Detroit Edison

Jon P. Christinidis
Staff Attorney
(313) 235-7706

May 4, 2001

Ms. Dorothy Wideman
Executive Secretary
Michigan Public Service Commission
6545 Mercantile Way
Lansing, Michigan 48909-7721

Re: **MPSC Case No. U-12485**

Dear Ms. Wideman:

Pursuant to MPSC order, dated February 5, 2001 in the above captioned case, please find enclosed The Detroit Edison Company's Draft Proposal for Distributed Generation Interconnection Guidelines.

Very truly yours,

Jon P. Christinidis

JPC/dj

cc: Service List

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

In the matter, of the Commission's own motion of the interconnection of merchant plants with the transmission and distribution systems experimental residential load management of electric utilities.	)))))	Case No: U-12485

THE DETROIT EDISON COMPANY

DRAFT PROPOSAL

DISTRIBUTED GENERATION

INTERCONNECTION GUIDELINES

May 4, 2001

DISTRIBUTED GENERATION INTERCONNECTION GUIDELINES

THE DETROIT EDISON COMPANY

Detroit Edison

TABLE OF CONTENTS

1 INTRODUCTION

Document Scope

This document replaces the existing Detroit Edison documents titled

- GENERAL PROCEDURES AND RELATED INFORMATION FOR THE INTERCONNECTION OF INDEPENDENTLY OWNED GENERATION

And

- PROTECTIVE RELAYING, OPERATING AND TELEMETERING GUIDELINES FOR INDEPENDENTLY OWNED GENERATION

This guide is intended for customers, independent power producers (IPPs), independently owned generation (IOG) or any other parties interested in operating generation in parallel with the Detroit Edison System at voltages of 41.6 kV or less. For consistency, the term "Customer" will be used throughout this Guideline when referring to any of the aforementioned parties.

In developing this document Detroit Edison is guided by Public Act 141 of 2000, subsection 10e(3) statement:

" The standards shall be consistent with generally accepted industry practices and guidelines and shall be established to ensure the reliability of electric service and safety of customers, utility employees, and the general public. The merchant plant will be responsible for all costs associated with the interconnection unless the commission has otherwise allocated the costs and provided for cost recovery."

Detroit Edison has further subdivided the requirements in this document according to the size and complexity of the installed generation and the new Distributed Generation (DG) technologies in the market.

Note: This document addresses requirements that need be met for all Generation that connects to the Detroit Edison System. For customers interested in adding small generation, i.e., less than 25 kVA, single phase, non-network, the process is much simpler. They may chose to go directly to Appendix I, which covers the Application Process and the Application Form for these installations. These installations should not take more than 4 weeks after the receipt of completed Application and the necessary payments. Delays caused by customer actions will not be the responsibility of Detroit Edison.

2 GENERAL INFORMATION

Customer Responsibilities

Customer responsibilities include the design, installation, operation, and maintenance of their generation facilities conforming with applicable codes, Detroit Edison interconnection guidelines, service installation requirements, and all relevant laws and regulations at the local, state, and Federal levels. The major code and safety organizations applicable to DG installations are the National Electric Code (NEC), the National Electrical Safety Code (NESC), the National Fire Protection Association (NFPA), Underwriters Laboratories (UL), and the Institute of Electrical and Electronics Engineers (IEEE). The requirements specified in the guidelines that follow are designed to protect Detroit Edison facilities, insure the safety of customers, utility employees, and the general public, and to maintain overall system reliability. The responsibility of protecting the Customer facilities is the Customer's alone and should be accomplished through the proper installation, setting, and maintenance of protective relay devices.

Types of Generation

These guidelines will apply to all non-utility generation facilities that intend to operate in parallel with the Detroit Edison System and are subject to the jurisdiction of the Michigan Public Service Commission.

These could be facilities that meet the requirements specified by the federal law under the Public Utility Regulatory Policy Act of 1978 (PURPA), Independent Power Producers (IPP's), Exempt Wholesale Generators (EWG's), or tariff customers of Detroit Edison.

Examples of issues that are neither within the bounds of Detroit Edison's control nor directly related to technical interconnection requirements, and which therefore will not be addressed include (but are not necessarily limited to):

1. Environmental permitting
2. Municipal ordinances
3. General rate structure
4. Stranded cost recovery mechanisms
5. Economic and system benefits
6. Gas infrastructure

These matters and possibly others, are beyond the scope of these guidelines.

2 GENERAL INFORMATION (continued)

Rates and Tariffs

General:
Any Customer planning to establish an electrical interconnection with Detroit Edison must have all necessary agreements executed before any parallel operation will be permitted. These agreements must address, at the minimum, the rates, terms, and conditions for energy flow both into and out of the facility.

For customers on Detroit Edison retail service tariffs, including those customers electing to take service on the Company's retail open access tariffs (RAST), the rates, terms, and conditions are described in detail in the Company's current "Rate Book for Electric Service" as approved by the Michigan Public Service Commission.

Those not taking retail service from the Company (e.g., IPP's, EWG's), but interconnecting to the Company's distribution system as a means to market their energy, are required to have an interconnection agreement with the Company in addition to the necessary FERC regulated transmission agreements with the transmission provider and any required state or federal licensing.

Service from the Company:
Customers taking service from the Company on either full-service tariffs or retail access tariffs may have different rules affecting the required metering and standby service offerings, and the following brief description is intended to clarify these:

- Customers on full service tariffs may choose any rate for which they qualify. Customers desiring to operate electrical generating equipment in parallel with the Company's system, or that desire the Company to serve load that is normally served by their generator, must either take standby service from the Company or qualify for rates or Riders not requiring standby service. Taking standby service from the Company may require metering specific to the application.

- Customers on open access tariffs are not eligible for standby service from the Company and must arrange for back-up service with their supplier.

Sales from the facility:
Sales of energy from any facility connected to the Company's distribution system are permitted only when such sales are addressed in contractual form and with written permission by the Company. The type of sales may effect the metering and telemetry required for the administration of the contract. The following list describes the forms of agreements where sales may be permitted:

- Customers on full service tariffs may elect to sell energy to the Company. Such sales will be addressed in a sales agreement with the Company, which will address metering requirements, and applicable tariffs or Riders enabling the sale.

- Customers or other parties wishing to make either wholesale or retail sales to others must first have a interconnection agreement with Detroit Edison, and, in order to transmit the energy, a transmission service agreement with the transmission provider. Transmission service agreements with the transmission provider are under the jurisdiction of the FERC.

2 GENERAL INFORMATION (continued)

Interconnection Cost Responsibility

The Customer is required to pay for costs incurred by Detroit Edison to accommodate interconnected operations. These costs include but are not limited to: Detroit Edison distribution system modifications required to accommodate the power source, engineering studies and evaluations including preparation of operating specifications, metering modifications, purchase and installation of any required Detroit Edison equipment, engineering, and administration. In addition, the Customer shall pay an annual charge based on the capital cost of the Detroit Edison's additional installation cost to cover property taxes, operation, and maintenance expenses. This charge established by the appropriate tariff or contract. Detroit Edison will provide an estimate of costs and must receive payment of such estimates prior to any work being performed.

Engineering Studies

The scope of the Detroit Edison engineering study to be performed is influenced by a variety of factors: the type and rating of the added generation, the voltage level of the connection, the location on the circuit, the circuit configuration, the available fault current, and the mode of operation (sell-back or load displacement mode). The result of the studies determines if the system can handle the added generation and what modifications or additions to the distribution system are required. Any work required addresses problems caused by the added generation in the areas of system protection, equipment loading or voltage regulation. The technical information supplied by the Customer in order to perform the study is described in more detail in Appendices I & II. It is the Customer's responsibility to evaluate the interaction between the added generation and their own facilities.

Note: Customers wishing to make either wholesale or retail sales to others may require an Interconnection System Impact Study from the Transmission Provider. Detroit Edison will help coordinate this study but the customer will be responsible for fulfilling the requirements of the Transmission Provider procedures.

Stability Studies

Stability studies are one type of engineering study performed to evaluate the potential of a synchronous generator to lose synchronism with the power system during a severe fault condition. This instability of a large generator can create large fluctuations in power and voltage. If the magnitudes are high enough, the resulting stress to the generator and power system could cause equipment damage to the Customer, the Detroit Edison System and other customers on that circuit.

Generally, stability studies are not required for generation smaller than 10 MVA. If necessary, Detroit Edison will perform a stability analysis in order to verify that the generator installation in question meets Detroit Edison stability requirements. If the study shows that the generator loses synchronism for typical fault scenarios, special generator trip schemes or loss of synchronism relay protection will be required. The Customer shall provide the required technical data for the generator and associated control systems as described in Appendix II of this guideline.

The Customer assumes all responsibility to evaluate the consequence of unstable generator operation in relation to the Customer's own equipment and to add any necessary protection

as required. In the event that additional generation is added to the Detroit Edison System in the vicinity of the Customer, Detroit Edison will again verify that stability requirements are met. There is a possibility that supplemental protection could be required at a cost to the Customer.

Protection Systems

Natural hazards (lightning, wind), human interference (automobiles, vandalism) and equipment malfunction can cause damage to the distribution system. Damage to equipment can result in short circuits referred to as faults by the utility. When faults occur they create a safety hazard for personnel, jeopardize the stability of the entire electrical network and impose severe damage to the faulted equipment. Protection systems are installed by the utility to minimize the effects of faults. All of the electrical equipment that comprises a utility network is protected by protection systems.

The Effect of Parallel Generation on System Protection

Generation connected in parallel with the distribution system has the potential to create two problems for the utility. One, it provides an additional energy source that increases fault current magnitudes. This additional fault current can interfere with the operation of the existing protective devices on the distribution system. Secondly, the generation can become isolated from the utility while still tied to a portion of the utility's system. This condition is referred to as islanding and is an unacceptable mode of operation. In order to prevent these problems from adversely affecting the utility, studies must be performed to determine a solution. This may require modifications to the existing system.

When modifications are required to the existing protection system, the extent of this modification is dependent upon both the size of the generation and the electrical characteristic of the utility's system at the point of common coupling. A relatively simple protection system may be required for a small generator that will never export power into the utility, while a more complex, high-speed scheme may be required for larger generators that will export power. In most cases the utility will require the customer-owned generation to have protective systems at the point of common coupling. These relays will serve to protect the utility's electrical system. It remains the Customer's responsibility for protecting customer-owned equipment from damage in the event of recloser operation, system faults, lightning strikes or any other disturbance on the Detroit Edison System.

Reclosing of Detroit Edison Supply Lines

The majority of faults on an overhead distribution line are transient in nature. Tree branches blown into wires cause a momentary fault as do lightning-induced flashover of insulators. By quickly de-energizing the line and then automatically re-energizing or reclosing it, the fault is usually cleared and the line is returned to service. The industry uses automatic reclosing of overhead lines as an effective way to improve the reliability of service to customers. When successful, a customer will only see a momentary interruption of power due to a recloser operation instead of a sustained outage if no automatic reclosing was used.

Effects of Automatic Reclosing on Parallel Generation

Generating equipment connected to distribution lines can experience severe damage during automatic reclosing. This occurs as the tie between the generator and the utility is re-established with the two entities out of synchronism. A system disturbance created by this event may result in a safety hazard and/or damage to both the utility and it's customer's facilities. When it is determined that automatic reclosing could lead to equipment damage and a possible safety hazard involving the Detroit Edison System or other customers, Detroit Edison will require the installation of supplemental protective equipment.

Revenue Metering Requirements

Metering of the output of each customer-owned generator may be needed. If required, instrument transformers and metering will be provided by Detroit Edison. When practical, multiple generators may be metered at a common point provided that the metered quantity represents only gross generator output. For sell-back arrangements, special interconnection revenue metering will be required in addition to the generator metering. The Customer shall provide, at a location approved by Detroit Edison, a suitable place for the Detroit Edison owned, operated, and maintained metering equipment. Normally the metering equipment is a stock item for Detroit Edison, but at times this equipment must be ordered and may have a substantial delivery time. It is in the best interest of the Customer to contact Detroit Edison early in the design stage to avoid any delays due to metering equipment arrival. The Customer shall provide authorized employees and agents of Detroit Edison access to the premises at all reasonable hours to install, turn on, disconnect, inspect, test, read, repair or remove the metering equipment. The Customer may, at its option, have a representative witness this work. The metering installation specifications are outlined in the Design Requirements section of this guideline.

Telemetry Requirements

Telemetering is required of all Customers who have the capability to supply one megawatt or over to Detroit Edison. If the Generating Facility is interconnected to the Distribution System at 13.2 kV or below, telemetering may be required on Generating Facilities 250 kVA or greater. Detroit Edison will monitor industry practices and Distributed Resource installations in the State to modify these requirements, if warranted. Detroit Edison may also consider, where possible, less intrusive and/or more cost effective options for providing the data in real time, in lieu of traditional telemetry designs.

The intent of telemetering is to provide a real-time indication to Detroit Edison of the status of the Customer's generator (operating in parallel or not) and the net flow of power to the Detroit Edison Electrical System. The specific requirements are listed in this document to clarify intent and to assist in budget planning and preliminary equipment design. The Customer is encouraged to contact Detroit Edison as early in the planning stage as possible to permit satisfactory telemetering to be installed as economically as possible. Telemetry may be required for any of the following reasons:

- **System Control:** Detroit Edison is required to maintain frequency and the balance between generation and load within its service territory. Large swings in generation, without the required telemetry, have a negative effect on system control.

- **Monitor Wholesale Power Transaction:** Detroit Edison has the responsibility to monitor wholesale power transactions between all generators and third parties utilizing the interconnection to the Detroit Edison System.

- **Transmission and Distribution System Operation:** Operating decisions are significantly impacted by the status of large generators. Operators need to know the status of these large generators before any decisions can be made concerning routine or emergency switching.

- **Public Safety:** Generators have the capability of keeping a section of the electrical grid energized while this section is isolated from the Detroit Edison System. It is imperative to detect these “islanding” situations immediately and to take corrective action. The safety of the general public and of Detroit Edison workers is at risk in these situations.

Telemetering of the following values may be required based upon meeting applicable criteria as outlined in the Design Requirements section:

- Instantaneous MW and MVAR of each generator.

- Instantaneous MW, MVAR; and at least one voltage measurement at the point of common coupling.

- Cumulative MWhr and MVARhr at the point of common coupling.

- Status of all circuit breaker(s) which can disconnect a generator from the Detroit Edison System.

- Status of bus tie circuit breaker(s).

- Supervisory control for turning generator(s) on/off from Detroit Edison.

- Status of the available supervisory control (available - disabled)

- Status (normal-fail) of protective relay communication channels: A status indication of "FAIL" indicates that the communication channel used for relaying (e.g. transfer trip) is unable to perform its protective function.

Operating Requirements

The generator-owner shall provide a 24-hour telephone contact(s). This contact will be used by Detroit Edison to arrange access for repairs, inspection or emergencies. Detroit Edison will make such arrangements (except for emergencies) during normal business hours. The generator-owner shall not supply power to the Detroit Edison System during any outages of the system that serves the point of common coupling. The generator-owner's generation may be operated during such outages only with an open tie to the Detroit Edison System. Islanding will not be permitted. The generator-owner shall not energize a de-energized Detroit Edison circuit for any reason.

Generation that does not operate in parallel with the Detroit Edison System is not subject to these requirements. However, notification of equipment installation must still be given to Detroit Edison, and the design will still be subject to review to ensure a non-parallel interconnection.

The required manual disconnecting device at the point of common coupling may be opened by Detroit Edison at any time for any of the following reasons:

- To eliminate conditions that constitute a potential hazard to Detroit Edison personnel or the general public.
- Pre-emergency or emergency conditions on the Detroit Edison System.
- A hazardous condition is revealed by a Detroit Edison inspection such as protective device tampering.

The disconnecting device may be opened by Detroit Edison for the following reasons after notice to the responsible party has been delivered and a reasonable time to correct (consistent with the conditions) has elapsed:

- A power producer has failed to make available records of verification tests and maintenance of its protective devices.
- A power producer's system interferes with Detroit Edison equipment or equipment belonging to other Detroit Edison customers.
- A power producer's system is found to affect quality of service of adjoining customers.

Following a generation facility disconnect as a result of a voltage or frequency excursion, the generation facility shall remain disconnected until the Detroit Edison's service voltage and frequency has recovered to the Detroit Edison's acceptable voltage and frequency limits for a minimum of five (5) minutes.

Detroit Edison may require direct transfer trip (DTT) whenever it is determined that the Customer's protective relaying may not operate for certain conditions or faults and/or the installation could increase the length of outages on a distribution circuit or jeopardize the reliability of the circuit.

Detroit Edison System Maintenance

Detroit Edison performs routine maintenance on its electrical system. This maintenance can be either scheduled or unscheduled. The latter is usually due to emergency repairs necessary to avoid or minimize customer outages. When maintenance is performed the goals are to minimize cost and customer inconvenience. Costs are controlled by the scheduling of work during normal daytime working hours. Customers are also transferred to alternate circuits, if possible, to eliminate any loss of service while maintenance is performed. These load transfers are not possible if a customer has a generator operating in parallel with the electric system because no study has been performed for this new configuration. The Customer may choose any of the following to allow the load transfer to occur:

- The Customer can elect to trip the generation and either continue or curtail electric consumption. The Standby Service Rate allows the Customer to purchase electricity from Detroit Edison.

- The Customer may request the maintenance work be performed when their generation is off line. Detroit Edison will attempt to accommodate requests of this nature, but reserves the right to deny any request and shall incur no liability whatsoever in the event of such denial. The Customer will be responsible for any extra costs (such as working over time instead of straight time) as a result of this request.

- The Customer's load and generation may be disconnected from the Detroit Edison System while the maintenance work is being performed. This is an option only if the Customer's system has been designed to operate independent of the Detroit Edison system.

