of service. The RTU shall be maintained and repaired by LIPA at the DG System's expense.

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

Whether the RTU is purchased by the DG System or by LIPA, it shall be delivered to LIPA for testing and programming. At this time, loss of AC/DC relays, fuses, and various terminal blocks will be installed within the RTU cabinet by LIPA at the DG System's expense.

The DG System shall make provisions adjacent to the supervisory control cabinet to terminate the supervisory control four (4) wire dedicated telephone lease line(s) on a double pole double throw open blade cut off switch(es) (diagram Appendix C). **The lease line(s) shall be ordered by LIPA and owned by LIPA. Installation, maintenance and subsequent monthly charges shall be charged by LIPA to the DG System.**

10. For facilities interconnected to LIPA by means of a dedicated feeder, a breaker shall be installed at the DG System's expense in the LIPA substation. For a non-dedicated feeder, a disconnect device controlled by LIPA shall be installed at the DG System's expense at the point of interconnection with the LIPA system.

11. The DG System shall be responsible for tripping its interconnection breaker if a fault occurs on the electric facilities serving its installation. Whenever the LIPA supply is de-energized, the DG System's interconnection breaker shall be tripped by voltage and/or frequency relays and transfer tripped from LIPA's interconnection substation. The 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. The interconnection breaker close circuit shall include a synch check and an over/under voltage permissive contact to prevent closing the breaker when unfavorable voltage conditions exist.

12. The direct transfer trip (DTT) receiving terminal shall provide two outputs: a trip output and an alarm output to indicate a loss of transfer trip condition. The trip output shall energize a utility type target relay with multiple output contacts. One (1) output contact of the target relay shall trip the interconnection breaker. A second output contact of the target relay and the alarm contact of the DTT terminal shall be wired to the RTU. The DTT terminal and associated target relay shall be mounted indoors.

13. The alarm for the loss of a DTT lease line must come from the DG System's SCADA or by having a bi-directional tone equipment that can give the alarm at the LIPA substation. If no SCADA is provided, a transfer trip receiver and transmitter with 4 wire lease line shall be provided. In the event of DDT lease line loss, the DG System shall cease parallel operation with the LIPA system. For DG systems less than 1500 KVA, the transfer trip system will be used for LIPA supervisory trip.

14. The required dedicated transfer trip lease line shall be ordered by LIPA. Installation, maintenance and subsequent monthly charges shall be charged to the DG System.

The DG System shall make provisions to terminate the lease line with a double pole double throw open knife blade switch adjacent to the transfer trip equipment (**Appendix C**). The DG System will not be allowed to parallel with the LIPA system if its transfer trip or associated lease line is out of service.

15. For DG System's utilizing only one microprocessor relay, the interconnection breaker or the generator breaker(s) must be tripped when the DG System's protective relaying system goes into an alarm condition. This trip shall also trip a lock-out relay that requires manual intervention before the breaker(s) can be reclosed following successful clearing of the relay alarm condition(s).

16. The following are the minimum relay requirements for the interconnection breaker:

a. Phase overcurrent relays (one per phase) with instantaneous and voltage restraint time delay elements are required as well as one ground overcurrent relay with instantaneous and time delay elements. Each element of the phase and ground relays shall have its own target.

b. Over/under voltage relays and over/under frequency relays are required on LIPA's side of the interconnection breaker.

c. Directional power relays may be required to limit power flow to contractual agreements.

d. Directional overcurrent relays shall be required at sites where the DG System's load requirements from LIPA exceed the DG Systems generating capability. Any exceptions to this requirement shall be approved by LIPA.

e. Transformer differential relaying shall be required for interconnections using transformer banks greater than 1500 kVA.

f. Negative sequence overcurrent relays.

g. All interconnection breaker relays and required generator breaker relays shall be approved by LIPA. Interconnection breaker relays must be capable of being calibrated and tested in their installed position to verify proper application of all relay settings and full functionality of the relay circuit(s).

17. All breakers shall be D.C. trip and close. Trip and close circuits of the interconnection breaker must be separately fused. If SCADA is provided then loss of D.C. and low DC voltage alarms shall be wired to the RTU.

18. 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 must be terminated using ring type connectors.

19. The station battery shall be sized for an eight hour duty cycle in accordance with IEEE Standard 485-1983. At the end of the duty cycle the battery shall be capable of tripping and closing all breakers.

20. All solid state relays requiring an auxiliary power source shall be powered from the station battery. AC to DC converters are unacceptable.

21. All relaying CTs shall have a minimum accuracy of C200. Saturation current shall not be more than 10% of fault current. Interconnection relaying and telemetering shall have dedicated CTs.

22. Three PTs shall be installed on the LIPA side of the interconnection breaker and shall be connected wye-grounded/wye-grounded. 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. Three (3) single phase over/under voltage relays, associated with the high side breaker, shall be connected phase to ground to these PTs.

23. During emergency conditions, all interconnection breakers shall be capable of being tripped by LIPA via supervisory control. LIPA will consider tripping the generator breaker instead of the interconnection breaker if the system configuration permits. Interconnection breaker and generator breaker(s) status will be transmitted to LIPA via the RTU. The supervisory equipment shall be installed and paid for by the DG System.

A digital meter or MW, MVAR, current, voltage and power factor transducers mounted in flexitest drawout cases shall be connected to the interconnection breaker CTs and line PTs and wired to the analog inputs of the RTU. LIPA shall furnish the DG System with the necessary wiring drawings to connect the transducers to the supervisory equipment.

24. Synch check relays are required across the interconnection breaker of a synchronous generator unless otherwise specified. A total of four potential transformers shall be required on the interconnection, three on LIPA's side of the breaker (as specified in #22) and one on the DG System's. Synch check relays shall be installed for manual synchronizing. Automatic synchronizing equipment shall be optional, however, it shall not permit the exclusion of a synch check relay.

