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May 7, 2001

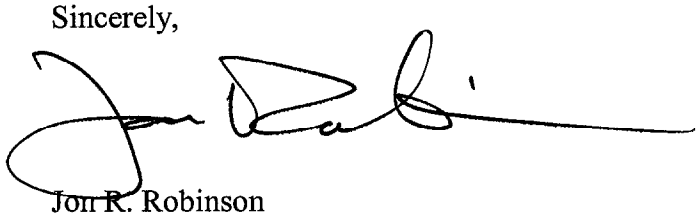
Ms. Dorothy Wideman
Executive Secretary
Michigan Public Service Commission
6545 Mercantile Way
P.O. Box 30221
Lansing, MI 48909

Re: Case No. U-12485

Dear Ms. Wideman:

Enclosed for filing in the above-referenced matter is an original and four copies of "**Consumers Energy Company's Response To The Commission's Order Directing The Filing Of Proposed Generator Interconnection Standards Pursuant To MCL 460.10e**". This document was also filed electronically as part of the Commission's Electronic Filings Program. I have also enclosed a Proof of Service.

Sincerely,



Jon R. Robinson

CC: David M. Gadaleto, Esq.

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STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

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

CONSUMERS ENERGY COMPANY'S RESPONSE TO THE COMMISSION'S ORDER DIRECTING THE FILING OF PROPOSED GENERATOR INTERCONNECTION STANDARDS PURSUANT TO MCL 460.10e

MCL 460.10e was added by 2000 PA 141, and provides in part as follows:

> "(3) The commission shall establish standards for the interconnection of merchant plants with the transmission and distribution systems of electric utilities. The standards shall not require an electric utility to interconnect with generating facilities with a capacity of less than 100 kilowatts for parallel operations. The standards shall be consistent with generally accepted industry practice and guidelines and shall be established to ensure the reliability of electric service and the 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.
>
> "(4) This section does not apply to interconnections or transactions that are subject to the jurisdiction of the federal energy regulatory commission."

On June 19, 2000, the Commission issued an Order commencing a proceeding, docketed as Case No. U-12485, for the purpose of implementing the above section of PA 141. The Commission directed the Staff to prepare a report making recommendations on that implementation. The Staff did prepare such a report, and, on February 5, 2001, the Commission issued a further order which essentially adopted the Staff's recommendations and directed

electric utilities subject to the Commission's jurisdiction to file draft proposed interconnection standards within 90 days. Included in this filing are the proposed interconnection standards of Consumers Energy.

Consumers Energy has attempted to develop standards that will achieve the statutory objectives of meeting industry practices and guidelines, ensuring the reliability of service and ensuring the safety of customers, utility employees and the general public. At the same time, Consumers Energy has attempted to be responsive to the Commission's desire to establish an expeditious procedure for the processing of interconnection requests. The Company notes that the proposed standards have been prepared in recognition of the fact that there are a host of variables that affect the interconnection process, and that most current generator interconnection requests are unique. Each project therefore typically requires individualized study and the design of customized interconnection facilities. Consumers Energy anticipates that, over time, at least smaller generator projects will become more standardized, thereby also allowing the Company to also adopt a more standardized interconnection process.

Consumers Energy has developed interconnection standards that attempt to recognize differences related to the size of the generator, as contemplated by the Commission's February 5, 2001 Order. Specifically, there are different sets of standards for generators below 100 kW, generators between 100 kW and 999 kW, and generators 1 MW and above. Attached are the following documents: Attachment 1 – Generator Interconnection Requirements – Generation Facilities with Aggregate Generator Output Below 100 kW; Attachment 2 – Generator Interconnection Requirements – Generation Facilities with Aggregate Generator Output Between 100 kW and 999 kW; Attachment 3 – Generator Interconnection Requirements – Generation Facilities with Aggregate Generator Output of 1 MW or more; and

Attachment 4 – Generator Interconnection Supplement – To Consumers Energy Generator Interconnection Requirements.

In general, the requirements for interconnecting with smaller generators are less extensive, and interconnection can therefore be achieved more quickly. Each of the sets of standards details the application process, the engineering studies required, the agreements required, along with the technical requirements by generation size and type. Consumers Energy notes that the proposed standards are quite comprehensive, in the sense that they attempt to address conditions and situations that will not apply to all generators. Thus, for some projects, much of the information and requirements set forth in the proposed standards will simply not apply.

An important distinction is made in the proposed standards between "sell-back" generators (i.e., generators that will actually deliver and sell power to the utility), and "non-sell-back" generators (i.e., those that will simply generate power for use on the customer's site). Interconnections with non-sell-back generators are less complex, require less study, and in most instances can be accomplished more quickly. For example, for a non-sell-back generator that is 100 kW or below, a detailed engineering study is not required and Consumers Energy and the customer can, in most cases, move to the stage of executing an Interconnection and Operating Agreement within 15 days of receipt of the customer's interconnection application. The Company can thereafter proceed to construct the necessary interconnection facilities.

Each of the proposed standards contains a flow chart detailing the "Interconnection Process." That flow chart not only identifies the various steps in the process, but also identifies the expected time periods that each step should take. As noted above, the time required to accomplish the necessary steps is less for smaller projects, and increases with the size

and complexity of the generator. Perhaps the most important step is the application that will provide necessary details about the size, type, nature and location of the generator that is proposed to be interconnected to the Company's system. This information is critical to Consumers Energy so that the Company can take the necessary planning and design steps to assure safety and reliability. As would be expected, larger generator units require more data.

Consumers Energy notes that MCL 460.10e(4) indicates that Act 141's requirements do not apply to interconnection or transactions that are subject to the jurisdiction of the Federal Energy Regulatory Commission. The Company believes that there is some considerable lack of clarity regarding the scope of state-federal jurisdiction over generator interconnection standards. Consumers Energy commits to working cooperatively with the Commission to resolve such issues as they arise.

Consumers Energy believes that the proposed standards are consistent with the objectives of PA 141, and with the goals discussed by the Commission in the February 5, 2001 Order. The Company looks forward to continuing to work with the Commission and its Staff in this process.

RESPECTFULLY SUBMITTED,

CONSUMERS ENERGY COMPANY

ATTACHMENT 1

Generator Interconnection Requirements

Generation Facilities with Aggregate Generator Output Below 100 kW

Effective May 1, 2001

INTRODUCTION

This document replaces the Consumers Energy document entitled "*CONSUMERS ENERGY COMPANY INTERCONNECTION REQUIREMENTS FOR GENERATION Effective 09/15/2000",* for purposes of interconnecting generating facilities below 100 kW to the Consumers Energy electric system.

This Generator Interconnection Requirements document contains the process, requirements, and agreements used to add or modify generation projects with aggregate generator output below 100 kW, desiring to operate in parallel with the Consumers Energy electric system. The process is designed to provide an expeditious interconnection to the Consumers Energy electric system that is both safe and reliable.

The term "Generator" will be used throughout this document to refer to the developers, owners, and operators of electric generating equipment interested in operating that equipment in parallel with the Consumers Energy electric system.

Generally, a Non-Sell-Back generating facility will be less complex and faster to interconnect than a Sell-Back generating facility. For Non-Sell-Back, once the Generator provides Consumers Energy an Interconnection Application with data about the generation to be interconnected, and a $400 application fee, an Abbreviated Study may indicate that a Disconnect Switch, Reverse Power Relay, and meter replacement are the only Consumers Energy mandated requirements.

A Sell-Back generating facility will require a detailed Interconnection Study, as well as, further agreements with Consumers Energy and/or the transmission provider, or state or federal licensing, to market the Generator's energy. An interconnection request does not constitute a request for transmission service.

Per Public Act 141 of 2000, subsection 10e(3): "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."

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INTERCONNECTION PROCESS

The Interconnection Process

This section outlines the process for interconnecting generation below 100 kW to the Consumers Energy electric system. This includes both new generation projects and modifications to existing generation projects. The general process is shown in Figure 1.

Interconnection Application

The Generator must first submit an Interconnection Application to Consumers Energy. A blank Interconnection Application can be found in Appendix A. A list of the required interconnection data, depending on the type of generation, can be found in Appendices B and C.

A complete submittal of required interconnection data and application fee of $400 must accompany the application. Consumers Energy will notify the Generator when the application has been received. Consumers Energy will review the completeness of the Interconnection Application and inform the Generator of its status within 5 days of receiving the application. If any portion of the application, data submittal, or application fee is incomplete and/or missing, the unapproved application will be sent back to the Generator with the deficiencies clearly identified.

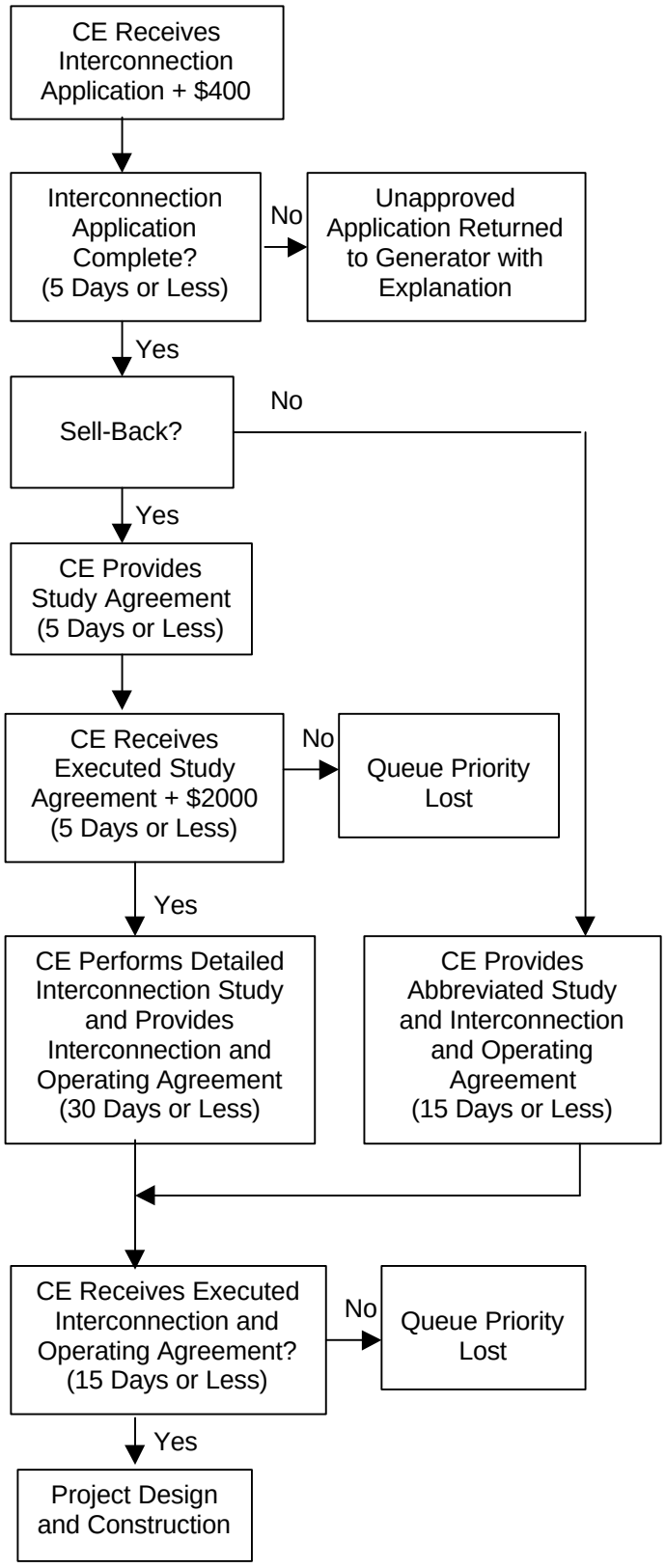
Once Consumers Energy has accepted an Interconnection Application, the generation project is considered in the generator queue. The generation project's position in the generator queue is determined by the date Consumers Energy received the accepted Interconnection Application.

Interconnection Study

Next, Consumers Energy determines if the Interconnection Application requires a detailed Interconnection Study or an Abbreviated Study. Generally, a Non-Sell-Back facility will not require a detailed Interconnection Study.

If a detailed Interconnection Study is required, Consumers Energy will send an Interconnection Study Agreement to the Generator within 5 days

Figure 1: The Interconnection Process



of accepting the Interconnection Application. The Interconnection Study Agreement will require the Generator to pay $2000 for the study. The Generator will have 5 days to sign the Interconnection Study Agreement and return it, with the $2000 study fee, to Consumers Energy. Otherwise, the generation project's queue priority will be lost and the Generator will have to reapply for interconnection service. A sample Interconnection Study Agreement can be found in Appendix D.

Upon receiving a signed Interconnection Study Agreement and study fee within 5 days, Consumers Energy will proceed to complete the detailed Interconnection Study within 30 days. The scope of the Interconnection Study will consist of power flow, short circuit, and relaying analyses. If the study cannot be completed within 30 days, or within the $2000 initial study fee, Consumers Energy will inform the Generator of the reason for, and extent of, the delay or the additional cost.

The outcome of the Interconnection study will be the scope, good faith cost estimates, and project lead times for the Interconnection Facilities and system upgrades required to connect the generation project to the Consumers Energy electric system.

Abbreviated Study

If a detailed Interconnection Study is not required, an Abbreviated Study will be made, and returned along with the Interconnection and Operating Agreement, within 15 days. There is no cost over the initial application fee for the Abbreviated Study.

Interconnection and Operating Agreement

Consumers Energy will submit an Interconnection and Operating Agreement to the Generator in final form at the completion of the Abbreviated Study or the detailed Interconnection Study.

The Interconnection and Operating Agreement shall cover matters customarily addressed in such agreements in accordance with Good Utility Practice, including, without limitation, construction of facilities, system operation, interconnection cost and billing, defaults and remedies, insurance and liability. In accordance with 2000 Michigan Public Act 141, all interconnection costs will be the responsibility of the interconnecting Generator.

The Generator will have 15 days to sign the Interconnection and Operating Agreement and return it to Consumers Energy. Otherwise, the generation project's queue priority will be lost and the Generator will have to reapply for interconnection service.

Project Design and Construction

After the Generator Interconnection and Operating Agreement is executed, Consumers Energy will proceed to acquire right-of-way, procure equipment, and design and construct the Interconnection Facilities.

TECHNICAL REQUIREMENTS

Technical Requirements

The following discussion details the technical requirements for interconnection of generators below 100 kW. Many of these requirements will vary based on the type of generation being used and whether the facility will be Sell-Back or Non-Sell-Back. A few of the requirements will vary based on location of the interconnection (isolated load and available fault current).

Certain requirements must be met to provide compatibility between the generation project equipment and the Consumers Energy electric system, and to assure the safety and reliability of the electric system is not degraded by the interconnection.

Revenue metering is required for settlement purposes for interconnection power and/or for standby power.

Major Component Design Requirements

Data for all major equipment and relaying proposed by the Generator to satisfy the interconnection requirements must be submitted for review and approval by Consumers Energy.

Once installed, the interconnection equipment must be reviewed and approved by Consumers Energy prior to being connected to the Consumers Energy electric system and before Parallel Operation is allowed.

Data
The data that Consumers Energy requires to evaluate the proposed connection is documented on a "fill in the blank" checklist by generator type in Appendices B and C.

A site plan, and electrical one-lines of the generation facilities and the interconnection are required as part of the application data. Control schematics of protective relaying used to isolate faults on the Consumers Energy electric system will be required for the Interconnection Study. In many cases, the generator manufacturer supplied data package will be sufficient.

Isolating Transformer(s)
If an isolating transformer is used, the transformer must comply with the current ANSI Standard C57.12.

The transformer should have voltage taps on the high and/or low voltage windings sufficient to assure satisfactory generator operation over the range of voltage variation expected on the Consumers Energy electric system. Two 2.5% taps above nominal and two 2.5% taps below nominal are typical.

The isolating transformer connections will be determined by the type of generation and electrical location of the interconnection. Allowable connections are detailed in "Specific Requirements by Generator Type".

Circuit Breaker
If a main circuit breaker is used between the generator and the electric system the device must comply with the current ANSI Standard C37.

All circuit breakers must have adequate interrupting capability for the maximum expected short circuit duty. Consumers Energy will provide information identifying the contribution from the electric system to faults at the selected site. The Generator is responsible to perform the short-circuit study to determine if the protective devices can safely interrupt the short-circuit currents.

Main Disconnect Switch
A gang-operated disconnecting device must be located between the generator and the Connection Point and must at all times be accessible to Consumers Energy and be suitable for use by Consumers Energy as a protective tagging location.

The device must comply with the current ANSI Standard C37.

This device shall have a visible open gap and be capable of being locked in the open position.

Interconnection Lines
Any new line construction required for the interconnection will be undertaken by Consumers Energy at the Generator's expense.

TECHNICAL REQUIREMENTS

Relaying Design Requirements

The interconnection relaying design requirements are intended to assure protection of the Consumers Energy electric system. Any additional relaying which may be necessary to protect equipment at the generation facility is solely the responsibility of the Generator to determine, design, and apply.

The relaying requirements will vary based on the type of generation being used and the mode of operation (Sell-Back or Non-Sell-Back).

All relaying proposed by the Generator to satisfy these requirements must be submitted for review and approval by Consumers Energy personnel.

Protective Relaying General Considerations
Industrial Grade relays are acceptable, but Utility Grade Relays are preferred.

If the protective system uses AC power as the control voltage, it must be designed to disconnect the generation from the Consumers Energy electric system if the AC control power is lost.

The relay system must be designed such that the generator is prevented from energizing the Consumers Energy electric system if that system is de-energized.

Momentary Paralleling
For situations where generation will only be operated in parallel with the Consumers Energy electric system for a short duration (less than 1 second), as in a make-before-break automatic transfer scheme, no additional relaying is required. A modern integrated automatic transfer switch (ATS) system incapable of paralleling the generator with the Consumers Energy electric system for more than the time to operate the transfer is required. The ATS must be tested and verified for proper operation every 2 years.

Instrument Transformer Requirements
All relaying must be connected into instrument transformers.

All current connections shall be connected into current transformers (CTs). All CTs shall be rated to provide no more than 5 amperes secondary current for all normal load conditions, and must be designed for relaying use, with an "accuracy class" of at least C50. Current transformers with an accuracy class designation such a T50 are NOT acceptable. For three-phase systems, all three-phases must be equipped with CTs.

All potential connections must be connected into voltage transformers (VTs). For single-phase connections, the VTs shall be provided such that the secondary voltage does not exceed 120 volts for normal operations. For three-phase connections, the VTs shall be provided such that the line-to-line voltage does not exceed 120 volts for normal operation, and both the primary and secondary of the VTs shall be connected for grounded-wye connections.

Direct Transfer Trip (DTT)
DTT is not required for Induction or Inverter-Type generators. DTT is not required for Synchronous generation facilities that will operate in the Non-Sell-Back mode since a simpler and more economic reverse power relay scheme can meet the requirements. For Synchronous Sell-Back generation facilities the need for DTT is determined based on the location of the Connection Point to the Consumers Energy electric system. Consumers Energy requires DTT when the total generation within a protective zone is greater than 50% of the minimum Consumers Energy load that could be isolated along with the generation. This prevents sustained isolated operation of the generation for conditions where generator protective relaying may not otherwise operate (see "Isolated Operation" in the Generator Interconnection Supplement).

Direct transfer trip adds significantly to the cost and complexity of an interconnection. A DTT transmitter is required for each Consumers Energy protective device whose operation could result in sustained isolated operation of the generator. An associated DTT receiver at the generation facility is required for each DTT

transmitter. A phone Data Circuit is required between each transmitter and receiver. Telemetry is required to monitor status of the DTT communication (Telemetry would not otherwise be required for generation less than 100 kW). See "Telemetry and Disturbance Monitoring".

Consumers Energy will provide the receiver(s) that the Generator must install, and will install the transmitter(s) at the appropriate Consumers Energy protective devices at the Generator's expense.

Reverse Power Relaying for Non-Sell-Back
If metering for "Sell-Back" mode is not present, reverse power protection must be provided. The reverse power relaying will detect power flow from the generation facility into the utility system, and operation of the reverse power relaying will separate the generator(s) from the utility system.

Automatic Reclosing
Since most system faults are transient in nature, automatic multiple-shot reclosing has been installed on most of Consumers Energy's circuit breakers and circuit reclosers to increase the reliability of service to its customers. In addition, automatic single-phase overhead reclosers are regularly installed on distribution circuits to isolate faulted segments of these circuits.

In addition to the risk of damage to the generator, an out-of-phase reclosing operation may also present a hazard to the electric system equipment since this equipment may not be rated or built to withstand this type of reclosing.

In some cases recloser settings can be modified to prevent out-of-phase reclosing. This could delay reclosing until the parallel generation is separated and the line is "dead." Hydraulic single-phase overhead recloser settings cannot be modified; therefore, these devices will have to be either replaced with three-phase overhead reclosers whose settings can be changed, or relocated beyond the generator location - depending upon the sectionalizing and protection requirements of the distribution circuit. If the generator can be connected to more than one circuit, these revisions may be required on the alternate circuit(s) as well.

Consumers Energy will determine relaying and control equipment that needs to be installed to protect its own equipment from out-of-phase reclosing. Installation of this protection will be undertaken by Consumers Energy at the Generator's expense.

Single-Phase Fusing
Consumers Energy also installs single-phase fuses on its distribution circuits to increase the reliability of service to its customers. Three-phase generator installations may require replacement of fuses with three-phase circuit breakers or circuit reclosers at the Generator's expense.

TECHNICAL REQUIREMENTS

Specific Requirements by Generator Type

Synchronous Generator Facilities
After IEEE Standard 1547 is passed (anticipated in late 2001), no additional protective relaying is required if the interconnection equipment is listed by an independent listing laboratory (such as Underwriters Labs) to satisfy IEEE 1547 requirements.

If the interconnection equipment is not listed as satisfying IEEE 1547, under/overfrequency relaying and under/overvoltage relaying are required. Each generator must also be equipped with voltage-controlled overcurrent relays to detect faults on the utility system. If the generator is a three-phase generator, the under/overvoltage relaying must be either a three-phase relay or three single-phase relays, and three-phase voltage controlled overcurrent relaying must be provided.

The isolation transformer must be incapable of producing ground fault current to the utility system; any connection except delta primary (generator side), grounded-wye secondary (utility side) is acceptable. The isolation transformer must be protected for internal faults; fuses are acceptable.

Protection for utility system ground faults is required for installations requiring DTT. Ground fault detection will consist of a (59N) ground overvoltage relay. The specific application of this relay will depend on the connection of the isolation transformer:

1. If a delta secondary/grounded-wye primary connection is used, the (59N) relay will be connected into the secondary of a set of three-phase VTs, which will be connected grounded-wye primary, with the secondary connected delta with one corner of the delta left open. The (59N) relay will be connected across this open-corner.

2. If an ungrounded-wye secondary/delta primary connection is used, the (59N) relay will be connected into the secondary of a single VT, which will be connected from the ungrounded-wye neutral of the isolation transformer to ground.

For a sample One-Line Diagram of this type of facility, see Appendix B.

Induction Generator Facilities
After IEEE Standard 1547 is passed (anticipated in late 2001), no additional protective relaying is required if the interconnection equipment is listed by an independent listing laboratory (such as Underwriters Labs) to satisfy IEEE 1547 requirements.

If the interconnection equipment is not listed as satisfying IEEE 1547, under/overfrequency relaying and under/overvoltage relaying are required. If the generator is a three-phase generator, the under/overvoltage relaying must be either a three-phase relay or three single-phase relays.

For three-phase installations, any isolation transformer connection is acceptable. The isolation transformer must be protected for internal faults; fuses are acceptable. No protection for utility system ground faults is required.

For a sample One-Line Diagram of this type of facility, see Appendix B.

Inverter-Type Generator Facilities
No additional protective relaying is required if the interconnection equipment is listed by Underwriters Laboratory as satisfying UL1741 requirements.

If the interconnection equipment is not listed under UL1741, under/overfrequency relaying and under/overvoltage relaying are required. If the Inverter is a three-phase Inverter, the under/overvoltage relaying must be either a three-phase relay or three single-phase relays.

No isolation transformer is required between the generator and the secondary distribution connection. If an isolation transformer is used for three-phase installations, any isolation transformer connection is acceptable. The isolation transformer must be protected for internal faults; fuses are acceptable. No protection for utility system ground faults is required.

For a sample One-Line Diagram of this type of facility, see Appendix C.

TECHNICAL REQUIREMENTS

Relay Setting Criteria
The relay settings as detailed in this section will apply in the vast majority of applications. Consumers Energy will issue relay settings for each individual project that will address the settings for these protective functions. All voltages will be adjusted for the specific VT ratio, and all currents will be adjusted for the specific CT ratio.

Undervoltage Relays
The undervoltage relays will normally be set to trip at 90% of the nominal primary voltage at the relay location, and must reset from a trip condition if the voltage increases to 92% of the nominal primary voltage at the relay location. In order to accommodate variations in this criteria, the trip point of the relays shall be adjustable over a range of 70% of the nominal voltage to 90% of the nominal voltage. The trip time shall not exceed 1.0 seconds at 90% of the relay setting.

Overvoltage Relays
The overvoltage relays will normally be set to trip at 107% of the nominal primary voltage at the relay location, and must reset from a trip condition if the voltage decreases to 105% of the nominal primary voltage at the relay location. In order to accommodate variations in this criteria, the trip point of the relays shall be adjustable over a range of 105% of the nominal voltage to 120% of the nominal voltage. The trip time shall not exceed 1.0 seconds at 110% of the relay setting.

Underfrequency Relays
The Underfrequency relay will normally be set for a trip point of 59.0 Hz, and must trip within 1.0 seconds. Relays with an inverse time characteristic (where the trip time changes with respect to the applied frequency) are not acceptable. These relays must respond reliably for applied source voltages as low as 70% of the nominal voltage.

Overfrequency Relays
The overfrequency relay will normally be set for a trip point of 61.0 Hz, and must trip within 1.0 seconds. Relays with an inverse time characteristic are not acceptable. These relays must respond reliably for applied source voltages as low as 70% of the nominal voltage.

51V Relays – Voltage Controlled Overcurrent Relays
For synchronous generator applications, the (51V) relays must be set to detect any phase faults that may occur between the generator and the nearest three-phase fault clearing device on the utility system. Since these faults may take up to 1-second to detect and isolate, the appropriate saturated direct-axis reactance of the generator will be used depending on its time constants. The settings of this device will consider the relay manufacturer's recommended practice for the type of generator and prime mover (mechanical energy source), and will be determined by Consumers Energy for the specific system application.

59N Relay – Ground Fault Detection
This relay will be applied to detect ground faults on the utility system when the generator facility is connected to a grounded utility system via an ungrounded transformer winding. This relay will be set for a 10% shift in the apparent power system neutral. For an ungrounded wye transformer winding with a single 120 V secondary VT, the setting will usually be 12 Volts. For a delta transformer winding with broken delta 120 V secondary VTs, the setting will usually be 20 Volts. The time delay will normally be 1 second.