The generating equipment shall be capable of being isolated from the Detroit Edison System by means of a manual disconnecting device to provide a visible break in the circuit. This switch shall be readily accessible for operating and locking by Detroit Edison personnel. Detroit Edison may operate this switch if the generation is contributing to an emergency situation, interfering with the service to other customers, or any other safety hazard.

Switching to Alternate Detroit Edison Supply Lines

Some customers have automatic throw-over equipment to allow for transfer from a normal line to an alternate line if the normal line has an outage. As a general rule, the Customer must not run any parallel generation when the normal line is out of service. The control equipment should discontinue parallel operation (trip the generator breaker) if a throw-over occurs while the generator is operating in parallel unless prior arrangements have been made with Detroit Edison to allow parallel operation on the alternate line.

Supply from the Secondary Network

Parallel operation of a generator on a Secondary Network is not recommended.
If a Customer requests to interconnect to a Secondary Network then a full engineering study will be required regardless of the size of generation.

Momentary Paralleling with Detroit Edison

For situations where generation will only be operated in parallel with the Detroit Edison System for short durations (less than 100 milliseconds per IEEE 1547- *Standard for Distributed Resources Interconnected with Electric Power Systems*), as in make-before-break automatic transfer schemes, a study will not be required. In these instances it is a requirement that the duration of parallel operation be minimized to the extent that normal breaker operating time allows with no intentional time delay.

2 GENERAL INFORMATION (continued)

Power Quality

Customers are not permitted to create system voltage disturbances (flicker) that are objectionable at other customers. This requirement applies to all customers whether they operate generation in parallel with the Detroit Edison System or not. Customers without generation may have cyclic loads, non-linear loads, and loads that create harmonic disturbances on the electrical system that have the potential to cause objectionable flicker at other customers. This is not permitted. Similarly, Customers operating generation in parallel with the Detroit Edison System are not permitted to create objectionable flicker at other customers sites.

However, the Customer should be aware that interruptions, switching transients, and other abnormal conditions may occur on the Detroit Edison System. All customers should install protective equipment if such occurrences may cause damage to their electrical equipment. Please refer to the Detroit Edison Rate Book for Electric Service, Rule B-3.2

Applicable Fees and Charges

Detroit Edison incurs costs that can be categorized into four different categories.

- **Application Fee Charge:** Initially the Company spends time answering customer questions, forwards paper work to the customer, reviews the application for completeness and contacts the customer for any missing information and spends time answering any technical or regulatory questions. In order to encourage Distributed Resources in the State of Michigan, Detroit Edison intends to minimize the charges it incurs in the form of a fee. This Application Fee will be commensurate with the size of the generation and work necessary by Detroit Edison. It will be $200.00 for single phase generators 25 kVA or less, $300.00 for other generators 100 kVA or less, and $1000.00 for generation greater than 100 kVA. The Application Fee is non-refundable, as Detroit Edison will incur these costs even if the Customer abandons the project.

- **System Impact Study Charge:** If the customer decides to proceed with the installation, Detroit Edison will have to conduct additional studies as described in the previous sections. Detroit Edison will not charge customers with generation of 100 kVA or less for this study. The exception will be single phase generators on the Secondary Network even if they are 25 kVA or less. Generation greater than 100 kVA, and single phase generators on the Secondary Network will be quoted the full cost of study.

- **System Modification Charge:** If there are any modifications necessary to the Detroit Edison System, the customer will be responsible for all such costs. Generally, no modifications are expected for single phase generators 25 kVA or less, but in exceptional cases they might be needed. Nevertheless, all system modification costs are to be borne by the customer.

2 GENERAL INFORMATION (continued)

- **Field Services Charge:** This charge is for Detroit Edison costs associated with the witness of tests, setting of relays, installation of any required metering, and site approval costs associated with final approval for paralleling with the Detroit Edison grid. This charge is dependent on the size of generation and commensurate with the work necessary on part of Detroit Edison personnel. For single phase generation 25 kVA or less there will be a fixed charge of $500.00, for all other generation 100 kVA or less the fixed charge will be $700.00. For generation greater than 100 kVA, Detroit Edison will quote costs based on size of generation and the Point of Common Coupling (PCC).

3 DESIGN REQUIREMENTS

Protective Relaying and Equipment

The protective relay systems required by Detroit Edison at the Customer's point of common coupling have the primary purpose of preventing islanding. Islanding occurs when Customer's generation becomes separated from the utility source and continues to independently serve a portion of the utility's electrical system. These systems as required by Detroit Edison are only intended for the protection of the Detroit Edison power grid. The Customer is totally responsible for the protection of its own system including the protection of its generation. The Customer is also responsible for the synchronizing systems required for parallel operation of their generation with the Detroit Edison System.

The Customer may not close their generator into a de-energized Detroit Edison line and must provide protection to prevent this from occurring.

This section will provide design and equipment guidelines to aid the Customer in providing the required protection. It is the Customer's responsibility to provide the final design and to install the protection schemes required by Detroit Edison. Detroit Edison will review and approve the design, the types of relays specified, and the installation. Mutually agreed upon exceptions may at times be necessary and desirable. It is strongly recommended that the Customer obtain Detroit Edison approval prior to ordering protective equipment for parallel operation. The Customer will own these protection schemes installed at their facility.

Detroit Edison shall specify all calibrations for Customer owned relays that are required herein. The Customer must obtain prior approval from Detroit Edison for any revisions to the specified relay calibrations.

The Detroit Edison protective relaying requirements for Customer owned generation are influenced by many factors such as:

- Type and size of generator
- Voltage level of the connection
- Location of the generator on the circuit
- Expansion plans of the Customer
- Circuit configuration and sectionalizing
- Available fault current
- Load that can remain connected to the generator under isolated conditions
- Whether the generator is operating in a sell-back or displacement mode
- Concentration of other existing independently owned generation on the circuit.

As a result, it is impossible to standardize protection requirements strictly according to any single criteria, such as generator size. The specific relaying for each proposed parallel connection must be individually determined for each installation. Protective relay requirements could differ for similar units because of a different combination of factors. It is therefore important that the Customer contact Detroit Edison at the earliest possible date, prior to the purchase of equipment, to determine the relay requirements for parallel operation.

3 DESIGN REQUIREMENTS (continued)

In the following sections, the basic protection requirements are defined for those classes of Customer owned generators served from the distribution system (41.6 kV and below). Additional protective relaying that might be required and other important protection considerations are also described.

Single Phase Units, 25 kVA or Less

Most units in this classification are expected to be owned by residential Customers and consist mainly of windmills, fuel cells, and photovoltaic devices designed to operate in the 120V to 240V range. For the devices in this category, it will not be necessary for the Customer to submit control drawings or schematics for Detroit Edison approval. Rather, final approval of the installation shall be contingent upon the results of the automatic shutdown test described in the Installation and Testing section.

Single Phase Units Greater Than 25 kVA and All Three Phase Units

Basic Isolation Protection - Sell-Back Operation

The following relaying will provide the basic isolation protection to prevent islanding where power flow to Detroit Edison is permitted. The IEEE device number is indicated for each relay function.

The purpose of the voltage and frequency relays is to define the acceptable band of operation as described below. Typical isolation protection for a three-phase generator is shown in Appendix IV - Figure 1. When the ratio of minimum isolated load to maximum generation is greater than 3 to 1, the over-voltage and over-frequency relays may not be required. Appendix IV contains a list of approved relays that provide the required functions.

1. Undervoltage Relays (Devices 27)

These relays must be adjustable from 70-90% nominal service voltage and have time delay to override system transients and clearing of external faults. All phase voltages shall be monitored with an under-voltage relay to provide maximum tripping reliability for three phase generators. Time under-voltage relays with inverse time characteristics are recommended.

2. Overvoltage Relays (Devices 59)

These relays must be adjustable from 105-120% nominal service voltage and have a definite time delay to override system transients. All phase voltages shall be monitored with an over-voltage relay to provide maximum tripping reliability for three phase generators.

3. Underfrequency Relay (Device 81U)

For a Customer with a total generation capacity of greater than 30 kVA the under-frequency (UF) relay must be adjustable from 57 - 59.3 Hertz. These (UF) relays must be definite time units and will be set to trip at 10 cycles. For installations with a total capacity of less than or equal to 30 kVA a UF relay with single set point of 59.3 Hz and 10 cycles definite time delay is acceptable.

4. Overfrequency Relay (Device 810)

The over-frequency relay with a single set point of 60.5 Hz and 10 cycles definite time is acceptable.

Basic Isolation Protection - Non-Sell-Back Operation

The following relaying will provide the basic isolation protection in those cases where the Customer is either unable to or has not contracted with Detroit Edison to transmit power to the Detroit Edison System.

This scheme consists of a three-phase power directional relay with an associated timer. A typical application of this scheme is shown in Appendix IV (Figures 2 and 3). This scheme will operate whenever the Customer creates an island with a portion of the Detroit Edison System. The IEEE device number is indicated for each relay function.

1. Reverse Power Relay (Device 32)

The reverse power relay scheme is designed to sense three phase power flow into the Customer. The relay is normally in the 'picked-up' state when the Customer is importing power from Detroit Edison and the system is in normal operation. If the power flow into the Customer falls below the pick-up of the relay, decrease to zero or reverses the relay will drop out and initiate the trip timer. A typical setting (import requirement) for the reverse power relay is 1.5 watts as measured at the relay.

2. Trip Delay Timer (Device 62)

The timer must have an adjustable range that will provide for a typical setting of 2.0 seconds. The time delay overrides momentary disturbances on the Detroit Edison System that could result in nuisance tripping.

Tripping times exceeding two seconds must be evaluated on each installation. Where the Customer can create an ungrounded island, the over-voltage withstand limits of system lightning arresters will often determine the maximum time delay. Grounding a phase conductor on an ungrounded system can increase the phase-to-ground voltage on the two ungrounded phases to full phase-to-phase system voltage.

Supplemental Isolation / Fault Protection

Where the above mentioned relays cannot provide adequate fault and isolation protection for the Detroit Edison System, additional relays as determined by Detroit Edison will be required. Detroit Edison shall inform the Customer of the reason for this additional relaying as part of the site specific interconnection study. Additional relaying may include but is not necessarily limited to any of the following:

1. A Remote Trip Channel

A communication channel for remote tripping may be required as part of the relay protection scheme to prevent islanding and to ensure fast and safe clearing of system faults. This channel may be (1) leased telephone circuit; (2) power line carrier; (3) radio system; (4) microwave; (5) Detroit Edison pilot wire; (6) fiber optics; or (7) other types to be mutually agreed upon by the Customer and Detroit Edison.

Remote tripping will normally only be considered for paralleled generation with sell-back arrangements.

2. A Zero Sequence Overvoltage Relay (Device N-59)

This relay is typically used to detect a grounded conductor on a circuit that has become isolated from system ground. It is applied where the Customer can create an ungrounded island from a portion of a Detroit Edison circuit that was previously grounded.

The relay may be instantaneous or time delay depending upon the coordination requirements and the potential hazards created by phase-to-ground overvoltages.

This scheme will require three potential transformers or potential dividers connected phase-to-ground on the primary and broken delta secondary (refer to Appendix IV - Figure 1).

3. A Primary Neutral Overcurrent Relay (Device N-A51)

This relay may be required when the primary of the power transformer is grounded creating a current source for line-to-ground faults on the Detroit Edison System. The relay may be instantaneous and/or inverse-time over-current depending on the coordination requirements for ground faults. The range of the relay and associated current transformer ratio must be determined for each case.

4. Voltage Restrained Time Overcurrent Relays (Device 51V)

These relays may be required for synchronous generators to limit the duration of fault current sustained by such units and minimize damage to Detroit Edison equipment.

Approved Relays and Control Scheme Requirements

Approved Relays

Three phase units of 100 kVA or above and single-phase units over 25 kVA will require Detroit Edison approved utility grade relays to provide protection for the Detroit Edison System. Where multiple generators are connected in parallel to the Detroit Edison System through a single connection point, the rating of the Customer will be determined by the sum of the ratings of the individual generators.

Detroit Edison will provide a list of approved utility grade relays. Relays will be added to the approved list by submitting certification that the relay meets IEEE C37.90 and C37.90.1. Detroit Edison reserves the option of acceptance testing any of the relays included in the Customer design prior to final approval.

The relays required for the protection of the Detroit Edison System shall have indicators or targets to verify their operation. The control circuit shall be designed to have these operational indicators or targets functional.

Industrial grade relays may be approved for those three-phase units under 100 kVA that pose little or no risk to other Detroit Edison customers, or Detroit Edison personnel, or equipment.

Relay and Test Switch Connection

All relays required for interconnection protection shall be draw out type or connected into systems equipped with test switches that permit isolation of the interconnection relays from live voltage and current circuits.

Non Draw Out Relay System Connection

The control system and test switches shall be wired to permit relay testing by applying secondary test voltage and test current. The control system shall also provide for isolation of the trip output contacts from all voltage sources and trip circuits to permit connection of test equipment to determine relay trip time.

Systems under 100 kVA that utilize relay functions integral to the controller may forego the requirement for isolation of the trip output contacts if fully functional inverter trip tests are permitted. In cases where the trip output shuts down the inverter without an associated circuit breaker operation, multiple trips with the inverter on line may be required.

Other Control System Requirements

Relay systems using AC control power must be designed to operate to interrupt the generator contactor on loss of AC potential. Refer to Appendix IV - Figure 4 for a typical installation using AC control power.

The Customer must be prevented from paralleling with Detroit Edison when the Detroit Edison line voltage is not present. This may be accomplished either with the under-voltage relays (Device 27), the reverse power scheme, with a separate phase sequence and under-voltage relay (Device 47) or with a synchronism check relay (Device 25) which are connected to block manual and automatic closing of the isolating breaker for a deenergized line.

Other Protection Considerations

Dedicated Transformer

Detroit Edison reserves the right to require a power producing facility to connect to the Detroit Edison System through a dedicated transformer. The transformer shall conform to Detroit Edison's specifications. The transformer may be necessary to ensure conformance with safe work practices, to enhance service restoration operations or to prevent detrimental effects to other Detroit Edison customers. The dedicated transformer that is part of the normal electrical service connection of a generator-owner's facility may meet this requirement if there are no other customers supplied from it. A dedicated transformer is not required if the installation is designed and coordinated with Detroit Edison to protect the Detroit Edison System and its customers adequately from potential detrimental net effects caused by the operation of the generator. If Detroit Edison determines a need for a dedicated transformer, it shall notify the generator-owner in writing of the requirements.

Manual Disconnecting Device

Generating equipment shall be capable of being isolated from the Detroit Edison System at the point of common coupling by means of a manual disconnecting device with a visible break. This device shall be accessible at all times by Detroit Edison, be under the control of Detroit Edison, and serve as a protective tag location.

Inverter Applications

UL1741 certified inverters are normally acceptable without additional relaying at the PCC for sites with only one inverter less than 100 kVA beyond the PCC. For these installations, voltage and frequency signals used for automatic shutdown may be monitored at the DG connection. Three phase inverter installations under 100 kVA may have isolation protection built into their internal circuitry and control in which case no additional relaying will generally be required. For three-phase operation, the inverter control must be able to detect and separate for the loss of one phase.

For larger sizes and for installations with more than one inverter, additional relaying may be required.

Type test results must be submitted to Detroit Edison and must be certified by a nationally recognized test organization, acceptable to Detroit Edison.

Revenue Metering

The required metering includes metering of the power flow at all points of common coupling (PCC) with Detroit Edison and the gross output of the generator(s). In the case of those Customer's with sell-back arrangements, the metering at the PCC shall also include provisions for metering power flow to Detroit Edison. In all cases the metering at these points shall be designated to provide the billing components required by the applicable tariffs.

- The metering installations for Customer locations shall be constructed in accordance with the practices that normally apply to the construction of metering installations for commercial, industrial or other customers with demand recording equipment.

- Detroit Edison shall supply to the Customer the standard detailed specifications and guidelines (Chapter 11 of The Detroit Edison Service Installation Manual) relating to the location, construction and access of the metering installation and will provide consultation pertaining to the meter installation as required.

- Detroit Edison shall supply all the required metering equipment such as instrument transformers, meters, demand recorders and associated connection cabinets, along with the interconnecting wiring and communication links if required. Insofar as practical, Detroit Edison will coordinate the delivery of these materials with the Customer's installation schedule.

- The Customer shall provide a mounting surface for the meters, recorders, and connection cabinets, a housing for the instrument transformers, a conduit for the conductors between the instrument transformer secondary windings in the meter connection cabinets, and a conduit for the communication links if required, all of which must meet Detroit Edison's standard detailed specifications and guidelines.

- Meters and related equipment shall be as near as possible to the PCC, in a clean, dry place, reasonably secure from injury, not subject to vibration, and readily accessible for reading and testing.

- Installation of the equipment is a shared responsibility with the Customer generally installing that equipment which attaches to his facilities, including the instrument transformers, cabinets, conduits and mounting surfaces.

- Detroit Edison or its agents shall install the meters, recorders and communication links. Insofar as practical, Detroit Edison will coordinate the installation of these items with the Customer's schedule.

- Customer's with sell-back arrangements shall have metering at the points of common coupling with Detroit Edison that is capable of properly measuring and recording all the required billing components for both power flow to Detroit Edison and to the Customer. The design and construction of this metering installation shall be in accordance with the requirements stated above.

Telemetry

Telemeter Values Based upon Criteria

Generators that meet any of the following criteria require telemetry installations to Detroit Edison's control center. The telemetry requirements are listed below each criterion. If

more than one criterion is applicable to a generator, the telemetry requirements for each particular criterion must be met.