25. The LIPA substation feeder breaker may require a set (3) of line side potential transformers to monitor the presence of voltage on the distribution feeder and to provide voltage to a synch check or voltage relay, which shall prevent closing the breaker into an unsynchronized DG System's generator. All costs incurred to purchase and place this system in service shall be at the DG System's expense.

26. The kVAR requirements of an induction generator, operating at 100% load, will be determined and the DG System will be charged that portion of the cost to install one or more 900 kVAR supervisory controlled distribution capacitor banks to provide the reactive supply.

27. Voltage and frequency relays shall be installed at the LIPA substation to disconnect the DG System's generator from the LIPA bus in the event that this bus becomes isolated from the LIPA system and the DG System's generator continues to carry the connected LIPA load. These relays shall be installed at the DG System's expense.

28. Interconnection breaker(s) for DG System owned generator(s) on the distribution system, unless otherwise specified, shall be automatically tripped for all trips of the LIPA substation feeder breaker. A generator breaker contact may be used to disable transfer trip of the interconnection breaker when the generator breaker is open. The communication tripping channel and transfer tripping equipment at the LIPA substation and at the DG System's facility shall be purchased and installed at DG System's expense, as part of the relay protection scheme. The transfer trip equipment and associated transfer trip communication channel shall be specified by LIPA.

29. The transformer configuration of an existing LIPA transformer that is to become customer-owned in a new primary metered installation must be verified in the field. The DG Systems will bear the cost of a replacement wye-wye transformer, which may be greater than the cost of purchasing the in-place LIPA transformer.

V. Maintenance and Operating Requirements

The following requirements apply to all DG System installations.

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

B. All final relay setting calculations for the DG System's interconnection breaker shall be submitted for review and acceptance by LIPA, to assure protection of LIPA equipment and reliability of service to the adjacent LIPA customers. The DG System shall be required to change relay settings, if necessary, to accommodate changes in the LIPA system.

C. If the DG Systems elects to install a solidly grounded neutral, LIPA will require that it be tested every 2 years and that the test reports be submitted to LIPA.

D. It shall be the DG System's responsibility to have calibration and functional trip tests performed on its fault and isolation protection equipment. These tests shall be performed prior to placing equipment in service and once every two (2) years thereafter. Copies of these test results shall be sent 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 and shall be submitted to LIPA for review and acceptance. 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 results of all tests. LIPA shall be notified of the testing two (2) weeks in advance.

E. After the DG System 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 DG System'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.

F. The failure of the DG System to maintain its equipment in a manner acceptable to LIPA or to furnish maintenance records on demand may result in the DG System being prevented from operating in parallel with the LIPA system.

G. If LIPA is requested to work at the DG System'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 shall be delayed until conditions are deemed safe by LIPA.

H. LIPA reserves the right to test for or to request the DG System 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. Inverter installations shall be required to take two sets of measurements; one with the inverter isolated and the other with the inverter connected to the LIPA system. The current harmonic levels should be observed and recorded at 0, 1/2, 3/4, and full power measurements.

If the % THD exceeds the limits outlined in Section II Part E the DG System shall install filters to meet the required limits.

If at any time during parallel operation harmonic distortion problems affecting other customers' equipment can be traced to the DG System's generator, the DG System's generating equipment shall be immediately disconnected from the LIPA system and shall remain disconnected until the problem is corrected.

I. The DG System shall close the interconnection circuit breaker only after obtaining approved switching orders from the responsible LIPA operator as defined in the Operating Instructions. No automatic reconnect shall be incorporated in the design. LIPA reserves the right to open the disconnecting device to the DG System for any of the following reasons:

1. System Emergency or System Pre-Emergency

2. Substandard conditions existing with the DG System's generating and/or protective equipment.

3. Failure of the DG System to maintain its equipment in accordance with the agreed upon schedule.

4. Failure of DG System to make maintenance records available to LIPA on request.

5. Interference by the DG System's generation system with the quality of service rendered by LIPA to its customers.

6. Personnel safety.

7. To eliminate conditions that constitute a potential hazard to the general public.

8. For LIPA maintenance and construction clearance.

VI. Classification of DG System Generator Installations

Distributed Generation installations are classified into two types - those interconnecting to the LIPA system on a dedicated radial feeder and those interconnecting on a non-dedicated feeder (Refer to **Appendix A**).

Maximum Gross Generation Capacity*		
Distribution Voltage		
Interconnection	13kV	4kV
1. Dedicated Radial Feeder	10MVA	3MVA
2A.i Synchronous Generators Non-Dedicated Feeder Main	3.0 MVA	1MVA
Branch	1.5 MVA	.5 MVA
2A ii. Primary Metered Secondary Protection	1.5 MVA	.5 MVA
2B.i Induction Generators Non-Dedicated Feeder Main	2.5 MVA	750KVA
Branch	1.0 MVA	300 kVA
2B. ii Induction Generators Non-Dedicated Primary Metered Secondary Protection Main	1.5 MVA	750 kVA
Branch	1.0 MVA	300 kVA

***** These generation capacities are on a per-Producer basis. It should be noted, however, that the aggregate generation (sum of the total gross generation of all DG Systems connected to a particular segment of the LIPA system) on a non-dedicated distribution feeder must not exceed 5 MVA on 13 kV or 1.5 MVA on 4 kV. The maximum capacity of the aggregate generation connected to a branch circuit is 1.5 MVA on 13 kV and .5 MVA on 4 kV. The maximum aggregate generation connected to one LIPA 13 kV substation is 10 MVA. The maximum aggregate generation connected to one LIPA 4 kV substation is 3 MVA. The maximum aggregate generation shall also be limited to approximately one-third of the MVA rating of the step-down transformer at LIPA's substation.