51N Relay – Ground Fault Detection
This relay will be applied to detect ground faults on the utility system when the generator facility is connected to a grounded utility system via a grounded-wye transformer winding, and will be connected into a CT in the transformer neutral connection. This relay will be set to detect faults on the directly connected utility system, and the timing will be set to comply with utility practice for overcurrent relay coordination. The CT ratio and specific relay setting will be determined via a fault study performed by Consumers.

32 Relay – Reverse Power
The reverse power relay must be selected such that it can detect a power flow into the utility system of a small fraction of the overall generator capacity. The relay will normally be set near its minimum (most sensitive) setting, and will trip after a 1 second time delay. The delay will avoid unnecessary tripping for momentary conditions.

TECHNICAL REQUIREMENTS

Maintenance and Testing
Consumers Energy reserves the right to test the relaying and control equipment that involves protection of the Consumers Energy electric system whenever Consumers Energy determines a reasonable need for such testing exists.

The Generator is solely responsible for conducting proper periodic maintenance on the generating equipment and its associated control, protective equipment, interrupting devices, and main Disconnect Switch.

The Generator is responsible for the periodic scheduled maintenance on those relays, interrupting devices, control schemes, and batteries that involve the protection of the Consumers Energy electric system. A periodic maintenance program is to be established to test these relays every 2 years. Consumers Energy may request to be present during this testing.

Each routine maintenance check of the relaying equipment shall include both an exact calibration check and an actual trip of the circuit breaker or contactor from the device being tested. For each test, a report shall be maintained on site available for inspection by Consumers Energy for 4 years. The report must indicate the results of the tests made and the "as found" and "as left" relay calibration values. Visually setting, without verification, a calibration dial or tap is not considered an adequate relay calibration check.

In the event there is demonstrated electrical interference (i.e. Voltage Flicker, Harmonic Distortion, etc.) to Consumers Energy's customers, suspected to be caused by the generator, and such interference exceeds then current system standards, Consumer Energy reserves the right, at Consumers Energy's initial expense, to install special test equipment as may be required to perform a disturbance analysis and monitor the operation and control of the generator to evaluate the quality of power produced by the generator. In the event that no standards exist, then the applicable tariffs and rules governing electric service shall apply. If the generator is proven to be the source of the interference, and that interference exceeds Consumers Energy's standards or the generally accepted industry standards, then it shall be the responsibility of the Generator to eliminate the interference problem and to reimburse Consumers Energy for the costs of the disturbance analysis excluding the cost of the meters or other special test equipment

Installation Approval
In the event that Consumers Energy exercises its option to Acceptance Test the proposed Generator relays that protect the Consumers Energy electric system, then Consumers Energy shall communicate the results of that testing to the Generator.

If the generator is not an inverter-type generator, or if an inverter is not certified by UL as specified under "Inverter-Type Generator Facilities", acceptable automatic shutdown upon loss of Consumers Energy's service can be simulated by opening the isolation switch while the generator is operating. Voltage across the Generator side of the isolation switch is to be measured and must be observed to reduce to zero within 2 seconds after isolation. The test is to be conducted with the generation as close to its full output as possible. Final approval for an installation requiring this automatic shutdown test shall not be given until the test has been performed or witnessed by Consumers Energy personnel and an automatic shutdown observed.

Prior to final approval for Parallel Operation, Consumers Energy's specified relay calibration settings shall be applied and an Acceptance Test for Service must be performed on the Generator relaying and control equipment that involves the protection of the Consumers Energy electric system. The Acceptance Test for Service must be witnessed by Consumers Energy and can be performed by Consumers Energy at the Generator's request. Upon satisfactory completion of this test and final inspection, Consumers Energy will provide written permission for Parallel Operation. If the results are unsatisfactory, Consumers Energy will provide written communication of these results to the Generator.

In the event the Generator submits a description of proposed revisions to the approved relaying and control equipment used to protect the Consumers Energy electric system, Consumers Energy shall either approve the Generator's amended relaying and control equipment or provide written communication to the Generator with a clear statement as to why they are not approved.

TECHNICAL REQUIREMENTS

Telemetry and Disturbance Monitoring Requirements

While disturbance monitoring is not required by Consumers Energy for generation facilities less than 100 kW, Consumer Energy recommends the Generator install a simple sequence of events recorder to facilitate investigation should an operational problem occur.

Telemetry is only required for generation facilities less than 100 kW when Direct Transfer Trip is required (see "Direct Transfer Trip").

When telemetry is required, the Generator shall provide a suitable indoor location, approved by Consumers Energy, for Consumers Energy's owned, operated, and maintained Remote Terminal Unit (RTU). The location must be equipped with a 48 V or 125 V DC power supply. The Generator must provide a properly protected phone Data Circuit and telephone board to be connected to the Consumers Energy RTU.

The following values will be telemetered:

1. The status (normal/fail) of protective relay Communication Channels. A status indication of "FAIL" indicates the Communication Channel used for relaying (i.e. transfer trip) is unable to per form its protective function.

2. The status (open/closed) of the main isolating breaker and each generating unit breaker (if the generation facility is composed of multiple units, a single logical (OR) status of the individual generator breaker states, indicating all generator breakers are open or any one or more generator breakers are closed, is permissible). A closed status would be indicated if any individual generator is on line.

Telemetry, when required, will be provided by Consumers Energy at the Generator's expense. In addition to other telemetry costs, a one-time charge will be assessed to the Generator for equipment and software installed at Consumers Energy's System Control Center to process the data signals.

Miscellaneous Operational Requirements

Miscellaneous requirements include synchronizing equipment for Parallel Operation, reactive requirements, and system stability limitations.

Operating in Parallel
The Generator will be solely responsible for the required synchronizing equipment and for properly synchronizing the generation with the Consumers Energy electric system.

Voltage fluctuation at the Connection Point during synchronizing shall be limited to $\pm$5%.

The Generator will notify Consumers Energy's System Control prior to synchronizing to and prior to scheduled disconnection from the electric system.

Reactive Power Control
Synchronous generators that will operate in the Sell-Back Mode must be dynamically capable of providing 0.90 power factor lagging (delivering reactive power to Consumers Energy) and 0.95 power factor leading (absorbing reactive power from Consumers Energy) at the Connection Point.

Induction and Inverter-Type generators that will operate in the Sell-Back Mode must:

1. Install a var supply source to maintain a 0.90 power factor lagging at the Connection Point; or

2. Provide Consumers Energy with funds for the installation of a var supply source equal to the generator reactive requirement of 0.90 power factor at full output.

There are no interconnection reactive power capability requirements for Synchronous, Induction, and Inverter-Type generators that will operate in the Non-Sell-Back Mode. Existing rate tariffs set forth in Consumers Energy's Standard Rules and Regulations contain power factor adjustments (credits and penalties) based on the power factor of the metered load at these facilities.

TECHNICAL REQUIREMENTS

System Stability and Site Limitations
Protection for unstable generator operation is not required for Induction or Inverter-Type generators. It is not required for Synchronous generation facilities where the Stiffness Ratio is greater than 40. For Synchronous generator facilities with a Stiffness Ratio less than 40, Consumers Energy requires special generator trip schemes or loss of synchronism (out-of-step) relay protection. This type of protection is typically applied at the Connection Point and trips the entire generation facility, if instability is detected, to protect the Consumers Energy electric system and its customers.

The Generator is responsible for evaluating the consequences of unstable generator operation on the equipment at the generation facility, and determining, designing, and applying any relaying which may be necessary to protect that equipment from unstable generator operation. This type of protection is typically applied on individual generators to protect the generator facilities.

Revenue Metering Requirements

Consumers Energy will own, operate, and maintain any required billing metering equipment at the Generator's expense.

The typical Consumers Energy meter will need to be replaced with a ratcheting version for a Non-Sell Back generator.

Special billing metering will be required for generators operating in the Sell-Back Mode. If telemetering is required, the billing metering will be included as part of the telemetering installation. The Generator may need to provide a suitable indoor location, approved by Consumers Energy, for Consumers Energy's owned, operated, and maintained billing metering.

Normally, metering equipment are stock items for Consumers Energy, but there may be times when this equipment will have to be ordered and it may have a substantial delivery time. It is in the best interest of the Generator to contact Consumers Energy early in the design process to avoid any delays in the arrival of the metering equipment.

The Generator shall provide authorized employees and agents of Consumers Energy access to the premises at all reasonable hours to install, turn on, disconnect, inspect, test, read, repair, or remove the metering equipment. The Generator may, at its option, have a representative witness this work.

The metering installations for Sell-Back generation facilities shall be constructed in accordance with the practices, which normally apply to the construction of metering installations for commercial, industrial, or other customers with demand recording equipment.

Consumers Energy shall supply to the Generator the standard detailed specifications and requirements relating to the location, construction, and access of the metering installation and will provide consultation pertaining to the meter installation as required.

Consumers Energy 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. Consumers Energy will endeavor to coordinate the delivery of these materials with the Generator's installation schedule.

The Generator shall provide a mounting surface for the meters, recorders, connection cabinets, a housing for the instrument transformers, a conduit for the conductors between the instrument transformer secondary windings and the meter connection cabinets, and a conduit for the communication links, as required. All of this equipment must meet Consumers Energy's specifications and requirements.

The responsibility for the installation of the equipment is shared between Consumers Energy and the Generator, with the Generator generally installing all of the equipment on its side of the Connection Point, including instrument transformers, cabinets, conduits, and mounting surfaces. Consumers Energy, or its agents, shall install the meters, recorders, and communication links. Consumers Energy will endeavor to coordinate the installation of these items with the Generator's schedule.

TECHNICAL REQUIREMENTS

Specific installation details and responsibilities will be established between Consumers Energy and the Generator in the Interconnection and Operating Agreement.

Telephone Circuits

For Sell-Back generation facilities, a standard Voice Circuit will be required for access ing the billing meters.

If Telemetry is required, a Data Circuit must be installed as specified by the local telephone utility. The circuit must be enclosed in conduit from the RTU to the point of connection to the telephone utility equipment. Wall space must be provided for adjacent mounting, next to the telephone board, of the billing metering panel and a telemetering enclosure. The billing meter panel typically is 60 inches high by 48 inches wide and the telemetering enclosure typically is 24 inches high by 24 inches wide. A clear space of 4.5 feet in front of this equipment is required to permit maintenance and testing. A review of each installation shall be made to determine the location and space requirements most agreeable to Consumers Energy and the Generator.

If DTT is required, a separate Data Circuit must be installed as specified by the local telephone utility for each DTT receiver.

If a Data Circuit is required, a standard Voice Circuit is required during testing to communicate with personnel performing the master station portion of the tests.

Consumers Energy will cooperate to provide utility information necessary for proper installation of the telephone circuits.

The Generator is responsible for ordering and acquiring the telephone circuits required for the generator interconnection. The Generator will assume all installation, operating, and maintenance costs associated with the telephone circuits, including the monthly charges for the telephone lines.

APPENDIX A

INTERCONNECTION APPLICATION

GENERATOR INTERCONNECTION APPLICATION

AGGREGATE GENERATOR OUTPUT BELOW 100 KW

1. The undersigned Generator submits this Generator Interconnection Application and $400 application fee to interconnect a new generating facility to the Consumers Energy Electric System or to increase the capacity of an existing generating facility connected to the Consumers Energy Electric System.

2. A Generator requesting interconnection or an increase in the capacity of an existing generating facility to the Consumers Energy Electric System must provide the following information:

   a. Completed Interconnection Application Data sheet appropriate for the size and type of generating unit(s), as found in Consumers' Generator Interconnection Requirements (Interconnection Application Data sheet, found in Appendix B or C, must be attached to this Interconnection Application).

   b. Description of the equipment configuration and proposed connection one-line diagram (one-line diagram must be attached to this Interconnection Application).

   c. Generator's contact person:
   Name: _____
   Address: _____
   _____
   Phone Number: _____
   Fax Number: _____
   e-mail Address: _____

3. This Generator Interconnection Application shall be directed to the Consumers Energy representative as indicated below:

   Tariff & Settlements Director
   Consumers Energy Company
   1945 West Parnall Road
   Jackson, MI 49201

4. I, the undersigned and authorized representative of the Generator, submit this Generator Interconnection Application and required technical data for Consumers Energy Company's review. I understand that upon acceptance, Consumers Energy shall subsequently provide an Interconnection Study Agreement, if said Interconnection Study is determined to be necessary. The Interconnection Study Agreement will include the Scope of the Interconnection Study. I also understand that I shall be required to furnish certain required technical data as requested by Consumers Energy in support of this study and a $2,000 study fee.

   Authorized Signature: _____

   Printed Name: _____

   Title: _____

   Company Name: _____

   Date: _____

APPENDIX B

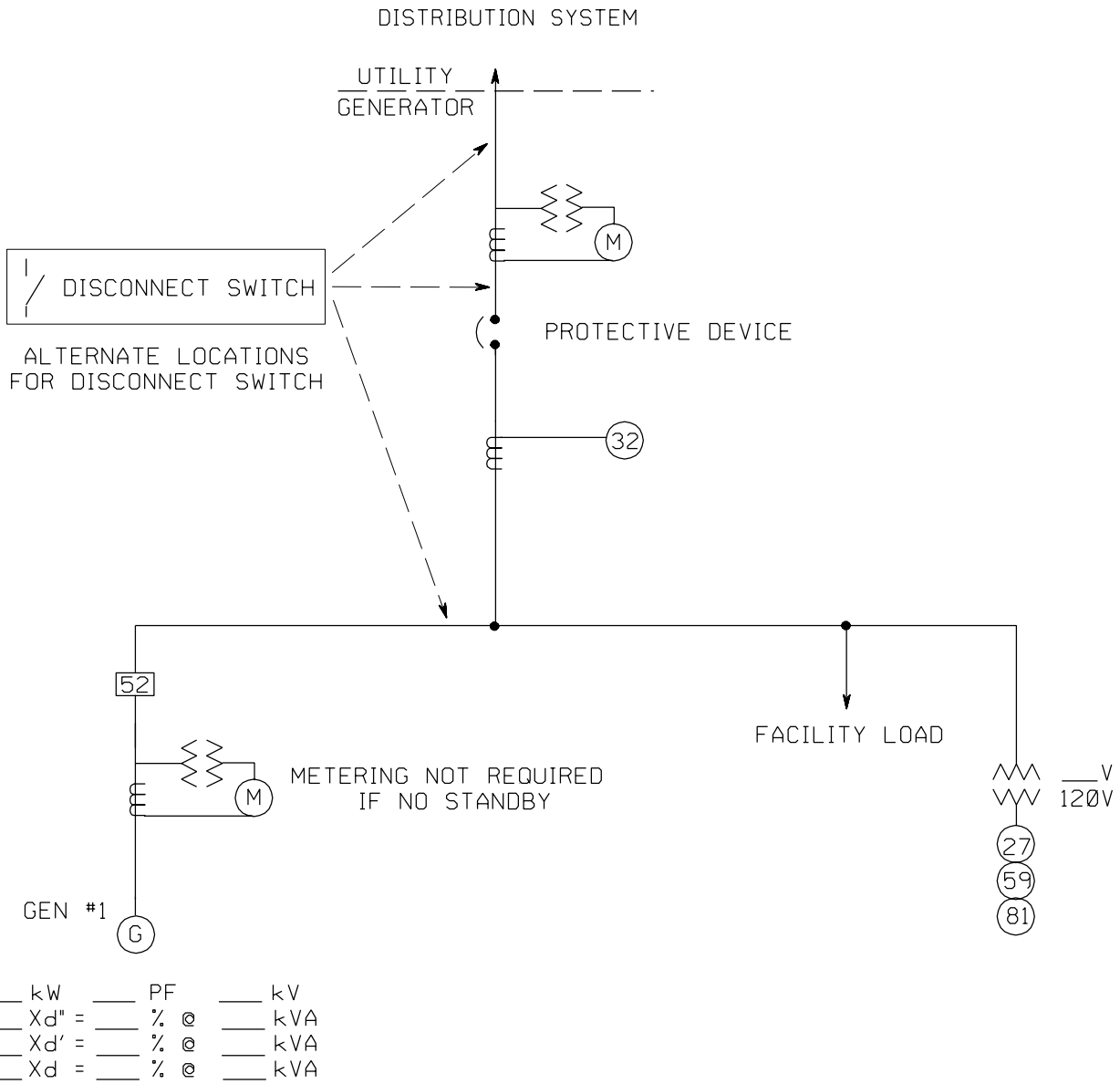
SYNCHRONOUS AND INDUCTION GENERATORS
AGGREGATE GENERATION LESS THAN 100 KW

REQUIRED DATA

TYPICAL ONE-LINE DIAGRAM FOR SYNCHRONOUS & INDUCTION GENERATORS AGGREGATE FACILITY GENERATION LESS THAN 100kW SELLBACK AND NON - SELLBACK

EQUIPMENT SCHEDULE

ANSI #	TYPE	QTY	MFGR	MODEL	STYLE #	NOTES
27	UNDERVOLTAGE	1	BASLER	BE1-27	A3E-E1J-AONOF	
32	DIRECTIONAL POWER	1	BASLER	BE1-32R	A1E-E1S-AONOF	NON-SELLBACK ONLY
52	POWER CIRCUIT BREAKER	?	VARIOUS	VARIOUS		
59	OVERVOLTAGE	1	BASLER	BE1-59	A3E-E1J-AONOF	
81	FREQUENCY	1	BASLER	BE1-810/U	T1E-E1J-A7NOF	



SYNCHRONOUS OR INDUCTION GENERATORS - AGGREGATE < 100 KW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the table below the page number of the attached data on which the requested information is provided.

General Information

Item No	Data Description	Attached Page No
1	Sell-Back or Non-Sell-Back	
2	Plant Type (Base load, peaking, intermediate)	
3	Site Plan	
4	Simple One-Line for Plant and Plant Load	
5	Detailed One-Line for Plant	
6a	Energization Date for Plant Switchyard	
6b	First Parallel Operation Date for Testing	
6c	Plant Commercial Operation Date	

The following information on these system components shall appear on the preliminary 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
- Fuses - normal operating status
- Generators - Size, location, type, method of grounding
- Grounding Resistors - Size (ohms)
- Isolating transformers - Size, location, impedance, voltage ratings, primary and secondary connections and method of grounding
- Potential Transformers - Ratio, connection
- 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), type, rating
- Tagging Point - Location, identification

SYNCHRONOUS OR INDUCTION GENERATORS - AGGREGATE < 100 KW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the table below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique generator.

Electric Generator(s) at the Plant: Generator No _____

Item No	(1)	Data Description	Attached Page No
1		Generator Type (synchronous or induction)	
2a		Generator Nameplate Voltage	
2b		Generator Nameplate Watts or Volt-Amperes	
2c		Generator Nameplate Power Factor (pf)	
3a	NA	Direct axis reactance (saturated)	
3b	NA	Direct axis transient reactance (saturated)	
3c	NA	Direct axis sub-transient reactance (saturated)	
4		Short Circuit Current contribution from generator at the Connection Point	

(1) – NA indicates not required for induction generators.

APPENDIX C

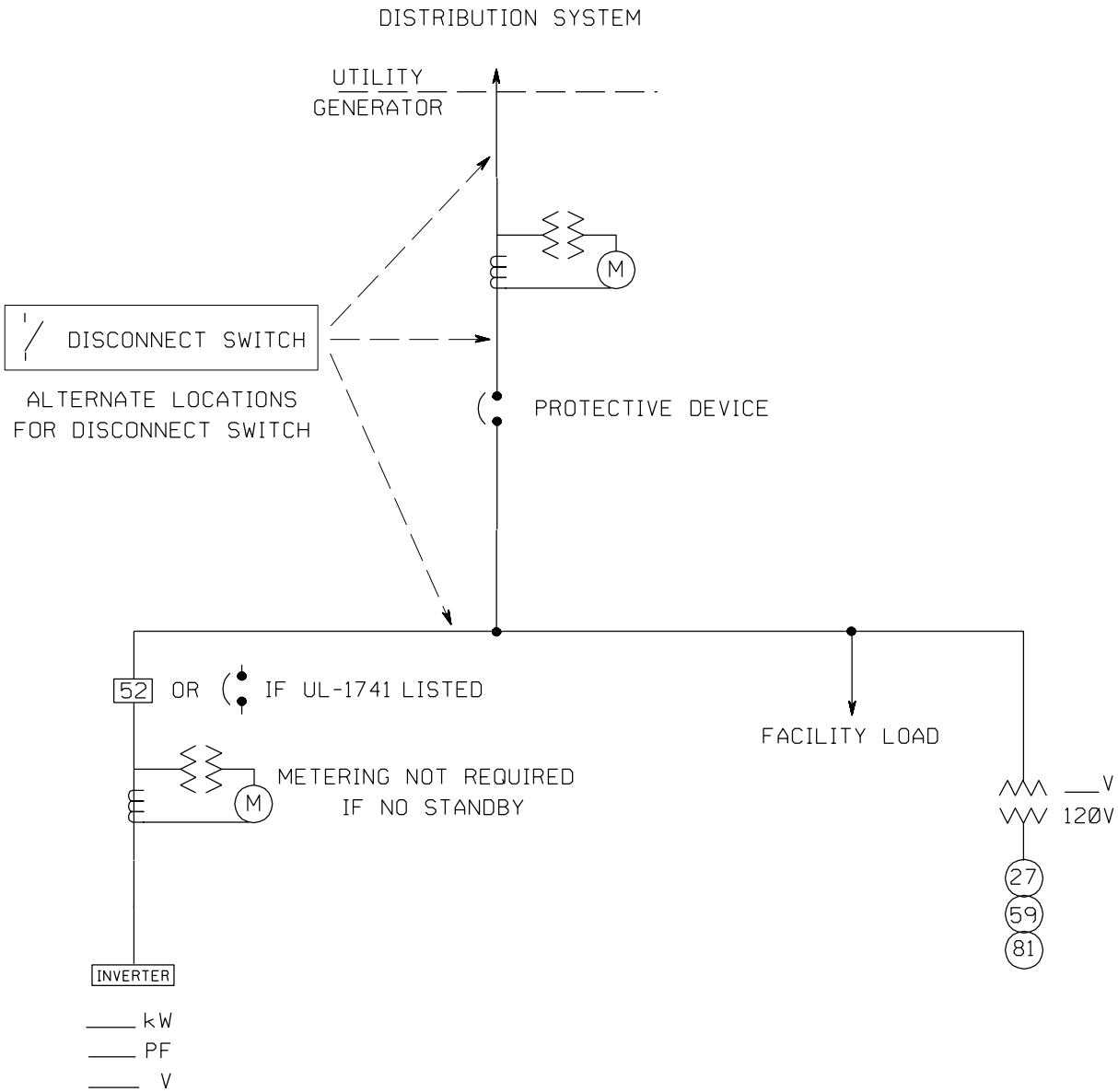
INVERTER-TYPE GENERATORS
AGGREGATE GENERATION LESS THAN 100 KW

REQUIRED DATA

TYPICAL ONE-LINE DIAGRAM FOR INVERTER - TYPE GENERATORS AGGREGATE FACILITY GENERATION LESS THAN 100kW SELLBACK AND NON - SELLBACK

EQUIPMENT SCHEDULE

ANSI #	TYPE	QTY	MFGR	MODEL	STYLE #	NOTES
27	UNDERVOLTAGE	1	BASLER	BE1-27	A3E-E1J-A0N0F	NOT REQUIRED IF ALL INVERTERS ARE UL-1741 LISTED
59	OVERVOLTAGE	1	BASLER	BE1-59	A3E-E1J-A0N0F	
81	FREQUENCY	1	BASLER	BE1-810/U	T3E-E1J-A7N0F	
52	POWER CIRCUIT BREAKER	?	VARIOUS	VARIOUS		



INVERTER-TYPE GENERATORS - AGGREGATE < 100 KW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the table below the page number of the attached data on which the requested information is provided.

General Information

Item No	Data Description	Attached Page No
1	Sell-Back or Non-Sell-Back	
2	Plant Type (Base load, peaking, intermediate)	
3	Site Plan	
4	Simple One-Line for Plant and Plant Load	
5	Detailed One-Line for Plant	
6a	Energization Date for Plant Switchyard	
6b	First Parallel Operation Date for Testing	
6c	Plant Commercial Operation Date	

The following information on these system components shall appear on the preliminary 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
- Fuses - normal operating status
- Generators - Size, location, type, method of grounding
- Grounding Resistors - Size (ohms)
- Isolating transformers - Size, location, impedance, voltage ratings, primary and secondary connections and method of grounding
- Potential Transformers - Ratio, connection
- 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), type, rating
- Tagging Point - Location, identification

INVERTER-TYPE GENERATORS - AGGREGATE < 100 KW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the table below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique generator.

Electric Generator(s) at the Plant: Generator No _____

Item No	Data Description	Attached Page No
1	Generator Type (Inverter)	
2a	Generator Nameplate Voltage	
2b	Generator Nameplate Watts or Volt-Amperes	
2c	Generator Nameplate Power Factor (pf)	
3	Short Circuit Current contribution from generator at the Connection Point	

APPENDIX D

INTERCONNECTION STUDY AGREEMENT

Consumers Energy Company
[Generator]
Interconnection Study Agreement for
Generator Interconnection
with Aggregate Generator Output Below 100 kW

WHEREAS, proposals to construct or upgrade generation facilities which will be operated in parallel with and interconnected with Consumers Energy's ("Consumers") electric system must be reviewed by Consumers to determine how they will impact Consumers' electric system.

WHEREAS, on _____ Consumers received from _____ (the "Generator") a Generator Interconnection Application.

WHEREAS, Consumers has determined that an Interconnection Study is necessary to determine whether Consumers' electric system can accommodate the requested interconnection.

NOW, THEREFORE, in consideration of the mutual covenants and agreements herein set forth, Consumers and the Generator agree as follows:

1. Consumers shall complete an Interconnection Study in accordance with Consumers' Generator Interconnection Requirements and this Agreement.

2. The estimated charge for the Interconnection Study is $2,000, which is due and payable to Consumers upon its receipt of this executed Interconnection Study Agreement. The charge shall not exceed the actual cost of the study. Any adjustments to the Interconnection Study estimate shall be reconciled with refund due the Generator or additional payment due Consumers.

3. The Generator is to return this executed Interconnection Study Agreement along with all required technical data and the necessary reimbursement for the Interconnection Study to Consumers within fifteen (15) days of receipt by the Generator of an unexecuted Interconnection Study Agreement form. If that form is not executed and returned within fifteen (15) days along with the required technical data and study reimbursement, the Generator's Interconnection Application will be deemed withdrawn.

4. Upon its receipt of this executed Interconnection Study Agreement, required technical data that is acceptable to and meets Consumers' Generator Interconnection Requirements and the estimated reimbursement required for completion of the study, Consumers will use due diligence to complete the study within a thirty (30) day period. The study shall consist of power flow, relaying, and short circuit analysis. The outcome of the Interconnection Study will be the scope, good faith cost estimates, and project lead times for the interconnection facilities and system upgrades required to connect the generation project to Consumers' electric system.