Note: If the Generating Facility is interconnected to the Distribution System at 13.2 kV or below, telemetering may be required on Generating Facilities 250 kVA or greater. Detroit Edison will monitor industry practices and DG installations in the State to modify these requirements, if warranted. Detroit Edison may also consider, where possible, less intrusive and/or more cost effective options for providing the data in real time, in lieu of traditional telemetry design.

1. If the aggregate “sell-back” generation at a site is greater than 1.0 MW then continuous telemetry is required including the following:

    - Instantaneous MW and MVAR of each generator.
    - Instantaneous MW and MVAR and at least one voltage measurement at the point of common coupling.
    - Cumulative MWhr and MVARhr at the point of common coupling.
    - Status of all circuit breaker(s) which can disconnect a generator from the Detroit Edison System.
    - Status of bus tie circuit breaker(s).

2. If the generation is involved in wholesale power transactions utilizing the interconnection to the Detroit Edison System then continuous telemetry is required including the following:

    - Instantaneous MW and MVAR of each generator.
    - Instantaneous MW and MVAR and at least one voltage measurement at the point of common coupling.
    - Cumulative MWhr and MVARhr at the point of common coupling.
    - Status of all circuit breaker(s) which can disconnect a generator from the Detroit Edison System.
    - Status of bus tie circuit breaker(s).
    - Aggregate instantaneous MW and cumulative MWhr of all third-party loads inside Detroit Edison's control area.

3. If the generation will be turned on/off remotely by Detroit Edison then continuous telemetry is required including the following:

    - Instantaneous MW and MVAR of each generator.
    - Instantaneous MW and MVAR and at least one voltage measurement at the point

of common coupling.

- Cumulative MWhr and MVARhr at the point of common coupling.
- Status of all circuit breaker(s) which can disconnect a generator from the Detroit Edison System.
- Status of bus tie circuit breaker(s).
- Supervisory control for turning generator(s) on/off from Detroit Edison
- Status of the available supervisory control (available – disabled)

4. If multiple generators, smaller than 1.0 MW each, dispersed over a large area with an aggregate generation greater than 1.0 MW are being centrally controlled, continuous telemetry is required during the period when any of the aggregated generators is connected including the following:
   - Aggregate instantaneous MW and MVAR and cumulative MWhr and MVARhr of all generators.
   - Connection status of each generator (connected / not connected).
5. If the generation requires transfer trip communication for protection reasons, the status of transfer trip communication at the generation site shall be telemetered.
6. If the Applicant has shown an unsatisfactory response to requests to separate the generation from the Detroit Edison System, Detroit Edison reserves the right to install supervisory control to initiate separation of the Applicant generation from its system. This control would be initiated by the Detroit Edison System Supervisor via telemetering equipment installed at the Applicant's location. If it becomes necessary to install such supervisory control, it is the responsibility of the Applicant to provide an interface that will achieve a controlled separation that is mutually acceptable to the Applicant and Detroit Edison. The control from Detroit Edison will normally be provided in the form of a "dry" relay contact closure.
7. The Applicant will be responsible for the installation and monthly communication costs of the required telemetry. Detroit Edison will own and maintain all telemetering facilities. The Applicant is responsible for meeting the requirements for interfacing their equipment to telemetering. The Applicant must provide access to the telemetering installation upon request of Detroit Edison service personnel.

Instrument Transformers for Telemetering Measurement

The current and potential required for power flow and voltage monitoring will normally be provided from current and potential transformers located at the point or points of common coupling. The current and potential transformers must be independent of those used for billing metering. This separation is required to insure the accuracy of the billing metering and also to permit repairs on the telemetering equipment to be performed by one group.

The current and potential sources will be connected to a Detroit Edison owned measuring device (transducer or power monitor) which is in turn connected to the telemetering equipment. Detroit Edison prefers voltage transformer secondaries which are Wye connected, nominally 120 volts phase to phase at normal bus voltage. Detroit Edison also prefers current transformer secondaries which have at least two phase currents (for a three-phase system) with a nominal rating of 5.0 amperes where the current at full interchange is not less than 2.0 amperes secondary. Current and potential transformers must have a maximum of 1% ratio error and a maximum of 2° phase angle error at normal power flow.

Contacts for Breaker Status Monitoring

The Customer applying for interconnection must provide auxiliary contacts for breaker status (open-closed) monitoring. Such contacts must be provided from:

- Breakers normally operated when connecting or disconnecting individual generators.
- Breakers used to isolate the Customer's plant from Detroit Edison.
- Contacts that monitor the status of protection transfer trip equipment.

The auxiliary contacts used to provide breaker status shall be isolated from ground and any voltage source (dry) and have connection points suitable for wiring to the telemetering equipment. The contacts can be provided through auxiliary relays or directly from breaker auxiliary switch contacts. Detroit Edison prefers breaker auxiliary switch contacts that are open when the breaker is open and closed when the breaker is closed. A "wetting" voltage will be applied to the auxiliary contacts by the telemetering equipment. Because of the many electrical configurations and operating circumstances involved with individual customers, the above listing may not apply to all situations. The intent of such breaker information is to provide Detroit Edison with a positive indication of whether the Customer's generation is indeed isolated or not isolated from the Detroit Edison Electrical System. Each installation must be reviewed on an individual basis to determine the breakers that should be monitored.

Supervisory Control for Remote Generator Separation

In cases where response to a request to separate is normally expected to take over one hour or when a faster response is required, Detroit Edison reserves the right to install supervisory control via the installed telemetering equipment or protective relay control to cause separation of the Customer's generator. This could perhaps be the case in an unmanned independently owned generating station.

Detroit Edison will attempt to contact the Customer as soon as possible after reconnection is permissible. Contact will normally be made via telephone. Other means of communication, such as facsimile (fax) or telemetered indication may be used where mutually agreeable. Automatic reconnection of the Customer to the system via SCADA control would be installed only where mutually agreeable to the Customer and Detroit Edison.

Telemetering Data Circuit

Installation of data circuits (phone lines) is the responsibility of the Applicant. The Applicant shall purchase four-wire C2 conditioned service from a telecommunications provider to allow the telemetering equipment to communicate to the Detroit Edison operations center from their facilities. The Customer shall route the data circuit from the telecommunications provider's point of connection at the Customer's facilities (demarcation point [D-Mark]) to the Detroit Edison owned telemetering cabinet. The data circuit must be installed as specified by the telecommunications provider. The telecommunications provider may require the circuit be enclosed in conduit from the telemetering equipment cabinet (RTU) to the point of connection. Detroit Edison will arrange extension of the Applicants data circuit from the D-Mark at Detroit Edison's operation center to the Detroit Edison communications gateway.

The telecommunications provider may require the circuit to be isolated from the ground mass at the Customers facilities to prevent ground rise damages to their equipment as the result of an electrical ground fault. The telecommunications provider will advise the Customer on this requirement. It is not a requirement of Detroit Edison.

For a fee, Detroit Edison Telecommunications Services will provide consulting and agent service to arrange data circuits for the Customer.

Voice Circuit

Access to standard voice telephone is required for use during testing to communicate with personnel performing the master station portion of the tests. A circuit with modular jack and instrument (telephone) at the telemetering equipment cabinet RTU is acceptable. An extension from an existing circuit is acceptable; however, Detroit Edison test personnel must have full access to the circuit during testing.

Space Requirement

Wall space must be provided for adjacent mounting of two telemetering enclosures. Each enclosure is nominally 36 inches high, 30 inches wide and 12 inches deep. A clear space 4.5 feet deep is required to permit maintenance and testing of the equipment. Generally this wall space should be near the Detroit Edison revenue meters. A review of each installation should be made to determine the location most agreeable to Detroit Edison and the Customer.

Power Requirement

The telemetering equipment can be powered by the Customer's power source at 24, 48 or 125 volts dc $\pm$ 10% or a reliable 120 volt ac +10% circuit. A 120 volt ac power source for the cabinet convenience outlet is also required.

Power Quality

The Customer shall conform to the power quality requirements of IEEE 1547 for the limits of DC injection, voltage flicker, harmonics, immunity protection, and surge capability (see Appendix V – Power Quality for a summary).

The Customer may not create system voltage disturbances (flicker) that are objectionable at other customers. Limits are defined in Appendix V.

When there is demonstrated, unreasonable interference to other customers and such interference exceeds Detroit Edison's current system standards, Detroit Edison reserves the right, at its initial expense, to install special test equipment as may be required to perform a disturbance analysis and monitor the operation of the Customer and its control to evaluate the quality of power produced.

If the Customer is conclusively demonstrated to be the source of the interference, and it is demonstrated that the interference produced by the Customer exceeds Detroit Edison's standards or, generally accepted industry standards, then it shall be the responsibility of the Customer to eliminate the interference problem and to reimburse Detroit Edison for the reasonable costs of the disturbance analysis excluding the cost of the meters or other special test equipment.

Detroit Edison will provide the Customer with all information available regarding the least cost method of eliminating the interference problem.

Synchronous Generators

Synchronous generation shall require synchronizing facilities. These shall include automatic synchronizing equipment or manual synchronizing with relay supervision, voltage regulator and power factor control. Voltage fluctuation at the PCC during synchronizing shall be limited to $\pm$5% as defined in IEEE 1547.

Induction Generators

Induction generation may be connected and brought up to synchronous speed (as an induction motor) if it can be demonstrated that the initial voltage drop measured at the point of common coupling is acceptable based on current inrush limits.

The same requirements also apply to induction generation connected at or near synchronous speed because a similar voltage dip is present due to an inrush magnetizing current. The generator-owner shall submit number of starts per specific time period and maximum starting kVA draw data for Detroit Edison to verify that the voltage dip due to starting is within the visible flicker limits as defined by IEEE 519-1992, "Recommended Practices and Requirements for Harmonic Control in Electric Power Systems (IEEE 519)".

Starting or rapid load fluctuations on induction generators can adversely impact Detroit Edison System voltage. Corrective step-switched capacitors or other techniques may be necessary. These measures can, in turn, cause ferroresonance (an interaction between capacitors and transformers that leads to overvoltage on the distribution system). If these measures (additional capacitors) are installed on the Customer's side of the point

of common coupling, Detroit Edison will review these measures and may require the Customer to install additional equipment.

Power Factor

If the power factor, as measured at the point of common coupling, is less than 0.9 (leading or lagging), the method of power factor correction necessitated by the installation of the generator will be negotiated with Detroit Edison as a commercial item. Induction power generators may be provided VAR capacity from the Detroit Edison System at the generator-owners expense. The installation of VAR correction equipment by the generator-owner on the generator-owner's side of the point of common coupling must be reviewed and approved by Detroit Edison prior to installation.

4 INSTALLATION AND TESTING

Commissioning Testing

Single Phase Installations 25 kVA and smaller

Automatic Shutdown Test

The automatic shutdown test requires that the unit shutdown with the loss of the Detroit Edison service. This can be simulated by either removing the Customer meter or opening an isolation switch while the generator is operating. Voltage across the Customer side of the meter or isolation switch is to be measured and must be observed to reduce to zero within two seconds after isolation. The test is to be conducted with the generation as close to its full output as possible. Final approval for the installation shall not be given until Detroit Edison personnel have performed the test and an automatic shutdown observed.

If a voltage is sustained after the isolation, approval of the installation shall not be given. In such cases, a schematic diagram of the control must be submitted to Detroit Edison for further review and recommendations regarding additional relay requirements.

Three Phase Installations and Single Phase Installations greater than 25 kVA

Commissioning testing (acceptance test for service) shall be performed per IEEE 1547 (see Appendix VI - Testing) for all Customers above 25 kVA. Functional testing and inspection of the protective relay control system shall be performed or witnessed by Detroit Edison. The testing shall verify correct operation for abnormal system conditions. The testing shall also verify correct application of interconnection protective relay settings. The following requirements are in addition to those included in IEEE 1547:

- ***One-Line Diagram Consistency***

  An inspection shall verify that all interconnection protective relays or devices (hereafter referred to as “relays”) are installed consistently with the approved one-line and schematic diagrams.

- ***Transfer Trip Operation***

  Correct trip and alarm operation of any required transfer trip system shall be verified.

- ***Test Records***

  Test results shall be recorded and copies forwarded to Detroit Edison for tests witnessed but not performed by Detroit Edison. Copies of test records made by Detroit Edison personnel shall be made available to the Customer or designated representative upon request.

4 INSTALLATION AND TESTING (continued)

Type Testing

Customers that are certified to have met the applicable type testing requirements of IEEE 1547, IEEE 929, and UL1741 shall be acceptable for connection to the Detroit Edison Distribution System. Where multiple units are being installed, the total group of multiple units must be certified as a group. Multiple units that have not been tested as a group shall not be considered as being certified to be type tested.

Note that interconnection protection is defined at the PCC. Therefore, voltage, frequency and current values used by the Customer for interconnection protection must be monitored at the PCC. In some cases, the type tested unit may be located an appreciable distance from the PCC. The Customer should be aware that the generating unit would typically require the capability to utilize voltage and current signals from a remote PCC.

Certified type tested units do not necessarily include all protective functions required for interconnection. Protective relays, in addition to those included in the type tested unit, may be required to satisfy interconnection requirements. Typical examples of such relays are as follows:

- Relays monitoring power import requirement at the PCC (reverse power relays)
- Zero sequence over-voltage relays and associated voltage transformers
- Neutral over-current relay on the utility side of the interconnection transformer
- Transfer tripping systems

The type tested certification of equipment does not automatically qualify the Customer to be connected to the Detroit Edison Distribution System at any selected PCC. An interconnection study must be performed to determine the compatibility of the generation with the distribution system capabilities at the selected PCC.

Note that IEEE 1547 permits the monitoring of voltage at the DG for systems where the aggregate capacity is under 30 kVA. IEEE 929 applies only to inverters up to 10 kVA and UL1741 is only for inverters.

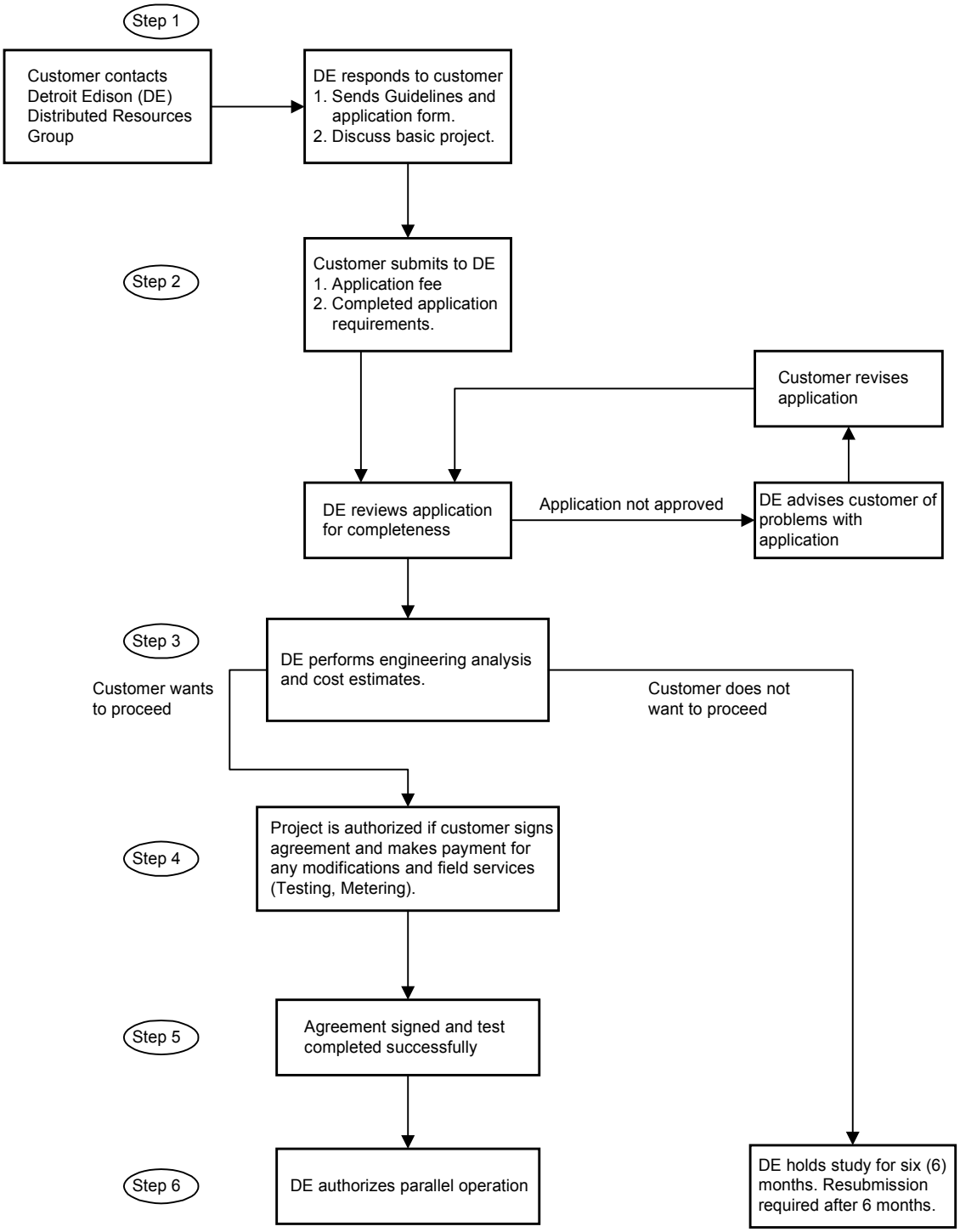
APPENDIX I

DISTRIBUTED GENERATION INTERCONNECTION GUIDELINES

SINGLE PHASE UNITS 25 kVA OR LESS

APPENDIX I – APPLICATION PROCESS - 25 kVA Units or Less

Application Process - Figure 2B
Single Phase Units 25 kVA or Less



APPENDIX I – APPLICATION PROCESS DESCRIPTION - 25 kVA Units or less

Process Description

Following is the detailed description of the Process Flow chart depicted in Figure 2B.
Wherever any payments are required the check shall be made out to Detroit Edison and sent to the attention of the Distributed Resources Coordinator.