The aggregate generation may be further limited by the load and fault duty capability of the substation equipment and connecting distribution feeder. LIPA shall evaluate each application before deciding on the maximum MVA allowed onto the LIPA system at a given point.

Special relay coordination problems may exist for non-dedicated feeder installations since all DG Systems may not be on-line at the same time. Each situation shall be evaluated on its own merits.

Appendix A

Interconnection Example Drawing List

1. Dedicated Feeder Relay Circuit Greater Than 1,000 Feet
   Primary Metered - Primary Protection

2. Dedicated Feeder Differential Circuit Less Than 1,000 Feet
   Primary Metered - Primary Protection

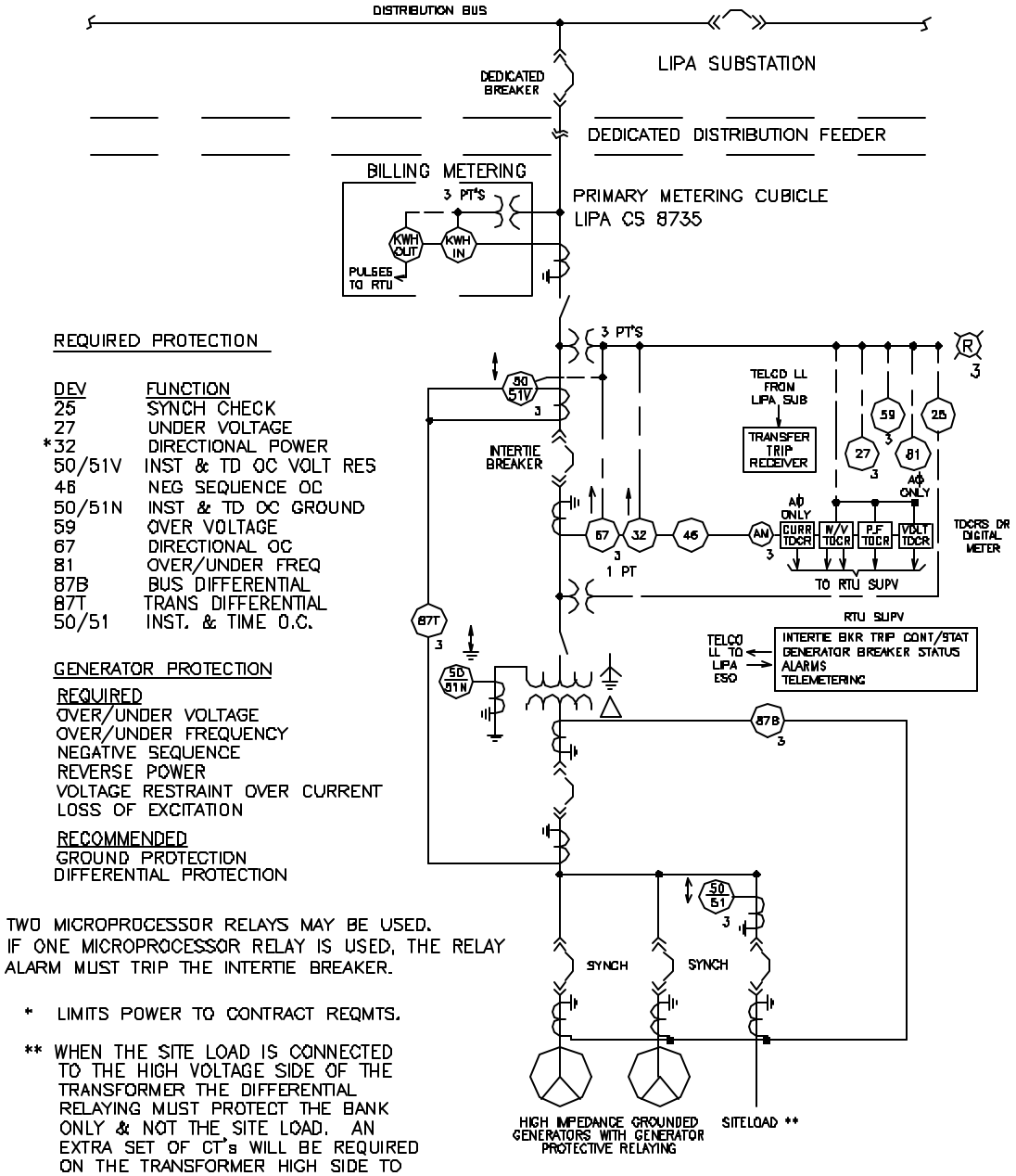
3. Non-Dedicated Feeder Primary Metered - Primary Protection

4. Non-Dedicated Feeder Primary Metered - Secondary Protection

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

APPENDIX A-DRAWING 1

DISTRIBUTION INTERCONNECTION
DEDICATED FEEDER – DIFFERENTIAL CIRCUIT > 1000 FT.
PRIMARY METERED- PRIMARY PROTECTION



REQUIRED PROTECTION

DEV	FUNCTION
25	SYNCH CHECK
27	UNDER VOLTAGE
*32	DIRECTIONAL POWER
50/51V	INST & TD OC VOLT RES
46	NEG SEQUENCE OC
50/51N	INST & TD OC GROUND
59	OVER VOLTAGE
67	DIRECTIONAL OC
81	OVER/UNDER FREQ
87B	BUS DIFFERENTIAL
87T	TRANS DIFFERENTIAL
50/51	INST. & TIME O.C.

GENERATOR PROTECTION

REQUIRED
OVER/UNDER VOLTAGE
OVER/UNDER FREQUENCY
NEGATIVE SEQUENCE
REVERSE POWER
VOLTAGE RESTRAINT OVER CURRENT
LOSS OF EXCITATION

RECOMMENDED
GROUND PROTECTION
DIFFERENTIAL PROTECTION

TWO MICROPROCESSOR RELAYS MAY BE USED. IF ONE MICROPROCESSOR RELAY IS USED, THE RELAY ALARM MUST TRIP THE INTERTIE BREAKER.