5. In the event Consumers is unable to complete the required Interconnection Study within the thirty (30) day time period, it shall notify the Generator and provide an estimated completion date along with an explanation of the reasons why additional time is needed.

6. Consumers shall supply a copy of the completed Interconnection Study to the Generator.

7. At the completion of the Interconnection Study, Consumers shall tender to the Generator for execution a final draft of an Interconnection and Operating Agreement ("Interconnection Agreement"). The Generator shall have a period of fifteen (15) days after receipt of the Interconnection Agreement to execute and return the Interconnection Agreement. Pursuant to the Interconnection Agreement, the Generator shall agree to reimburse Consumers for the full cost of Consumers' Interconnection Facilities.

8. The Generator shall be required to reapply for interconnection if (a) the Generator has lost its position in the queue under the provisions of Consumers' Generator Interconnection Requirements, (b) project changes are made from the original application which increases plant sizing by fifteen percent (15%) or more, (c) the original location of the plant is moved, and the move affects the interconnection to the electric system, or (d) the in-service date of the project is

9. delayed by more than six (6) months from the in-service date entered on the Generator's Interconnection Application.

10. Any notice or request made to or by either Party regarding this Agreement shall be made to the representative of the other Party, or its designated agent, as indicated below.

Utility	Generator
Karen E. Feahr	
Consumers Energy Company	
1945 West Parnall Road	
Jackson, MI 49201	

IN WITNESS WHEREOF, the Parties have caused this Interconnection Study Agreement to be executed by their respective authorized officials.

Consumers Energy Company	
By:	By:
(Signature)	(Signature)
Karen E. Feahr	
(Typewritten or Printed Name)	(Typewritten or Printed Name)
Tariff & Settlements Director	
Title	Title
Date	Date

APPENDIX E

OPERATING AUTHORITY AGREEMENT

(current date)

[ ] SUBSTATION
OPERATING AUTHORITY AGREEMENT
Normal Operations and Emergency Switching

Operating Authority for [Generator] will be its Facilities Manager or a Company Officer, Area Code ( ) _____.

For normal operations, the Operating Authority for Consumers Energy will be the System Controller at:

Area Code (___) ___-____ or (800) ___-____

EMERGENCY SWITCHING PROCEDURES

All Emergency Switching Procedures for [ ] Substation will be under the direct supervision of the System Controller at:

Area Code (___) ___-____ or (800) ___-____

The ___ switch (see substation WD ____) will be opened by the [Generator] representative or at their discretion, the Consumers Energy "operator."

SCHEDULED OUTAGE PROCEDURE

1. Request initiated by [Generator]. [Generator] will contact the System Controller ____ at the phone numbers above to schedule and coordinate work.

2. Request initiated by Consumers Energy. The System Controller ____ will contact [Generator] to make necessary arrangements and to agree on switching procedures.

NOTE: Each authority will attempt to provide a minimum of 48 hours notice on scheduled weekday outage requests (weekends are not considered as part of required notice).

PROTECTIVE TAGGING PROCEDURE - SCHEDULED

The ___ switch will be considered as the normal tagging point between Consumers Energy and [ ] Substation.

The ___ switch (see substation WD ____) will be opened by the [Generator] representative or at their discretion, the Consumers Energy "operator."

CUSTOMER REQUESTS

1. When [Generator] requires protection to work on their equipment, [Generator] will contact the System Controller ____.

At [Generator]s' discretion, their representative can accompany the Consumers Energy "operator" and place a tag and lock on the protection points. Consumers Energy will inform [Generator] of the tagged protection points.

2. When work has been completed and Consumers Energy and [Generator] are ready, the station will be returned to normal by the Consumers Energy "operator."

CONSUMERS ENERGY REQUESTS

1. When Consumers Energy requires protection on their line exits:

Consumers Energy "operator" will request [Generator] representative or at [Generator]s' discretion, the Consumers Energy "operator" to open the ___ switch after checking the ___ circuit breaker open. The Consumers Energy "operator" will place Consumers Energy Personal Protective Tags and locks on the ___ switch.

2. When work has been completed, a Consumers Energy "operator," accompanied by [Generator]s' representative, will remove the tags and locks.

3. The ___ switch will be closed by [Generator] with the Consumers Energy "operator" present or at their discretion, the Consumers Energy "operator" will close the ___ switch.

CONSUMERS ENERGY ACCESS

Consumers Energy shall be allowed access to the substation by means of a Consumers Energy lock in combination with a [Generator]s' lock on the substation gate and ___ switch at all times.

Approved by _____ Approved by _____

Consumers Energy [Generator]

SC_ Superintendent [Title]

ATTACHMENT 2

Generator Interconnection Requirements

Generation Facilities with Aggregate Generator Output Between 100 kW and 999 kW

Effective May 1, 2001

INTRODUCTION

This document replaces the Consumers Energy document entitled "*CONSUMERS ENERGY COMPANY INTERCONNECTION REQUIREMENTS FOR GENERATION Effective 09/15/2000",* for purposes of interconnecting between 100 kW and 999 kW of generation to the Consumers Energy electric system.

This Generator Interconnection Requirements document contains the process, requirements, and agreements used to add or modify generation projects with aggregate generator output between 100 kW and 999 kW, and desiring to operate in parallel with the Consumers Energy electric system. Technical requirements (data, equipment, relaying, metering) are defined according to the size and type of generation, location of the interconnection, and mode of operation (Sell-Back or Non-Sell-Back). The process is designed to provide an expeditious interconnection to the Consumers Energy electric system that is both safe and reliable.

Per Public Act 141 of 2000, subsection 10e(3): "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."

The term "Generator" will be used throughout this document to refer to the developers, owners, and operators of electric generating equipment interested in operating that equipment in parallel with the Consumers Energy electric system.

This document does not address other Generator concerns such as environmental permitting, local ordinances, or fuel supply. Nor does it address interconnection agreements that may be required with Consumers Energy and/or the transmission provider, or state or federal licensing, to market the Generator's energy. An interconnection request does not constitute a request for transmission service.

CONTENTS

CONTENTS

INTERCONNECTION PROCESS

The Interconnection Process

This section outlines the process for interconnecting between 100 kW and 999 kW of generation to the Consumers Energy electric system. This includes both new generation projects and modifications to existing generation projects. The general process is shown in Figure 1.

Interconnection Application

The Generator must first submit an Interconnection Application to Consumers Energy. A blank Interconnection Application can be found in Appendix A. A list of the required interconnection data, depending on the type of generation, can be found in Appendices B and C.

A complete submittal of required interconnection data and application fee of $1000 must accompany the application. Consumers Energy will notify the Generator when the application has been received. Consumers Energy will review the completeness of the Interconnection Application and inform the Generator of the status within 5 days of receiving the application. If any portion of the application, data submittal, or application fee is incomplete and/or missing, the unapproved application will be sent back to the Generator with the deficiencies clearly identified.

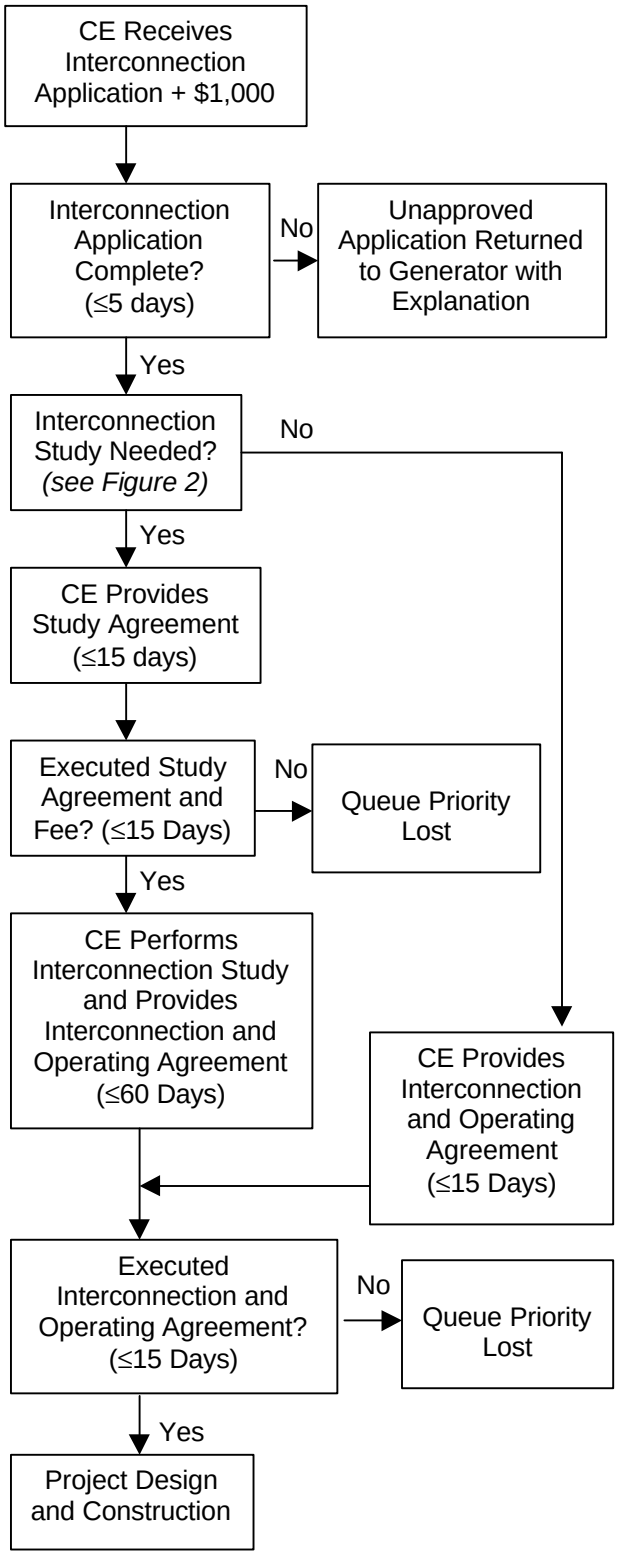
Once Consumers Energy has accepted an Interconnection Application, the generation project is considered in the generator queue. The generation project's position in the generator queue is determined by the date Consumers Energy received the accepted Interconnection Application.

Interconnection Study

Next, Consumers Energy determines if the Interconnection Application requires an Interconnection Study. Figure 2 shows the Interconnection Study determination process.

If an Interconnection Study is required, Consumers Energy will send an Interconnection Study Agreement to the Generator within 15 days of accepting the Interconnection Application. The Interconnection Study Agreement will require the Generator to pay $4,000 for the study. The Generator will have 15 days to sign the Interconnection Study Agreement and return it, with the appropriate study fee to Consumers Energy

Figure 1: The Interconnection Process



INTERCONNECTION PROCESS

Otherwise, the generation project's queue priority will be lost and the Generator will have to reapply for interconnection service. A sample Interconnection Study Agreement can be found in Appendix D.

Upon receiving a signed Interconnection Study Agreement and associated study fee within 15 days, Consumers Energy will proceed to complete the Interconnection Study within 60 days. The scope of the Interconnection Study will consist of power flow, short circuit, relaying, and stability analyses. If the study cannot be completed within 60 days, Consumers Energy will inform the Generator of the reason for, and extent of, the delay.

The outcome of the Interconnection study will be the scope, good faith cost estimates, and project lead times for the Interconnection Facilities and system upgrades required to connect the generation project to the Consumers Energy electric system.

Interconnection and Operating Agreement

Consumers Energy will submit an Interconnection and Operating Agreement to the Generator at the conclusion of the Interconnection Study, or if an Interconnection Study is not required, within 15 days of the Interconnection Application date.

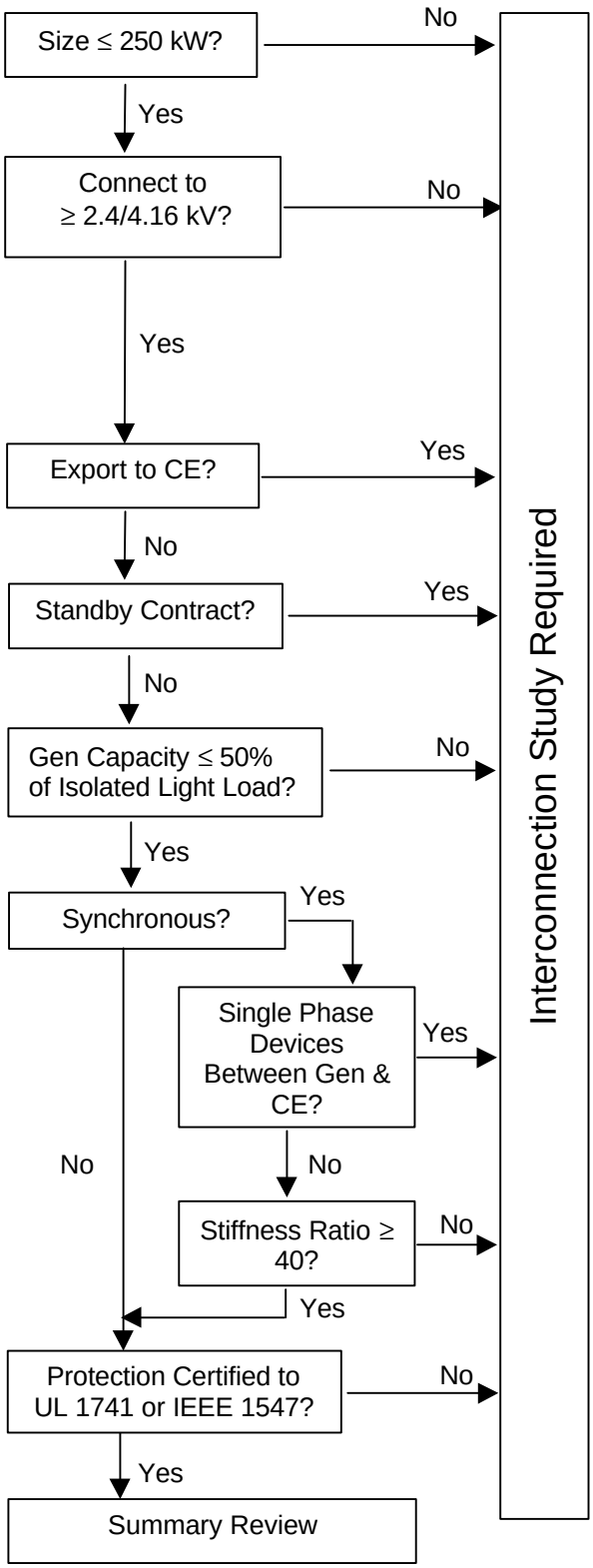
The Interconnection and Operating Agreement shall cover matters customarily addressed in such agreements in accordance with Good Utility Practice, including, without limitation, construction of facilities, system operation, interconnection cost and billing, defaults and remedies, insurance and liability. In accordance with 2000 Michigan Public Act 141, all interconnection costs will be the responsibility of the interconnecting Generator.

The Generator will have 15 days to sign the Interconnection and Operating Agreement and return it to Consumers Energy. Otherwise, the generation project's queue priority will be lost and the Generator will have to reapply for interconnection service.

Project Design and Construction

After the Generator Interconnection and Operating Agreement is executed, Consumers Energy will proceed to acquire right-of-way, procure equipment a, and design and construct the Interconnection Facilities.

Figure 2: Interconnection Study Determination Process



TECHNICAL REQUIREMENTS

Technical Requirements

The following discussion details the technical requirements for generator interconnections for generation facilities with aggregate generator output between 100 kW and 999 kW. Many of these requirements will vary based on the size of the generation facility, the type of generation being used, and the mode of operation (Sell-Back or Non-Sell-Back). A few of the requirements will vary based on location of the interconnection (isolated load and available fault current).

Certain major component, relaying, telemetry, and operational requirements must be met to provide compatibility between the generation project equipment and the Consumers Energy electric system, and to assure the safety and reliability of the electric system is not degraded by the interconnection.

Revenue metering is required for settlement purposes for interconnection power and/or for standby power.

Major Component Design Requirements

Data for all major equipment and relaying proposed by the Generator to satisfy the interconnection requirements must be submitted for review and approval by Consumers Energy.

Once installed, the interconnection equipment must be reviewed and approved by Consumers Energy prior to being connected to the Consumers Energy electric system and before Parallel Operation is allowed.

Data
The data that Consumers Energy requires to evaluate the proposed connection will vary with the type of generation being used. Initial data requirements are conveniently provided in the form of "fill in the blank" checklists by generator type in Appendices B and C.

A site plan, and preliminary (not including relaying) electrical one-lines of the generation facilities and the interconnection are required as part of the application data. Control schematics of protective relaying used to isolate faults on the Consumers Energy electric system will be required for the Interconnection Study. "Design Drawing Requirements" are detailed in the Generator Interconnection Supplement.

Isolating Transformer(s)
If an isolating transformer is required, the transformer must comply with the current ANSI Standard C57.12.

The transformer must have voltage taps on the high and/or low voltage windings sufficient to assure satisfactory generator operation over the range of voltage variation expected on the Consumers Energy electric system. The Generator also needs to assure sufficient voltage regulation at its facility to maintain an acceptable voltage level for its equipment during such periods when its generator(s) is off line. This may involve the provision of voltage regulation or a separate transformer between Consumers Energy and the generation facility station power bus.

The isolating transformer connections will be determined by the type of generation and electrical location of the interconnection. Allowable connections are detailed in "Relaying Design Requirements" under the specific generator type.

The proper selection and specification of transformer impedance is important relative to enabling the proposed generation facility to meet Consumers Energy's reactive power requirements (see "Reactive Power Control").

Circuit Breaker
If a main circuit breaker (or circuit switcher) between the isolating transformer and Consumers Energy is required (see applicable plan in Appendix B or C), the device must comply with the current ANSI Standard C37.

Any circuit breaker (or circuit switcher) must have adequate interrupting capability for the maximum expected short circuit duty. Consumers Energy will provide information identifying the contribution from the electric system to faults at the selected site. The Generator is responsible to perform the short-circuit study to determine if the protective devices can safely interrupt the short-circuit currents.

Main Disconnect Switch
A gang-operated disconnecting device must be located at the Connection Point and must at all times be accessible to Consumers Energy and be suitable for use by Consumers Energy as a

protective tagging location. The device must comply with the current ANSI Standard C37.

This device shall have a visible open gap and be capable of being locked in the open position.

For facilities served from the 46 kV system, this disconnecting device must be mounted on the substation structure and have provided with it an operating platform which is properly grounded and designed in accordance with specifications to be provided by Consumers Energy. Access to the device must be restricted to Consumers Energy personnel and properly trained operators designated by the Generator.

Interconnection Lines
The interconnecting line(s) will be either a secondary voltage (120, 240, 480 V), a distribution voltage (generally 2.4/4.16, 4.8/8.32, 7.2/12.47, or 14.4/24.9 kV), or 23 or 46 kV. The physically closest available system voltage, as well as equipment and operational constraints influence the chosen point of interconnection. Consumers Energy has the ultimate authority to determine the acceptability of a particular Connection Point.

Any new line construction required for the interconnection will be undertaken by Consumers Energy at the Generator's expense. The new lines will terminate on a substation structure provided by the Generator.

Substation Structure
The Generator is responsible for ensuring that substation structural material strengths are adequate for all requirements, incorporating appropriate safety factors. Consumers Energy will provide line tension information for maximum transmission line dead-end tensions under heavy icing conditions. The structure must be designed for this maximum line tension along with an adequate margin of safety.

Substation electrical clearances shall comply with requirements of the National Electrical Safety Code and Michigan Public Service Commission Standard 16-79.
The installation of disconnect switches, bus support insulators, and other equipment shall comply with accepted industry practices.

Lightning arresters shall be selected to coordinate with the BIL rating of major equipment components and shall comply with recommendations set forth in the current ANSI Standard C62.2.

Relaying Design Requirements

The interconnection relaying design requirements are intended to assure protection of the Consumers Energy electric system. Any additional relaying which may be necessary to protect equipment at the generation facility is solely the responsibility of the Generator to determine, design, and apply.

The relaying requirements will vary with the size of the generation facility, the type of generation being used, and the mode of operation (Sell-Back or Non-Sell-Back).

All relaying proposed by the Generator to satisfy these requirements must be submitted for review and approval by Consumers Energy personnel.

Protective Relaying General Considerations
All relays must be equipped with targets or other visible indicators to indicate that the relay has operated.

If the protective system uses AC power as the control voltage, it must be designed to disconnect the generation from the Consumers Energy electric system if the AC control power is lost.

The relay system must be designed such that the generator is prevented from energizing the Consumers Energy electric system if that system is de-energized.

See "Approved Relays Types" in the Generator Interconnection Supplement.

Momentary Paralleling
For situations where generation will only be operated in parallel with the Consumers Energy electric system for a short duration (less than 1 second), as in a make-before-break automatic transfer scheme, no additional relaying is required. A modern integrated automatic transfer switch (ATS) system incapable of paralleling the generator with the Consumers Energy electric system for more than the time to operate the transfer is required. The ATS must be tested and verified for proper operation every 2 years.

TECHNICAL REQUIREMENTS

Instrument Transformer Requirements
All relaying must be connected into instrument transformers.

All current connections shall be connected into current transformers (CTs). All CTs shall be rated to provide no more than 5 amperes secondary current for all normal load conditions, and must be designed for relaying use, with an "accuracy class" of at least C50. Current transformers with an accuracy class designation such a T50 are NOT acceptable. For three-phase systems, all three phases must be equipped with CTs.

All potential connections must be connected into voltage transformers (VTs). For single-phase connections, the VTs shall be provided such that the secondary voltage does not exceed 120 volts for normal operations. For three-phase connections, the VTs shall be provided such that the line-to-line voltage does not exceed 120 volts for normal operation, and both the primary and secondary of the VTs shall be connected for grounded-wye connections.

Direct Transfer Trip (DTT)
DTT is generally not required for Induction or Inverter-Type generators. DTT generally is not required for Synchronous generation facilities that will operate in the Non-Sell-Back mode since a simpler and more economic reverse power relay scheme can usually meet the requirements. For Synchronous Sell-Back generation facilities the need for DTT is determined based on the location of the Connection Point to the Consumers Energy electric system. Consumers Energy requires DTT when the total generation within a protective zone is greater than 50% of the minimum Consumers Energy load that could be isolated along with the generation. This prevents sustained isolated operation of the generation for conditions where generator protective relaying may not otherwise operate (see "Isolated Operation" in the Generator Interconnection Supplement).

Direct transfer trip adds to the cost and complexity of an interconnection. A DTT transmitter is required for each Consumers Energy protective device whose operation could result in sustained isolated operation of the generator. An associated DTT receiver at the generation facility is required for each DTT transmitter. A phone Data Circuit is required between each transmitter and receiver. Telemetry is required to monitor status of the DTT communication.

Consumers Energy will provide the receiver(s) that the Generator must install, and will install the transmitter(s) at the appropriate Consumers Energy protective devices at the Generator's expense.

Reverse Power Relaying for Non-Sell-Back
If metering for "Sell-Back" mode is not present, reverse power protection must be provided. The reverse power relaying will detect power flow from the generation facility into the utility system, and operation of the reverse power relaying will separate the generator(s) from the utility system.

Automatic Reclosing
Since most system faults are transient in nature, automatic multiple-shot reclosing has been installed on most of Consumers Energy's circuit breakers and circuit reclosers to increase the reliability of service to its customers. In addition, automatic single-phase overhead reclosers are regularly installed on distribution circuits to isolate faulted segments of these circuits.

In addition to the risk of damage to the generator, an out-of-phase reclosing operation may also present a hazard to the electric system equipment since this equipment may not be rated or built to withstand this type of reclosing.

To prevent out-of-phase reclosing, circuit breakers can be modified with voltage check relays. These relays block reclosing until the parallel generation is separated and the line is "dead." Hydraulic single phase overhead reclosers cannot be modified with voltage check relays; therefore, these devices will have to be either replaced with three phase overhead reclosers, which can be voltage controlled, or relocated beyond the generator location - depending upon the sectionalizing and protection requirements of the distribution circuit. If the generator can be connected to more than one circuit, these revisions may be required on the alternate circuit(s) as well.

Consumers Energy will determine relaying and control equipment that needs to be installed to protect its own equipment from out-of-phase reclosing. Installation of this protection will be undertaken by Consumers Energy at the Generator's expense.

TECHNICAL REQUIREMENTS

Single-Phase Fusing
Consumers Energy also installs single-phase fuses on its distribution circuits to increase the reliability of service to its customers. Three-phase generator installations may require replacement of fuses with three-phase circuit breakers or circuit reclosers at the Generator's expense.

TECHNICAL REQUIREMENTS

Synchronous Generator Facilities

General
After IEEE Standard 1547 is passed (anticipated in late 2001), no additional protective relaying is required if the interconnection equipment is listed by an independent listing laboratory (such as Underwriters Labs) to satisfy IEEE 1547 requirements.

If the interconnection equipment is not listed as satisfying IEEE 1547, under/overfrequency relaying and under/overvoltage relaying are required. Each generator must also be equipped with voltage-controlled overcurrent relays to detect faults on the utility system. The under/overvoltage relaying must be either a three-phase relay or three single-phase relays, and three-phase voltage controlled overcurrent relaying must be provided. In order to minimize damage to both the generator system equipment and to utility system equipment for loss-of-synchronism (also called out-of-step), and to minimize disruptions to other utility customers in the area, out-of-step relaying may also be required if the Stiffness Ratio is less than 40. Consumers Energy has evaluated and approved a relay for this purpose, which would usually be installed at the same location as the metering, and would isolate the generation from the utility system.

For a sample One-Line Diagram of this type of facility, see Appendix B.

100 kW to 499 kW
Industrial Grade relays are acceptable, but Utility Grade Relays are preferred.

The isolation transformer must be incapable of producing ground fault current to the utility system; any connection except delta primary (generator side), grounded-wye secondary (utility side) is acceptable. The isolation transformer must be protected for internal faults; fuses are acceptable.

Protection for utility system ground faults is required for installations requiring DTT. Ground fault detection will consist of a (59N) ground overvoltage relay. The specific application of this relay will depend on the connection of the isolation transformer:

1. If a delta secondary/grounded-wye primary connection is used, the (59N) relay will be connected into the secondary of a set of three-phase VTs, which will be connected grounded-wye primary, with the secondary connected delta with one corner of the delta left open. The (59N) relay will be connected across this open-corner.
2. If an ungrounded-wye secondary/delta primary connection is used, the (59N) relay will be connected into the secondary of a single VT, which will be connected from the ungrounded-wye neutral of the isolation transformer to ground

500 kW to 999 kW
Utility Grade Relays are required.

If the facility is connected to an ungrounded distribution system, the secondary winding (utility side) of the isolation transformer must be connected delta.

If the facility is connected to a grounded distribution system, the developer has a choice of two different transformer connections:

1. The isolation transformer may be connected for a delta secondary (utility side) connection with any primary (generator side) connection, or
2. Ungrounded-wye secondary connection with a delta primary connection.