STEP 1 – Initial Communication from Customer

The initial communication will be made with the Detroit Edison, Distributed Resources (DR) Group. The DR coordinator or representative will serve as a single point of contact for any interconnection of generation to the Distribution system. The response will include items such as application form, contract and technical requirements, application fee information, etc. The initial response (general) to this inquiry will generally be provided within two to three business days.

STEP 2 – Potential Customer Files an Application

The potential Customer files an application. Applications received after 1500 hours will be earmarked as received the following day. The filing must include a completed application form, including the information requested in these Guidelines, and a non-refundable $200.00 application fee. Typically, within five business days of receiving the application, Detroit Edison will notify the Customer of receipt and whether the application has been completed adequately. Several exchanges of information between Detroit Edison and the Customer might occur until the application has been completed according to Detroit Edison's technical requirements.
For expeditious processing of Applications, it is recommended that the Customers fill out the Applications with all the required information in the first instance. They are encouraged to contact the Distributed Resources group, for any questions, in the process of application.

STEP 3 – Detroit Edison Performs Engineering Review & Cost Estimates

After the application is completed to the Detroit Edison requirements, Detroit Edison will conduct a review to determine if any modifications are needed to the Detroit Edison System. Detroit Edison will also review for any power quality concerns and the other documents furnished with the Application.

Generally, no Detroit Edison system modifications are expected for this class of generation. If no system modifications are required, Detroit Edison will notify the Customer of the same within five business days. If no type test data exists for the Customer's generator, Detroit Edison may insist on additional testing requirements and that will take additional time. See Installation and Testing (Section 4) of the main document for the definition of Type Tested Systems.

In the unlikely situation, any modifications are warranted to the Detroit Edison system, Detroit Edison will prepare a detailed cost estimate and notify the Customer of the cost and the approximate schedule for such modifications. This will be provided to the Customer within fifteen business days. As stated above, this is not expected in majority of the cases.

APPENDIX I – APPLICATION PROCESS DESCRIPTION - 25 kVA Units or less

STEP 4 - Customer Commits to Proceed with Installation

If the Customer wants to proceed with the installation the following steps must be completed:

- Execute an interconnection agreement and enter into a contract for the applicable tariff with Detroit Edison. The interconnect agreement, specifies the rights and obligations of the Customer and Detroit Edison. It discusses the applicable tariffs, insurance requirements and other details of the interconnection requirements.

- Provide Detroit Edison with an advance payment for the Detroit Edison's estimated costs associated with system modifications (if required) and a check of $500.00 for field services such as metering and on-site verification**.**

If the Customer does not want to proceed, Detroit Edison will retain the study and cost estimates for a period of six months.

STEP 5 - The Customer's Facility is Tested in Accordance With the Detroit Edison's Technical Requirements

After completion of the following items, the Customer will give Detroit Edison two weeks notice to witness the required testing. In many cases this would be the Automatic Shutdown Test described below.

1. Execute an interconnection agreement and enter into a contract for the applicable tariff and insurance requirements with Detroit Edison.
2. Detroit Edison System work complete.*
3. Customer's installation complete.

***** In most of the cases this item may not be required.

Automatic Shutdown Test

The automatic shutdown test requires that the unit shutdown with the loss of the Detroit Edison service. This can be simulated by either removing the Customer meter or opening an isolation switch while the generator is operating. Voltage across the Customer side of the meter or isolation switch is to be measured and must be observed to reduce to zero within two seconds after isolation. The test is to be conducted with the generation as close to its full output as possible. Final approval for the installation shall not be given until Detroit Edison personnel have performed the test and an automatic shutdown observed.

If a voltage is sustained after the isolation, approval of the installation shall not be given. In such cases, a schematic diagram of the control must be submitted to Detroit Edison for further review and recommendations regarding additional relay requirements.

Should Detroit Edison find problems with Customer installation or testing, the Customer shall correct the same before Detroit Edison can authorize any parallel operation.

STEP 6 - Interconnection

Detroit Edison will review the results of its on-site verification tests in STEP 5 and if acceptable, will issue the Customer a formal letter of acceptance for interconnection.

Appendix I – APPLICATION FORM – 25 kVA Units or less

Application for Interconnection to Detroit Edison System (Single Phase ≤ 25 kVA)

Application # _____DE Date Received: _____

The following information is required for single-phase generation that is less than or equal to 25 kVA. An Application Fee of $200.00 must accompany all completed Applications prior to Detroit Edison commencing the Initial Review. The check should be made out to Detroit Edison and forwarded to Distributed Resources Coordinator.

1. **Customer:**
   Name: _____ Phone: (___)_____
   Address: _____ Municipality: _____

2. **Location of New Generation Facilities:**
   (include address if different from Customer address)
   _____

3. **Consulting Engineer or Contractor:**
   Name: _____ Phone: (___)_____
   Address: _____

4. **Estimated In-Service Date:** _____

5. Furnish One-Line Diagram: (See sample Figure 2A, attached)

   The one line drawing will typically represent the following:
   - The size of the generation in kVA.
   - Point of common coupling to the Detroit Edison System.
   - Isolation features provided to disconnect from the grid in case of loss of grid.
   - Method of grounding.

6. Do you plan to operate your unit in parallel with Detroit Edison? _____ _____
   Yes No

   If you answered No, but expect momentary paralleling, provide documentation that the momentary paralleling operation will be less than 100 msec. If you answered Yes, please complete the remaining application.

7. Generator/Inverter Information:

   Manufacturer: _____

   Model No. _____ Version No. _____

   ( ) Synchronous, ( ) Induction, ( ) Inverter, ( ) Other_____

   Rating: _____kW : Rating: _____kVA

   Generator Output Voltage: _____Volts

APPENDIX I – APPLICATION FORM – 25 kVA Units or less (continued)

8. Has the generating system you are installing been Type Tested? (See Appendix VI of the main document for Type Testing Requirements).

_____ _____
Yes No

If Yes, please attach your generation equipment certificate for each certified generation package. If No, more discussion will be needed and this may require additional requirements being imposed. This will delay Application Processing and also final paralleling agreement.

9. Does the proposed generating system meet the Power Quality Requirements described in Appendix V of the main document?

_____ _____
Yes No

If yes, furnish details. If you do not know the answer, it is recommended you contact the equipment manufacturer for the answer and provide the same with the completed Application. Detroit Edison cannot let generators with power quality issues be interconnected to its grid.

10. Do you plan to export to the Detroit Edison Distribution System?

_____ _____
Yes No

If yes, indicate the estimated net annual export in kWhr _____

11. Does your unit shutdown automatically within 2 seconds after isolation from the Detroit Edison grid?

_____ _____
Yes No

If yes, furnish details, If no, additional schematics may be needed.

Signature:

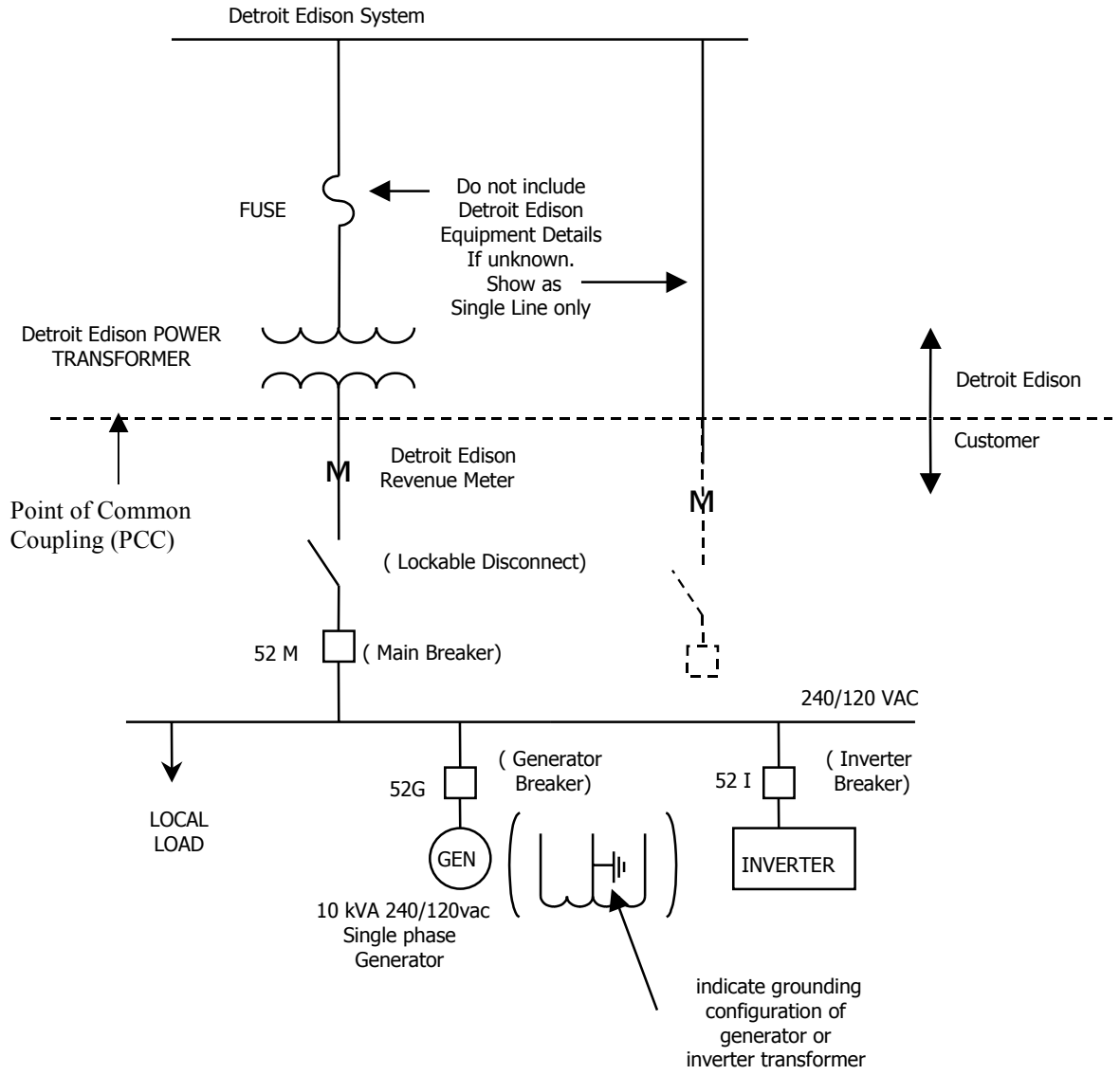
_____ _____ _____
CUSTOMER SIGNATURE TITLE DATE

APPENDIX I – SAMPLE ONE LINE DIAGRAM (25 kVA Units or less)

Detroit Edison

Figure 2 A

TYPICAL ONE-LINE DIAGRAM
FOR SINGLE PHASE GENERATION UNDER 25KVA



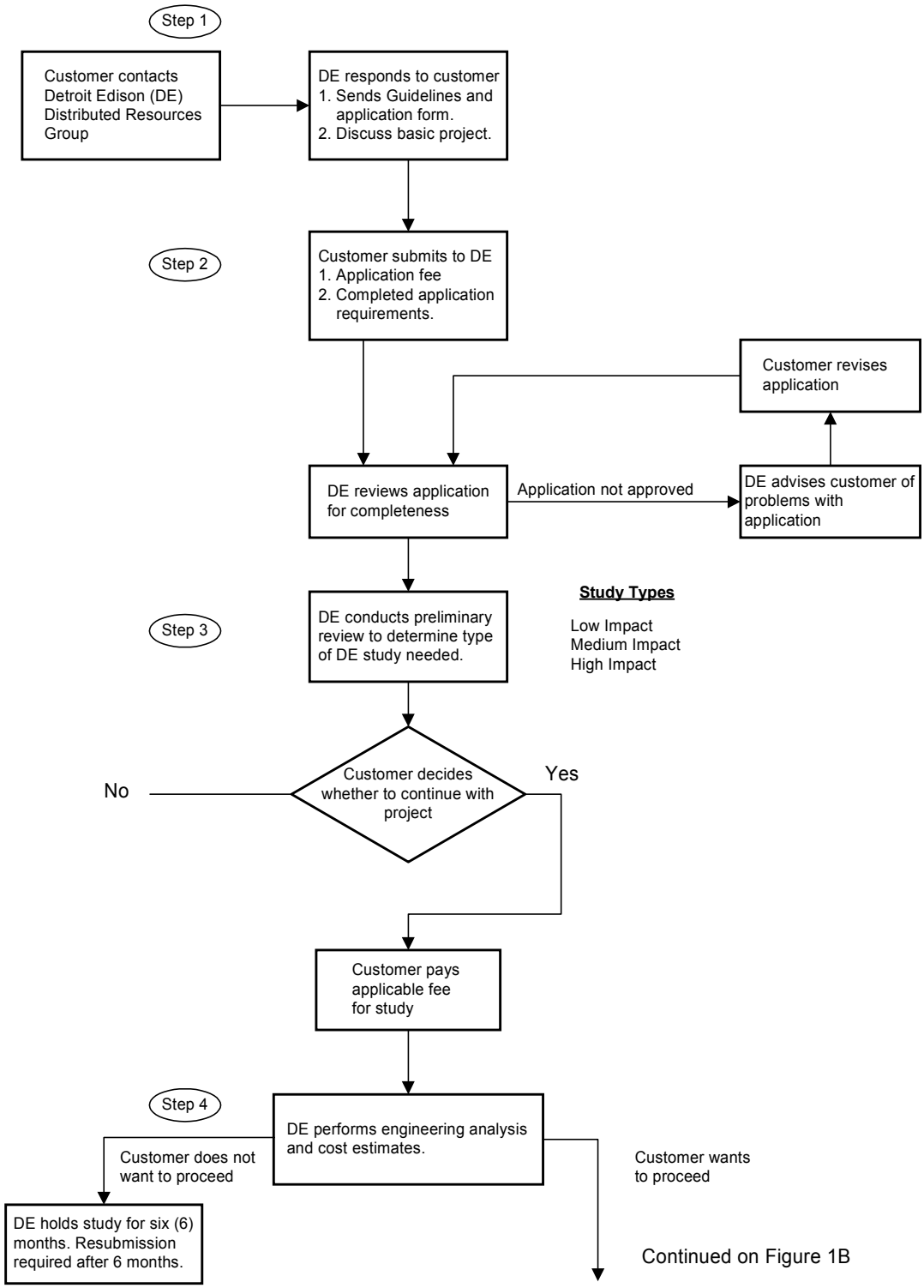
APPENDIX II

DISTRIBUTED GENERATION INTERCONNECTION GUIDELINES

UNITS GREATER THAN 25 kVA

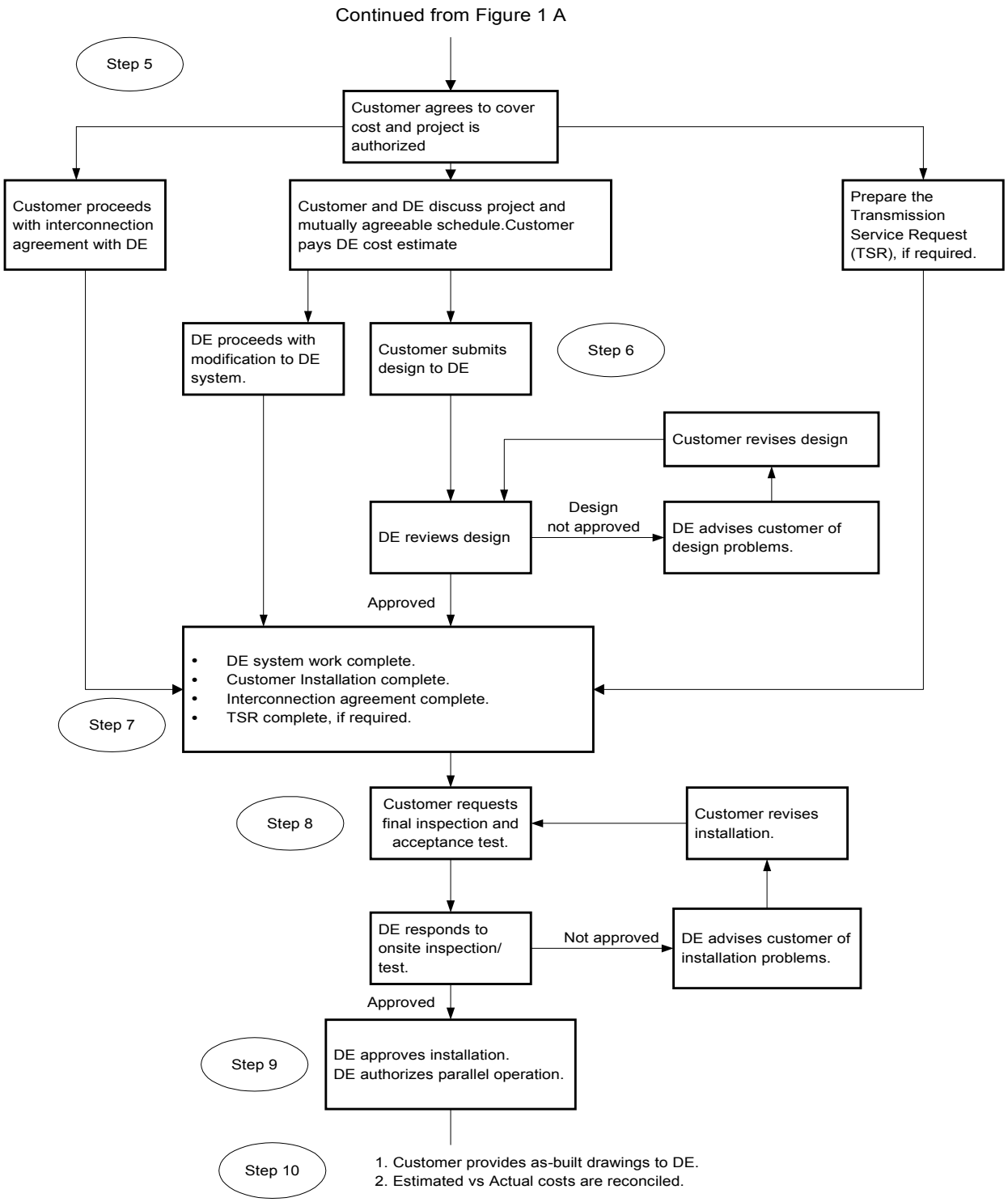
APPENDIX II - APPLICATION PROCESS (Units greater than 25 kVA)