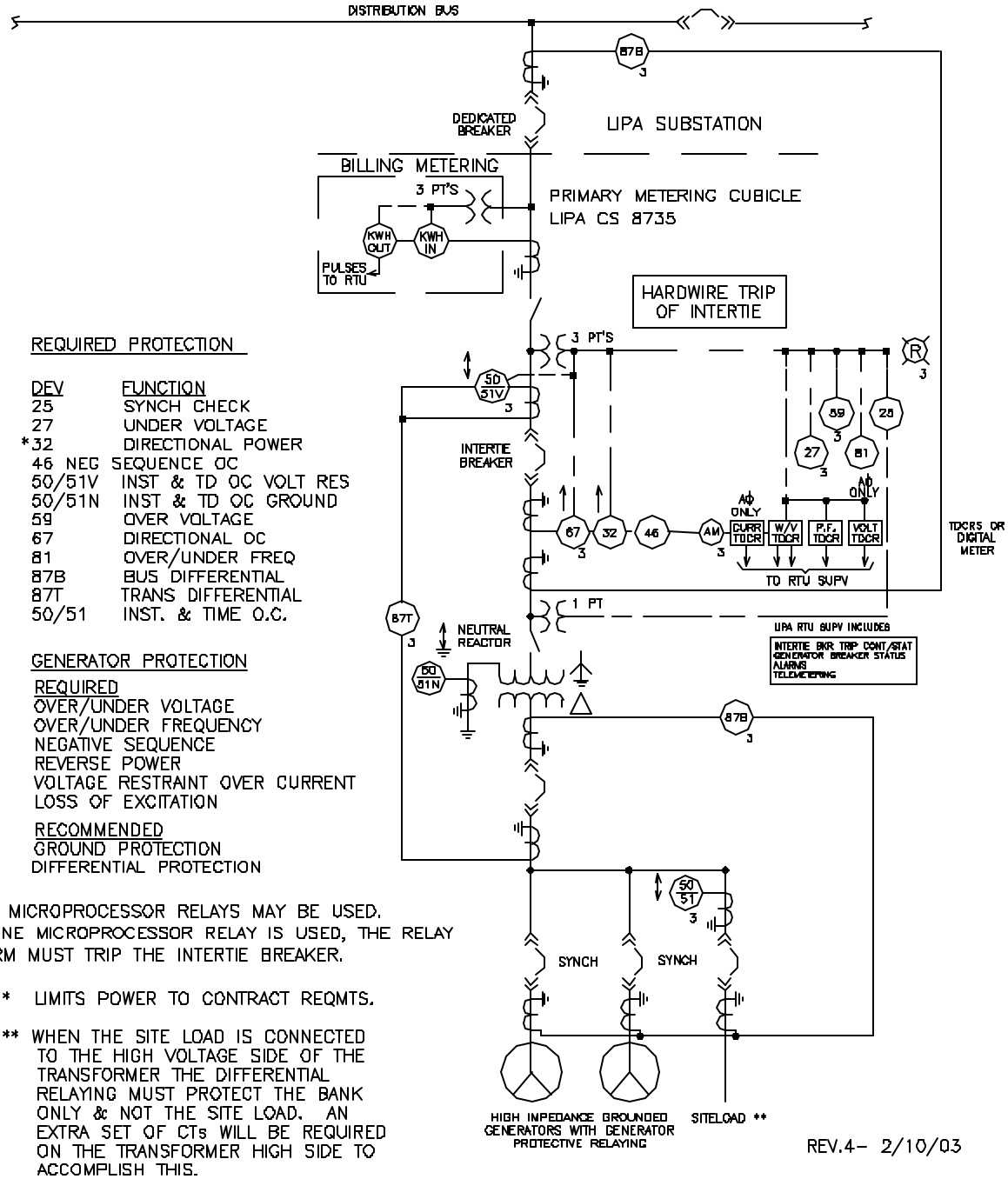
* LIMITS POWER TO CONTRACT REQMTS.

** WHEN THE SITE LOAD IS CONNECTED TO THE HIGH VOLTAGE SIDE OF THE TRANSFORMER THE DIFFERENTIAL RELAYING MUST PROTECT THE BANK ONLY & NOT THE SITE LOAD. AN EXTRA SET OF CT's WILL BE REQUIRED ON THE TRANSFORMER HIGH SIDE TO ACCOMPLISH THIS.

REV.4– 2/10/03

APPENDIX A - DRAWING 2

DISTRIBUTION INTERCONNECTION
DEDICATED FEEDER DIFFERENTIAL CIRCUIT < 1000 FT.
PRIMARY METERED- PRIMARY PROTECTION



REQUIRED PROTECTION

DEV	FUNCTION
25	SYNCH CHECK
27	UNDER VOLTAGE
*32	DIRECTIONAL POWER
46	NEG SEQUENCE OC
50/51V	INST & TD OC VOLT RES
50/51N	INST & TD OC GROUND
59	OVER VOLTAGE
67	DIRECTIONAL OC
81	OVER/UNDER FREQ
87B	BUS DIFFERENTIAL
87T	TRANS DIFFERENTIAL
50/51	INST. & TIME O.C.

GENERATOR PROTECTION

REQUIRED
OVER/UNDER VOLTAGE
OVER/UNDER FREQUENCY
NEGATIVE SEQUENCE
REVERSE POWER
VOLTAGE RESTRAINT OVER CURRENT
LOSS OF EXCITATION

RECOMMENDED
GROUND PROTECTION
DIFFERENTIAL PROTECTION

TWO MICROPROCESSOR RELAYS MAY BE USED. IF ONE MICROPROCESSOR RELAY IS USED, THE RELAY ALARM MUST TRIP THE INTERTIE BREAKER.