If the facility is connected to a grounded distribution system via one of the isolation transformer connections specified above, ground fault detection for utility faults must be provided, and will consist of a (59N) ground overvoltage relay. The specific application of this relay will depend on the connection of the isolation transformer:

1. If a delta secondary/grounded-wye primary connection is used, the (59N) relay will be connected into the secondary of a set of three-phase VTs, which will be connected grounded-wye primary, with the secondary connected delta with one corner of the delta left open. The (59N) relay will be connected across this open-corner.
2. If an ungrounded-wye secondary/delta primary connection is used, the (59N) relay will be connected into the secondary of a single VT, which will be connected from the ungrounded-wye neutral of the isolation transformer to ground.

TECHNICAL REQUIREMENTS

Induction Generator Facilities

General
After IEEE Standard 1547 is passed (anticipated in late 2001), no additional protective relaying is required if the interconnection equipment is listed by an independent listing laboratory (such as Underwriters Labs) to satisfy IEEE 1547 requirements.

If the interconnection equipment is not listed as satisfying IEEE 1547, under/overfrequency relaying and under/overvoltage relaying are required. The under/overvoltage relaying must be either a three-phase relay or three single-phase relays.

For a sample One-Line Diagram of this type of facility, see Appendix B.

100 kW to 499 kW
Industrial Grade relays are acceptable, but Utility Grade Relays are preferred.

The isolation transformer must be incapable of producing ground fault current to the utility system; any connection except delta primary (generator side), grounded-wye secondary (utility side) is acceptable. The isolation transformer must be protected for internal faults; fuses are acceptable. No protection for utility system ground faults is required.

500 kW to 999 kW
Utility Grade Relays are required.

If the facility is connected to an ungrounded distribution system, the secondary winding (utility side) of the isolation transformer must be connected delta.

If the facility is connected to a grounded distribution system, the developer has a choice of two different transformer connections:

1. The isolation transformer may be connected for a delta secondary (utility side) connection with any primary (generator side) connection, or
2. For an ungrounded-wye secondary connection with a delta primary connection.

No protection for utility system ground faults is required.

TECHNICAL REQUIREMENTS

Inverter-Type Generator Facilities

General
No additional protective relaying is required if the interconnection equipment is listed by Underwriters Laboratory as satisfying UL1741 requirements.

If the interconnection equipment is not listed under UL1741, under/overfrequency relaying and under/overvoltage relaying are required. The under/overvoltage relaying must be either a three-phase relay or three single-phase relays.

The isolation transformer must be incapable of producing ground fault current to the utility system; any connection except delta primary (generator side), grounded-wye secondary (utility side) is acceptable. The isolation transformer must be protected for internal faults; fuses are acceptable. No protection for utility system ground faults is required.

For a sample One-Line Diagram of this type of facility, see Appendix C.

100 kW to 499 kW
Industrial Grade relays are acceptable, but Utility Grade Relays are preferred.

500 kW to 999 kW
Utility Grade Relays are required.

TECHNICAL REQUIREMENTS

Relay Setting Criteria
The relay settings as detailed in this section will apply in the vast majority of applications. Consumers Energy will issue relay settings for each individual project that will address the settings for these protective functions. All voltages will be adjusted for the specific VT ratio, and all currents will be adjusted for the specific CT ratio.

Undervoltage Relays
The undervoltage relays will normally be set to trip at 90% of the nominal primary voltage at the relay location, and must reset from a trip condition if the voltage increases to 92% of the nominal primary voltage at the relay location. In order to accommodate variations in this criteria, the trip point of the relays shall be adjustable over a range of 70% of the nominal voltage to 90% of the nominal voltage. The trip time shall not exceed 1.0 seconds at 90% of the relay setting.

Overvoltage Relays
The overvoltage relays will normally be set to trip at 107% of the nominal primary voltage at the relay location, and must reset from a trip condition if the voltage decreases to 105% of the nominal primary voltage at the relay location. In order to accommodate variations in this criteria, the trip point of the relays shall be adjustable over a range of 105% of the nominal voltage to 120% of the nominal voltage. The trip time shall not exceed 1.0 seconds at 110% of the relay setting.

Underfrequency Relays
The Underfrequency relay will normally be set for a trip point of 59.0 Hz, and must trip within 1.0 seconds. Relays with an inverse time characteristic (where the trip time changes with respect to the applied frequency) are not acceptable. These relays must respond reliably for applied source voltages as low as 70% of the nominal voltage.

Overfrequency Relays
The overfrequency relay will normally be set for a trip point of 61.0 Hz, and must trip within 1.0 seconds. Relays with an inverse time characteristic are not acceptable. These relays must respond reliably for applied source voltages as low as 70% of the nominal voltage.

51V Relays – Voltage Controlled Overcurrent Relays
For synchronous generator applications, the (51V) relays must be set to detect any phase faults that may occur between the generator and the nearest three-phase fault clearing device on the utility system. Since these faults may take up to 1-second to detect and isolate, the appropriate saturated direct-axis reactance of the generator will be used depending on its time constants. The settings of this device will consider the relay manufacturer's recommended practice for the type of generator and prime mover (mechanical energy source), and will be determined by Consumers Energy for the specific system application.

59N Relay – Ground Fault Detection
This relay will be applied to detect ground faults on the utility system when the generator facility is connected to a grounded utility system via an ungrounded transformer winding. This relay will be set for a 10% shift in the apparent power system neutral. For an ungrounded wye transformer winding with a single 120 V secondary VT, the setting will usually be 12 Volts. For a delta transformer winding with broken delta 120 V secondary VTs, the setting will usually be 20 Volts. The time delay will normally be 1 second.

51N Relay – Ground Fault Detection
This relay will be applied to detect ground faults on the utility system when the generator facility is connected to a grounded utility system via a grounded-wye transformer winding, and will be connected into a CT in the transformer neutral connection. This relay will be set to detect faults on the directly connected utility system, and the timing will be set to comply with utility practice for overcurrent relay coordination. The CT ratio and specific relay setting will be determined via a fault study performed by Consumers.

32 Relay – Reverse Power
The reverse power relay must be selected such that it can detect a power flow into the utility system of a small fraction of the overall generator capacity. The relay will normally be set near its minimum (most sensitive) setting, and will trip after a 1 second time delay. The delay will avoid unnecessary tripping for momentary conditions.

TECHNICAL REQUIREMENTS

Maintenance and Testing
Consumers Energy reserves the right to test the relaying and control equipment that involves protection of the Consumers Energy electric system whenever Consumers Energy determines a reasonable need for such testing exists.

The Generator is solely responsible for conducting proper periodic maintenance on the generating equipment and its associated control, protective equipment, interrupting devices, and main Disconnect Switch.

The Generator is responsible for the periodic scheduled maintenance on those relays, interrupting devices, control schemes, and batteries that involve the protection of the Consumers Energy electric system. A periodic maintenance program is to be established to test these relays every 2 years. This maintenance testing must be witnessed by Consumers Energy.

Each routine maintenance check of the relaying equipment shall include both an exact calibration check and an actual trip of the circuit breaker or contactor from the device being tested. For each test, a report shall be submitted to Consumers Energy indicating the results of the tests made and the "as found" and "as left" relay calibration values. Visually setting, without verification, a calibration dial or tap is not considered an adequate relay calibration check.

In the event there is demonstrated electrical interference (i.e. Voltage Flicker, Harmonic Distortion, etc.) to Consumers Energy's customers, suspected to be caused by the generator, and such interference exceeds then current system standards, Consumer Energy reserves the right, at Consumers Energy's initial expense, to install special test equipment as may be required to perform a disturbance analysis and monitor the operation and control of the generator to evaluate the quality of power produced by the generator. In the event that no standards exist, then the applicable tariffs and rules governing electric service shall apply. If the generator is proven to be the source of the interference, and that interference exceeds Consumers Energy's standards or the generally accepted industry standards, then it shall be the responsibility of the Generator to eliminate the interference problem and to reimburse Consumers Energy for the costs of the disturbance analysis excluding the cost of the meters or other special test equipment.

Installation and Design Approval
Consumers Energy will review the design drawings, for approval, after the Interconnection Study has been completed. The design drawings must be submitted by the Generator in accordance with "Engineering Design Drawing Requirements"(see Generator Interconnection Supplement). Consumers Energy shall either approve the Generator's design drawings as submitted or return them to the Generator with a clear statement as to why they were not approved. Where appropriate, Consumers Energy will indicate required changes on the engineering drawings.

In the event that revisions are necessary to the Generator's submitted design drawings and the Generator submits revised design drawings to Consumers Energy, then Consumers Energy shall either approve, in writing, the Generator's revised design drawings as resubmitted, or return them to the Generator with a clear statement as to why they were not approved. Where appropriate, Consumers Energy will indicate required changes on the engineering drawings.

Consumers Energy will retain one copy of the approved design drawings.

In the event that Consumers Energy exercises its option to Acceptance Test the proposed Generator relays that protect the Consumers Energy electric system, then Consumers Energy shall communicate the results of that testing to the Generator for both the relays and the necessary documentation on the relays.

Prior to final approval for Parallel Operation, Consumers Energy's specified relay calibration settings shall be applied and an Acceptance Test for Service must be performed on the Generator relaying and control equipment that involves the protection of the Consumers Energy electric system. The Acceptance Test for Service must be witnessed by Consumers Energy and can be performed by Consumers Energy at the Generator's request. Upon satisfactory completion of this test and final

inspection, Consumers Energy will provide written permission for Parallel Operation. If the results are unsatisfactory, Consumers Energy will provide written communication of these results to the Generator.

In the event the Generator proposes a revision to Consumers Energy's approved relaying and control equipment used to protect the Consumers Energy electric system and submits a description and engineering design drawings of the proposed changes, Consumers Energy shall either approve the Generator's amended design drawings or return them to the Generator with a clear statement as to why they were not approved. Where appropriate, Consumers Energy will indicate required changes on the engineering drawings.

Telemetry and Disturbance Monitoring Requirements

Telemetry and disturbance monitoring for this size generation is only required if DTT is required (see "Direct Transfer Trip").

When telemetry is required, the Generator shall provide a suitable indoor location, approved by Consumers Energy, for Consumers Energy's owned, operated, and maintained Remote Terminal Unit (RTU). The location must be equipped with a 48 V or 125 V DC power supply. The Generator must provide a properly protected phone Data Circuit and telephone board to be connected to the Consumers Energy RTU.

The RTU will be provided by Consumers Energy at the Generator's expense. In addition to other telemetry costs, a one-time charge will be assessed to the Generator for equipment and software installed at Consumers Energy's System Control Center to process the data signals.

See "Typical RTU Installation Where Telemetry is Required" in the Generator Interconnection Supplement.

The following values will be telemetered:

1. Real and reactive power flow between the generation facility and the Consumers Energy electric system.

2. Bus voltage at the Connection Point.

3. The status (normal/fail) of protective relay Communication Channels. A status indication of "FAIL" indicates the Communication Channel used for relaying (i.e. transfer trip) is unable to per form its protective function.

4. The status (open/closed) of the main isolating breaker and each generating unit breaker (if the generation facility is composed of multiple units of 2 MW or less, a single logical (OR) status of the individual generator breaker states, indicating all generator breakers are open or any one or more generator breakers are closed, is permissible). A closed status would be indicated if any individual generator is on line.

The RTU will be equipped with "sequence of events" recording. The Generator shall provide, wired to a terminal block near the RTU panel, sufficient connections to separately monitor the following:

1. Each and every trip of an interconnecting isolation device which is initiated by any of the generator interconnection relaying schemes required by Consumers Energy.

2. Each and every trip of an interconnecting isolation device which is initiated by any of the protective systems for the generator.

3. Each and every trip or opening of an interconnecting isolation device which is initiated by any other manual or electrical means.

4. The following individual contacts from each individual Direct Transfer Trip receiver required by Consumers Energy:
   i. Loss of guard (LOG) alarm
   ii. Receive trip relay (RTX)
   iii. Lockout relay

TECHNICAL REQUIREMENTS

Miscellaneous Operational Requirements

Miscellaneous requirements include synchronizing equipment for Parallel Operation, reactive requirements, standby power considerations, and system stability limitations.

Operating in Parallel
The Generator will be solely responsible for the required synchronizing equipment and for properly synchronizing the generation with the Consumers Energy electric system.

Voltage fluctuation at the Connection Point during synchronizing shall be limited to ±5%.

The Generator will notify Consumers Energy's System Control prior to synchronizing to and prior to scheduled disconnection from the electric system.

Reactive Power Control
Synchronous generators that will operate in the Sell-Back Mode must be dynamically capable of providing 0.90 power factor lagging (delivering reactive power to Consumers Energy) and 0.95 power factor leading (absorbing reactive power from Consumers Energy) at the Connection Point.

Induction and Inverter-Type generators which will operate in the Sell-Back Mode must:

1. Install a var supply source to maintain a 0.90 power factor lagging at the Connection Point; or

2. Provide Consumers Energy with funds for the installation of a var supply source equal to the generator reactive requirement of 0.90 power factor at full output.

There are no interconnection reactive power capability requirements for Synchronous, Induction, and Inverter-Type generators that will operate in the Non-Sell-Back Mode. Existing rate tariffs set forth in Consumers Energy's Standard Rules and Regulations contain power factor adjustments (credits and penalties) based on the power factor of the metered load at these facilities.

Standby Power
Unless the generating facility incorporates its own auxiliary power source, such as a diesel generator, separate arrangements must be made with Consumers Energy for provision of this backup power, or for any power needed for construction. Any such power provided will be under the terms of an approved rate set forth in Consumers Energy's Standard Rules and Regulations. The Generator should be aware that to qualify for Standby Rates, a separate meter must be installed at the generator.

If outside of Consumers Energy's franchise area, it will be the Generator's responsibility to arrange contractually and technically for the supply of its facility's standby, maintenance, and any supplemental power needs.

System Stability and Site Limitations
A stability study may be required for synchronous generation facilities, depending on the Stiffness Ratio at the Connection Point. If the Stiffness Ratio is very low, special generator trip schemes or loss of synchronism (out-of-step) relay protection will be required. This type of protection is typically applied at the Connection Point and trips the entire generation facility, if instability is detected, to protect the Consumers Energy electric system and its customers. Consumers Energy generally will not require such protection at a Connection Point with a Stiffness Ratio of 40 or greater.

The Generator is responsible for evaluating the consequences of unstable generator operation on the equipment at the generation facility, and determining, designing, and applying any relaying which may be necessary to protect that equipment from unstable generator operation. This type of protection is typically applied on individual generators to protect the generator facilities.

Revenue Metering Requirements

Consumers Energy will own, operate, and maintain any added billing metering equipment at the Generator's expense. The billing metering will meter both real and reactive interconnection flows between the generation facility and the Consumers Energy electric system. Where applicable, separate metering of station power

may be required to accurately meter the generation facility load when the generator is off line.

Special billing metering will be required for generators operating in the Sell-Back Mode. If telemetering is required, the billing metering will be included as part of the telemetering installation.

The Generator shall provide a suitable indoor location, approved by Consumers Energy, for Consumers Energy's owned, operated, and maintained billing metering.

Normally, metering equipment are stock items for Consumers Energy, but there may be times when this equipment will have to be ordered and it may have a substantial delivery time. This is especially true for high voltage connections. It is in the best interest of the Generator to contact Consumers Energy early in the design process to avoid any delays in the arrival of the metering equipment.

The Generator shall provide authorized employees and agents of Consumers Energy access to the premises at all reasonable hours to install, turn on, disconnect, inspect, test, read, repair, or remove the metering equipment. The Generator may, at its option, have a representative witness this work.

The metering installations for generation facilities shall be constructed in accordance with the practices, which normally apply to the construction of metering installations for commercial, industrial, or other customers with demand recording equipment.

Consumers Energy shall supply to the Generator the standard detailed specifications and requirements relating to the location, construction, and access of the metering installation and will provide consultation pertaining to the meter installation as required.

Consumers Energy 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. Consumers Energy will endeavor to coordinate the delivery of these materials with the Generator's installation schedule.

The Generator shall provide a mounting surface for the meters, recorders, connection cabinets, a housing for the instrument transformers, a conduit for the conductors between the instrument transformer secondary windings and the meter connection cabinets, and a conduit for the communication links, if required. All of this equipment must meet Consumers Energy's specifications and requirements.

The responsibility for the installation of the equipment is shared between Consumers Energy and the Generator, with the Generator generally installing all of the equipment on its side of the Connection Point, including instrument transformers, cabinets, conduits, and mounting surfaces. Consumers Energy, or its agents, shall install the meters, recorders, and communication links. Consumers Energy will endeavor to coordinate the installation of these items with the Generator's schedule.

Specific installation details and responsibilities will be established between Consumers Energy and the Generator after completion of the Interconnection Study.

Telephone Circuits

For Sell-Back generation facilities, a standard Voice Circuit will be required for accessing the billing meters.

If Telemetry is required, a Data Circuit must be installed as specified by the local telephone utility. The circuit must be enclosed in conduit from the RTU to the point of connection to the telephone utility equipment. Wall space must be provided for adjacent mounting, next to the telephone board, of the billing metering panel and a telemetering enclosure. The billing meter panel typically is 60 inches high by 48 inches wide and the telemetering enclosure typically is 24 inches high by 24 inches wide. A clear space of 4.5 feet in front of this equipment is required to permit maintenance and testing. A review of each installation shall be made to determine the location and space requirements most agreeable to Consumers Energy and the Generator.

TECHNICAL REQUIREMENTS

If DTT is required, a separate Data Circuit must be installed as specified by the local telephone utility for each DTT receiver.

If a Data Circuit is required, a standard Voice Circuit is required during testing to communicate with personnel performing the master station portion of the tests.

Consumers Energy will cooperate to provide utility information necessary for proper installation of the telephone circuits.

The Generator is responsible for ordering and acquiring the telephone circuits required for the generator interconnection. The Generator will assume all installation, operating, and maintenance costs associated with the telephone circuits, including the monthly charges for the telephone lines.

APPENDIX A

INTERCONNECTION APPLICATION

GENERATOR INTERCONNECTION APPLICATION

AGGREGATE GENERATOR OUTPUT BETWEEN 100 KW AND 999 KW

1. The undersigned Generator submits this Generator Interconnection Application and $1,000 application fee to interconnect a new generating facility to the Consumers Energy Electric System or to increase the capacity of an existing generating facility connected to the Consumers Energy Electric System.

2. A Generator requesting interconnection or an increase in the capacity of an existing generating facility to the Consumers Energy Electric System must provide the following information:

   a. Completed Interconnection Application Data sheet appropriate for the size and type of generating unit(s), as found in Consumers' Generator Interconnection Requirements (Interconnection Application Data sheet must be attached to this Interconnection Application).

   b. Description of the equipment configuration and proposed connection one-line diagram (one-line diagram must be attached to this Interconnection Application).

   c. Generator's contact person:
   Name: _____
   Address: _____
   _____
   Phone Number: _____
   Fax Number: _____
   e-mail Address: _____

3. This Generator Interconnection Application shall be directed to the Consumers Energy representative as indicated below:

   Tariff & Settlements Director
   Consumers Energy Company
   1945 West Parnall Road
   Jackson, MI 49201

4. I, the undersigned and authorized representative of the Generator, submit this Generator Interconnection Application and required technical data for Consumers Energy Company's review. I understand that upon acceptance, Consumers Energy shall subsequently provide an Interconnection Study Agreement, if said Interconnection Study is determined to be necessary. The Interconnection Study Agreement will include the Scope of the Interconnection Study. I also understand that I shall be required to furnish certain required technical data as requested by Consumers Energy in support of this study and a $4,000 study fee.

   Authorized Signature: _____

   Printed Name: _____

   Title: _____

   Company Name: _____

   Date: _____

APPENDIX B

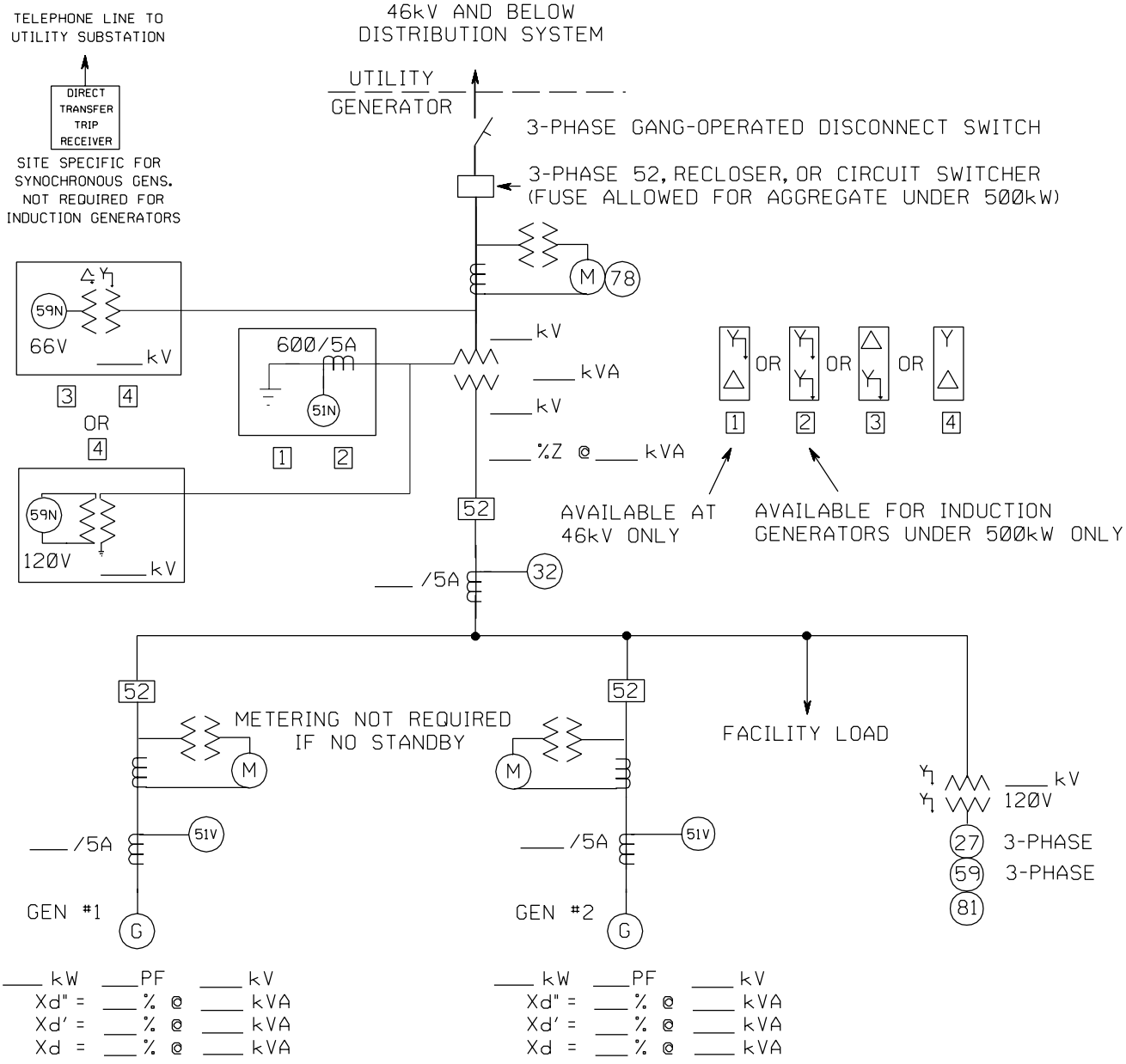
SYNCHRONOUS AND INDUCTION GENERATORS
AGGREGATE GENERATION 100 KW TO 999 KW

REQUIRED DATA

TYPICAL ONE-LINE DIAGRAM FOR SYNCHRONOUS & INDUCTION GENERATORS (THREE PHASE) AGGREGATE FACILITY GENERATION GREATER THAN 100kW SELLBACK AND NON - SELLBACK

EQUIPMENT SCHEDULE

ANSI #	TYPE	QTY	MFGR	MODEL	STYLE #	NOTES
27	UNDERVOLTAGE	3	BASLER	BE1-27	A3E-E1J-A0NOF	
32	DIRECTIONAL POWER	1	ABB	ABB-32R	437W487Ø	NOT REQUIRED FOR SELLBACK
51N	NEUTRAL OVERCURRENT	1	GE	IAC53	12IAC53A803A	SITE SPECIFIC
51V	VOLTAGE CONTROLLED OVERCURRENT	3/GEN	GE	IFCV	12IFCV51801A	NOT REQ. FOR INDUCTION GENS.
52	POWER CIRCUIT BREAKER	?	VARIOUS	VARIOUS	VARIOUS	
59	OVERVOLTAGE	3	BASLER	BE1-59	A3E-E1J-A0NOF	
59N	NEUTRAL OVERVOLTAGE	1	BASLER	BE1-59	A2E-E1K-A0ASF	SITE SPECIFIC
78	MULTI-FUNCTIONAL	1	SCHWEITZER	SEL-311C		SITE SPECIFIC
81	FREQUENCY	1	BASLER	BE1-810/U	T3E-E1J-A7NOF	



SYNCHRONOUS OR INDUCTION GENERATORS - AGGREGATE 100 KW TO 999 KW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the tables below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique transformer.

General Information

Item No	Data Description	Attached Page No
1	Sell-Back or Non-Sell-Back	
2	Plant Type (Base load, peaking, intermediate)	
3	Site Plan	
4	Simple One-Line for Plant and Plant Load	
5	Detailed One-Line for Plant	
6a	Energization Date for Plant Switchyard	
6b	First Parallel Operation Date for Testing	
6c	Plant Commercial Operation Date	

Isolating Transformer(s) between Generator(s) and Utility: Transformer No _____

Item No	Data Description	Attached Page No
1	Rated kV and connection (delta, wye, wye-gnd) of each winding	
2	kVA of each winding	
3	BIL of each winding	
4	Fixed taps available for each winding	
5	Positive/negative range for any LTC windings	
6	%Z Impedance on transformer self cooled rating	

The following information on these system components shall appear on the preliminary One-Line Diagram:

- Breakers - Rating, location and normal operating status (open or closed)
- Buses - Operating voltage
- Capacitors - Size of bank
- Circuit Switchers - Rating, location and normal operating status (open or closed)
- Current Transformers - Overall ratio, connected ratio
- Fuses - normal operating status
- Generators - Size, location, type, method of grounding
- Grounding Resistors - Size (ohms)
- Isolating transformers - Size, location, impedance, voltage ratings, primary and secondary connections and method of grounding
- Potential Transformers - Ratio, connection
- 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), type, rating
- Tagging Point - Location, identification

SYNCHRONOUS OR INDUCTION GENERATORS - AGGREGATE 100 KW TO 999 KW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the table below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique generator.