Application Process - Figure 1A.
DG Units greater than 25 kVA



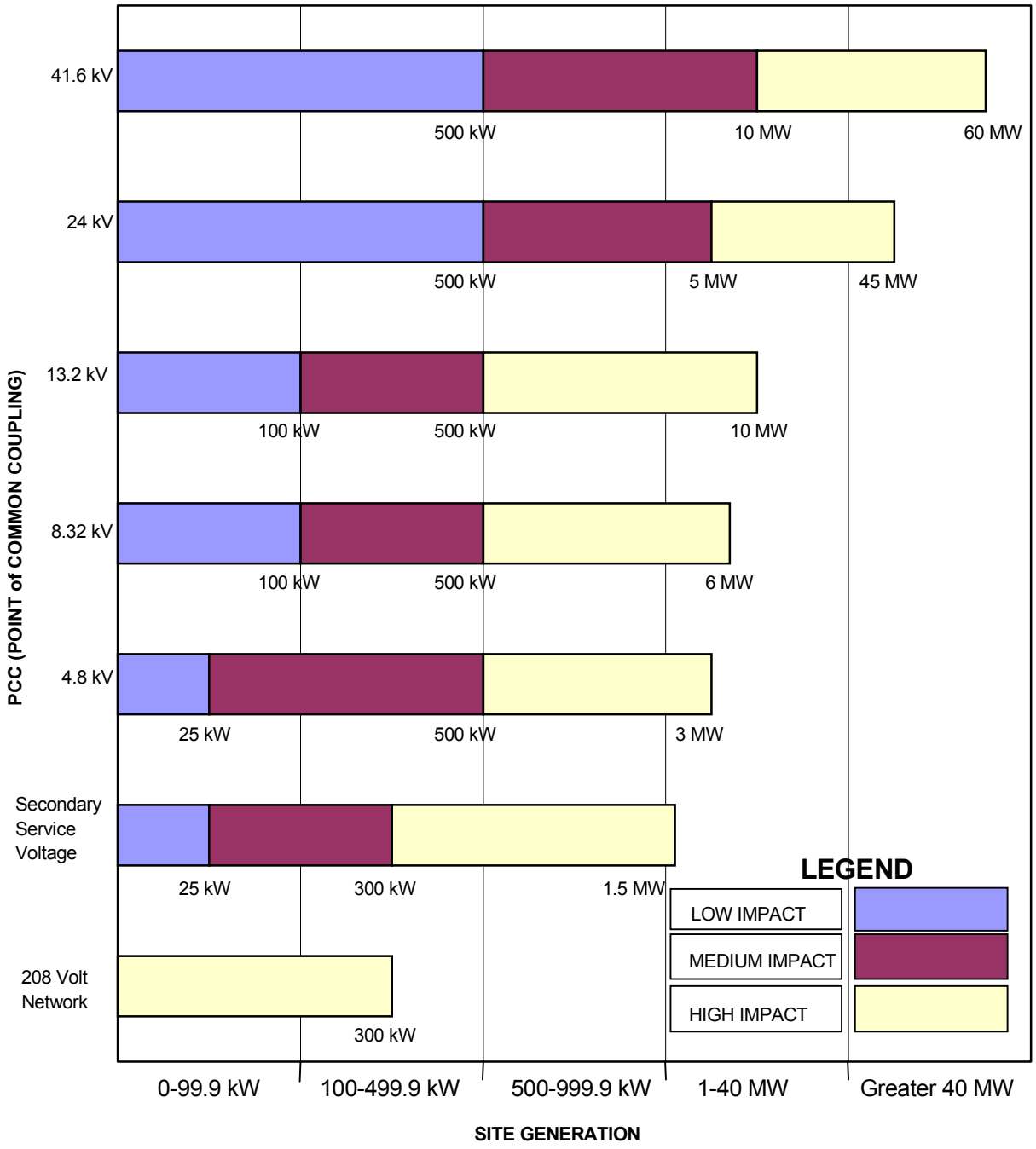
APPENDIX II - APPLICATION PROCESS (Units greater than 25 kVA)

Application Process - Figure 1B.
DG Units greater than 25 kVA



APPENDIX II – APPLICATION PROCESS

Figure 2. GUIDELINES FOR ESTIMATING STUDY TYPE



This illustration is for informational purposes only. The actual impact depends on many factors including PCC (point of common coupling) and will be determined during the application review process.

APPENDIX II – APPLICATION PROCESS DESCRIPTION (Units greater than 25 kVA)

Process Description

Following is the detailed description of the Process Flow chart depicted in Figures 1A and 1B.

STEP 1 – Initial Communication from Customer

The initial communication will be made with the Detroit Edison, Distributed Resources (DR) Group. The DR coordinator or representative will serve as a single point of contact for any interconnection of generation to the distribution system. The response will include items such as application form, contract and technical requirements, application fee information, etc. The initial response (general) to this inquiry will generally be provided within two to three business days. Applications received after 1500 hours will be earmarked as received the following day.
See attached Application Form and Design Data Questionnaire for other technical details that need to be furnished.

Detroit Edison recommends parties contact the company in the early conceptual stages of a project. A Customer performing an initial viability study for a project should include an estimate of interconnection costs to be incurred for modification to the Detroit Edison System. For those Customers that desire a "rough cut" analysis and ballpark cost estimate for the interconnection, Detroit Edison will perform an initial feasibility study for a nominal cost.

STEP 2 – Potential Customer Files an Application

The potential Customer files an application. The filing must include a completed application form, including the information requested in the Detroit Edison Guidelines, and a non-refundable application fee. (see Applicable Fees and Charges Section under General Information for the amount of the Application Fee). The check for the Application Fee will be made out to Detroit Edison and sent to the Distributed Resources Coordinator. Typically, within five business days of receiving the application, Detroit Edison will notify the Customer of receipt and whether the application has been completed adequately. Several exchanges of information between Detroit Edison and the Customer might occur until the application has been completed according to the Detroit Edison's technical requirements for interconnection.

STEP 3 – Detroit Edison Determines Type of Study

After the application is satisfactorily completed, Detroit Edison will conduct a preliminary review to determine what type of study may be required (See Application Process - Figure 2 for guidance). The type of study that may be needed is based on many factors, such as the gross generation being added, the voltage level, the location in the distribution circuit where it will be added, commonly known as Point of Common Coupling (PCC), etc. Typically, a low impact study is defined as a study that will not require any or only minimal modification to the Detroit Edison System. Medium and High Impact studies are studies that will likely show the need for some modifications to the Detroit Edison System and potentially the transmission system. This determination can take anywhere from 5 - 20 business days. Typically a low impact determination would be around 5 days and a high impact could be 20 days. Detroit Edison will also determine the associated cost for such a study and inform the Customer of the same.

APPENDIX II – APPLICATION PROCESS DESCRIPTION (Units greater than 25 kVA)

STEP 3 – Detroit Edison Determines Type of Study (continued)

At this stage, if the Customer wants to proceed further, the necessary payment for the study fee will be made to Detroit Edison and submitted to the DR coordinator. Otherwise, the Application Process will be deemed terminated at that point in time.

STEP 4 – Detroit Edison Initiates an Interconnection Review and develops a Cost Estimate

After receipt of the study fee, Detroit Edison will initiate a Coordinated Interconnection Review and inform the Customer of Detroit Edison's necessary system additions/modifications and of the contractual requirements for interconnection. Detroit Edison will provide the Customer with a written assessment of the technical feasibility of the proposed interconnection, a preliminary schedule, and a good-faith, detailed estimate of the interconnection costs (see note below). Contract elements might include a parallel interconnection agreement, Transmission Service Request (TSR) if needed, coverage of interconnection costs, agreement to tariff conditions, requirements for design, insurance, and O&M specifications. A full coordinated interconnection review will not be required in all instances e.g., low impact situations. This process will typically take anywhere from 10 to 40 days. The low impact study should typically take 10 days and the high impact around 40 days.

A full Coordinated Interconnection Review may need to be performed by Detroit Edison to determine if the generation on the circuit results in any relay coordination, fault current, and/or voltage regulation problems.

Note: These costs include but are not limited to: Detroit Edison System and Transmission System (if required) modifications necessary to accommodate the power source, engineering work and evaluations including preparation of operating specifications, metering modifications, purchase and installation of any required additional Detroit Edison equipment, and administration. In addition, the Customer shall pay an annual charge based on a percentage of the capital cost to cover property taxes, operation, and maintenance expenses. This charge is established by the appropriate tariff or contract. It would not be equitable to recover the additional cost to accommodate the generator from all customers.

If the Customer decides not to proceed, Detroit Edison will hold the study for a period of six months. If the Customer decides to proceed with the application after six months, a new application will have to be submitted to Detroit Edison.

STEP 5 - Customer Commits to Proceed with Installation

If the Customer wants to proceed with the installation the following steps must be completed:

- Execute an interconnection agreement and enter into a contract for the applicable tariff requirements with Detroit Edison. The interconnect agreement, specifies the rights and obligations of the Customer and Detroit Edison.

APPENDIX II – APPLICATION PROCESS DESCRIPTION (Units greater than 25 kVA)

STEP 5 - Customer Commits to Proceed with Installation (continued)

It discusses the applicable tariffs, insurance requirements and other details of the interconnection requirements.

- Provide an advance payment for the estimated costs associated with system modifications, metering, and on-site verification. (Estimated costs will be reconciled with actual costs as described in Step 10).

- Submit a detailed design package.

- Confirm with Detroit Edison a mutually agreeable schedule for the project based on the Customer's work plans.

If the Customer's generation requires the use of the transmission system, then the Customer will need to apply for a Transmission Service Request (TSR) through the applicable transmission provider. The transmission service agreement is totally independent of any system studies and the Detroit Edison Interconnect Agreement. Transmission service is provided by legal entities other than Detroit Edison.

STEP 6 - Detroit Edison Commences Review of Customer's Design Package

Detroit Edison will:

- Conduct a review of the design package to ensure that the plans/design satisfy the technical requirements for interconnection. It may take several exchanges of information between Detroit Edison and the Customer until the design package has been completed according to the Detroit Edison's technical requirements for interconnection.

- Upon completion of the review, notify the Customer of its final acceptance of the Customer's design or an explanation of the technical requirements the design fails to meet. In addition, this notice will include any site-specific test requirements as described in Design Requirements (section 3) of this document.

For type-tested systems, Detroit Edison will complete its review within four weeks after the receipt of a complete design package. Non-type-tested systems may require more time. See Installation and Testing (Section 4) of this document for the definition of Type Tested Systems.

APPENDIX II – APPLICATION PROCESS DESCRIPTION (Units greater than 25 kVA)

STEP 7 - Project Construction

The Customer will build the facility in accordance with Detroit Edison's accepted design practices. Detroit Edison will commence construction/installation of system modifications and metering requirements. Detroit Edison System modifications will vary in construction time depending on the scope of work, equipment required and other factors. The schedule for this work is to be discussed with the Customer in STEP 5.

STEP 8 - The Customer's Facility is Tested in Accordance With the Detroit Edison's Technical Requirements

Before the Customer informs Detroit Edison of the readiness of the facility for testing, the following items must be completed:

1. Execute an interconnection agreement and commit in writing to the applicable tariff requirements with Detroit Edison.
2. If necessary, TSR agreement completed and executed.
3. System modifications complete.
4. Customer's installation complete.

The Customer will develop a written testing plan to be submitted to Detroit Edison for review and acceptance. This testing plan will be designed to verify compliance of the facility with Detroit Edison's accepted drawings and details of the interconnection. The final testing will include testing in accordance with the interconnection agreement requirements and the site-specific requirements identified by Detroit Edison in STEP 6. The final testing will be conducted at a mutually agreeable time, and Detroit Edison shall be provided a notice of at least ten working days prior to witnessing the tests.

Should Detroit Edison find problems with Customer installation or testing, the Customer shall correct the same before Detroit Edison will authorize parallel operation.

STEP 9 - Interconnection

Detroit Edison will review the results of its on-site verification tests in STEP 8 and if acceptable, will issue the Customer a formal letter of acceptance for interconnection.

STEP 10 - Final Acceptance and Detroit Edison Cost Reconciliation

Within a reasonable time after interconnection:

- The Customer will provide the As Built Drawings to Detroit Edison.
- Detroit Edison will reconcile its actual costs related to the Customer's project against the advance payments made by the Customer. The Customer will receive either a bill for any balance due or a reimbursement for overpayment as determined by Detroit Edison's reconciliation.

APPENDIX II – APPLICATION FORM – Units greater than 25 kVA

Application for Interconnection to Detroit Edison System (Generation > 25 kVA)

Application # _____DE, Date Received: _____

The following information is required for all generation that is greater than 25 kVA. **An Application Fee of $ _____ must accompany all completed Applications prior to Detroit Edison commencing the Initial Review.**

1. **Customer:**
   Name: _____ Phone: (___)_____
   Address: _____ Municipality: _____
   _____

2. **Location of New Generation Facilities:**
   (include address if different from customer address)
   _____

3. **Consulting Engineer or Contractor:**
   Name: _____ Phone: (___)_____
   Address: _____
   _____

4. **Estimated In-Service Date: _____**

5. Furnish one copy of the one line diagram and facility drawing. Typically, the following information on system components is required on the one-line diagram. Not all information may be pertinent to any particular generation addition.
   - Circuit Breakers - Rating, location and normal operating status (open or closed)
   - Buses - Operating voltage
   - Capacitors - Size of bank
   - Current Transformers - Overall ratio, connected ratio
   - Fused load break switches - Type, fuse size, normal operating status
   - Generators - Size, location, type, method of grounding
   - Grounding Resistors - Size (ohms)
   - Potential Transformers - Ratio, connection, rating in kVA
   - Power Transformers - Size, location, impedance, voltage ratings, primary and secondary connections and method of grounding
   - Reactors - Ohms/phase
   - Relays - Types, quantity, IEEE device number (Std C37.2), operator lines indicating the device initiated by the relays.
   - Switches - Location and normal operating status (open or closed)
   - Protective Tagging Points - Location, identification

   The facility drawing will show the physical layout of the equipment shown on the one line drawing, including the location of the proposed connection to Detroit Edison System.

APPENDIX II – APPLICATION FORM - Units greater than 25 kVA (continued)

6. Prime Mover Information:

- Indicate type of prime mover ( )IC engine ( ) Fuel cell ( )Microturbine ( )Steam Turbine ( )Hydro ( )Wind ( ) PV
- If other, please describe.
- Manufacturer: _____
- Model No. _____ Version No. _____
- Rated HP/Max. HP_____ Gross kVA/Net kVA _____
- Inertia Constant_____
- Governor Control Freq. Response_____ or Governor Control Load Response _____

7. Generator/Inverter Information:

Manufacturer: _____

Model No. _____ Version No. _____

( ) Synchronous, ( ) Induction, ( ) Inverter, ( ) Single Phase, ( ) Three Phase

Rating: _____kW Rating: _____kVA

Generator Output Voltage: _____Volts

Fill out the attached **Design Data Questionnaire**. **Part I**, if a dedicated transformer is used; **Part II**, for Synchronous generators; **Part III**, for Induction generators; and **Part IV**, for Inverters.

8. What is the power factor range? _____ _____. Is this range adjustable? _____ _____
Min Max Yes No

Note: Paralleling with Detroit Edison System requires units to operate in power factor regulation mode (not in voltage regulation mode).

9. Has the generating system you are installing been type tested by any recognized National Lab?

_____ _____
Yes No

If yes, please attach your generation equipment certificate for each certified generation package**.**

10. Do you plan to operate your unit in parallel with Detroit Edison? _____ _____
Yes No

If you answered No, but expect momentary paralleling, provide documentation that the momentary paralleling operation will be less than 100 msec. If you answered Yes, please complete the remaining application.

APPENDIX II – APPLICATION FORM - Units greater than 25 kVA (continued)

11. Do you plan to export to the Detroit Edison Distribution System? _____ Yes _____ No

If yes, indicate the estimated net annual export in kWhr _____
Note 1: For non-export conditions, under power relay is required.
Note 2: If incidental export could occur, then all the following conditions must be met:

- Aggregate DG capacity must be ≤ 25% of nominal Customer Load.
- DG must be certified as non-islanding.
- Total DG capacity must be ≤ 50% of the transformer rating (not required if primary service is provided by Detroit Edison.)

12. How will this generation be utilized?

_____	_____	_____	_____	_____	Furnish Details
Peak Shaving	Prime Power (base load)	Load Following	Demand Management	Combined Heat & Power	Other

13. Is Grid Power required to start the DG? _____ Yes _____ No

If yes, what is the inrush current? _____ ; What is the continuous rating of your equipment?_____

14. What is the short circuit contribution of the proposed DG system?

At the Generator Terminals: _____ Amps. At the point of common coupling: _____ Amps.

15. Is this DG on a secondary network system? _____ Yes _____ No

16. Is the proposed DG system connected to the Distribution System through a transformer shared by other customers?

_____ Yes _____ No

If yes, what is the interrupting rating of the other customer's service panel? _____ Amps.