* LIMITS POWER TO CONTRACT REQMTS.

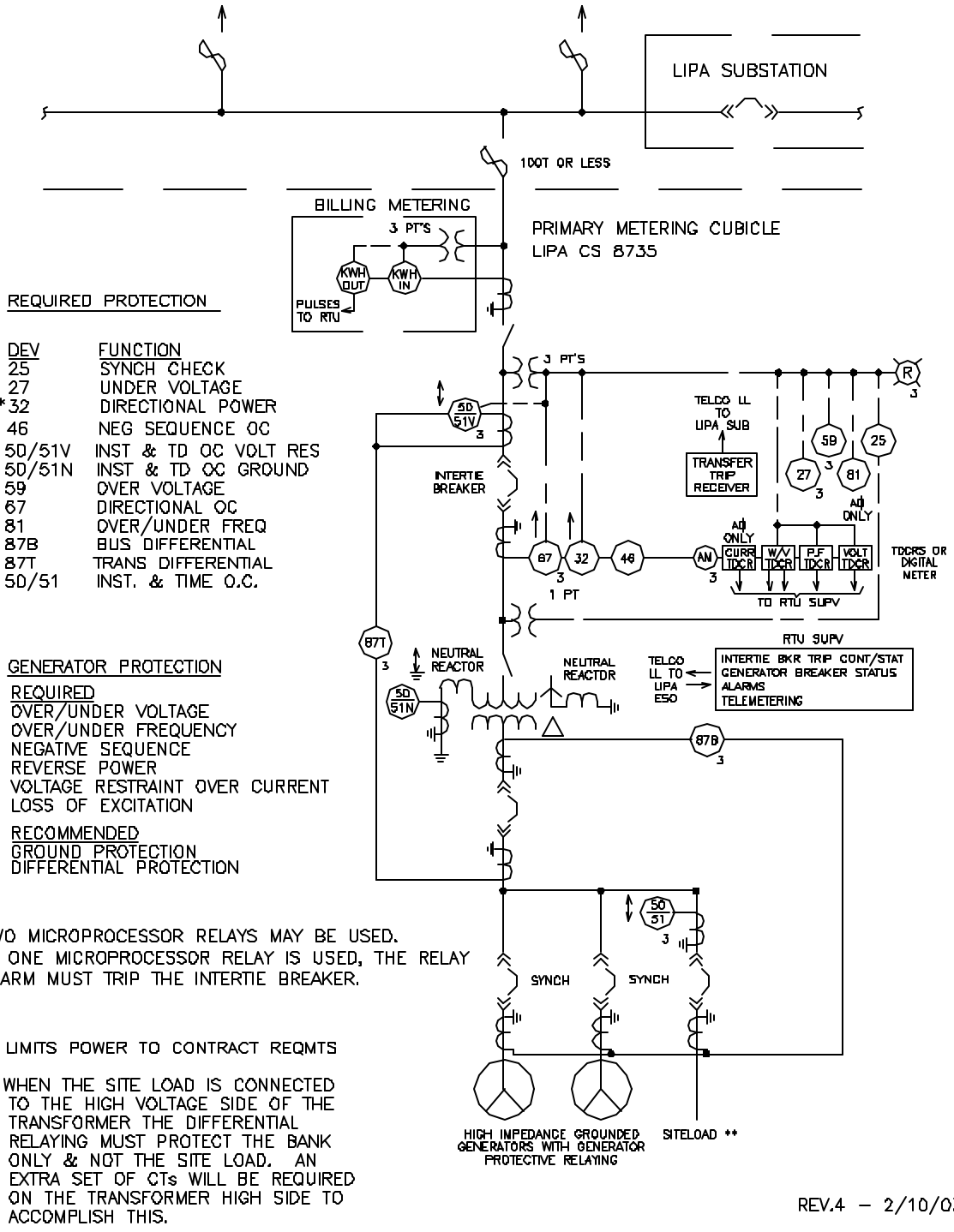
** WHEN THE SITE LOAD IS CONNECTED TO THE HIGH VOLTAGE SIDE OF THE TRANSFORMER THE DIFFERENTIAL RELAYING MUST PROTECT THE BANK ONLY & NOT THE SITE LOAD. AN EXTRA SET OF CTs WILL BE REQUIRED ON THE TRANSFORMER HIGH SIDE TO ACCOMPLISH THIS.

REV.4– 2/10/03

APPENDIX A-DRAWING 3

DISTRIBUTION INTERCONNECTION
NON–DEDICATED FEEDER

PRIMARY METERED- PRIMARY PROTECTION



REQUIRED PROTECTION

DEV	FUNCTION
25	SYNCH CHECK
27	UNDER VOLTAGE
*32	DIRECTIONAL POWER
46	NEG SEQUENCE OC
50/51V	INST & TD OC VOLT RES
50/51N	INST & TD OC GROUND
59	OVER VOLTAGE
67	DIRECTIONAL OC
81	OVER/UNDER FREQ
87B	BUS DIFFERENTIAL
87T	TRANS DIFFERENTIAL
50/51	INST. & TIME O.C.