Electric Generator(s) at the Plant: Generator No _____

Item No	(1)	Data Description	Attached Page No
1		Generator Type (synchronous or induction)	
2a		Generator Nameplate Voltage	
2b		Generator Nameplate Watts or Volt-Amperes	
2c		Generator Nameplate Power Factor (pf)	
2d	NA	RPM	
3		Minimum and Maximum Acceptable Terminal Voltage	
4a	NA	Direct axis reactance (saturated)	
4b	NA	Direct axis reactance (unsaturated)	
4c	NA	Quadrature axis reactance (unsaturated)	
5a	NA	Direct axis transient reactance (saturated)	
5b	NA	Direct axis transient reactance (unsaturated)	
5c	NA	Quadrature axis transient reactance (unsaturated)	
6a	NA	Direct axis sub-transient reactance (saturated)	
6b	NA	Direct axis sub-transient reactance (unsaturated)	
7	NA	Leakage Reactance	
8a	NA	Direct axis transient open circuit time constant	
8b	NA	Quadrature axis transient open circuit time constant	
9a	NA	Direct axis subtransient open circuit time constant	
9b	NA	Quadrature axis subtransient open circuit time constant	
10	NA	Open Circuit saturation curve	
11		Reactive Capability Curve showing overexcited and underexcited limits (Reactive Information if non-synchronous)	
12	NA	Excitation System Block Diagram with values for gains and time constants (Laplace transforms)	
13		Short Circuit Current contribution from generator at the Connection Point	
14	NA	Rotating inertia of overall combination generator, prime mover, couplers and gear drives	
15a		Station Power load when generator is off-line, Watts, pf	
15b		Station Power load during start-up, Watts, pf	
15c		Station Power load during operation, Watts, pf	

(1) – NA indicates not required for induction generators.

APPENDIX C

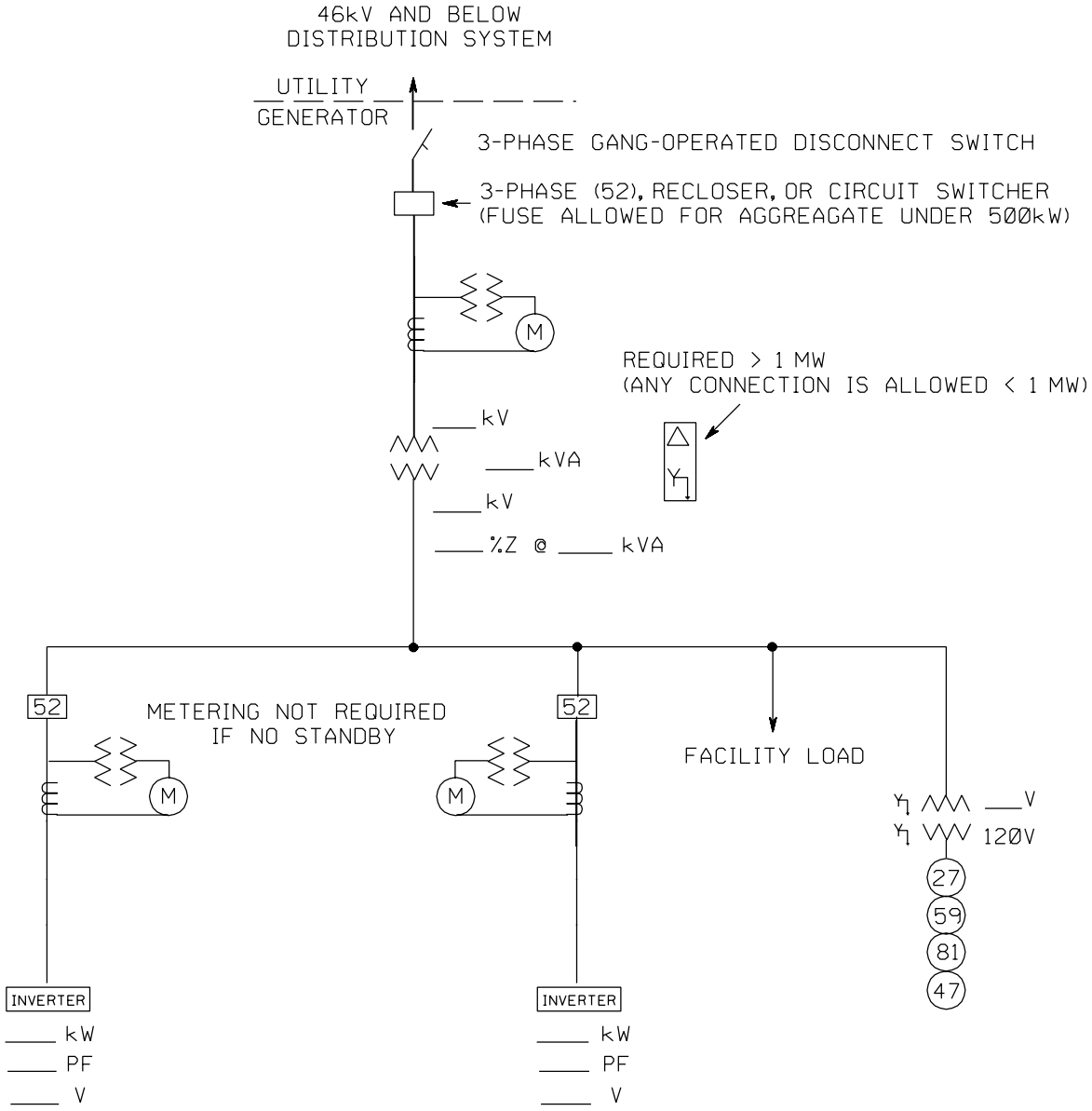
INVERTER-TYPE GENERATORS
AGGREGATE GENERATION 100 KW TO 999 KW

REQUIRED DATA

TYPICAL ONE-LINE DIAGRAM FOR INVERTER TYPE GENERATORS (THREE PHASE) AGGREGATE FACILITY GENERATION GREATER THAN 100kW SELLBACK AND NON - SELLBACK

EQUIPMENT SCHEDULE

ANSI #	TYPE	QTY	MFGR	MODEL	STYLE #	NOTES
27	UNDERVOLTAGE	3	BASLER	BE1-27	A3E-E1J-A0N0F	NOT REQUIRED FOR LESS THAN 1 MW IF ALL INVERTERS ARE UL-1741 LISTED
59	OVERVOLTAGE	3	BASLER	BE1-59	A3E-E1J-A0N0F	
81	FREQUENCY	1	BASLER	BE1-810/U	T3E-E1J-A7N0F	
47	PHASE SEQUENCE	1	ABB	ABB-470		
52	POWER CIRCUIT BREAKER	?	VARIOUS	VARIOUS		



INVERTER-TYPE GENERATORS - AGGREGATE 100 KW TO 999 KW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the table below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique transformer.

General Information

Item No	Data Description	Attached Page No
1	Sell-Back or Non-Sell-Back	
2	Plant Type (Base load, peaking, intermediate)	
3	Site Plan	
4	Simple One-Line for Plant and Plant Load	
5	Detailed One-Line for Plant	
6a	Energization Date for Plant Switchyard	
6b	First Parallel Operation Date for Testing	
6c	Plant Commercial Operation Date	

Isolating Transformer(s) between Generator(s) and Utility: Transformer No _____

Item No	Data Description	Attached Page No
1	Rated kV and connection (delta, wye, wye-gnd) of each winding	
2	kVA of each winding	
3	BIL of each winding	
4	Fixed taps available for each winding	
5	Positive/negative range for any LTC windings	
6	%Z Impedance on transformer self cooled rating	

The following information on these system components shall appear on the preliminary One-Line Diagram:

- Breakers - Rating, location and normal operating status (open or closed)
- Buses - Operating voltage
- Capacitors - Size of bank
- Circuit Switchers - Rating, location and normal operating status (open or closed)
- Current Transformers - Overall ratio, connected ratio
- Fuses - normal operating status
- Generators - Size, location, type, method of grounding
- Grounding Resistors - Size (ohms)
- Isolating transformers - Size, location, impedance, voltage ratings, primary and secondary connections and method of grounding
- Potential Transformers - Ratio, connection
- 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), type, rating
- Tagging Point - Location, identification

INVERTER-TYPE GENERATORS - AGGREGATE 100 KW TO 999 KW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the table below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique generator.

Electric Generator(s) at the Plant: Generator No _____

Item No	Data Description	Attached Page No
1	Generator Type (Inverter)	
2a	Generator Nameplate Voltage	
2b	Generator Nameplate Watts or Volt-Amperes	
2c	Generator Nameplate Power Factor (pf)	
3	Minimum and Maximum Acceptable Terminal Voltage	
4	Reactive Capability Curve showing overexcited and underexcited limits (Reactive Information if non-synchronous)	
5	Short Circuit Current contribution from generator at the Connection Point	

APPENDIX D

INTERCONNECTION STUDY AGREEMENT

Consumers Energy Company
[Generator]
Interconnection Study Agreement for
Generator Interconnection
With Aggregate Generator Output Between 100 kW and 999 kW

WHEREAS, proposals to construct or upgrade generation facilities which will be operated in parallel with and interconnected with Consumers Energy's ("Consumers") electric system must be reviewed by Consumers to determine how they will impact Consumers' electric system.

WHEREAS, on _____ Consumers received from _____ (the "Generator") a Generator Interconnection Application.

WHEREAS, Consumers has determined that an Interconnection Study is necessary to determine whether Consumers' electric system can accommodate the requested interconnection.

NOW, THEREFORE, in consideration of the mutual covenants and agreements herein set forth, Consumers and the Generator agree as follows:

1. Consumers shall complete an Interconnection Study in accordance with Consumers' Generator Interconnection Requirements and this Agreement.

2. The estimated charge for the Interconnection Study is $4,000, which is due and payable to Consumers upon its receipt of this executed Interconnection Study Agreement. The charge shall not exceed the actual cost of the study. Any adjustments to the Interconnection Study estimate shall be reconciled with refund due the Generator or additional payment due Consumers.

3. The Generator is to return this executed Interconnection Study Agreement along with all required technical data and the necessary reimbursement for the Interconnection Study to Consumers within fifteen (15) days of receipt by the Generator of an unexecuted Interconnection Study Agreement form. If that form is not executed and returned within fifteen (15) days along with the required technical data and study reimbursement, the Generator's Interconnection Application will be deemed withdrawn.

4. Upon its receipt of this executed Interconnection Study Agreement, required technical data that is acceptable to and meets Consumers' Generator Interconnection Requirements and the estimated reimbursement required for completion of the study, Consumers will use due diligence to complete the study within a sixty (60) day period. The study shall consist of power flow, relaying, short circuit, and if necessary, stability analysis. The outcome of the Interconnection Study will be the scope, good faith cost estimates, and project lead times for the interconnection facilities and system upgrades required to connect the generation project to Consumers' electric system.

5. In the event Consumers is unable to complete the required Interconnection Study within the sixty (60) day time period, it shall notify the Generator and provide an estimated completion date along with an explanation of the reasons why additional time is needed.

6. Consumers shall supply a copy of the completed Interconnection Study to the Generator.

7. At the completion of the Interconnection Study, Consumers shall tender to the Generator for execution a final draft of an Interconnection and Operating Agreement ("Interconnection Agreement"). The Generator shall have a period of fifteen (15) days after receipt of the Interconnection Agreement to execute and return the Interconnection Agreement. Pursuant to the Interconnection Agreement, the Generator shall agree to reimburse Consumers for the full cost of Consumers' Interconnection Facilities.

8. The Generator shall be required to reapply for interconnection if (a) the Generator has lost its position in the queue under the provisions of Consumers' Generator Interconnection Requirements, (b) project changes are made from the original application which increases plant sizing by fifteen percent (15%) or more, (c) the original location of the plant is moved, and the move affects the interconnection to the electric system, or (d) the in-service date of the project is

9. delayed by more than six (6) months from the in-service date entered on the Generator's Interconnection Application.

10. Any notice or request made to or by either Party regarding this Agreement shall be made to the representative of the other Party, or its designated agent, as indicated below.

Utility	Generator
Karen E. Feahr	
Consumers Energy Company	
1945 West Parnall Road	
Jackson, MI 49201	

IN WITNESS WHEREOF, the Parties have caused this Interconnection Study Agreement to be executed by their respective authorized officials.

Consumers Energy Company By:	By:
(Signature)	(Signature)
Karen E. Feahr (Typewritten or Printed Name)	(Typewritten or Printed Name)
Tariff & Settlements Director Title	Title
Date	Date

APPENDIX E

OPERATING AUTHORITY AGREEMENT

(current date)

[ ] SUBSTATION
OPERATING AUTHORITY AGREEMENT
Normal Operations and Emergency Switching

Operating Authority for [Generator] will be its Facilities Manager or a Company Officer, Area Code ( ) _____.

For normal operations, the Operating Authority for Consumers Energy will be the System Controller at:

Area Code (___) ___-____ or (800) ___-____

EMERGENCY SWITCHING PROCEDURES

All Emergency Switching Procedures for [ ] Substation will be under the direct supervision of the System Controller at:

Area Code (___) ___-____ or (800) ___-____

The ___ switch (see substation WD ____) will be opened by the [Generator] representative or at their discretion, the Consumers Energy "operator."

SCHEDULED OUTAGE PROCEDURE

1. Request initiated by [Generator]. [Generator] will contact the System Controller ____ at the phone numbers above to schedule and coordinate work.

2. Request initiated by Consumers Energy. The System Controller ____ will contact [Generator] to make necessary arrangements and to agree on switching procedures.

NOTE: Each authority will attempt to provide a minimum of 48 hours notice on scheduled weekday outage requests (weekends are not considered as part of required notice).

PROTECTIVE TAGGING PROCEDURE - SCHEDULED

The ___ switch will be considered as the normal tagging point between Consumers Energy and [ ] Substation.

The ___ switch (see substation WD ____) will be opened by the [Generator] representative or at their discretion, the Consumers Energy "operator."

CUSTOMER REQUESTS

1. When [Generator] requires protection to work on their equipment, [Generator] will contact the System Controller ____.

At [Generator]s' discretion, their representative can accompany the Consumers Energy "operator" and place a tag and lock on the protection points. Consumers Energy will inform [Generator] of the tagged protection points.

2. When work has been completed and Consumers Energy and [Generator] are ready, the station will be returned to normal by the Consumers Energy "operator."

CONSUMERS ENERGY REQUESTS

1. When Consumers Energy requires protection on their line exits:

Consumers Energy "operator" will request [Generator] representative or at [Generator]s' discretion, the Consumers Energy "operator" to open the ___ switch after checking the ___ circuit breaker open. The Consumers Energy "operator" will place Consumers Energy Personal Protective Tags and locks on the ___ switch.

2. When work has been completed, a Consumers Energy "operator," accompanied by [Generator]s' representative, will remove the tags and locks.

3. The ___ switch will be closed by [Generator] with the Consumers Energy "operator" present or at their discretion, the Consumers Energy "operator" will close the ___ switch.

CONSUMERS ENERGY ACCESS

Consumers Energy shall be allowed access to the substation by means of a Consumers Energy lock in combination with a [Generator]s' lock on the substation gate and ___ switch at all times.

Approved by _____ Approved by _____

Consumers Energy [Generator]

SC_ Superintendent [Title]

ATTACHMENT 3

Generator Interconnection Requirements

Generation Facilities with Aggregate Generator Output Of 1 MW or More

Effective May 1, 2001

INTRODUCTION

This document replaces the Consumers Energy document entitled "*CONSUMERS ENERGY COMPANY INTERCONNECTION REQUIREMENTS FOR GENERATION Effective 09/15/2000",* for purposes of interconnecting 1 MW or more of generation to the Consumers Energy electric system at voltages of 46 kV and below (or to 138 kV facilities classified as distribution).

This Generator Interconnection Requirements document contains the process, requirements, and agreements used to add or modify generation projects with aggregate generator output 1 MW or more, desiring to operate in parallel with the Consumers Energy electric system. Technical requirements (data, equipment, relaying, telemetry, metering) are defined according to the size and type of generation, location of the interconnection, and mode of operation (Sell-Back or Non-Sell-Back). The process is designed to provide an expeditious interconnection to the Consumers Energy electric system that is both safe and reliable.

Per Public Act 141 of 2000, subsection 10e(3): "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."

The term "Generator" will be used throughout this document to refer to the developers, owners, and operators of electric generating equipment interested in operating that equipment in parallel with the Consumers Energy electric system.

This document does not address other Generator concerns such as environmental permitting, local ordinances, or fuel supply. Nor does it address interconnection agreements that may be required with Consumers Energy and/or the transmission provider, or state or federal licensing, to market the Generator's energy. An interconnection request does not constitute a request for transmission service.

Generators requiring connection to 138 kV facilities classified as transmission or to 345 kV transmission facilities will be handled by the Michigan Electric Transmission Company and will use the Michigan Electric Transmission Company Interconnection Requirements for Generation document Effective April 1, 2001. Interconnection procedures and associated documents for transmission connected generators can be found in Attachment J of the Michigan Electric Transmission Company Open Access Transmission Tariff on file at the Federal Energy Regulatory Commission.

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CONTENTS

INTERCONNECTION PROCESS

The Interconnection Process

This section outlines the process for interconnecting 1 MW or more of generation to the Consumers Energy electric system. This includes both new generation projects and modifications to existing generation projects. The general process is shown in Figure 1.

Interconnection Application

The Generator must first submit an Interconnection Application to Consumers Energy. A blank Interconnection Application can be found in Appendix A. A list of the required interconnection data, depending on the size and type of generation, can be found in Appendices B and C.

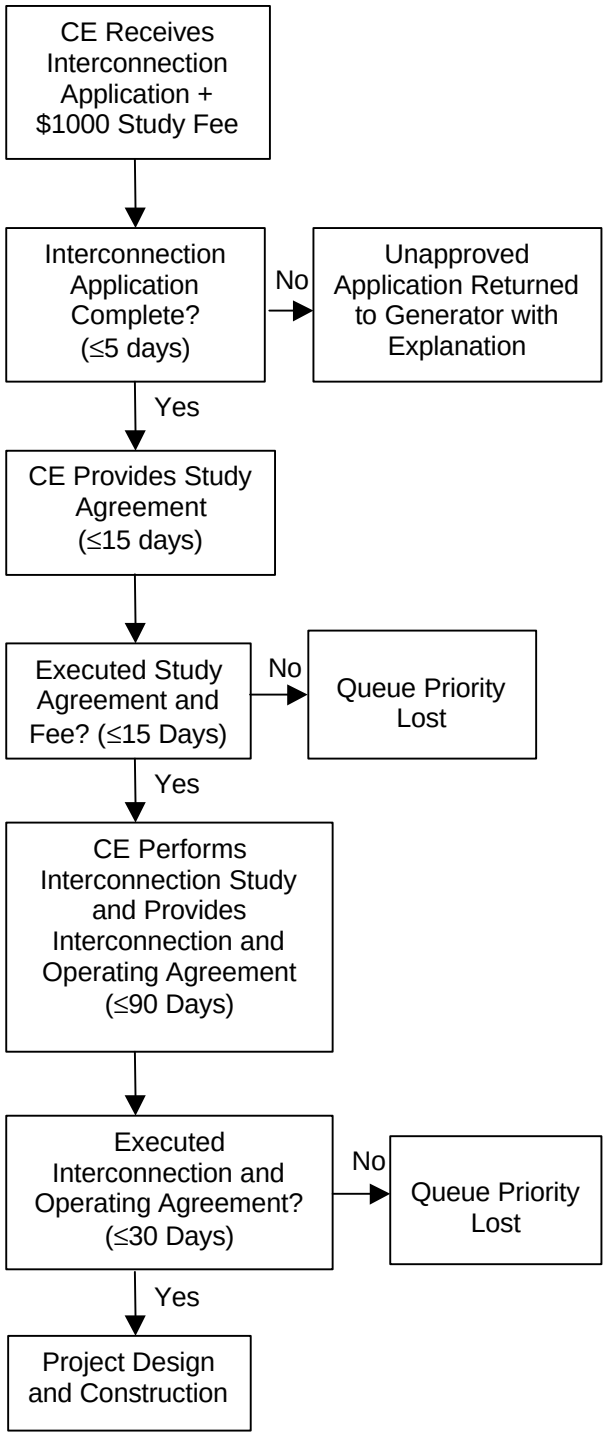
A complete submittal of required interconnection data and application fee of $1000 must accompany the application. Consumers Energy will notify the Generator when the application has been received. Consumers Energy will review the completeness of the Interconnection Application and inform the Generator of the status within 5 days of receiving the application. If any portion of the application, data submittal, or application fee is incomplete and/or missing, the unapproved application will be sent back to the Generator with the deficiencies clearly identified.

Once Consumers Energy has accepted an Interconnection Application, the generation project is considered in the generator queue. The generation project's position in the generator queue is determined by the date Consumers Energy received the accepted Interconnection Application.

Interconnection Study

Consumers Energy will send an Interconnection Study Agreement to the Generator within 15 days of accepting the Interconnection Application. The Interconnection Study Agreement will require the Generator to pay $6,000 for the study. The Generator will have 15 days to sign the Interconnection Study Agreement and return it, with the appropriate study fee, to Consumers Energy. Otherwise, the generation project's queue priority will be lost and the Generator will have to reapply for interconnection service. A sample Interconnection Study Agreement can be found in Appendix D.

Figure 1: The Interconnection Process



INTERCONNECTION PROCESS

Upon receiving a signed Interconnection Study Agreement and associated study fee within 15 days, Consumers Energy will proceed to complete the Interconnection Study within 90 days. The scope of the Interconnection Study will consist of power flow, short circuit, relaying, and stability analyses. If the study cannot be completed within 90 days, Consumers Energy will inform the Generator of the reason for, and extent of, the delay.

The outcome of the Interconnection study will be the scope, good faith cost estimates, and project lead times for the Interconnection Facilities and system upgrades required to connect the generation project to the Consumers Energy electric system.

Interconnection and Operating Agreement

Consumers Energy will submit an Interconnection and Operating Agreement to the Generator in final form at the conclusion of the Interconnection Study, or if an Interconnection Study.

The Interconnection and Operating Agreement shall cover matters customarily addressed in such agreements in accordance with Good Utility Practice, including, without limitation, construction of facilities, system operation, interconnection cost and billing, defaults and remedies, insurance and liability. In accordance with 2000 Michigan Public Act 141, all interconnection costs will be the responsibility of the interconnecting Generator.

The Generator will have 30 days to sign the Interconnection and Operating Agreement and return it to Consumers Energy. Otherwise, the generation project's queue priority will be lost and the Generator will have to reapply for interconnection service.

Project Design and Construction

After the Generator Interconnection and Operating Agreement is executed, Consumers Energy will proceed to acquire right-of-way, procure equipment, and design and construct the Interconnection Facilities.

TECHNICAL REQUIREMENTS

Technical Requirements

The following discussion details the technical requirements for interconnection of 1 MW or more of generation. Many of these requirements will vary based on the size of the generation facility, type of generation being used, and mode of operation (Sell-Back or Non-Sell-Back). A few of the requirements will vary based on location of the interconnection (isolated load and available fault current).

Certain major component, relaying, telemetry, and operational requirements must be met to provide compatibility between the generation project equipment and the Consumers Energy electric system, and to assure the safety and reliability of the electric system is not degraded by the interconnection.

Revenue metering is required for settlement purposes for interconnection power and/or for standby power.

Major Component Design Requirements

Data for all major equipment and relaying proposed by the Generator to satisfy the interconnection requirements must be submitted for review and approval by Consumers Energy.

Once installed, the interconnection equipment must be reviewed and approved by Consumers Energy prior to being connected to the Consumers Energy electric system and before Parallel Operation is allowed.

Data
The data that Consumers Energy requires to evaluate the proposed connection will vary with the type of generation being used. Initial data requirements are conveniently provided in the form of "fill in the blank" checklists by type in Appendices B and C.

A site plan, and preliminary (not including relaying) electrical one-lines of the generation facilities and the interconnection are required as part of the application data. Control schematics of protective relaying used to isolate faults on the Consumers Energy electric system will be required for the Interconnection Study. "Design Drawing Requirements" are detailed in the Generator Interconnection Supplement.

Isolating Transformer(s)
If an isolating transformer is required, the transformer must comply with the current ANSI Standard C57.12.

The transformer must have voltage taps on the high and/or low voltage windings sufficient to assure satisfactory generator operation over the range of voltage variation expected on the Consumers Energy electric system. The Generator also needs to assure sufficient voltage regulation at its facility to maintain an acceptable voltage level for its equipment during such periods when its generator(s) is off line. This may involve the provision of voltage regulation or a separate transformer between Consumers Energy and the generation facility station power bus.

The isolating transformer connections will be determined by the type of generation and electrical location of the interconnection. Allowable connections are detailed in "Relaying Design Requirements" under the specific generator type.

The proper selection and specification of transformer impedance is important relative to enabling the proposed generation facility to meet Consumers Energy's reactive power requirements (see "Reactive Power Control").

Circuit Breaker
If a main circuit breaker (or circuit switcher) between the isolating transformer and Consumers Energy is required (see applicable plan in Appendices B or C), the device must comply with the current ANSI Standard C37.

Any circuit breaker (or circuit switcher) must have adequate interrupting capability for the maximum expected short circuit duty. Consumers Energy will provide information identifying the contribution from the electric system to faults at the selected site. The Generator is responsible to perform the short-circuit study to determine if the protective devices can safely interrupt the short-circuit currents.

Main Disconnect Switch
A gang-operated disconnecting device must be located at the Connection Point and must at all times be accessible to Consumers Energy and be suitable for use by Consumers Energy as a protective tagging location.

TECHNICAL REQUIREMENTS

The device must comply with the current ANSI Standard C37.

This device shall have a visible open gap and be capable of being locked in the open position.

For facilities served from the 46 kV system, this disconnecting device must be mounted on the substation structure and have provided with it an operating platform which is properly grounded and designed in accordance with specifications to be provided by Consumers Energy. Access to the device must be restricted to Consumers Energy personnel and properly trained operators designated by the Generator.

Interconnection Lines
The interconnecting line(s) will most often be a distribution voltage (generally 2.4/4.16, 4.8/8.32, 7.2/12.47, or 14.4/24.9 kV), or 23, 46, or (radial) 138 kV. The physically closest available system voltage, as well as equipment and operational constraints influence the chosen point of interconnection. Consumers Energy has the ultimate authority to determine the acceptability of a particular Connection Point.

Any new line construction required for the interconnection will be undertaken by Consumers Energy at the Generator's expense. The new lines will terminate on a substation structure provided by the Generator.

Substation Structure
The Generator is responsible for ensuring that substation structural material strengths are adequate for all requirements, incorporating appropriate safety factors. Consumers Energy will provide line tension information for maximum transmission line dead-end tensions under heavy icing conditions. The structure must be designed for this maximum line tension along with an adequate margin of safety.

Substation electrical clearances shall comply with requirements of the National Electrical Safety Code and Michigan Public Service Commission Standard 16-79.

The installation of disconnect switches, bus support insulators, and other equipment shall comply with accepted industry practices.

Lightning arresters shall be selected to coordinate with the BIL rating of major equipment components and shall comply with recommendations set forth in the current ANSI Standard C62.2.

Relaying Design Requirements

The interconnection relaying design requirements are intended to assure protection of the Consumers Energy electric system. Any additional relaying which may be necessary to protect equipment at the generation facility is solely the responsibility of the Generator to determine, design, and apply.

The relaying requirements will vary with the size of the generation facility, the type of generation being used, and the mode of operation (Sell-Back or Non-Sell-Back).