17. Is a Dedicated Transformer proposed for this DG addition? _____ Yes _____ No

If yes, fill out part I of the attached Design Data Questionnaire.
Detroit Edison, upon review, may require a Dedicated Transformer.

APPENDIX II – APPLICATION FORM - Units greater than 25 kVA (continued)

18. The following attachments must accompany the Application:

- Description of operations.
- Description of the proposed protection schemes.
- Maintenance plans for the interconnection interrupting devices and interconnection protective devices.

Signature:

_____ _____ _____

CUSTOMER SIGNATURE TITLE DATE

APPENDIX II – DESIGN DATA QUESTIONNAIRE

Customer Owned Generation Design Data Questionnaire

Part I – Transformer Parameters

1. Manufacturer . . . . . _____
2. Model/ type . . . . . _____
3. Number of transformers / number of phases _____
4. Rated frequency (Hz) . . . . . _____

	Primary (H)	Secondary (X)	Tertiary (Y)*
5. Rated capacity (kVA)			
6. Rated voltage (kV)			
7. Winding connections			
8. No. of taps ; % per tap			
9. Type of Grounding			
10. BIL (kV)			

	H-X	H-Y	X-Y
11. Percent Z (%)			
12. Zero seq. Z if grounded w/ tertiary (%) . .			
13. X/R ratio			

*if transformer is equipped with tertiary winding

14. Current transformer ratio:
    - Primary . . . . . _____
    - Secondary . . . . . _____
    - Tertiary . . . . . _____
    - Neutral . . . . . _____

15. Surge arrester:
    - Voltage (kV) . . . . . _____
    - Rating . . . . . _____
    - Type . . . . . _____

16. Grounding:
    - Configuration . . . . . _____
    - Impedance . . . . . _____

APPENDIX II – DESIGN DATA QUESTIONNAIRE (continued)

Part II Synchronous Generator Parameters (For Each Unit)

1. Rated capacity (kVA base) . . . . . _____
2. Full load current (amp) . . . . . _____
3. Rated frequency (Hz) . . . . . _____
4. Speed (RPM) . . . . . _____
5. Rated power factor (%) . . . . . _____
6. Rated Voltage:
   - Line to Line (kV) . . . . . _____
   - Line to Ground (kV) . . . . . _____
7. Voltage regulation: (1)
   - Steady State (%) . . . . . _____
   - Transient at full load (%) . . . . . _____
   - Recovery time at full load (sec) . . . . . _____
8. Total Harmonic Distortion into a linear load:
   - Line to Line (%) . . . . . _____
   - Line to Ground (%) . . . . . _____
9. Reactances:
   - Direct Synchronous (P.U.) . . . . . Xd _____
   - Direct Transient (P.U.) . . . . . X'd _____
   - Direct Subtransient (P.U.). . . . . X"d _____
   - Open Circuit Transient Reactance . . . _____
10. Time Constants:
    - Armature (sec) . . . . . Td _____
    - Open Circuit Transient Reactance(sec)T'do _____
    - Short Circuit Transient (sec) . . . . . T'd _____
    - Short Circuit Subtransient (sec) . . . . . T"d _____
11. Armature Resistance (ohms/phase) (1) . . _____
12. Inertia Constant: (1)
    - Generator Only (sec) . . . . . H _____
    - Generator + Prime Mover (sec) . . . . . H _____
13. Exciter Information: (1)
    - Type (IEEE designation) . . . . . _____
    - Rated Voltage (volts) . . . . . _____
    - Rated Current (amp) . . . . . _____
    - Regulated or Unregulated . . . . . _____
14. Three Phase Generator connection (delta, wye, grounded, ungrounded) . . . . . _____

(1) Not required for Units less than 40 MVA

APPENDIX II – DESIGN DATA QUESTIONNAIRE (continued)

Part II Synchronous Generator Parameters (For Each Unit) continued:

15. Grounding Resistor:
    Resistance (ohms) . . . . . _____
    Resistor time/current rating (sec/amp) . _____ / _____
16. Grounding Transformer:
    Transformer rating (kVA) . . . . . _____
    Transformer resistance (ohm) . . . . . _____
17. Generator operating curve [2] . . . . . (Include kVAR vs kW capability curve attachment)

(2) Not required for Units less than 1 MVA

APPENDIX II – DESIGN DATA QUESTIONNAIRE (continued)

Part III Induction Generator Parameters

1. Rated capacity (kVA base) . . . . . _____
2. Full load current (amp) . . . . . _____
3. Rated frequency (Hz) . . . . . _____
4. Full load speed (RPM) . . . . . _____
5. Rated power factor (%) . . . . . _____
6. Rated Voltage :
   - Line to Line (kV) . . . . . _____
   - Line to Ground (kV) . . . . . _____
7. Locked rotor current (amp) . . . . . _____
8. Short circuit reactance (P.U.) . . . . . _____
9. Reactive power required: (3)
   - at no load (kVAR) . . . . . _____
   - at full load (kVAR) . . . . . _____
10. Excitation Capacitor Bank data: (3)
    - Rated size (kVAR) . . . . . _____
    - Rated Voltage (volt) . . . . . _____
11. Inrush current if energized at sync. speed (amp) (3) . . _____

(3) Not required for Units less than 100 kVA

APPENDIX II – DESIGN DATA QUESTIONNAIRE (continued)

Part IV Inverter Parameters

1. Frequency (Hz). . . . . _____
2. Rated Output (kVA) . . . . . _____
3. Rated Voltage (volts) . . . . . _____
4. Rated Current (amp) . . . . . _____
5. Commutation type:
   Self/pulse width . . . . . _____
   Line . . . . . _____
6. Harmonic Characteristics:
   Total harmonic voltage distortion (%) . . _____
   Total harmonic current distortion (%) . . _____
7. Fault Current Capability for bolted fault (P.U.) _____
8. Power Factor Regulator Accuracy (%) [3] _____

9. Provide Regulator response curve to 4- 25% step load changes from 0 to 100% load. [3]
10. Provide kW - kVAR capability curve in all quadrants on an attachment [3]
11. Provide Voltage vs Current pullback characteristic on an attachment. [3]

(3) Not required for Units less than 100 kVA

APPENDIX III

DISTRIBUTED GENERATION INTERCONNECTION GUIDELINES

DEFINITION OF TERMS

APPENDIX III – DEFINITION OF TERMS

Acceptance Test for Service

Perform a series of field tests on a newly installed relay scheme to prove its acceptability for service. The sequence of tests includes phasing of current, potential and control circuits; meggering (500V d.c.) and hipotting (1000V a.c.) to verify the quality of insulation of the current, potential and control wiring; confirming the ratio and deriving the saturation characteristics of current transformers; calibrating relays; determining minimum operating levels of auxiliary control relays; and performing functional tests to verify that the relay scheme actually operates as intended and that the proper relay operation indicators (targets) are obtained.

Detroit Edison shall perform such tests only on the relaying and control required for protection of the Detroit Edison System.

Applicant

A customer or entity who intends to apply or has applied to Detroit Edison for interconnection**.**

Area Control Error (ACE)

The mismatch (in megawatts) between generation and load for a particular geographical area. The figure also accounts for interchange agreements with utilities beyond the area boundaries. Automatic generation control attempts to minimize this mismatch. May also contain a component of power to account for frequency adjustment.

Automatic Generation Control (AGC)

Computer control of generation output for a given geographical area. Generation output is raised or lowered to match system load and also to satisfy any interchange agreements with utilities beyond the area boundaries. AGC normally tries to minimize ACE and make maximum use of the most efficient generation.

Automatic Reclosing

Process in which the closing circuit of a circuit breaker is automatically energized by a reclosing relay following a relay-initiated trip. The prime reason for the use of reclosing relays is continuity of service since the majority of faults on overhead circuits are temporary and therefore there is a high probability that an overhead circuit can be successfully reestablished.

Automatic Shutdown

Upon the loss of the Detroit Edison source, the capability to cease generating without manual intervention.

Auxiliary Contacts

Contacts of a power circuit breaker that are separate from the main power contacts of the breaker. Such contacts operate in unison with the power contacts. Circuit breakers are often equipped with “a” auxiliary contacts that are closed when the power contacts are closed and open when the power contacts are open. They are also often equipped with

APPENDIX III – DEFINITION OF TERMS (continued)

"b" contacts that are open when the power contacts are closed and closed when the power contacts are open. Such contacts are used to provide input to protective relay equipment, automatic control equipment, and telemetering equipment.

Communication Channel

Communication path that interconnects two or more locations for the purpose of transmitting electrical signals from one location to another. When provided for protective relaying, the communication channel is used to operate a remote interrupting device.

Communication Link (As used for 24 hour contact with customer-owned generation)

Standard, dial-up, voice grade, telephone equipment.

Customer

Any entity interconnected to the company's utility system for the purpose of receiving or exporting electric power. In this guideline "Customer" is anyone applying to interconnect generation to the Detroit Edison System.

Data Circuit (As used by Detroit Edison SCADA equipment)

A leased, four-wire circuit continuously available for the transmission of data. The circuit differs from a standard voice channel in that it uses two wires (one pair) to send data from the master station computer to the electronic equipment at a remote site and the other two wires (other pair) to send data in the opposite direction. The circuit is specifically conditioned to carry data while voice grade circuits are not so conditioned. Voice grade circuits almost always consist of two wires that form a circuit capable of passing voice in both directions simultaneously.

Dedicated Service Transformer or Dedicated Transformer

A transformer with a secondary winding that serves only one customer.

DG (or Distributed Generation)

An electrical generating facility located at a customer's point of delivery (point of common coupling) of usually 40 MW or less and connected at or below 41.6 kV, which may be connected in parallel operation to the utility system. May include energy storage technologies as well as conventional generation technologies.

Direct Transfer Trip (DTT)

Remote operation of a circuit breaker by means of a communication channel.

Disconnect Switch
A mechanical device used for isolating a circuit or equipment from a source of power.

Distribution Feeder

An electric line operated at or below a voltage of 13.2 kV that serves to deliver power from a utility substation or other supply point to customers.

APPENDIX III – DEFINITION OF TERMS (continued)

Engineering Quality Drawings

Engineering quality drawings are complete, neat, accurate, detailed, easily readable and interpretable drawings produced by either computer graphics or utilizing drafting equipment such as straight edge, template, lettering guide, etc.

Exempt Wholesale Generator (EWG)

An entity determined by FERC to be engaged directly or indirectly, through one or more affiliates as defined in PUCHA Section 2(a)(11)(B), exclusively in the business of owning and/or operating all or part of one or more eligible facilities and selling electric energy at wholesale.

FERC

Federal Energy Regulatory Commission.

Harmonic Distortion

Distortion of the normal sine wave typically caused by nonlinear loads or by inverters.

IEEE

The Institute of Electrical and Electronic Engineers.

Independently Owned Generation (IOG)

Term used to refer to generators operating in parallel with the Detroit Edison System which are not owned and operated by Detroit Edison. The term is also sometimes used to refer to the owners and operators of the independently owned generators.

Independent Power Producer (IPP)

As defined by FERC, a non-qualifying producer of electric energy that is unaffiliated with any franchised utilities in the IPP's market area and that for other reasons lacks significant market power.

Induction Generator

A rotating AC (alternating current) machine which operates above synchronous speed over its range of power output. The faster it is driven above synchronous speed by a prime mover, the more power is available. Excitation is provided by the power system in the form of reactive power (vars). The induction generator normally loses its ability to produce voltage and power output when it is isolated from the utility since it loses its source of excitation.

Industrial Grade Relay

Relay having lesser quality than the utility grade relays used by Detroit Edison to protect its system. Industrial grade relays are designed with a lesser degree of reliability.

APPENDIX III – DEFINITION OF TERMS (continued)

In-rush Current

The current drawn by the DG during startup.

Instantaneous Reclosing

Reclosing process in which the closing circuit of a circuit breaker is automatically energized instantaneously by the reclosing relay following a relay-initiated trip. A common automatic reclosing sequence consists of an instantaneous reclosure followed by two time-delayed reclosures.

Insulator

Insulating material in a form designed to support a conductor (wire) physically and separate it electrically from another conductor or object.

Interconnection

The physical connection of distributed generation to the utility system in accordance with the requirements of this document so that parallel operation can occur.

Interconnection Agreement

The interconnection agreement sets forth the contractual conditions under which a utility and a customer agree that one or more facilities may be interconnected with the utility's distribution system.

Inverter

A machine, device or system that changes direct-current power to alternating-current power [IEEE Std. 100].

Islanding

A condition in which a portion of the utility system that contains both load and distributed generation is isolated from the remainder of the utility system. [Adopted from IEEE 929, draft 9].

kV

kilovolt, a level of voltage equal to one thousand volts.

kW

kilowatt, an amount of power equal to one thousand watts.

MW

Megawatt, an amount of power equal to one million watts.

APPENDIX III – DEFINITION OF TERMS (continued)

Non Sell-Back

A mode of operation in which the generating facility cannot generate power into the Detroit Edison System.

One-Line Diagram

A one-line representation of the three phase electrical system. The one-line diagram required in these Guidelines must indicate those electrical system components (e.g. buses, feeders, transformers and generators) that are necessary to show how the generation is to be paralleled with the Detroit Edison System. The following information on these system components shall appear on the one-line diagram.

- Breakers - Rating, location and normal operating status (open or closed)
- Buses - Operating voltage
- Capacitors - Size of bank
- Current Transformers - Overall ratio, connected ratio
- Fused load break switches - Type, fuse size, normal operating status
- Generators - Size, location, type, method of grounding
- Grounding Resistors - Size (ohms)
- Potential Transformers - Ratio, connection
- Power Transformers - Size, location, impedance, voltage ratings, primary and secondary connections and method of grounding
- Reactors - Ohms/phase
- Relays - Types, quantity, IEEE device number, operator lines indicating the device initiated by the relays.
- Switches - Location and normal operating status (open or closed)
- Tagging Point - Location, identification

The Guidelines make reference to a preliminary one-line and a final one-line. The final one-line must also include information on the relaying and associated current and/or potential transformers that provide protection for the Detroit Edison System. The preliminary one-line may exclude this information since the site specific relaying required to protect the Detroit Edison System will not have been determined as yet.

Out-of-Phase Reclosing

Reclosing a device, such as a breaker or recloser, to parallel two electrical systems when the systems are not in synchronism or in-phase with each other. Such a reclosing can produce high inrush currents and result in high transient shaft torques and mechanical forces on rotating equipment.

Parallel Operation

Mode of operation in which the generation can normally be connected to a bus common with the Detroit Edison System. It is not intended to include operation where there is only a momentary connection between the generation and the Detroit Edison System such as a closed transition go-back of emergency standby generation.

APPENDIX III – DEFINITION OF TERMS (continued)

Point of Common Coupling (PCC)

The point at which the electric utility and the customer interface occurs. Typically, this is the customer side of the utility revenue meter. [Adopted from IEEE 929, draft 9].

Primary Neutral Overcurrent Relay

An over-current relay energized by a current transformer in the neutral of a wye connected primary winding of a transformer. A ground fault on the Detroit Edison System will produce current in the primary neutral which can operate the over-current relay.

Protective Tag

A tag placed on equipment during maintenance and testing. The purpose of a protective tag is the protection of life, by indicating the fact that the piece of equipment to which the tag is attached to Must Not Be Operated.

Protective Tag Location

A location acceptable for the hanging or placement of a Detroit Edison protective tag. Visible breaks such as open switches or open fused cutouts are preferred. Invisible breaks may be used provided they can be properly blocked with Detroit Edison approved devices and tested for back feed.

Qualifying Facility (QF)

As defined by Section 201 of PURPA, a cogenerator or small power producer which meets certain ownership, operating, and efficiency criteria as established by FERC.

Real Time Indication

An indication that is available for use very soon after an actual event. For the purposes of telemetering, real time is normally within 10 seconds of the actual event. A schedule of what generation is planned is not considered a real time indication of the generation. Electronic equipment that provides power flow information which follows any change in generation within 10 seconds of that change is considered to be operating in real time.

Remote Trip Channel

A communication channel to extend relay tripping circuits to remote circuit breaker locations. Initiating relays and control at the Detroit Edison terminal produce transmission of a trip signal over the communication channel. Reception of the trip signal at the remote location results in separation of the generation from the Detroit Edison System.

Reverse Power Scheme

A control circuit consisting of a timing relay initiated from a contact of a directional power relay. The directional power relay is responsive to low levels of power flow so that for power flow in the trip direction, the relay will operate to initiate the timer. The contacts of the timer are connected to trip the appropriate breaker and separate the generation.

APPENDIX III – DEFINITION OF TERMS (continued)

SCADA

An acronym for "Supervisory Control And Data Acquisition". Supervisory control means the remote control of a monitored device; monitoring being provided by the data acquisition (telemetering) equipment. At Detroit Edison the controlled device is typically a circuit breaker. The state of the breaker is monitored by the same SCADA equipment, sometimes referred to as telemetering equipment. Please see section on telemetering.

If the System Supervisor is required to change the state of the breaker, he will initiate the transmission of a digital control message from the computer at the main office to the field equipment at the breaker site. The message is carried by a leased data circuit (essentially the same as two phone lines). The electronic equipment at the breaker site is capable of decoding the message and providing a relay contact operation to initiate operation of the breaker.

Secondary Network

A secondary network consists of two or more utility primary distribution feeder sources electrically tied together on the secondary (or low voltage) side to form one power source for one or more customers. The service is designed to maintain service to the customers even after the loss of one of these primary distribution feeder sources.

Sectionalizing

The use of automatic over-current protective devices on distribution circuits to isolate faults so that the minimum number of customers is out of service. The protective devices usually consist of overhead fuse cutouts, power fuses, reclosers and sectionalizers.