GENERATOR PROTECTION

REQUIRED
OVER/UNDER VOLTAGE
OVER/UNDER FREQUENCY
NEGATIVE SEQUENCE
REVERSE POWER
VOLTAGE RESTRAINT OVER CURRENT
LOSS OF EXCITATION

RECOMMENDED
GROUND PROTECTION
DIFFERENTIAL PROTECTION

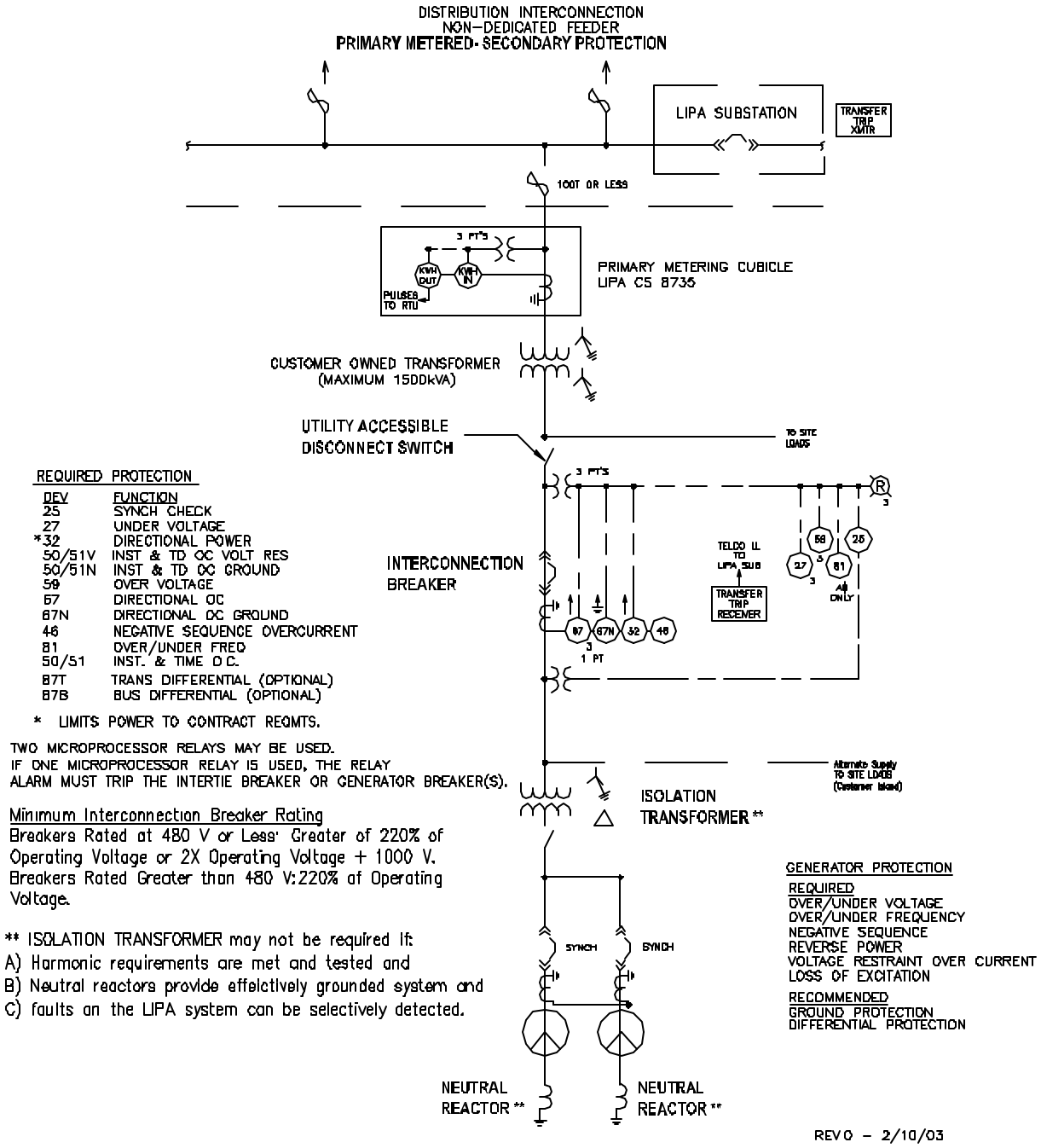
TWO MICROPROCESSOR RELAYS MAY BE USED. IF ONE MICROPROCESSOR RELAY IS USED, THE RELAY ALARM MUST TRIP THE INTERTIE BREAKER.

* LIMITS POWER TO CONTRACT REQMTS

** WHEN THE SITE LOAD IS CONNECTED TO THE HIGH VOLTAGE SIDE OF THE TRANSFORMER THE DIFFERENTIAL RELAYING MUST PROTECT THE BANK ONLY & NOT THE SITE LOAD. AN EXTRA SET OF CTs WILL BE REQUIRED ON THE TRANSFORMER HIGH SIDE TO ACCOMPLISH THIS.

REV.4 – 2/10/03

APPENDIX A - DRAWING 4



Appendix B

Explanation of the Requirement for
A Wye Grounded Transformer

All DG System interconnections with LIPA must be grounded sources. During a phase to ground fault on the LIPA system, the DG System's generator can be isolated with the phase to ground fault if the LIPA source opens before the DG System's protective equipment detects the fault condition and isolates from the LIPA system. If the generator is not grounded during the period 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 generator. To avoid the possibility of an overvoltage due to a neutral shift, LIPA requires that the DG System's generator interconnect into the LIPA system as a grounded source.