All relaying proposed by the Generator to satisfy these requirements must be submitted for review and approval by Consumers Energy personnel.

Protective Relaying General Considerations
Utility grade relays are required. See "Approved Relays Types" in the Generator Interconnection Supplement.

All relays must be equipped with targets or other visible indicators to indicate that the relay has operated.

If the protective system uses AC power as the control voltage, it must be designed to disconnect the generation from the Consumers Energy electric system if the AC control power is lost.

The relay system must be designed such that the generator is prevented from energizing the Consumers Energy electric system if that system is de-energized.

Momentary Paralleling
For situations where generation will only be operated in parallel with the Consumers Energy electric system for a short duration (less than 1 second), as in a make-before-break automatic transfer scheme, no additional relaying is required. A modern integrated automatic transfer switch (ATS) system incapable of paralleling the generator with the Consumers Energy electric system for more than the time to operate the transfer is required. The ATS must be tested and verified for proper operation every 2 years.

TECHNICAL REQUIREMENTS

Instrument Transformer Requirements
All relaying must be connected into instrument transformers.

All current connections shall be connected into current transformers (CTs). All CTs shall be rated to provide no more than 5 amperes secondary current for all normal load conditions, and must be designed for relaying use, with an "accuracy class" of at least C50. Current transformers with an accuracy class designation such a T50 are NOT acceptable. For three-phase systems, all three phases must be equipped with CTs.

All potential connections must be connected into voltage transformers (VTs). For single-phase connections, the VTs shall be provided such that the secondary voltage does not exceed 120 volts for normal operations. For three-phase connections, the VTs shall be provided such that the line-to-line voltage does not exceed 120 volts for normal operation, and both the primary and secondary of the VTs shall be connected for grounded-wye connections.

Direct Transfer Trip (DTT)
DTT is generally not required for Induction or Inverter-Type generators. DTT is generally not required for Synchronous generation facilities that will operate in the Non-Sell-Back mode since a more economic reverse power relay scheme can usually meet the requirements. For Synchronous Sell-Back generation facilities the need for DTT is determined based on the location of the Connection Point to the Consumers Energy electric system. Consumers Energy requires DTT when the total generation within a protective zone is greater than 50% of the minimum Consumers Energy load that could be isolated along with the generation. This prevents sustained isolated operation of the generation for conditions where generator protective relaying may not otherwise operate (see "Isolated Operation" in the Generator Interconnection Supplement).

Direct transfer trip adds to the cost and complexity of an interconnection. A DTT transmitter is required for each Consumers Energy protective device whose operation could result in sustained isolated operation of the generator. An associated DTT receiver at the generation facility is required for each DTT transmitter. A phone Data Circuit is required between each transmitter and receiver.

Telemetry is required to monitor status of the DTT communication, even if telemetry would not otherwise have been required.

Consumers Energy will provide the receiver(s) that the Generator must install, and will install the transmitter(s) at the appropriate Consumers Energy protective devices at the Generator's expense.

Reverse Power Relaying for Non-Sell-Back
If metering for "Sell-Back" mode is not present, reverse power protection must be provided. The reverse power relaying will detect power flow from the generation facility into the utility system, and operation of the reverse power relaying will separate the generator(s) from the utility system.

Automatic Reclosing
Since most system faults are transient in nature, automatic multiple-shot reclosing has been installed on most of Consumers Energy's circuit breakers and circuit reclosers to increase the reliability of service to its customers. In addition, automatic single-phase overhead reclosers are regularly installed on distribution circuits to isolate faulted segments of these circuits.

In addition to the risk of damage to the generator, an out-of-phase reclosing operation may also present a hazard to the electric system equipment since this equipment may not be rated or built to withstand this type of reclosing.

To prevent out-of-phase reclosing, circuit breakers can be modified with voltage check relays. These relays block reclosing until the parallel generation is separated and the line is "dead." Hydraulic single phase overhead reclosers cannot be modified with voltage check relays; therefore, these devices will have to be either replaced with three phase overhead reclosers, which can be voltage controlled, or relocated beyond the generator location - depending upon the sectionalizing and protection requirements of the distribution circuit.
If the generator can be connected to more than one circuit, these revisions may be required on the alternate circuit(s) as well.

Consumers Energy will determine relaying and control equipment that needs to be installed to protect its own equipment from out-of-phase reclosing. Installation of this protection will be undertaken by Consumers Energy at the Generator's expense.

TECHNICAL REQUIREMENTS

Single-Phase Fusing
Consumers Energy also installs single-phase fuses on its distribution circuits to increase the reliability of service to its customers. Three-phase generator installations may require replacement of fuses with three-phase circuit breakers or circuit reclosers at the Generator's expense.

TECHNICAL REQUIREMENTS

Synchronous Generator Facilities 1 MW – 40 MW

Synchronous Generator Facilities
1 MW – 40 MW

Under/overfrequency relaying and under/overvoltage relaying are required. Each generator must also be equipped with voltage-controlled overcurrent relays to detect faults on the utility system. The under/overvoltage relaying must be either a three-phase relay or three single-phase relays, and three-phase voltage controlled overcurrent relaying must be provided. In order to minimize damage to both the generator system equipment and to utility system equipment for loss-of-synchronism (also called out-of-step), and to minimize disruptions to other utility customers in the area, out-of-step relaying may also be required. Consumers Energy has evaluated and approved a relay for this purpose, which would usually be installed at the same location as the metering, and would isolate the generation from the utility system.

If the facility is connected to an ungrounded distribution system, the secondary winding (utility side) of the isolation transformer must be connected delta.

If the facility is connected to a grounded distribution system, the developer has a choice of two different transformer connections:

1. The isolation transformer may be connected for a delta secondary (utility side) connection with any primary (generator side) connection, or

2. The isolation transformer may be connected for an ungrounded-wye secondary (utility side) connection with a delta primary (generator side) connection.

If the facility is connected to a grounded distribution system via one of the isolation transformer connections specified above, ground fault detection for utility faults must be provided, and will consist of a (59N) ground overvoltage relay. The specific application of this relay will depend on the connection of the isolation transformer:

1. If a delta secondary/grounded-wye primary connection is used, the (59N) relay will be connected into the secondary of a set of three-phase VTs, which will be connected grounded-wye primary, with the secondary connected delta with one corner of the delta left open. The (59N) relay will be connected across this open-corner.

2. If an ungrounded-wye secondary/delta primary connection is used, the (59N) relay will be connected into the secondary of a single VT that will be connected from the ungrounded-wye neutral of the isolation transformer to ground.

If the facility is connected to the 46 kV system, the isolation transformer connection will be determined by Consumers Energy for the specific system location. The potential connection alternatives will include all alternatives listed above for application on a grounded distribution system, but will add a possible connection of grounded-wye (utility side), delta (generator side). In the case of this additional isolation transformer connection, utility system ground fault detection will take the form of a time overcurrent relay connected into a current transformer located in the utility-side transformer neutral. This time overcurrent relay must have a very-inverse time characteristic.

For a sample One-Line Diagram of this type of facility including the various methods of (59N) application, see Appendix B.

TECHNICAL REQUIREMENTS

Synchronous Generator Facilities Over 40 MW

Synchronous Generator Facilities Over 40 MW

These facilities will normally be connected to the Michigan Electric Transmission Company transmission system. The interconnection process for those facilities connecting to the Michigan Electric Transmission Company will follow the procedures listed in Attachment J of the Michigan Electric Transmission Company Open Access Transmission Tariff. Connection requirements for 138 kV and 345 kV connected generators can be found in the Michigan Electric Transmission Company Interconnection Requirements for Generation.

Generation facilities above 40 MW aggregate that can be connected to the Consumers Energy electric system will usually be connected to the 46 kV system.

Under/overfrequency relaying and under/overvoltage relaying are required. Each generator must also be equipped with voltage-controlled overcurrent relays to detect faults on the utility system. The under/overvoltage relaying must be either a three-phase relay or three single-phase relays, and three-phase voltage controlled overcurrent relaying must be provided. In order to minimize damage to both the generator system equipment and to utility system equipment for loss-of-synchronism (also called out-of-step), and to minimize disruptions to other utility customers in the area, out-of-step relaying may also be required. Consumers Energy has evaluated and approved a relay for this purpose, which would usually be installed at the same location as the metering, and would isolate the generation from the utility system.

The isolation transformer connection for facilities of this size will be determined by Consumers Energy for the specific system location. The usual connection will be grounded-wye (utility side), delta (generator side). Utility system ground fault detection will take the form of a time overcurrent relay connected into a current transformer located in the utility-side transformer neutral. This time overcurrent relay must have a very-inverse time characteristic.

In some cases, the transformer grounding methods listed in the previous section (Synchronous Generator Facilities 1-40 MW) for connection to a grounded distribution system will be required by Consumers Energy. In these cases, the associated ground fault detection methods listed in the previous section will be required.

For a sample One-Line Diagram of this type of facility including the various methods of (59N) application, see Appendix B.

TECHNICAL REQUIREMENTS

Induction Generator Facilities Over 1 MW

Induction Generator Facilities Over 1 MW
Three-phase under/overvoltage relays and three-phase under/overfrequency relays must be provided. Utility-grade relays are required.

If the facility is connected to an ungrounded distribution system, the secondary winding (utility side) of the isolation transformer must be connected delta.

If the facility is connected to a grounded distribution system or to the 46 kV system, the developer has a choice of two different transformer connections:

1. The isolation transformer may be connected for a delta secondary (utility side) connection with any primary (generator side) connection, or

2. The isolation transformer may be connected for an ungrounded-wye secondary (utility side) connection with a delta primary (generator side) connection.

No protection for utility system ground faults is required.

For a sample One-Line Diagram of this type of facility, see Appendix B.

TECHNICAL REQUIREMENTS

Inverter-Type Generator Facilities Over 1 MW

Inverter-Type Generator Facilities Over 1 MW
Under/overfrequency relaying and under/overvoltage relaying are required. The under/overvoltage relaying must be either a three-phase relay or three single-phase relays.

The isolation transformer must be incapable of producing ground fault current to the utility system; any connection except delta primary (generator side), grounded-wye secondary (utility side) is acceptable. The isolation transformer must be protected for internal faults; fuses are acceptable.

No protection for utility system ground faults is required.

For a sample One-Line Diagram of this type of facility, see Appendix C.

TECHNICAL REQUIREMENTS

Relay Setting Criteria
The relay settings as detailed in this section will apply in the vast majority of applications. Consumers Energy will issue relay settings for each individual project that will address the settings for these protective functions. All voltages will be adjusted for the specific VT ratio, and all currents will be adjusted for the specific CT ratio.

Undervoltage Relays
The undervoltage relays will normally be set to trip at 90% of the nominal primary voltage at the relay location, and must reset from a trip condition if the voltage increases to 92% of the nominal primary voltage at the relay location. In order to accommodate variations in this criteria, the trip point of the relays shall be adjustable over a range of 70% of the nominal voltage to 90% of the nominal voltage. The trip time shall not exceed 1.0 seconds at 90% of the relay setting.

Overvoltage Relays
The overvoltage relays will normally be set to trip at 107% of the nominal primary voltage at the relay location, and must reset from a trip condition if the voltage decreases to 105% of the nominal primary voltage at the relay location. In order to accommodate variations in this criteria, the trip point of the relays shall be adjustable over a range of 105% of the nominal voltage to 120% of the nominal voltage. The trip time shall not exceed 1.0 seconds at 110% of the relay setting.

Underfrequency Relays
The Underfrequency relay will normally be set for a trip point of 59.0 Hz, and must trip within 1.0 seconds. Relays with an inverse time characteristic (where the trip time changes with respect to the applied frequency) are not acceptable. These relays must respond reliably for applied source voltages as low as 70% of the nominal voltage.

Overfrequency Relays
The overfrequency relay will normally be set for a trip point of 61.0 Hz, and must trip within 1.0 seconds. Relays with an inverse time characteristic are not acceptable. These relays must respond reliably for applied source voltages as low as 70% of the nominal voltage.

51V Relays – Voltage Controlled Overcurrent Relays
For synchronous generator applications, the (51V) relays must be set to detect any phase faults that may occur between the generator and the nearest three-phase fault clearing device on the utility system. Since these faults may take up to 1-second to detect and isolate, the appropriate saturated direct-axis reactance of the generator will be used depending on its time constants. The settings of this device will consider the relay manufacturer's recommended practice for the type of generator and prime mover (mechanical energy source), and will be determined by Consumers Energy for the specific system application.

59N Relay – Ground Fault Detection
This relay will be applied to detect ground faults on the utility system when the generator facility is connected to a grounded utility system via an ungrounded transformer winding. This relay will be set for a 10% shift in the apparent power system neutral. For an ungrounded wye transformer winding with a single 120 V secondary VT, the setting will usually be 12 Volts. For a delta transformer winding with broken delta 120 V secondary VTs, the setting will usually be 20 Volts. The time delay will normally be 1 second.

51N Relay – Ground Fault Detection
This relay will be applied to detect ground faults on the utility system when the generator facility is connected to a grounded utility system via a grounded-wye transformer winding, and will be connected into a CT in the transformer neutral connection. This relay will be set to detect faults on the directly connected utility system, and the timing will be set to comply with utility practice for overcurrent relay coordination. The CT ratio and specific relay setting will be determined via a fault study performed by Consumers.

32 Relay – Reverse Power
The reverse power relay must be selected such that it can detect a power flow into the utility system of a small fraction of the overall generator capacity. The relay will normally be set near its minimum (most sensitive) setting, and will trip after a 1 second time delay. The delay will avoid unnecessary tripping for momentary conditions.

TECHNICAL REQUIREMENTS

Maintenance and Testing
Consumers Energy reserves the right to test the relaying and control equipment that involves protection of the Consumers Energy electric system whenever Consumers Energy determines a reasonable need for such testing exists.

The Generator is solely responsible for conducting proper periodic maintenance on the generating equipment and its associated control, protective equipment, interrupting devices, and main Disconnect Switch.

The Generator is responsible for the periodic scheduled maintenance on those relays, interrupting devices, control schemes, and batteries that involve the protection of the Consumers Energy electric system. A periodic maintenance program is to be established to test these relays every 2 years. This maintenance testing must be witnessed by Consumers Energy.

Each routine maintenance check of the relaying equipment shall include both an exact calibration check and an actual trip of the circuit breaker or contactor from the device being tested. For each test, a report shall be submitted to Consumers Energy indicating the results of the tests made and the "as found" and "as left" relay calibration values. Visually setting, without verification, a calibration dial or tap is not considered an adequate relay calibration check.

In the event there is demonstrated electrical interference (i.e. Voltage Flicker, Harmonic Distortion, etc.) to Consumers Energy's customers, suspected to be caused by the generator, and such interference exceeds then current system standards, Consumer Energy reserves the right, at Consumers Energy's initial expense, to install special test equipment as may be required to perform a disturbance analysis and monitor the operation and control of the generator to evaluate the quality of power produced by the generator. In the event that no standards exist, then the applicable tariffs and rules governing electric service shall apply. If the generator is proven to be the source of the interference, and that interference exceeds Consumers Energy's standards or the generally accepted industry standards, then it shall be the responsibility of the Generator to eliminate the interference problem and to reimburse Consumers Energy for the costs of the disturbance analysis excluding the cost of the meters or other special test equipment.

Installation and Design Approval
Consumers Energy will review the design drawings, for approval, after the Interconnection Study has been completed. The design drawings must be submitted by the Generator in accordance with "Engineering Design Drawing Requirements"(see Generator Interconnection Supplement). Consumers Energy shall either approve the Generator's design drawings as submitted or return them to the Generator with a clear statement as to why they were not approved. Where appropriate, Consumers Energy will indicate required changes on the engineering drawings.

In the event that revisions are necessary to the Generator's submitted design drawings and the Generator submits revised design drawings to Consumers Energy, then Consumers Energy shall either approve, in writing, the Generator's revised design drawings as resubmitted, or return them to the Generator with a clear statement as to why they were not approved. Where appropriate, Consumers Energy will indicate required changes on the engineering drawings.

Consumers Energy will retain one copy of the approved design drawings.

In the event that Consumers Energy exercises its option to Acceptance Test the proposed Generator relays that protect the Consumers Energy electric system, then Consumers Energy shall communicate the results of that testing to the Generator for both the relays and the necessary documentation on the relays.

Prior to final approval for Parallel Operation, Consumers Energy's specified relay calibration settings shall be applied and an Acceptance Test for Service must be performed on the Generator relaying and control equipment that involves the protection of the Consumers Energy electric system. The Acceptance Test for Service must be witnessed by Consumers Energy and can be performed by Consumers Energy at the Generator's request. Upon satisfactory completion of this test and final

inspection, Consumers Energy will provide written permission for Parallel Operation. If the results are unsatisfactory, Consumers Energy will provide written communication of these results to the Generator.

In the event the Generator proposes a revision to Consumers Energy's approved relaying and control equipment used to protect the Consumers Energy electric system and submits a description and engineering design drawings of the proposed changes, Consumers Energy shall either approve the Generator's amended design drawings or return them to the Generator with a clear statement as to why they were not approved. Where appropriate, Consumers Energy will indicate required changes on the engineering drawings.

Telemetry and Disturbance Monitoring Requirements

Telemetry and disturbance monitoring is always required for generation facilities that will operate in the Sell-Back Mode and have the capability to supply aggregate generation of 1 MW or more to Consumers Energy. For generation facilities that will operate in the Non-Sell-Back Mode, the requirement for telemetry will be determined on a case by case basis as part of the Interconnection Study.

Telemetry enables Consumers Energy to operate the electric system safely and reliably under both normal and emergency conditions. Consumers Energy measures its internal load plus losses (generation) on a real time basis via an extensive telemetry system. This system sums all energy flowing into the Consumers Energy electric system from generation facilities connected to the system and from interconnections with other utilities. During system disturbances when portions of the electrical systems are out of service, it is essential to know if a generator is on line or off line to determine the proper action to correct the problem. Time saved during restoration activities translates to fewer outages and outages of shorter duration for Consumers Energy's customers.

Consumers Energy evaluates the performance of the overall protective system for all faults on the electric system. It is critical that sufficient monitoring of the protective system is in place to determine its response. It is preferable to deploy disturbance monitoring into all generation facilities, but it can be expensive to deploy. Therefore, disturbance monitoring is required only for installations that already require telemetry.

The Generator shall provide a suitable indoor location, approved by Consumers Energy, for Consumers Energy's owned, operated, and maintained Remote Terminal Unit (RTU). The location must be equipped with a 48 V or 125 V DC power supply. The Generator must provide a properly protected phone Data Circuit and telephone board to be connected to the Consumers Energy RTU. See "Typical RTU Installation Where Telemetry is Required" in the Generator Interconnection Supplement.

When telemetry is required the following values will be telemetered:

1. Real and reactive power flow between the generation facility and the Consumers Energy electric system.

2. Bus voltage at the Connection Point.

3. The status (normal/fail) of protective relay Communication Channels. A status indication of "FAIL" indicates the Communication Channel used for relaying (i.e. transfer trip) is unable to per form its protective function.

4. The status (open/closed) of the main isolating breaker and each generating unit breaker (if the generation facility is composed of multiple units of 2 MW or less, a single logical (OR) status of the individual generator breaker states, indicating all generator breakers are open or any one or more generator breakers are closed, is permissible). A closed status would be indicated if any individual generator is on line.

The RTU will be equipped with "sequence of events" recording.

A. For 1-40 MW, the Generator shall provide, wired to a terminal block near the RTU

panel, sufficient connections to separately monitor the following:

1. Each and every trip of an interconnecting isolation device which is initiated by any of the generator interconnection relaying schemes required by Consumers Energy.

2. Each and every trip of an interconnecting isolation device which is initiated by any of the protective systems for the generator.

3. Each and every trip or opening of an interconnecting isolation device which is initiated by any other manual or electrical means.

4. The following individual contacts from each individual Direct Transfer Trip receiver required by Consumers Energy:
   i. Loss of guard (LOG) alarm
   ii. Receive trip relay (RTX)
   iii. Lockout relay

B. For greater than 40 MW, the Generator shall provide, wired to a terminal block near the RTU panel, the following general equipment Auxiliary Contacts and relay contacts:

1. An instantaneous relay to act as a ground fault detector for faults on the Consumers Energy electric system. This relay shall be connected into the same sensing source as the ground fault protective relay required by Consumers Energy.

2. A contact indicating operation of the over/undervoltage relays.

3. A contact indicating operation of the under/overfrequency relay or Consumers Energy's ground fault relay.

4. A contact indicating operation of the Generator-provided transformer bank relaying.

5. A contact indicating the position of the generator's primary-side main breaker.

6. A contact indicating operation of any of the (51V) relaying.

7. The following individual contacts from each individual Direct Transfer Trip receiver, required by Consumers Energy:
   i. Loss-of-guard (LOG) alarm.
   Ii. Receive-trip relay (RTX).
   iii. Lockout relay.

8. A contact indicating the position of the high-side fault clearing device.

9. A contact indicating the operation of the reverse power relay, if said relay is required by Consumers Energy.

Telemetry, when required, will be provided by Consumers Energy at the Generator's expense. In addition to other telemetry costs, a one-time charge will be assessed to the Generator for equipment and software installed at Consumers Energy's System Control Center to process the data signals.

Miscellaneous Operational Requirements

Miscellaneous requirements include synchronizing equipment for Parallel Operation, reactive requirements, standby power considerations, and system stability limitations.

Operating in Parallel
The Generator will be solely responsible for the required synchronizing equipment and for properly synchronizing the generation with the Consumers Energy electric system.

Voltage fluctuation at the Connection Point during synchronizing shall be limited to $\pm$5%.

The Generator will notify Consumers Energy's System Control prior to synchronizing to and prior to scheduled disconnection from the electric system.

Reactive Power Control
Synchronous generators that will operate in the Sell-Back Mode must be dynamically capable of providing 0.90 power factor lagging (delivering

reactive power to Consumers Energy) and 0.95 power factor leading (absorbing reactive power from Consumers Energy) at the Connection Point.

Induction and Inverter-Type generators which will operate in the Sell-Back Mode must:

1. Install a var supply source to maintain a 0.90 power factor lagging at the Connection Point; or

2. Provide Consumers Energy with funds for the installation of a var supply source equal to the generator reactive requirement of 0.90 power factor at full output.

There are no interconnection reactive power capability requirements for Synchronous, Induction, and Inverter-Type generators that will operate in the Non-Sell-Back Mode. Existing rate tariffs set forth in Consumers Energy's Standard Rules and Regulations contain power factor adjustments (credits and penalties) based on the power factor of the metered load at these facilities.

Standby Power
Unless the generating facility incorporates its own auxiliary power source, such as a diesel generator, separate arrangements must be made with Consumers Energy for provision of this backup power, or for any power needed for construction. Any such power provided will be under the terms of an approved rate set forth in Consumers Energy's Standard Rules and Regulations. The Generator should be aware that to qualify for Standby Rates, a separate meter must be installed at the generator.

If outside of Consumers Energy's franchise area, it will be the Generator's responsibility to arrange contractually and technically for the supply of its facility's standby, maintenance, and any supplemental power needs.

System Stability and Site Limitations
Consumers Energy requires a stability study for synchronous generation facilities if the aggregate generation is greater than 25 MW. A stability study may also be required for smaller synchronous generation facilities, depending on the Stiffness Ratio at the Connection Point. If the Stiffness Ratio is very low, special generator trip schemes or loss of synchronism (out-of-step) relay protection will be required. This type of protection is typically applied at the Connection Point and trips the entire generation facility, if instability is detected, to protect the Consumers Energy electric system and its customers. Consumers Energy generally will not require such protection at a Connection Point with a Stiffness Ratio of 40 or greater.

The Generator is responsible for evaluating the consequences of unstable generator operation on the equipment at the generation facility, and determining, designing, and applying any relaying which may be necessary to protect that equipment from unstable generator operation. This type of protection is typically applied on individual generators to protect the generator facilities.

Revenue Metering Requirements

Consumers Energy will own, operate, and maintain the billing metering equipment at the Generator's expense. The billing metering will meter both real and reactive interconnection flows between the generation facility and the Consumers Energy electric system. Where applicable, separate metering of station power may be required to accurately meter the generation facility load when the generator is off line.

Special billing metering will be required for generators operating in the Sell-Back Mode. If telemetering is required, the billing metering will be included as part of the telemetering installation.

The Generator shall provide a suitable indoor location, approved by Consumers Energy, for Consumers Energy's owned, operated, and maintained billing metering.

Normally, metering equipment are stock items for Consumers Energy, but there may be times when this equipment will have to be ordered and it may have a substantial delivery time. This is especially true for high voltage connections. It is in the best interest of the Generator to contact Consumers Energy early in the design process to avoid any delays in the arrival of the metering equipment.

TECHNICAL REQUIREMENTS

The Generator shall provide authorized employees and agents of Consumers Energy access to the premises at all reasonable hours to install, turn on, disconnect, inspect, test, read, repair, or remove the metering equipment. The Generator may, at its option, have a representative witness this work.

The metering installations for generation facilities shall be constructed in accordance with the practices, which normally apply to the construction of metering installations for commercial, industrial, or other customers with demand recording equipment.

Consumers Energy shall supply to the Generator the standard detailed specifications and requirements relating to the location, construction, and access of the metering installation and will provide consultation pertaining to the meter installation as required.

Consumers Energy 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. Consumers Energy will endeavor to coordinate the delivery of these materials with the Generator's installation schedule.

The Generator shall provide a mounting surface for the meters, recorders, connection cabinets, a housing for the instrument transformers, a conduit for the conductors between the instrument transformer secondary windings and the meter connection cabinets, and a conduit for the communication links, if required. All of this equipment must meet Consumers Energy's specifications and requirements.

The responsibility for the installation of the equipment is shared between Consumers Energy and the Generator, with the Generator generally installing all of the equipment on its side of the Connection Point, including instrument transformers, cabinets, conduits, and mounting surfaces. Consumers Energy, or its agents, shall install the meters, recorders, and communication links. Consumers Energy will endeavor to coordinate the installation of these items with the Generator's schedule.

Specific installation details and responsibilities will be established between Consumers Energy and the Generator after completion of the Interconnection Study.

Telephone Circuits

For Sell-Back generation facilities, a standard Voice Circuit will be required for accessing the billing meters.

If Telemetry is required, a Data Circuit must be installed as specified by the local telephone utility. The circuit must be enclosed in conduit from the RTU to the point of connection to the telephone utility equipment. Wall space must be provided for adjacent mounting, next to the telephone board, of the billing metering panel and a telemetering enclosure. The billing meter panel typically is 60 inches high by 48 inches wide and the telemetering enclosure typically is 24 inches high by 24 inches wide. A clear space of 4.5 feet in front of this equipment is required to permit maintenance and testing. A review of each installation shall be made to determine the location and space requirements most agreeable to Consumers Energy and the Generator.

If DTT is required, a separate Data Circuit must be installed as specified by the local telephone utility for each DTT receiver.