Sell-Back

A mode of operation allowing the generating facility to generate power into the Detroit Edison System.

Switchgear

An enclosed metal assembly containing components for switching, protecting, monitoring and controlling electric power systems [IEEE Std. 100].

Synchronous Generator

A rotating AC (alternating current) machine which maintains a constant speed over its entire range of normal power output. It utilizes a separate DC (direct current) excitation system, independent of the utility source, to produce the magnetic flux required to generate voltage and current.

System Load

The total power flow taken through customer's billing meters. Normally includes system losses. The value is monitored by summing power flow into the system from generators and interconnections.

APPENDIX III – DEFINITION OF TERMS (continued)

System Operation Center

Facility located at the Detroit Edison main office where the SCADA computers and the control room used by the System Supervisors are located.

System Supervisors

Persons working in the System Operation Center's control room who are responsible for operation of the Detroit Edison Electrical System. In other utilities, persons performing similar functions are sometimes called dispatchers or controllers.

Telemetering

Providing the reading, of a measurement, to a site that is remote from a measured quantity. In some applications, the term "telemetering" has meant: "to provide a remote reading by using a signal of D.C. current or A.C. frequency whose level is proportional to the measured quantity". At Detroit Edison the majority of telemetering is accomplished by using digital signals which contain a binary representation of the measured quantity.

Power, current and voltage are measured by transducers that provide a low level D.C. output current which is proportional to the measured quantity. Electronic equipment located at the measuring site converts the D.C. current to a digital message which is transmitted via a telephone line to a computer located at the central office of Detroit Edison. In cases where breaker status information is telemetered, the information is already essentially in digital format, (closed = 0, open = 1 in binary format) and no conversion is required.

The same computer displays the telemetered values, in decimal format, on CRT terminals for the System Supervisors. The values are typically displayed on one-line diagrams which represent the monitored electrical equipment in the field.

Telemetering equipment, that uses digitally encoded messages to transmit data, is typically called SCADA (Supervisory Control And Data Acquisition) equipment. Such equipment is normally equipped with control capability which may or may not be fully implemented at any particular Detroit Edison site.

Type Test

A protection device or system that has been certified by a qualified independent testing laboratory as to meeting the requirements listed in the testing section of this proposal is considered "type-tested". Type-testing will typically be sponsored by equipment manufacturers.

UL

Underwriters Laboratories

Utility Grade Relay

Relay having the same quality as those relays used by Detroit Edison to protect its system. Utility grade relays are designed to provide the highest degree of reliability,

repeatability, longevity, security and calibration accuracy. Such relays meet the performance tests and specifications in ANSI/IEEE Standard C37.90.

Physical characteristics include:

- A draw-out case so the relays can be maintained or replaced without disturbing the connections to the external current, potential and control circuits.
- A steel case to minimize the risk of electromagnetic interference.
- Terminal blocks with 600 volt insulation class.
- Operation indicators or targets that are electromechanical and must be reset manually.

Voice Circuit

Standard, dial-up, voice grade, telephone equipment. Please see communication link and data circuit.

Voltage Flicker

A rapid change in voltage, which may repeat at varying intervals. Various operating equipment can be the cause of flicker. This fluctuating voltage will cause lights to flicker, which may be objectionable to customers. Because of this, flicker limits are established to limit the amount of flicker that one customer can impose upon another, and to inform the customer of these limits prior to the installation of their equipment.

Voltage Restrained Time-Overcurrent Relay

A relay in which the operating value of the over-current unit is a function of the applied voltage. The operating value or pickup is greatest at normal voltage and decreases with lower voltage. The relay is set so that maximum load current will not cause operation with the minimum expected system operating voltage. During fault conditions, the reduced voltage causes less restraint and the relay will operate at a lower current.

Wetting Voltage

A voltage applied to "dry" contacts to provide power/energy in order to drive some function dependent on the state of those contacts. Dry contacts are isolated from ground and any voltage source. Electronic monitoring normally attempts to pass a small current through those contacts to determine if they are open or closed. The wetting voltage is what drives the test current.

Zero Sequence Overvoltage Relay

A voltage relay that responds to the sum of these line-to-neutral voltages on a three-phase circuit. The over-voltage relay is connected across the open corner of an open delta connected secondary winding of a potential transformer and is arranged to provide contact closure when the voltage applied to its coil is in excess of a preset level. The potential transformer that provides the operating voltage is connected grounded-wye primary and broken-delta secondary.

APPENDIX IV

DISTRIBUTED GENERATION INTERCONNECTION GUIDELINES

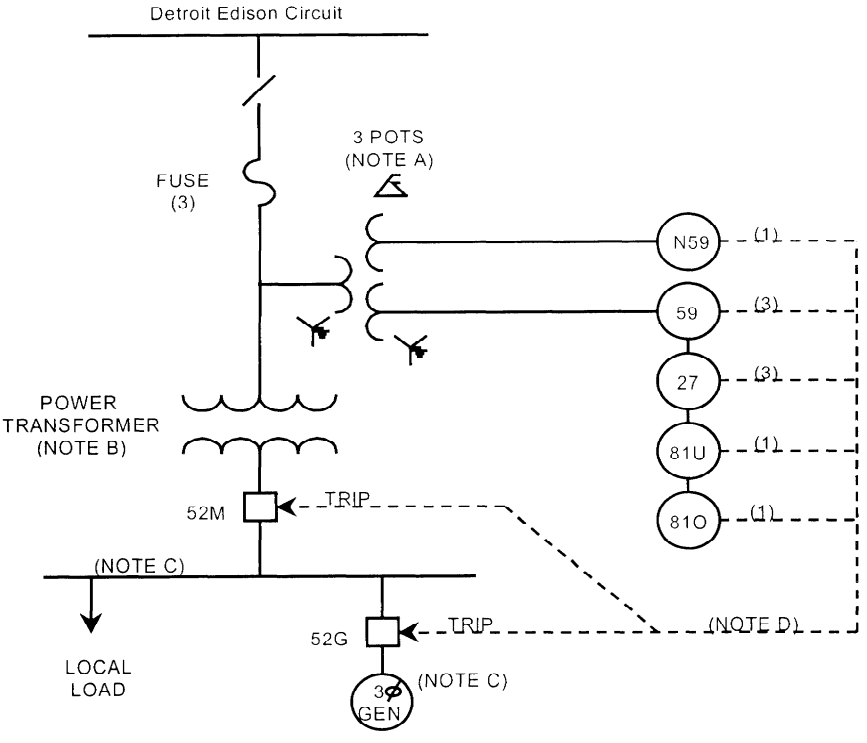
RELAY SPECIFICATIONS

APPENDIX IV – RELAY SPECIFICATIONS

Detroit Edison

ONE-LINE REPRESENTATION
TYPICAL ISOLATION AND FAULT PROTECTION
FOR SELL-BACK INSTALLATIONS

Figure - 1



LEGEND

N59-- ZERO SEQUENCE OVERVOLTAGE (ASSUMING UNGROUNDED PRIMARY ON POWER TRF.)
59 --- OVER VOLTAGE
27 -- UNDERVOLTAGE
81U- UNDERFREQUENCY
810 - OVERFREQUENCY

NOTES

A) LOCATION OF POTENTIAL TRANSFORMERS IS ON THE HIGH SIDE OF THE POWER TRANSFORMER IF AN N59 IS REQUIRED.

B TRANSFORMER CONNECTION AND PRIMARY GROUNDING TO BE APPROVED BY DECo.

C) MAIN BREAKER PROTECTION, GENERATOR PROTECTION AND SYNCHRONIZING EQUIPMENT ARE NOT SHOWN.

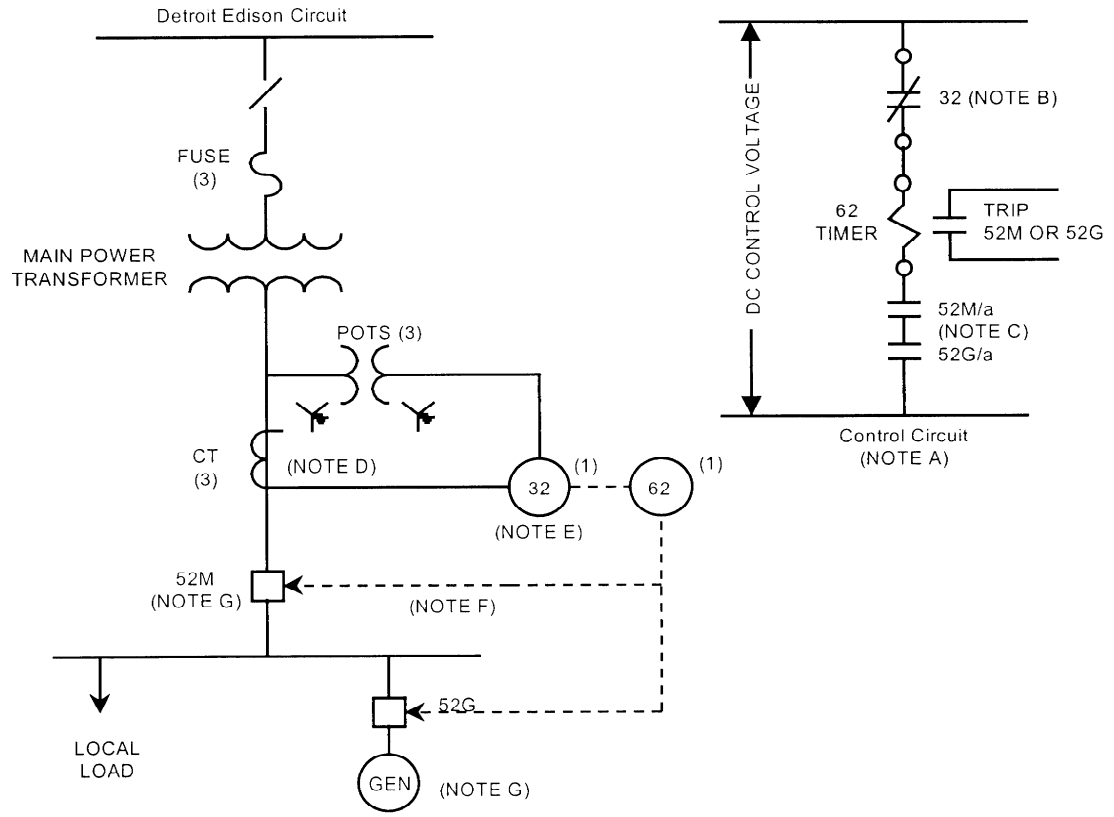
D) TRIP OF EITHER BREAKER IS ACCEPTABLE, DEPENDING UPON WHETHER THE IOG WANTS TO SERVE ITS OWN ISOLATED LOAD AFTER LOSS OF DECo SERVICE. IF GENERATOR IS SYNCHRONOUS , THE FIELD SHOULD ALSO BE TRIPPED.

APPENDIX IV – RELAY SPECIFICATIONS (continued)

Detroit Edison

ONE-LINE DIAGRAM & CONTROL SCHEMATIC:
TYPICAL ISOLATION PROTECTION
FOR NON SELL-BACK INSTALLATIONS

Figure - 2



LEGEND

32 -- REVERSE POWER (NOTE E)
62 -- TIMER FOR 32

NOTES

A) SCHEME TO BE USED ONLY WITH NO NORMAL POWER FLOW TO DECo SYSTEM.

B) CONTACT OF 32 RELAY OPENS FOR MINIMAL POWER FLOW INTO IOG LOAD BUS & CLOSES EITHER FOR POWER FLOW INTO DECo OR NO POWER FLOW INTO THE IOG LOAD BUS.

C) BREAKER AUXILIARY CONTACTS ARE REQUIRED TO INTERLOCK OPERATION.

D) RATIO OF CTS TO BE DETERMINED FOR EACH SPECIFIC CASE.

E) DEVICE 32 MAY BE EITHER THREE PHASE OR THREE SINGLE PHASE RELAYS. TO BE DETERMINED BY DECo.

F) TRIP OF EITHER BREAKER IS ACCEPTABLE.

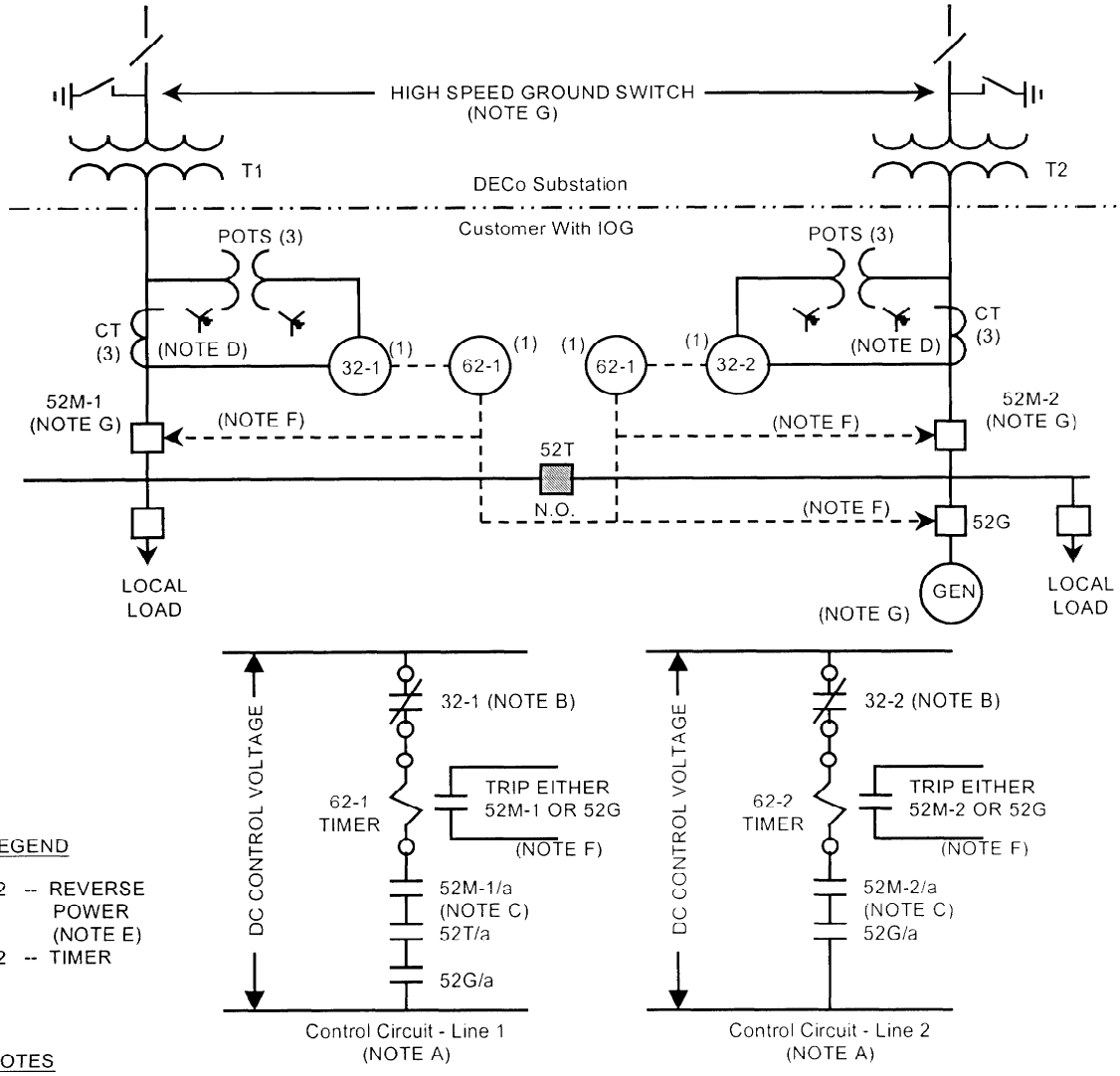
G) MAIN BREAKER PROTECTION, GENERATOR PROTECTION AND SYNCHRONIZING EQUIPMENT ARE NOT SHOWN.

APPENDIX IV – RELAY SPECIFICATIONS (continued)

Detroit Edison

ONE-LINE DIAGRAM & CONTROL SCHEMATIC: TYPICAL
ISOLATION PROTECTION FOR NON SELL-BACK INSTALLATIONS
WHERE CUSTOMER WITH IOG IS SERVED BY DECo SUBSTATION

Figure - 3



LEGEND

32 -- REVERSE POWER (NOTE E)
62 -- TIMER

NOTES

A) SCHEME TO BE USED ONLY WITH NO NORMAL POWER FLOW TO DECo SYSTEM.

B) CONTACT OF 32 RELAY OPENS FOR MINIMAL POWER FLOW INTO IOG LOAD BUS & CLOSES EITHER FOR POWER FLOW INTO DECo OR NO POWER FLOW INTO THE IOG LOAD BUS.

C) BREAKER AUXILIARY CONTACTS ARE REQUIRED TO INTERLOCK OPERATION.

D) RATIO OF CTS TO BE DETERMINED FOR EACH SPECIFIC CASE

E) DEVICE 32 MAY BE EITHER THREE PHASE OR THREE SINGLE PHASE RELAYS. TO BE DETERMINED BY DECo.