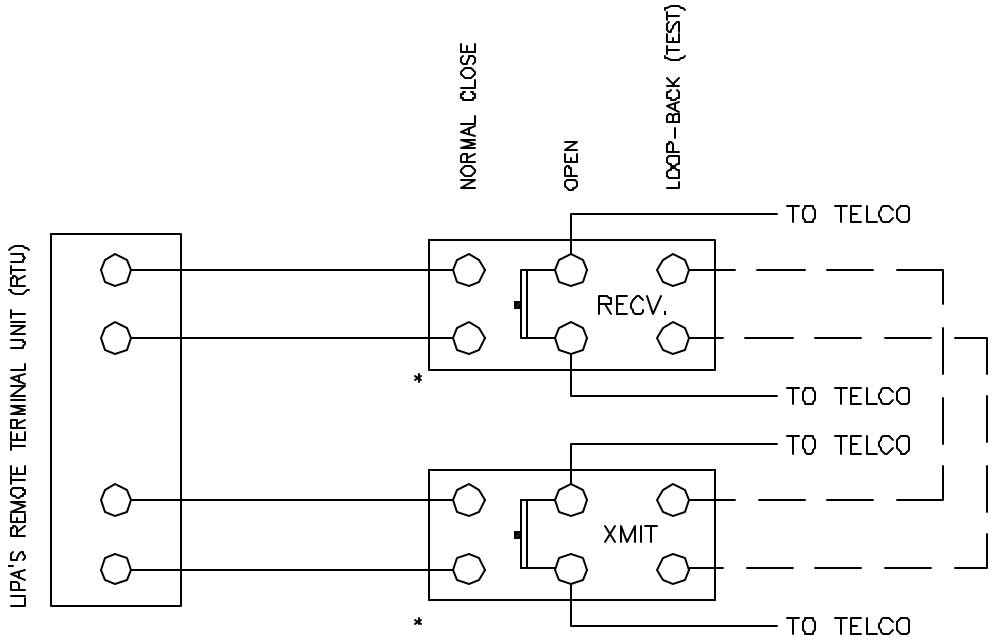
The designer of the DG installation should be aware that the isolation transformer provides a path for zero sequence fault current for all phase to ground faults on the circuit. In order to limit the ground fault current from the DG System's equipment, LIPA may require that the system be designed to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

There are several methods to ground a source. **Accepted method is to use a wye grounded-delta step-up transformer with the generator grounded**.

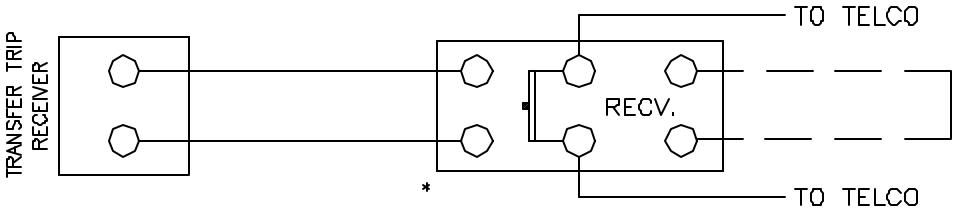
An additional purpose of the wye-grounded (LIPA side)/delta (DG System side) isolation transformer is to filter out the third harmonics and multiples of the third harmonics and to provide a ground source that enables the DG System(s) protection to be able to detect faults on the LIPA system.

APPENDIX "C"

SUPERVISORY LEASE LINE
KNIFE SWITCH



TRANSFER TRIP LEASE LINE
KNIFE SWITCH



* D.P.D.T. KNIFE SWITCH – LEVITON # 9919

REV.4 – 2/6/03

APPENDIX D
LONG ISLAND POWER AUTHORITY
APPLICATION FOR OPERATION OF DISTRIBUTED GENERATION GREATER THAN 300 KVA IN PARALLEL WITH THE LIPA RADIAL DISTRIBUTION SYSTEM

Producer's Name: _____

Contact Person: _____

Location: _____ Zip Code: _____

Telephone: _____

Service Point Location: _____

(Name of Existing Service _____

Point or Attach Map) _____

The following information shall be furnished upon application by the DG System or his representative for consideration in the mutual interest of the DG System and the Long Island Power Authority:

Generator (Complete all applicable items)

Manufacturer: _____

Synchronous, Induction or Other:

_____

Generator is Single Phase _____ or Three Phase _____

Kilowatt Rating: _____

Kilovolt-Ampere Rating: _____

Appendix D (Cont'd.)
LONG ISLAND POWER AUTHORITY
APPLICATION FOR OPERATION OF DISTRIBUTED GENERATION
GREATER THAN 300 KVA IN PARALLEL WITH THE
LIPA RADIAL DISTRIBUTION SYSTEM

Three Phase Generator is Connected:

Delta _____ Wye Grounded _____ Ungrounded _____

Impedance Grounded _____

Power Factor: _____

Volts: _____

Amperes: _____

R.P.M.: _____

Field Amps: _____

Field Volts: _____

GENERATOR CONSTANTS AT _____ KVA:

Xd_____Xq_____T'do_____

X'di_____X'q_____T"do_____

X'dv_____Xo_____Ta3_____

X"di_____Xlm_____T'qo_____

Xdv_____R1_____T"qo_____

X2v_____R2_____

Motoring Power_____kW_____

TOTAL UNIT WR^2_____ $lb\text{-}ft^2$, H = _____ kW-sec/kVA
kVA Base

Appendix D (Cont'd.)
LONG ISLAND POWER AUTHORITY
APPLICATION FOR OPERATION OF DISTRIBUTED GENERATION GREATER THAN 300 KVA IN PARALLEL WITH THE LIPA RADIAL DISTRIBUTION SYSTEM

Year Manufactured: _____

Serial Number: _____

Prime Mover:
Manufacturer: _____

Type: _____

Energy Source: Briefly describe the cogeneration, distributed generation, wind, solar, hydro or other energy source:

_____

_____

_____

_____

Additional Required Information:

(a)Maximum net generated capacity to the LIPA system.

_____ kVA

(b)Output voltage to system: _____ kV

( ) single phase ( ) three phase (check one)

Items c, d, and e apply to **non type tested** inverter installations only.