If a Data Circuit is required, a standard Voice Circuit is required during testing to communicate with personnel performing the master station portion of the tests. A circuit with modular jack and instrument (telephone) at the RTU is acceptable.

Consumers Energy will cooperate to provide utility information necessary for proper installation of the telephone circuits.

The Generator is responsible for ordering and acquiring the telephone circuits required for the generator interconnection. The Generator will assume all installation, operating, and maintenance costs associated with the telephone circuits, including the monthly charges for the telephone lines.

APPENDIX A

INTERCONNECTION APPLICATION

GENERATOR INTERCONNECTION APPLICATION

AGGREGATE GENERATOR OUTPUT OF 1 MW OR MORE

1. The undersigned Generator submits this Generator Interconnection Application and $1,000 application fee to interconnect a new generating facility to the Consumers Energy Electric System or to increase the capacity of an existing generating facility connected to the Consumers Energy Electric System.

2. A Generator requesting interconnection or an increase in the capacity of an existing generating facility to the Consumers Energy Electric System must provide the following information:

   a. Completed Interconnection Application Data sheet appropriate for the size and type of generating unit(s), as found in Consumers' Generator Interconnection Requirements (Interconnection Application Data sheet, found in Appendix B or C, must be attached to this Interconnection Application).

   b. Description of the equipment configuration and proposed connection one-line diagram (one-line diagram must be attached to this Interconnection Application).

   c. Generator's contact person:
   Name: _____
   Address: _____
   _____
   Phone Number: _____
   Fax Number: _____
   e-mail Address: _____

3. This Generator Interconnection Application shall be directed to the Consumers Energy representative as indicated below:

   Tariff & Settlements Director
   Consumers Energy Company
   1945 West Parnall Road
   Jackson, MI 49201

4. I, the undersigned and authorized representative of the Generator, submit this Generator Interconnection Application and required technical data for Consumers Energy Company's review. I understand that upon acceptance, Consumers Energy shall subsequently provide an Interconnection Study Agreement. The Interconnection Study Agreement will include the Scope of the Interconnection Study. I also understand that I shall be required to furnish certain required technical data as requested by Consumers Energy in support of this study and a $6,000 estimated study fee.

   Authorized Signature: _____

   Printed Name: _____

   Title: _____

   Company Name: _____

   Date: _____

APPENDIX B

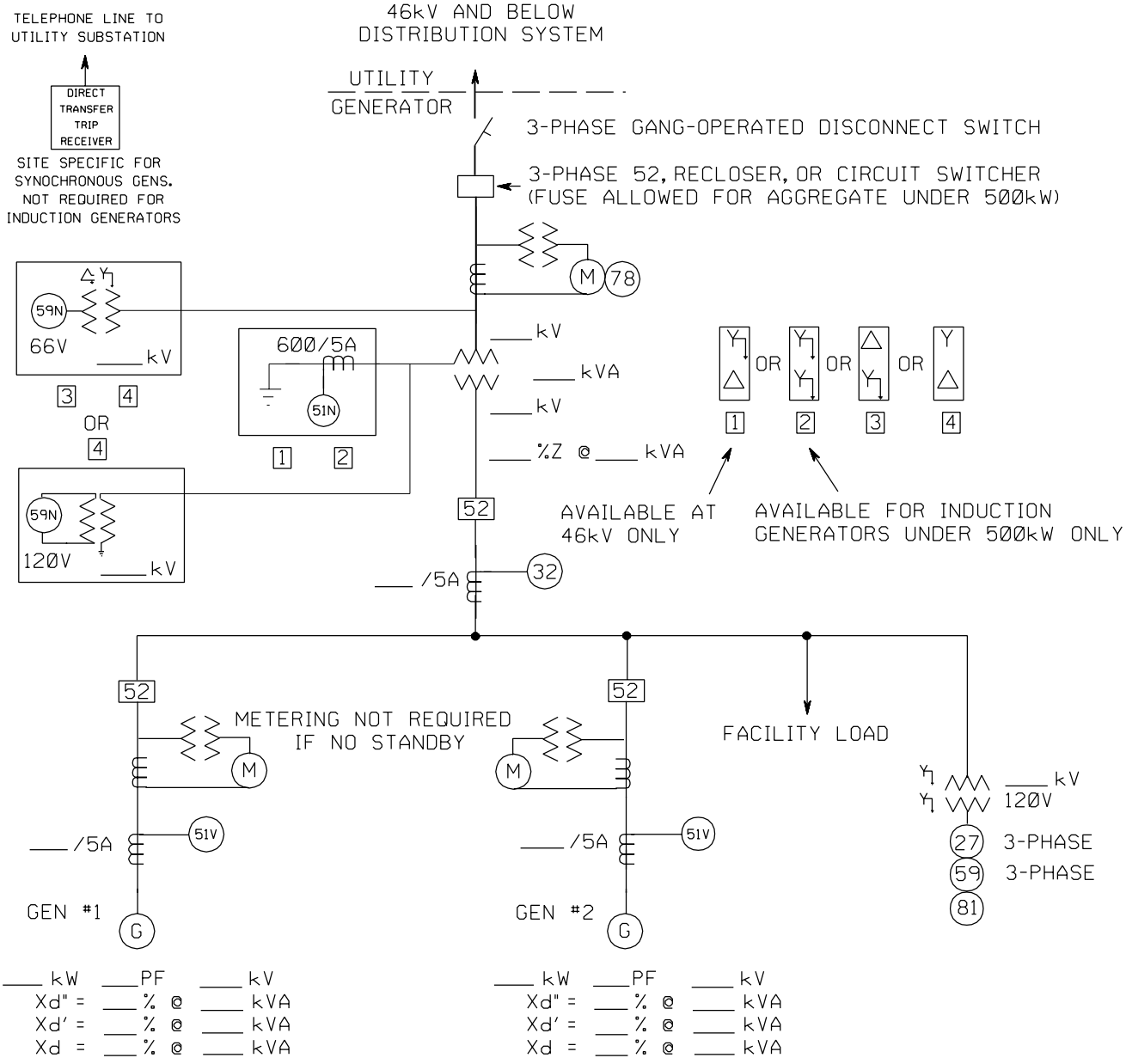
SYNCHRONOUS AND INDUCTION GENERATORS AGGREGATE GENERATION OF 1 MW OR MORE

REQUIRED DATA

TYPICAL ONE-LINE DIAGRAM FOR SYNCHRONOUS & INDUCTION GENERATORS (THREE PHASE) AGGREGATE FACILITY GENERATION GREATER THAN 100kW SELLBACK AND NON - SELLBACK

EQUIPMENT SCHEDULE

ANSI #	TYPE	QTY	MFGR	MODEL	STYLE #	NOTES
27	UNDERVOLTAGE	3	BASLER	BE1-27	A3E-E1J-A0NOF	
32	DIRECTIONAL POWER	1	ABB	ABB-32R	437W487Ø	NOT REQUIRED FOR SELLBACK
51N	NEUTRAL OVERCURRENT	1	GE	IAC53	12IAC53A803A	SITE SPECIFIC
51V	VOLTAGE CONTROLLED OVERCURRENT	3/GEN	GE	IFCV	12IFCV51801A	NOT REQ. FOR INDUCTION GENS.
52	POWER CIRCUIT BREAKER	?	VARIOUS	VARIOUS	VARIOUS	
59	OVERVOLTAGE	3	BASLER	BE1-59	A3E-E1J-A0NOF	
59N	NEUTRAL OVERVOLTAGE	1	BASLER	BE1-59	A2E-E1K-A0ASF	SITE SPECIFIC
78	MULTI-FUNCTIONAL	1	SCHWEITZER	SEL-311C		SITE SPECIFIC
81	FREQUENCY	1	BASLER	BE1-810/U	T3E-E1J-A7NOF	



SYNCHRONOUS OR INDUCTION GENERATORS - AGGREGATE ≥ 1 MW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the tables below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique transformer.

General Information

Item No	Data Description	Attached Page No
1	Sell-Back or Non-Sell-Back	
2	Plant Type (Base load, peaking, intermediate)	
3	Site Plan	
4	Simple One-Line for Plant and Plant Load	
5	Detailed One-Line for Plant	
6a	Energization Date for Plant Switchyard	
6b	First Parallel Operation Date for Testing	
6c	Plant Commercial Operation Date	

Isolating Transformer(s) between Generator(s) and Utility: Transformer No _____

Item No	Data Description	Attached Page No
1	Rated kV and connection (delta, wye, wye-gnd) of each winding	
2	kVA of each winding	
3	BIL of each winding	
4	Fixed taps available for each winding	
5	Positive/negative range for any LTC windings	
6	%Z Impedance on transformer self cooled rating	
7	Percent excitation current at rated kV	
8	Load Loss Watts at full load or X/R ratio	

The following information on these system components shall appear on the preliminary One-Line Diagram:

- Breakers - Rating, location and normal operating status (open or closed)
- Buses - Operating voltage
- Capacitors - Size of bank
- Circuit Switchers - Rating, location and normal operating status (open or closed)
- Current Transformers - Overall ratio, connected ratio
- Fuses - normal operating status
- Generators - Size, location, type, method of grounding
- Grounding Resistors - Size (ohms)
- Isolating transformers - Size, location, impedance, voltage ratings, primary and secondary connections and method of grounding
- Potential Transformers - Ratio, connection
- 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), type, rating
- Tagging Point - Location, identification

SYNCHRONOUS OR INDUCTION GENERATORS - AGGREGATE ≥ 1 MW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the table below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique generator.

Electric Generator(s) at the Plant: Generator No _____

Item No	(1)	Data Description	Attached Page No
1		Generator Type (synchronous or induction)	
2a		Generator Nameplate Voltage	
2b		Generator Nameplate Watts or Volt-Amperes	
2c		Generator Nameplate Power Factor (pf)	
2d	NA	RPM	
3		Minimum and Maximum Acceptable Terminal Voltage	
4a	NA	Direct axis reactance (saturated)	
4b	NA	Direct axis reactance (unsaturated)	
4c	NA	Quadrature axis reactance (unsaturated)	
5a	NA	Direct axis transient reactance (saturated)	
5b	NA	Direct axis transient reactance (unsaturated)	
5c	NA	Quadrature axis transient reactance (unsaturated)	
6a	NA	Direct axis sub-transient reactance (saturated)	
6b	NA	Direct axis sub-transient reactance (unsaturated)	
7	NA	Leakage Reactance	
8a	NA	Direct axis transient open circuit time constant	
8b	NA	Quadrature axis transient open circuit time constant	
9a	NA	Direct axis subtransient open circuit time constant	
9b	NA	Quadrature axis subtransient open circuit time constant	
10	NA	Open Circuit saturation curve	
11		Reactive Capability Curve showing overexcited and underexcited limits (Reactive Information if non-synchronous)	
12	NA	Excitation System Block Diagram with values for gains and time constants (Laplace transforms)	
13		Short Circuit Current contribution from generator at the Connection Point	
14	NA	Rotating inertia of overall combination generator, prime mover, couplers and gear drives	
15a		Station Power load when generator is off-line, Watts, pf	
15b		Station Power load during start-up, Watts, pf	
15c		Station Power load during operation, Watts, pf	

(1) – NA indicates not required for Induction Generators.

APPENDIX C

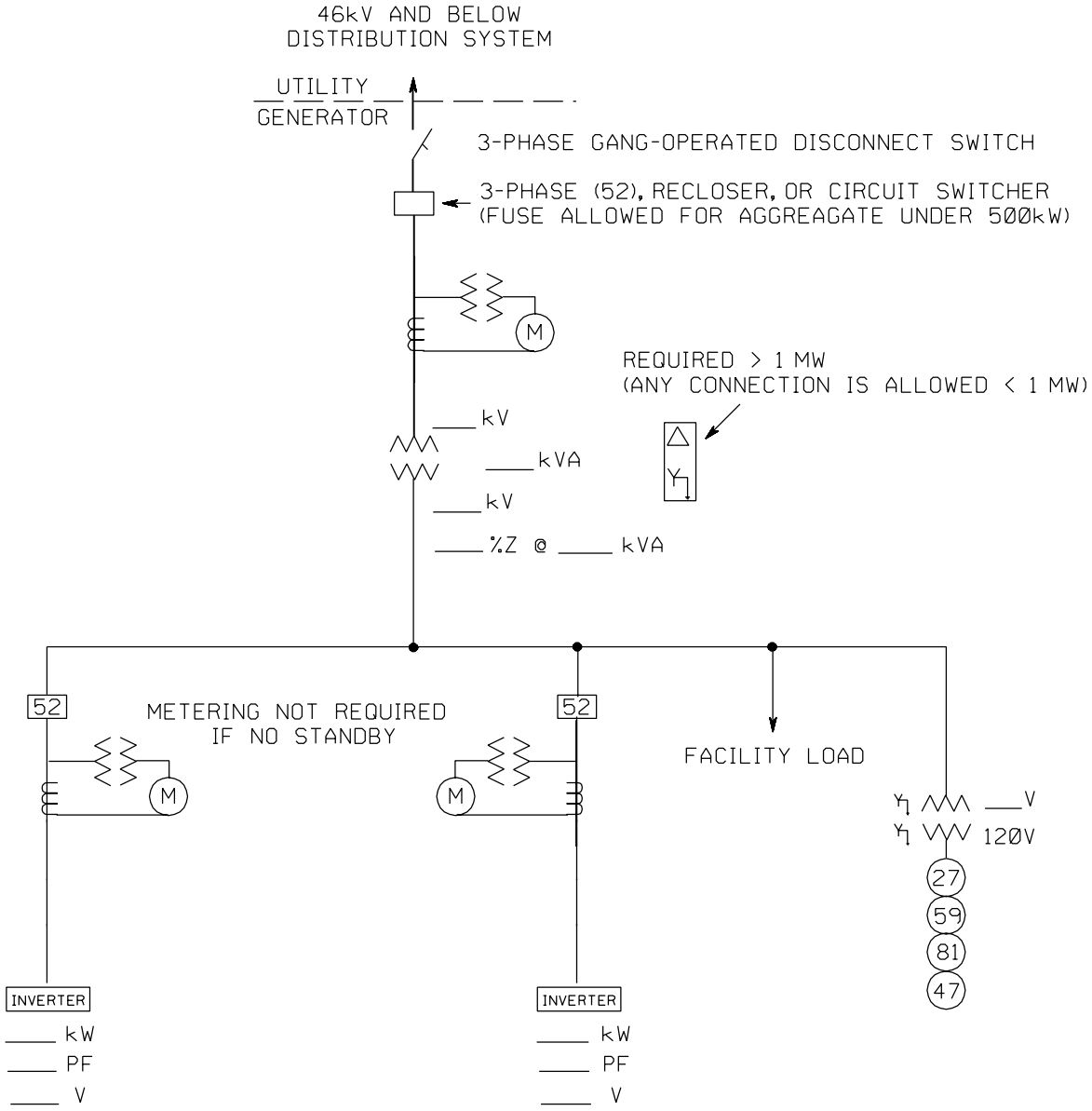
INVERTER-TYPE GENERATORS
AGGREGATE GENERATION 1 MW OR MORE

REQUIRED DATA

TYPICAL ONE-LINE DIAGRAM FOR INVERTER TYPE GENERATORS (THREE PHASE) AGGREGATE FACILITY GENERATION GREATER THAN 100kW SELLBACK AND NON - SELLBACK

EQUIPMENT SCHEDULE

ANSI #	TYPE	QTY	MFGR	MODEL	STYLE #	NOTES
27	UNDERVOLTAGE	3	BASLER	BE1-27	A3E-E1J-A0N0F	NOT REQUIRED FOR LESS THAN 1 MW IF ALL INVERTERS ARE UL-1741 LISTED
59	OVERVOLTAGE	3	BASLER	BE1-59	A3E-E1J-A0N0F	
81	FREQUENCY	1	BASLER	BE1-810/U	T3E-E1J-A7N0F	
47	PHASE SEQUENCE	1	ABB	ABB-470		
52	POWER CIRCUIT BREAKER	?	VARIOUS	VARIOUS		



INVERTER-TYPE GENERATORS - AGGREGATE ≥ 1 MW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the tables below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique transformer.

General Information

Item No	Data Description	Attached Page No
1	Sell-Back or Non-Sell-Back	
2	Plant Type (Base load, peaking, intermediate)	
3	Site Plan	
4	Simple One-Line for Plant and Plant Load	
5	Detailed One-Line for Plant	
6a	Energization Date for Plant Switchyard	
6b	First Parallel Operation Date for Testing	
6c	Plant Commercial Operation Date	

Isolating Transformer(s) between Generator(s) and Utility: Transformer No _____

Item No	Data Description	Attached Page No
1	Rated kV and connection (delta, wye, wye-gnd) of each winding	
2	kVA of each winding	
3	BIL of each winding	
4	Fixed taps available for each winding	
5	Positive/negative range for any LTC windings	
6	%Z Impedance on transformer self cooled rating	
7	Load Loss Watts at full load or X/R ratio	

The following information on these system components shall appear on the preliminary One-Line Diagram:

- Breakers - Rating, location and normal operating status (open or closed)
- Buses - Operating voltage
- Capacitors - Size of bank
- Circuit Switchers - Rating, location and normal operating status (open or closed)
- Current Transformers - Overall ratio, connected ratio
- Fuses - normal operating status
- Generators - Size, location, type, method of grounding
- Grounding Resistors - Size (ohms)
- Isolating transformers - Size, location, impedance, voltage ratings, primary and secondary connections and method of grounding
- Potential Transformers - Ratio, connection
- 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), type, rating
- Tagging Point - Location, identification

INVERTER-TYPE GENERATORS - AGGREGATE ≥ 1 MW
INTERCONNECTION APPLICATION DATA FOR: _____
PROVIDED BY: _____ DATE: _____

Instructions: Attach data sheets as required. Indicate in the table below the page number of the attached data (manufacturer's data where appropriate) on which the requested information is provided. Provide one table for each unique generator.

Electric Generator(s) at the Plant: Generator No _____

Item No	Data Description	Attached Page No
1	Generator Type (Inverter)	
2a	Generator Nameplate Voltage	
2b	Generator Nameplate Watts or Volt-Amperes	
2c	Generator Nameplate Power Factor (pf)	
3	Minimum and Maximum Acceptable Terminal Voltage	
4	Reactive Capability Curve showing overexcited and underexcited limits (Reactive Information if non-synchronous)	
5	Short Circuit Current contribution from generator at the Connection Point	
6a	Station Power load when generator is off-line, Watts, pf	
6b	Station Power load during start-up, Watts, pf	
6c	Station Power load during operation, Watts, pf	

APPENDIX D

INTERCONNECTION STUDY AGREEMENT

Consumers Energy Company
[Generator]
Interconnection Study Agreement for
Generator Interconnection
With Aggregate Generator Output of 1 MW or More

WHEREAS, proposals to construct or upgrade generation facilities which will be operated in parallel with and interconnected with Consumers Energy's ("Consumers") electric system must be reviewed by Consumers to determine how they will impact Consumers' electric system.

WHEREAS, on _____ Consumers received from _____ (the "Generator") a Generator Interconnection Application.

WHEREAS, Consumers has determined that an Interconnection Study is necessary to determine whether Consumers' electric system can accommodate the requested interconnection.

NOW, THEREFORE, in consideration of the mutual covenants and agreements herein set forth, Consumers and the Generator agree as follows:

1. Consumers shall complete an Interconnection Study in accordance with Consumers' Generator Interconnection Requirements and this Agreement.

2. The estimated charge for the Interconnection Study is $6,000, which is due and payable to Consumers upon its receipt of this executed Interconnection Study Agreement. The charge shall not exceed the actual cost of the study. Any adjustments to the Interconnection Study estimate shall be reconciled with refund due the Generator or additional payment due Consumers.

3. The Generator is to return this executed Interconnection Study Agreement along with all required technical data and the necessary reimbursement for the Interconnection Study to Consumers within fifteen (15) days of receipt by the Generator of an unexecuted Interconnection Study Agreement form. If that form is not executed and returned within fifteen (15) days along with the required technical data and study reimbursement, the Generator's Interconnection Application will be deemed withdrawn.

4. Upon its receipt of this executed Interconnection Study Agreement, required technical data that is acceptable to and meets Consumers' Generator Interconnection Requirements and the estimated reimbursement required for completion of the study, Consumers will use due diligence to complete the study within a ninety (90) day period. The study shall consist of power flow, relaying, short circuit, and if necessary, stability analysis. The outcome of the Interconnection Study will be the scope, good faith cost estimates, and project lead times for the interconnection facilities and system upgrades required to connect the generation project to Consumers' electric system.

5. In the event Consumers is unable to complete the required Interconnection Study within the ninety (90) day time period, it shall notify the Generator and provide an estimated completion date along with an explanation of the reasons why additional time is needed.

6. Consumers shall supply a copy of the completed Interconnection Study to the Generator.

7. At the completion of the Interconnection Study, Consumers shall tender to the Generator for execution a final draft of an Interconnection and Operating Agreement ("Interconnection Agreement"). The Generator shall have a period of thirty (30) days after receipt of the Interconnection Agreement to execute and return the Interconnection Agreement. Pursuant to the Interconnection Agreement, the Generator shall agree to reimburse Consumers for the full cost of Consumers' Interconnection Facilities.

8. The Generator shall be required to reapply for interconnection if (a) the Generator has lost its position in the queue under the provisions of Consumers' Generator Interconnection Requirements, (b) project changes are made from the original application which increases plant sizing by fifteen percent (15%) or more, (c) the original location of the plant is moved, and the move affects the interconnection to the electric system, or (d) the in-service date of the project is

9. delayed by more than six (6) months from the in-service date entered on the Generator's Interconnection Application.

10. Any notice or request made to or by either Party regarding this Agreement shall be made to the representative of the other Party, or its designated agent, as indicated below.

Utility	Generator
Karen E. Feahr	
Consumers Energy Company	
1945 West Parnall Road	
Jackson, MI 49201	

IN WITNESS WHEREOF, the Parties have caused this Interconnection Study Agreement to be executed by their respective authorized officials.

Consumers Energy Company	
By:	By:
(Signature)	(Signature)
Karen E. Feahr	
(Typewritten or Printed Name)	(Typewritten or Printed Name)
Tariff & Settlements Director	
Title	Title
Date	Date

APPENDIX E

OPERATING AUTHORITY AGREEMENT

(current date)

[ ] SUBSTATION
OPERATING AUTHORITY AGREEMENT
Normal Operations and Emergency Switching

Operating Authority for [Generator] will be its Facilities Manager or a Company Officer, Area Code ( ) _____.

For normal operations, the Operating Authority for Consumers Energy will be the System Controller at:

Area Code (___) ___-____ or (800) ___-____

EMERGENCY SWITCHING PROCEDURES

All Emergency Switching Procedures for [ ] Substation will be under the direct supervision of the System Controller at:

Area Code (___) ___-____ or (800) ___-____

The ___ switch (see substation WD ____) will be opened by the [Generator] representative or at their discretion, the Consumers Energy "operator."

SCHEDULED OUTAGE PROCEDURE

1. Request initiated by [Generator]. [Generator] will contact the System Controller ____ at the phone numbers above to schedule and coordinate work.

2. Request initiated by Consumers Energy. The System Controller ____ will contact [Generator] to make necessary arrangements and to agree on switching procedures.

NOTE: Each authority will attempt to provide a minimum of 48 hours notice on scheduled weekday outage requests (weekends are not considered as part of required notice).

PROTECTIVE TAGGING PROCEDURE - SCHEDULED

The ___ switch will be considered as the normal tagging point between Consumers Energy and [ ] Substation.

The ___ switch (see substation WD ____) will be opened by the [Generator] representative or at their discretion, the Consumers Energy "operator."

CUSTOMER REQUESTS

1. When [Generator] requires protection to work on their equipment, [Generator] will contact the System Controller ____.

At [Generator]s' discretion, their representative can accompany the Consumers Energy "operator" and place a tag and lock on the protection points. Consumers Energy will inform [Generator] of the tagged protection points.

2. When work has been completed and Consumers Energy and [Generator] are ready, the station will be returned to normal by the Consumers Energy "operator."

CONSUMERS ENERGY REQUESTS

1. When Consumers Energy requires protection on their line exits:

Consumers Energy "operator" will request [Generator] representative or at [Generator]s' discretion, the Consumers Energy "operator" to open the ___ switch after checking the ___ circuit breaker open. The Consumers Energy "operator" will place Consumers Energy Personal Protective Tags and locks on the ___ switch.

2. When work has been completed, a Consumers Energy "operator," accompanied by [Generator]s' representative, will remove the tags and locks.

3. The ___ switch will be closed by [Generator] with the Consumers Energy "operator" present or at their discretion, the Consumers Energy "operator" will close the ___ switch.

CONSUMERS ENERGY ACCESS

Consumers Energy shall be allowed access to the substation by means of a Consumers Energy lock in combination with a [Generator]s' lock on the substation gate and ___ switch at all times.

Approved by _____ Approved by _____

Consumers Energy [Generator]

SC_ Superintendent [Title]

ATTACHMENT 4

Generator Interconnection Supplement

To
Consumers Energy Generator Interconnection Requirements

Effective May 1, 2001

INTRODUCTION

This document contains the Consumers Energy Electric System Operation Philosophy and other information supplemental to these Consumers Energy documents:

Generator Interconnection Requirements
Generation Facilities with
Aggregate Generator Output
Below 100 kW
Effective May 1, 2001

Generator Interconnection Requirements
Generation Facilities with
Aggregate Generator Output
Between 100 kW and 999 kW
Effective May 1, 2001

Generator Interconnection Requirements
Generation Facilities with
Aggregate Generator Output
Of 1 MW or More
Effective May 1, 2001

CONTENTS

ELECTRIC SYSTEM OPERATION PHILOSOPHY

Electric System Operation Philosophy

The Consumers Energy 46 kV, 23 kV and distribution systems are ultimately served by the Michigan Electric Transmission Company 138 kV and 345 kV transmission system. The 138 kV and 345 kV systems provide a safe and highly reliable transmission supply for the lower voltage Consumers Energy systems. The Consumers Energy 46 kV, 23 kV, and distribution electric systems are planned and operated in the following manner.

46 kV and 23 kV System Operation

Consumers Energy operates its 46 kV and 23 kV electric system as a looped system. These systems provide a safe and highly reliable supply for the lower voltage distribution systems.

46 kV and 23 kV Facility Planning
Design standards must meet the requirements in the National Electric Safety Code and further detailed in Consumers Energy Standard Engineering Manuals.

Equipment short-circuit capability must be sufficient to interrupt fault conditions.

Equipment thermal capability must be sufficient to carry loads under anticipated peak conditions with all equipment in-service, and under loss of a single system element at 80% of anticipated peak conditions.

Adequate voltage must be provided to connected distribution substations under anticipated peak conditions with all equipment in-service, and under loss of a single system element at 80% of anticipated peak conditions.

Voltage flicker must meet the Consumers Energy Voltage Flicker standards.

46 kV and 23 kV System Relaying
The 46 kV and 23 kV systems are protected by a variety of directional relays for phase and ground fault detection.

This approach allows rapid detection and isolation of faults and other disturbances while minimizing the effect on the overall system and the connected customers.