F) TRIP OF EITHER BREAKER IS ACCEPTABLE. (MAINS OR GENERATOR). IF THE CUSTOMER HAS AN AUTOMATIC THROWOVER (A.T.O.) SCHEME ON THE MAIN SWITCHGEAR AND TRIPPING OF THE MAINS IS DESIRED, ADDITIONAL RELAYING CONTROL WILL BE REQUIRED IN THE A.T.O. SCHEME

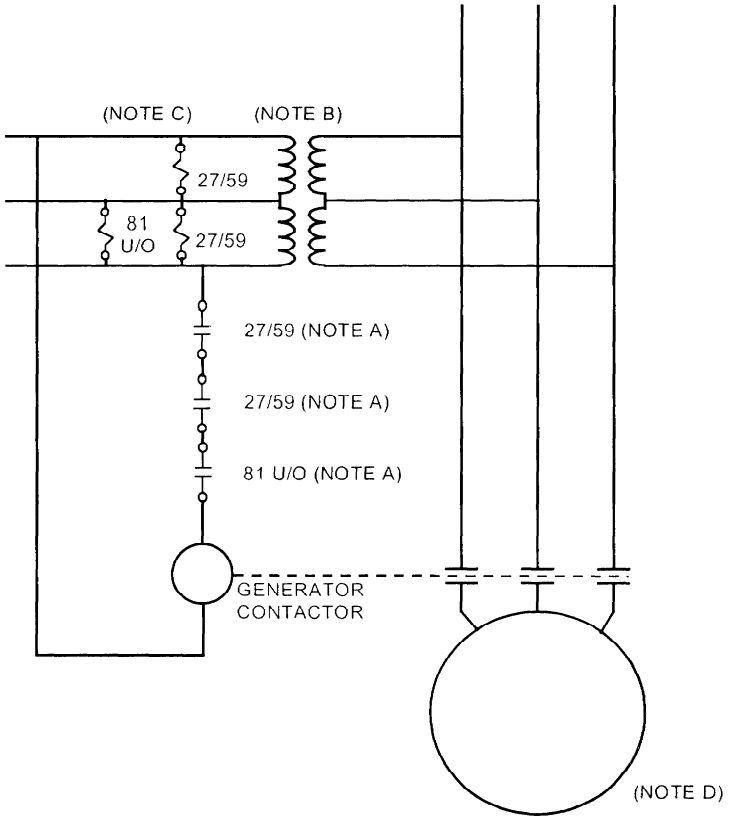
G) MAIN BREAKER PROTECTION, GENERATOR PROTECTION AND SYNCHRONIZING EQUIPMENT ARE NOT SHOWN.

APPENDIX IV – RELAY SPECIFICATIONS (continued)

Detroit Edison

TYPICAL RELAY/CONTACTOR ARRANGEMENT
UTILIZING A.C. CONTROL POWER
FOR SELL-BACK INSTALLATIONS (UNDER 100 KW)

Figure - 4



LEGEND

27/59 -- UNDER/OVERVOLTAGE
81U/O - UNDER/OVERFREQUENCY

NOTES

A) RELAY CONTACTS CLOSED WITH NORMAL VOLTAGE & FREQUENCY

B CONTROL TRANSFORMERS ARE NOT REQUIRED IF SUPPLY VOLTAGE MATCHES RELAY/CONTACTOR VOLTAGE RATING.

C) VOLTAGE & FREQUENCY FUNCTIONS MAY BE PROVIDED IN ONE RELAY

D) GENERATOR PROTECTION AND SYNCHRONIZING EQUIPMENT ARE NOT SHOWN.

APPENDIX IV – RELAY SPECIFICATIONS (continued)

Approved Relays

(For use as protection of the Detroit Edison System at independently owned generation facilities)

UTILITY GRADE
Items

1. • Under & Over/Underfrequency (81U & 81O/U)
   - Basler: BEI-81, BEI-81 O/U
2. • Undervoltaqe (27)
   - General Electric: IAV54
   - ABB: CV-2, CVD*
3. • Overvoltage (59)
   - General Electric: IAV51, PJV
   - ABB: CV-4, SV-1
4. • Zero Sequence Overvoltage (N-59)
   - General Electric: PJV
   - ABB: SV-1
5. • Primary Neutral Overcurrent (N-A51)
   - General Electric: IAC53
   - ABB: CO-8
6. • Voltage Restraint Time Overcurrent (51V).
   - General Electric: IJCV
7. • Reverse Power (32)
   - Basler: BEI-32R* (30 or 10), BEI-32 ON
   - ABB: H3*
8. • Timing (62)
   - General Electric: SAM
   - ABB: TD-5
9. • Transfer Trip
   - RFL Industries Type 6710 Audio Tone Transfer Trip Receiver

INDUSTRIAL GRADE
Items

10. • Reverse Power (32)
    - Basler: BE4-32 (10)*
11. • Timing (62)
    - Agastat: 7000 Series

* Requires separate time delay relay

Note: The exact model or style of the above listed relays will be dependent upon the particular site-specific application, or Detroit Edison specification.

Applicable Referenced Standards

ANSI/IEEE C37.90-1989 IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.

Concern: Devices that adhere to this standard are more likely to operate correctly in a typical environment that will subject the device to overloads, transient over-voltages, and temperatures that can cause less robust devices to fail.

ANSI/IEEE C37.90.2-1989 IEEE Standard Surge Withstand Capability Tests for Protective Relays and Relay Systems.

Concern: Typical transient voltages and currents should not interfere with the correct operation of the interconnection protective devices

ANSI/IEEE C37.90.2-1989 IEEE Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

Concern: Typical radiated electromagnetic interference should not cause miss-operation of the interconnection relays

ANSI/IEEE C37.95-1989 IEEE Guide for Protective Relaying of Utility-Consumer Interconnections.

Note that this standard applies to consumers with and without generation.
Concern: All good engineering practices that apply to Consumers shall apply to IPPs. Coordination of fuses and relays with upstream protective devices on the utility system as is in Clause 9.1 of the standard

IEEE 1547 Standard

References

The following standards shall be used along with IEEE 1547:

IEEE Std C37.13-1990 (R1995) IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures

IEEE Std C37.41-1994 IEEE Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.

APPENDIX IV – RELAY SPECIFICATIONS (continued)

IEEE Std C37.90.1-1989 (R1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

IEEE Std C37.90.2 IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

IEEE Std C62.41-1991 (R1980) IEEE Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.

IEEE Std C62.45-1992 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

IEEE Std C62.92.1-1987 (R2000) IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part 1 - Introduction

IEEE Std C84.1-1995, Electric Power Systems and Equipment - Voltage Ratings (60Hertz)

IEEE Std C37.108-1989 (R1994) IEEE Guide for the Protection of Network Transformers.

IEEE Std 100-1996, IEEE Standard Dictionary of Electrical and Electronic Terms

IEEE Std 386-1995 IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.

IEC 61000-4-15 Electromagnetic compatibility (EMC) - Part 4: Testing and measuring techniques - Section 15: Flickermeter - Functional and design specifications

IEC 61000-3-7 Electromagnetic compatibility (EMC) - Part 3: Limits - Section 7: Assessment of emission limits for fluctuating loads in MV and HV power systems - Basic EMC publication.

UL 98-1994 Standard for Safety for Enclosed and Dead-Front Switches.

UL 363-2000 UL Standard for Safety for Knife Switches

UL 489-9 Standard for Safety for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

UL 1741-2000 Standard for Safety for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems

APPENDIX V

DISTRIBUTED GENERATION INTERCONNECTION GUIDELINES

POWER QUALITY

APPENDIX V – POWER QUALITY

IEEE Standard Power Quality Summarized

IEEE 1547

The requirements of IEEE 1547 are summarized below for convenience. The reader is encouraged to consult the current version of this standard for the complete text describing requirements.

- Voltage fluctuation at the PCC during synchronization is limited to ±5%.
- DC Injection Limits: 0.5% of rated output.
- Voltage Flicker: Cannot cause objectionable flicker to other customers. References to IEEE 519 and IEC Technical Reports IEC 61000-3-7, IEC 61000-4-15, IEC 61400-21.
- Harmonics: Total Harmonic current distortion 5%.
- Immunity Protection: Electromagnetic Interference shall not cause misoperation of the interconnection system.
- Surge Capability: Meet IEEE/ANSI C62.41 and IEEE C37.90.1 for withstanding current and voltage surges.

IEEE 519

The harmonic requirements of IEEE 519 are summarized below for convenience. The reader is encouraged to consult the current version of this standard for the complete text describing requirements.

The objective of IEEE 519 is to limit the maximum individual frequency voltage harmonic to 3% of the fundamental frequency and the voltage Total Harmonic Distortion (THD) to 5% on the Detroit Edison side of the point of common coupling.
In addition, any voltage flicker resulting from the connection of the customer's energy producing equipment to the Detroit Edison System must not exceed the limits defined by the maximum permissible voltage fluctuations border line of visibility curve, Figure 10.3 identified in IEEE 519. This requirement is necessary to minimize the adverse voltage effect upon other customers on the Detroit Edison System.

Voltage Flicker Limits

Distribution Flicker Limits

The normal operating characteristics of equipment such as motors, welders and electric furnaces can cause abrupt changes in supply and voltage. Repetitive abrupt voltage change (fluctuating voltage) is defined as voltage flicker. A fluctuating voltage will cause lights to flicker, which may become objectionable to customers. Because of this, flicker limits are established to limit the amount of flicker one customer can impose upon another, and to inform the customer of these

limits prior to the installation of their equipment. The limits in Table 1.0 will maintain the flicker at an acceptable level for the majority of people.

TABLE 1.0

Distribution Flicker Limits in Volts on a 120 Volt Base							
Location	**Very Infrequent**	**Infrequent**	**Frequent**	**Very Frequent**	**Extremely Frequent**	**Cyclic**	**Residential A/C**
Substation Bus; or Distribution Circuit Primary	10.0	6.0	3.0	2.0	2.0	0.5	3.0
Power Line [1] Primary	10.0	8.0	6.0	4.0	4.0	0.5	-
Distribution [2] Circuit Secondary							
A. Customer Causing Flicker	10.0	6.0	6.0	4.0	3.0	0.5	9.0
B. Customer Not Causing Flicker	10.0	6.0	5.0	3.0	2.0	0.5	6.0
Detroit Edison does not impose flicker limits on customer-owned buses or systems (≤10% recommended).							
1. These limits refer to a power line that serves multiple customers. If the power line serves only one customer, no flicker limitation other than the customer requirements and the limits that apply at the substation bus.							
2. These limits are measured at the customer's metering point.							

Notes and Definitions

Very Infrequent Flicker includes cases occurring once per day or motor starts for storm pumping.

Infrequent Flicker includes cases occurring 6 times or less in 24 hours, but not more than once between 1800 hr. and 2400 hr. This provision is intended to cover apparatus such as motor generators, fans, pumps, etc., which normally run continuously throughout the working day, and capacitors being turned on and off.

Frequent Flicker includes cases occurring not more than 3 times per hour, except that they shall not occur more than once per hour between 1800 hr. and 2400 hr. This provision is intended to

cover apparatus such as machine tools, electric resistance furnaces, etc., which are periodically started and stopped throughout the working day.

Very Frequent Flicker includes cases occurring not more than once per minute on the average and will include all, except rapidly and regularly recurring flickers. This provision is intended to cover such apparatus as elevator motors, automatic pumps, ice machines, etc., which start frequently, but in general are not regularly recurring several times a minute.

Extremely Frequent Flicker includes cases occurring more often than one per minute, but at a rate of less than once per second. This provision is intended to cover such apparatus as flashing signs, spot welders, gravel pit hoists, and certain electric arc furnaces which are frequently and repeatedly stopped and started or have rapidly fluctuating loads during normal cycle use.

Cyclic Flicker includes cases occurring rapidly and regularly at a rate in excess of once per second. This provision is intended to cover such apparatus as seam and pulsation type welders, reciprocating compressors, and certain large electric arc furnaces which exhibit load fluctuations occurring at a cyclic rate. Prior to 1977 cyclic flicker limits were governed by the curve shown in Figure 2.1 on page 70-2-4, titled Cyclic Flicker Limits. Cyclic flicker can be extremely annoying and dependent on the frequency of operation of equipment. In 1997 the cyclic flicker limits were changed to 0.5 volts on a 120 volt base, both for distribution and subtransmission lines.

Residential Air Conditioners are not to exceed four (4) starts per hour.

Subtransmission Flicker Limits

The normal characteristics of industrial equipment such as large motors, welders, and electric furnaces can cause short duration current flow magnitudes on the subtransmission system of several times the steady-state flow. The resultant short duration voltage disturbances are referred to as voltage flicker. The allowable flicker limits on the subtransmission level at the point of common coupling with other customers is defined in Table 2.0.

TABLE 2.0

Subtransmission Flicker Limits in Volts on a 120 Volt Base					
Location	**Infrequent**	**Frequent**	**Very Frequent**	**Extremely Frequent**	**Cyclic**
120 kV Buses	1.0	1.0	1.0	1.0	0.5
120 kV Lines	1.0	1.0	1.0	1.0	0.5
24 or 40 kV Buses	1.5	1.0	1.0	1.0	0.5
24 or 40 kV Lines	3.0	1.5	1.5	1.5	0.5
There are no Detroit Edison imposed flicker limits on customer-owned buses or systems ($\leq$10% recommended).					

APPENDIX VI

DISTRIBUTED GENERATION INTERCONNECTION GUIDELINES

TESTING

APPENDIX VI – TESTING

IEEE Standard Commissioning Tests Summarized

IEEE 1547

The requirements of IEEE 1547 are summarized below for convenience. The reader is encouraged to consult the current version of this standard for the complete text describing requirements.

Protective Function Tests

- Protection settings shall be field verified if they have been changed from settings that were factory tested. Testing will show that the device trips at required voltage and/or frequency values.

- Any anti-islanding functions shall be verified through the operation of a load break isolating device. The interconnected generation should stop energizing its output terminals and will not re-energize until the proper time delay once the switch is closed.

- Any reverse-power function used to prevent islanding shall be tested.

Verification of Final Protective Settings Test

Any protection settings readjusted during the commissioning tests should be checked after the testing is completed to verify that they are at the required settings.

Trip Test

Protective devices that haven't been tested with their associated interrupting devices shall be trip tested to verify that interruption occurs when protective devices operate.

In-service Test

Protective devices not previously tested with associated instrument transformers shall be given an in-service test to verify wiring accuracy, polarity, sensing signals, current and potential transformer ratios, and measuring circuit operation. This test is performed with an energized power system carrying a known current level.

Hardware or Software Changes

Hardware or software changes that could affect the following functions, require a retest:

- Over-voltage and under-voltage
- Over-frequency and under-frequency
- Anti-Islanding function
- Reverse or minimum power function
- Inability to energize a dead line
- Time delay restart after utility system outage
- Fault detection
- Synchronizing controls

APPENDIX VI – TESTING (continued)

Flicker Test

A flicker test for wind powered generation shall be conducted in accordance with IEC 61000-4-15.

Type Test Requirements

The certification must verify that the testing conforms to the applicable portions of IEEE 1547, IEEE 929, and UL 1741. Note that certain portions of the tests may not apply to all units. For example, units designed to continue operation after isolation from the Detroit Edison System by a transfer trip scheme; in this case, the non-islanding tests would not apply.

Detroit Edison is particularly concerned that the type-tested units pass the following tests:

Synchronization

The following values shall be tested as described in the current version of IEEE 1547 and to be within the limits set in the current version of IEEE 1547 at the time of the writing of this document as noted below.

Synchronous Generators

The DG will be prevented from synchronizing to the system for operating values outside of the following:

DG Rating (kVA)	Frequency Difference (Hz)	Voltage Difference (%)	Phase angle difference (degrees)
0-500	0.3	10	20
500-1,500	0.2	5	15
1,500-10,000	0.1	3	10

Induction Generators

- Voltage drop on startup must not exceed power quality limits as noted under Power Quality in Design Requirements (Section 4 of this document).

Static Inverters, non Line-interactive

- Same limits and tests as synchronous generator of like size.

Static Inverters, Line-interactive

- Shall not be capable of contributing more than 120% of the rated current on synchronization to a simulated power source with zero impedance.

APPENDIX VI – TESTING (continued)

Response to Abnormal Voltage and Frequency

The unit must disconnect from the system for the following conditions within the time noted:

Range	Clearing Time		
	All Units	**<30kW**	**>30kW**
Voltage < 50%	0.16 sec		
50% ≤Voltage<88%	2.0 sec		
110%<Voltage<120%	1.0 sec		
Voltage ≥ 120%	0.10 sec		
Frequency > 60.5 Hz	0.16 sec		
Frequency < 59.3 Hz		0.16 sec	0.16 sec and 0.5 sec*
Frequency < 59.0 Hz		0.16 sec	0.5 sec
Frequency < 57.0 Hz	0.16 sec		

*Units greater than 30kW require adjustable time delay and multiple under frequency settings.

Limits of D.C. Injection for Inverters

The inverter shall be tested to verify that the unit injects less than 0.5% DC current based on the rating of the unit.

Harmonic Distortion

The unit shall be tested to verify the total harmonic current distortion at 25%, 50%, 75%, and 100% of rated output is less than 5%.

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

In the matter of, the Commission's own motion of the interconnection of merchant plants with the transmission and distribution systems experimental residential load management of electric utilities.	))))))	Case No. U-12485

PROOF OF SERVICE

STATE OF MICHIGAN)
) ss
COUNTY OF WAYNE)

DORIS J. HILL, being first duly sworn, deposes and says that on the 4th day of May, 2001, a copy of **correspondence** was served upon the parties listed on the attached Service List, a copy of which is attached, by electronic mail and by depositing properly addressed sealed and stamped envelopes into the Unites States mail by first class.

DORIS J. HILL

Subscribed and sworn to before
me this 4th day of May, 2001

CHRISTINA R. JACOBSON
NOTARY PUBLIC WAYNE CO., MI
MY COMMISSION EXPIRES Mar 16, 2005

MPSC Case No: U-12485

SERVICE LIST
(As of May 4, 2001)

MPSC Staff
David Gadaleto
6545 Mercantile Way
Suite 15
Lansing, MI 48911
(517) 241-6680
(517) 482-6937 (Fax)
(e-mail) gadaletod@ag.state.mi.us

Paul Carlson
MPSC Staff
6545 Mercantile Way
P.O. Box 30221
Lansing, MI 48909-7721