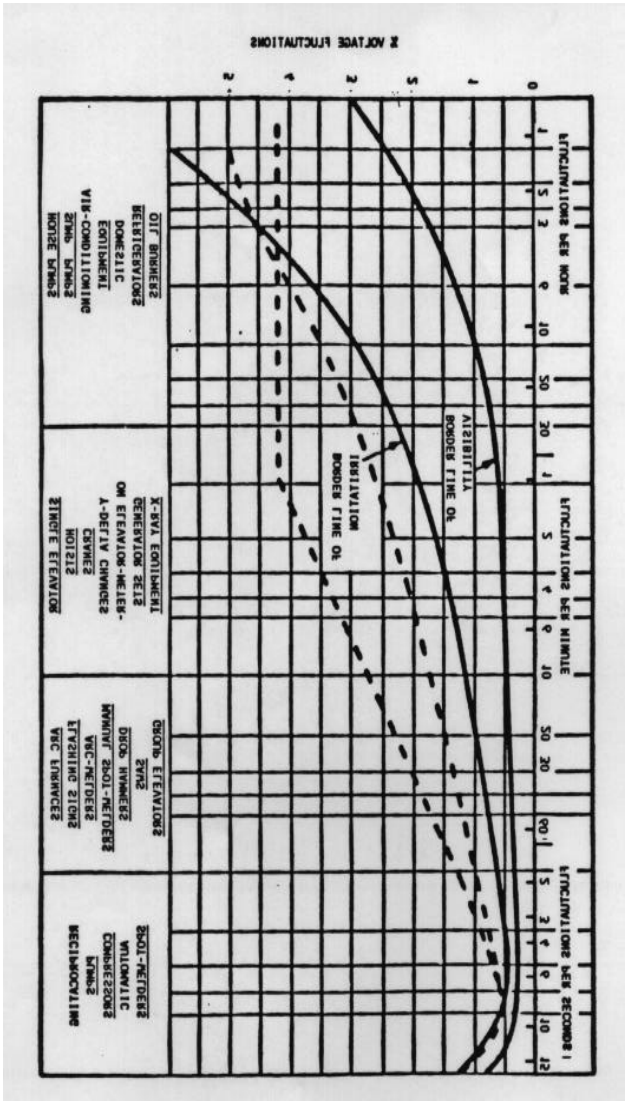
(c) Attached to this form an oscillographic print showing the wave shape of current supplied to the network system at the interface output terminals. The wave shape of the utility system voltage should also be shown on the same print. If energy source is wind, state wind velocity at time of the test and output capacity (power supplied to the system). If actual data is not available, oscillograms from a similar installation are acceptable.

(d) Estimated (or measured) percent wave-shape distortion, at interface output terminals, for equipment operating at maximum output. Submit calculations or certified test report.

(e) Estimated (or measured) power factor at interface output terminals for same conditions as above. Submit calculations or certified test report.

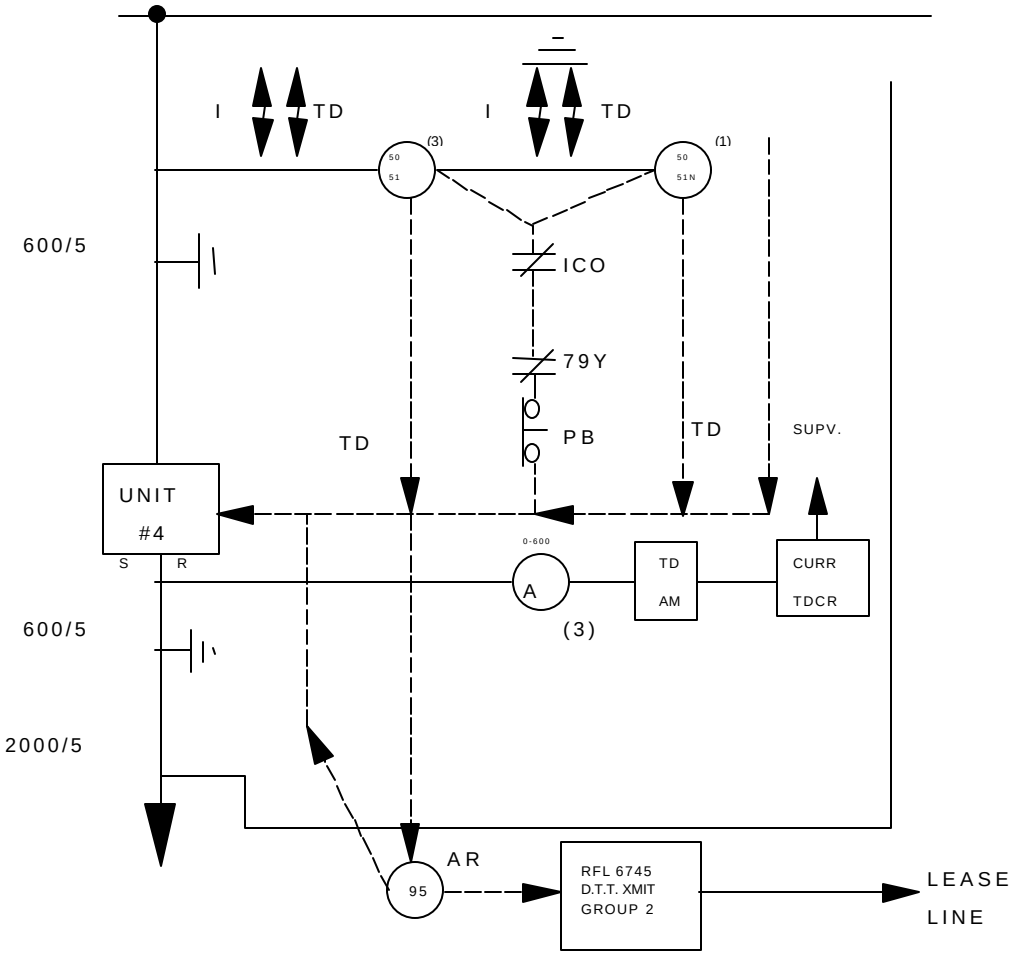
Appendix E

Voltage Flicker Curves



Appendix F

Relaying Functional Example



NOTE: This is a sample of an acceptable Relaying Functional Diagram, and shall only be used for reference purposes.