This section will detail the most common approaches to protection of these systems.

Phase fault protection for the 46 kV and 23 kV systems is provided by overcurrent relays. These relays have both inverse-time-overcurrent characteristics and instantaneous overcurrent elements. The operation of these relays is supervised by impedance relays to provide the directional logic and to allow their settings to be optimized for detection of faults while limiting their response to normal System Load conditions.

Ground fault detection for the 46 kV and 23 kV systems is provided by directional overcurrent ground relays. The design of these relays is optimized for ground fault detection, and includes the necessary design characteristics to provide the directional control. Again, these relays are equipped with both inverse-time-overcurrent and instantaneous-overcurrent characteristics.

The settings for the relaying at 46 kV and 23 kV are meticulously determined using fault studies representing a wide range of possible system conditions.

Motor-operated air-break switches are widely deployed into the 46 kV lines. These switches are not usually capable of breaking any magnitude of current, and open automatically after a time delay for dead-line conditions, isolating only the minimum portion of the system.

Automatic reclosing is widely used on the 46 kV and 23 kV systems. Depending on the location and whether any motor-operated air-break switches are employed, each end of a line may reclose as many as three times. Most 46 kV and 23 kV reclosing is simply based on time delays, but undervoltage-line and synchronism-check supervision can be added.

46 kV and 23 kV System Operation
Consumers Energy employees follow specific safety rules when operating the 46 kV and 23 kV systems. These rules are in place to protect employees and the public from the hazards

imposed by high voltage electricity. No Consumers employee is allowed to work under unsafe conditions. The addition of generators by others must not introduce unacceptable hazards to anyone and they must not compromise the levels of safety that are inherently built into the design and operation of the 46 kV and 23 kV systems.

In general, Consumers Energy does not perform maintenance on the 46 kV and 23 kV systems during heavy electric load periods. The 46 kV and 23 kV systems are sometimes reconfigured to minimize equipment loading and customer interruption should an unplanned outage event occur during maintenance periods. This reconfiguration could have an impact on generator operation, and system configurations during maintenance periods should be considered by Generators when selecting connection configurations to the Consumers Energy 46 kV and 23 kV systems.

Distribution System Operation

Consumers Energy operates its distribution electric system (24.9 kV and lower, excluding 23 kV facilities) as a radial system. Most distribution substations are connected to the 46 kV system, but some are connected to the 23 kV system or radially served from the 138 kV transmission system.

Distribution Facility Planning
Design standards must meet the requirements in the National Electric Safety Code and further detailed in Consumers Energy Standard Engineering Manuals.

Equipment short-circuit capability must be sufficient to interrupt fault conditions.

Equipment thermal capability must be sufficient to carry loads under anticipated peak conditions.
.

The voltage provided to the customer at the meter must meet MPSC requirements and be at 120 volts +/-5%.

Voltage flicker must meet the Consumers Energy Voltage Flicker standards.

Distribution System Relaying and Fusing
The distribution system is protected by a variety of three-phase and single-phase hydraulic reclosers, and fuses. The three-phase reclosers are usually equipped with electronic recloser controls that allow some flexibility to adjust the sensitivity. The single-phase reclosers are generally designed with a specific sensitivity, and must be replaced if a different sensitivity is needed.

These protective systems automatically disconnect any portion of the system that becomes faulted, while minimizing the portion of the system isolated. The fault must not be allowed to exist for more than a predetermined period of time. The sensitivity of the protective devices must also allow normal load to be served without interruption.

The reverse power flow conditions that generators are capable of producing must be evaluated to ensure proper coordination is not compromised.

Distribution System Operation
Consumers Energy employees follow specific safety rules when operating the electric distribution system. These rules are in place to protect them and the public from the hazards imposed by high voltage electricity. No Consumers Energy employee is allowed to work under unsafe conditions. The addition of generators by others must not introduce unacceptable hazards to anyone and they must not compromise the levels of safety that inherently built into the design and operation of the distribution system

TYPES AND CHARACTERISTICS OF GENERATING SYSTEMS

Types and Characteristics of Generating Systems

There are three basic types of generating systems:

Synchronous Generator

Induction Generator

Static Inverter

The effect that each of these may have on safety, system operation and protection, and the quality of service to other customers is a function of the electrical characteristics of the generating system. Some of these characteristics are as follows:

SYNCHRONOUS GENERATOR

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

The synchronous generator has three characteristics that are important in analyzing its effect upon the system.

1. Because of its separate excitation system, the synchronous generator can sustain voltage to an isolated load independent of the utility source.

2. The synchronous generator can sustain fault current for several seconds depending upon the characteristics of the excitation system. It can contribute an initial symmetrical fault current that is from five to eight times the normal rated current.

3. The synchronous generator can operate over a wide range of power factor depending upon the magnitude of field current or DC excitation. Changes in excitation determine the terminal voltage and the reactive power (or kVAR) of the generator.

The output of a synchronous generator generally contains few harmonics and should not be a source of interference to customers.

A synchronous generator requires a complex control system both to synchronize with the utility and to regulate the field excitation.

INDUCTION GENERATOR

An induction generator is a rotating AC 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 electrical power is generated. Excitation is provided by the utility in the form of reactive power. 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.

Under special conditions, an induction generator can continue to operate after it is isolated from the utility source. One condition, called self-excitation, can occur if sufficient capacitance is connected in parallel with the generator to provide the excitation current. Overhead line capacitors as well as line and cable capacitance on the circuit can cause self-excitation of an induction generator. Self-excitation can be very unstable and can result in system overvoltages.

TYPES AND CHARACTERISTICS OF GENERATING SYSTEMS

Induction generator excitation under isolated conditions can also be provided by paralleled synchronous generators serving the same isolated load. The prob ability of this condition occurring increases as the concentration of generation increases on the circuit.

Induction generators characteristically operate at a low power factor under lightly loaded conditions and always appear as inductive loads to the system since reactive power is being provided for excitation. As more induction generators are interconnected to the system, the utility will be required to supply increasing magnitudes of reactive power.

An induction generator can contribute momentary fault current of five to eight times the rated current, which decays over a short time period of two to three cycles. The induction generator cannot sustain fault current because it does not have an independent excitation system.

The induction generator, like the synchronous generator, is not a major source of harmonics. An induction generator is usually cheaper than a similarly sized synchronous machine and doesn't require the synchronizing equipment and control that a synchronous generator does.

INVERTERS

An Inverter is a device that changes DC power to AC power. Sources of DC power are batteries, photovoltaic devices, DC generators and rectified alternators.

Static inverters convert DC to AC by electronically switching a bridge of thyristors, SCR's, etc., at appropriate times to control frequency. Two types of static inverters used are the line-commutated and force-commutated (or self-commutated) Inverter.

A line-commutated inverter uses the AC line voltage of the system to control the thyristor switching. Such an inverter cannot normally establish a voltage independent of the utility source and so normally cannot operate independently or isolated from the utility. In this respect it acts much like an induction generator. It is possible, as with induction generators, to self excite line commutated inverters when sufficient line capacitance exists under isolated conditions.

A force or self-commutated inverter uses its own internal circuitry to control the thyristor switching. This type of static inverter can produce voltage and current independently of the utility source, and so it acts much like a synchronous generator.

The fault current capability of static inverters depends upon the inverter design and the DC power source feeding the inverter. Because of low thermal tolerances of semiconductors, many of these devices have an overcurrent capability of only 120% of rated current.

Line commutated inverters, like induction generators, require substantial reactive power support and so can affect the power factor on the utility system.

Inverters inherently produce harmonic distortion, which could affect the quality of service to other customers.

ISOLATED OPERATION

Isolated Operation

Isolated operation, or Islanding, of generation results when it becomes separated from the utility source and continues to serve Consumers Energy's load as an isolated system independent of the utility. Some possible causes of Islanding are:

1. Clearing of transient faults from either a circuit breaker or an overhead, sectionalizing device.

2. Opening lines for maintenance or repair purposes.

3. Opening of switching devices by operation personnel.

From a utility standpoint, isolated operation poses a safety hazard and is detrimental to operating efficiency and the quality of service to customers.

Generation backfeeding a supposedly deenergized line poses a safety hazard to overhead line crews. This is especially so on distribution circuits, which are normally radial in nature with unidirectional power flow. With generation at various locations along the distribution circuit, the line may not be "dead" as expected when the primary feed is opened and isolated from the substation source.

Isolated operation would also cause delays in the restoration of service from the normal utility feed. Automatic reclosing after an interruption would have to be delayed to avoid damage to the generator and possibly to utility equipment as well. Normal service could not be restored until all generating facilities were contacted and their generators separated from the Consumers Energy electric system. The delays would become more severe as the concentration of generators increased on a particular circuit or substation.

Isolated operation of generation also results in the loss of utility control over the quality of service since voltage and frequency are no longer controlled or regulated by the utility. Voltage and frequency on the isolated system could be abnormal. The utility customers served from the isolated system could not therefore be guaranteed the same quality of power as normal.

For all of these reasons, the generator must be able to detect an islanded condition and automatically disconnect from the Consumers Energy electric system.

In those cases where the generator may transmit power to Consumers Energy this can be accomplished by allowing the operation of the generator only within narrow voltage and frequency limits. Voltage and frequency relays at the generator location can define the acceptable bands of operation and separate generation from the Consumers Energy electric system when it falls outside the specified voltage and/or frequency limits. Upon the loss of Consumers Energy's source, the basic assumption is that the suddenly applied load will be either greater or less than the generation and will therefore cause a trip from either the voltage relays or the frequency relays or both. This basic isolation protection for generators is described in the Relaying Design Requirements section of this document.

As the concentration of generation increases, the probability of an isolated system also increases since it becomes more difficult for the voltage and frequency relays at each generator location to detect Islanding and disconnect the generation from the Consumers Energy electric system. The probability of isolated generation also increases as the size of a non-utility generator approaches minimum circuit loads.

In these cases, the basic isolation protection consisting of voltage and frequency relays will have to be supplemented with additional protective relaying such as Direct Transfer Trip (DTT) in a Sell-Back arrangement, or reverse power relaying in a Non-Sell-Back arrangement).

APPROVED RELAY TYPES

Approved Relay Types

The relays listed below are generally acceptable for applications that satisfy Consumers Energy's Interconnection Requirements. Generators desiring to use unlisted relays must submit sufficient information for evaluating the suitability of such devices.

Many listed relays are not equipped with required test facilities. Such test facilities must be added before the installation may be approved. (All testing is limited to a nominal maximum of 120 volts and 5 amperes. Relay devices must be selected which do not exceed these values.)

Where different models or styles of the listed relays are available, acceptability of the relay is dependent on the proper model or style being selected for the particular application. Relays requiring the use of a separate time delay relay are noted with an asterisk (*).

UTILITY GRADE RELAYS:

A. NEUTRAL OVERVOLTAGE GROUND PROTECTION RELAY (59N)

Westinghouse	SV*
Brown Boveri	ITE-59G
ASEA Electric	RXEG21*
Basler	BE1-59N*, BE1-59*

B. UNDER & OVER FREQUENCY RELAYS (81U/O)

General Electric	SFF
Westinghouse	MDF, KD*
Brown Boveri	ITE-81
ASEA Electric	RXFE-4*
Basler	BE1-81 O/U

C. UNDER & OVERVOLTAGE PROTECTION (27 AND 59)

General Electric	SLV
Westinghouse	SSVT*
Brown Boveri	ITE-47D (27 only)
	ITE-59N (59 only)
	ITE-27/59
Basler	BE1-27 (27 only)
	BE1-59 (59 only)
	BE1-27/59

D. PHASE FAULT PROTECTION (51V)

General Electric	IJCV (discontinued relay type)
	IFCV, IFCS
Westinghouse	COV
Brown Boveri	ITE-47H with ITE-51I (both relays required)
ASEA Electric	RXPE-42 with RXIDF-2H (both relays required)
Basler	BE1-51/27R
	BE1-51/27C

E. REVERSE POWER (32)

Westinghouse	CRN-1
Basler	BE1-32
Brown Boveri	ITE-32
ASEA Electric	RXPE-41/40
General Electric	GGP53

APPROVED RELAY TYPES

F. MULTIFUNCTION

Beckwith Electric	PRIDE Model M-0296 (27, 59, 810, 81U)
	PRIDE Model M-0420 (27, 59, 810, 81U)
Schweitzer Eng (SEL)	SEL-351, SEL-311
Basler	BE1-951, BE1-GPS100
General Electric	SR489 Gen Management Relay
	SR745
	DGP Digital Gen Protection

G. TIMING RELAYS

Agastat	SSC Series, SCC Series
Westinghouse	TD
General Electric	SAM
Brown Boveri	ITE-62K, ITE-62L
ASEA Electric	RXKF

H. NEUTRAL OVERCURRENT RELAYS (51N)

General Electric	IAC53, IFC53
Westinghouse	CO8
Basler	BE1-51
Brown Boveri	ITE-51
ASEA Electric	RXIDF2H

I. DIRECT TRANSFER TRIP

A system has been developed which utilizes the RFL Industries 6745 transfer trip equipment. Consumers Energy will supply technical details, utility costs and specifications when responding to service inquiries.

ENGINEERING DESIGN DRAWING REQUIREMENTS

Engineering Design Drawing Requirements

After site specific relaying requirements have been determined from a technical Interconnection Study performed by Consumers, the Generator shall submit, for approval by Consumers Energy, two (2) copies of the design drawings of the relaying and control equipment providing protection for the Consumers Energy electric system. The design drawings shall be submitted early in the planning stage of the project and prior to the purchase of the Generator's relaying equipment.

The drawings submitted must include two (2) copies of the final One-Line Diagram and two (2) copies of the control schematics of the protective relaying used to isolate and/or separate faults on the Consumers Energy electric system. The submitted drawings must be of engineering quality. Free hand sketches are not acceptable. The engineering drawings shall include the following:

1. The location and ratios of the current and potential trans formers used for the isolation protection.

2. The connection of relay terminals in current, potential, and control circuits.

3. Relays identified by their IEEE device numbers.

4. When telemetry is required:
   a. All RTU sequence of events monitoring with the IEEE device numbers.

   b. The location of the current and potential transformers used for telemetering.

   c. Breaker status contacts used for telemetering.

   d. Estimates of wiring distance from the remote terminal unit (RTU) to the breaker-status contacts and current and potential transformers.

   e. RTU location (note on drawing).

   f. Power source for RTU (note on drawing).

   g. Wetting voltage required for breaker status contacts.

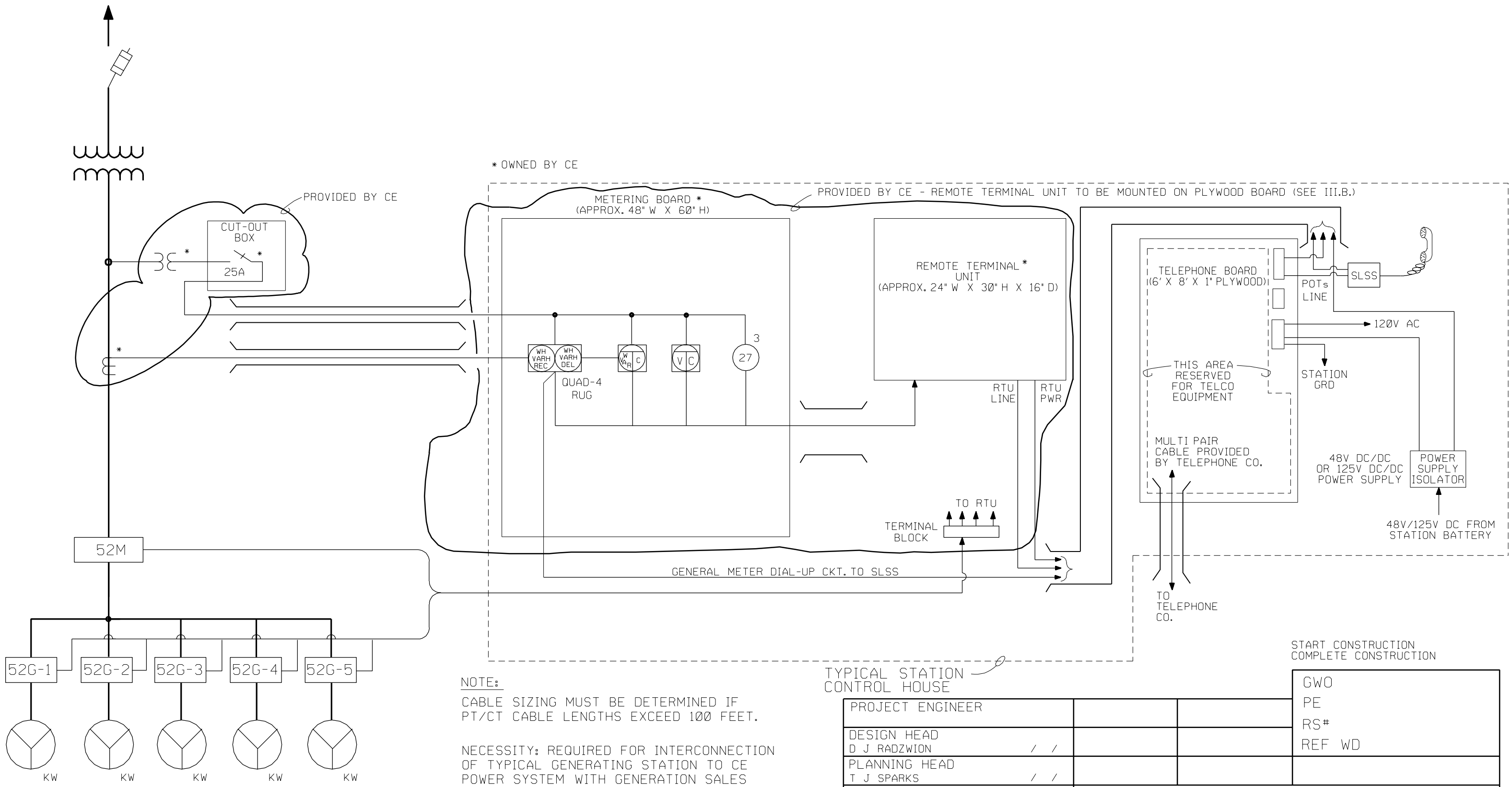
The Generator shall provide information on those relays to be used for the protection of the Consumers Energy electric system including the manufacturer of the relays, the relay types and calibration range(s), and the model or style number of the relay.

All design changes required by Consumers shall be made by the Generator. The revised drawings, incorporating all the required changes, must then be resubmitted to Consumers for review and approval. Consumers will retain one copy of each of the approved drawings. In general, Consumers will comment only on aspects of the design, which concern the protection of the Consumers Energy electric system and its customers.

If field revisions to the approved design are necessary and are mutually agreed to by Consumers and the Generator, then the Generator shall provide Consumers a final set of design drawings of engineering quality, incorporating all such field changes within ninety (90) days after approval for Parallel Operation has been given by Consumers.

Any future revision to the approved relaying and control equipment, or settings, used to protect the Consumers Energy electric system must be approved by Consumers. The Generator shall then submit design drawings showing the proposed changes.

TYPICAL METER AND RTU INSTALLATION WHERE TELEMETRY IS REQUIRED



NOTE:

CABLE SIZING MUST BE DETERMINED IF PT/CT CABLE LENGTHS EXCEED 100 FEET.

NECESSITY: REQUIRED FOR INTERCONNECTION OF TYPICAL GENERATING STATION TO CE POWER SYSTEM WITH GENERATION SALES TO CE.

START CONSTRUCTION
COMPLETE CONSTRUCTION

PROJECT ENGINEER			GWO
DESIGN HEAD D J RADZWION / /			PE
PLANNING HEAD T J SPARKS / /			RS#
PROTECTION HEAD J A ZIPP / /			REF WD
OPERATING HEAD D P WILLIAMS / /	PREPARED BY:	/ / REV	
CONSTRUCTION HEAD T L KRUMMREY / /	CONSUMERS ENERGY TRANSMISSION ENGINEERING JACKSON, MICHIGAN DWG PD		TYPICAL GENERATING STATION INSTALL METERING AND RTU REGION T

I. CE ELECTRIC TRANSMISSION TO:

A. PROVIDE ASSEMBLED & WIRED METERING BOARD, INCLUDING METER SOCKET, REMOTE TERMINAL UNIT & TERMINAL BLOCK, A POTENTIAL CUT-OUT SWITCH IN A CUT-OUT BOX, AND METERING PT'S AND CT'S.

B. PROVIDE CABLES TO BE RUN BETWEEN METERING BOARD & REMOTE TERMINAL UNIT, AND REMOTE TERMINAL UNIT & TERMINAL BLOCK, AND METER BOARD & SLSS, AND REMOTE TERMINAL UNIT & TELEPHONE BOARD, AND TELEPHONE BOARD & SLSS.

C. PROVIDE CAPABILITY FOR TELEMETRY FROM METERING TO CUSTOMER.

II. CE GENERAL/REGION METERING TO:

A. PROVIDE RUG METER.

III. GENERATING CUSTOMER TO:

A. INSTALL PT'S AND CT'S. INSTALL POTENTIAL CUT-OUT SWITCH BOX.

B. PROVIDE AND INSTALL, ON CONTROL HOUSE WALL, ONE 4'X8'X1" & ONE 6'X8'X1" GRAY-PAINTED, SMOOTH-SURFACED PLYWOOD BOARDS FOR MOUNTING OF REMOTE TERMINAL UNIT AND TELEPHONE EQUIPMENT. PLYWOOD BOARDS ARE MOUNTED ADJACENT TO ONE ANOTHER.

C. PROVIDE TWO 2" ID PVC CONDUITS FROM METER CUT-OUT BOXES TO CUSTOMER'S CONTROL HOUSE. PROVIDE AND PULL #10 PT AND CT SECONDARY CABLES (SEE NOTE).

D. PROVIDE AND INSTALL 120V AC 2/C #12 WITH GROUND CABLES TO TELEPHONE BOARD.

E. PROVIDE AND INSTALL 4" PVC CONDUIT FOR LOCAL TELEPHONE CO. TO PULL IN A MULTI-PAIR TELEPHONE CABLE. CONDUIT TO RUN FROM TELEPHONE BOARD TO 15 FEET BEYOND GROUND GRID USING 100% PVC SWEEPING BENDS.

F. PROVIDE EITHER 48VDC/24VDC OR 125VDC/24VDC POWER SUPPLY FOR TELEPHONE BOARD LOOPBACK RECEIVER (FOR ISOLATION).

G. PROVIDE EITHER 48V DC/DC OR 125V DC/DC POWER SUPPLY FOR TELEPHONE BOARD EQUIPMENT (FOR ISOLATION).

H. PROVIDE AND INSTALL A 2/C #8 CABLE FROM 48V/125V STATION BATTERY TO DC/DC POWER SUPPLIES AND THEN TO THE TELEPHONE BOARD. PROVIDE AND INSTALL A 2/C #10 CABLE FROM 48V/125V STATION BATTERY TO REMOTE TERMINAL UNIT.

I. PROVIDE TERMINATION BLOCKS ON TELEPHONE BOARD.

J. PROVIDE 1½" ID PVC CONDUIT FROM REMOTE TERMINAL UNIT TO TELEPHONE BOARD.

K. ORDER ALL TELEPHONE CIRCUITS REQUIRED FOR THE FACILITY. CONTACT & COORDINATE WITH THE LOCAL TELEPHONE CO. THE INSTALLATION OF TELEPHONE SERVICE WITH THE APPROPRIATE PROTECTIVE EQUIPMENT (i.e. POSITRON, HIGH DIELECTRIC STRENGTH CABLE, ETC.) PER CE TYPICAL INSTALLATION DRAWINGS.

L. PROVIDE POTs LINE TELEPHONE RECEIVER FOR CHECKOUT OF METERING PACKAGE AND RTU. CE WILL USE SLSS AND POTS LINE TO DOWNLOAD METER DATA.

M. PROVIDE DATA TELEPHONE LINE REQUIRED BY CE REMOTE TERMINAL UNIT.

N. PROVIDE AND INSTALL TWISTED, SHIELDED PAIR #16 CABLES FOR DRY CONTACTS INDICATING POSITIONS OF ALL BREAKERS AND TRIP INDICATION FOR THE MAIN ISOLATING DEVICE. CONNECT FROM SOURCE TO TERMINAL BLOCK, LOCATED ON RTU BOARD, FOR INPUT TO RTU.

O. PROVIDE GROUND CONNECTION FROM CONTROL HOUSE TO SUBSTATION GROUND MAT. PROVIDE GROUND TIE-POINT AT METERING BOARD. PROVIDE GROUND TIE-POINT AT TELEPHONE BOARD.

P. MOUNT METERING BOARD, REMOTE TERMINAL UNIT, TERMINAL BLOCK & PANDUIT (IF NEEDED) ON CONTROL HOUSE WALL.

Q. PULL & TERMINATE CABLES FROM METER BOARD TO REMOTE TERMINAL UNIT, AND REMOTE TERMINAL UNIT TO TERMINAL BLOCK, AND METER BOARD TO SLSS, AND REMOTE TERMINAL UNIT TO TELEPHONE BOARD, AND TELEPHONE BOARD TO SLSS.

R. TERMINATE 120V AC CABLE AND DRY CONTACT DEVICE POSITION INDICATING CABLES.

S. TERMINATE PT & CT SECONDARY CABLES.

NOTE:

CABLE SIZING MUST BE DETERMINED IF PT/CT CABLE LENGTHS EXCEED 100 FEET.

NECESSITY: REQUIRED FOR INTERCONNECTION OF TYPICAL GENERATING STATION TO CE POWER SYSTEM WITH GENERATION SALES TO CE.

START CONSTRUCTION
COMPLETE CONSTRUCTION

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CONSTRUCTION HEAD T L KRUMMREY / /		

DEFINITION OF TERMS

Definition of Terms

AC (Alternating Current)
A periodic current the average value of which over a period is zero.

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 (500 V DC) and hi-potting (1000 V AC) 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. Consumers Energy shall perform such tests only on the relaying and control required for protection of the Consumers Energy electric system.

Automatic Reclosing
Process in which the closing circuit of a circuit breaker or recloser 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 re-energized.

Automatic Shutdown
The capability to cease generating without manual intervention upon loss of the Consumers Energy source.

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 "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, disturbance monitoring 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. See "Data Circuit" for more details.

Connection Point
The ownership point of demarcation between the generation facilities and the Consumers Energy electric system. This is generally the point of metering, unless special contractual arrangements can be made.

Consumers Energy
Relative to this document, the "Consumers Energy" is Consumers Energy Company.

(The) Consumers Energy Electric System
The integrated system of electrical generation and distribution facilities and all equipment and facilities ancillary thereto, owned and/or operated by Consumers Energy.

DEFINITION OF TERMS

Data Circuit (As used by Consumers Energy's telemetering equipment)
A leased, four wire telephone circuit continuously available for the transmission of data. The circuit differs from a standard Voice Circuit 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 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. For public safety, this circuit must conform to requirements for a Class A circuit as defined in IEEE Standard 487-1992.

DC (Direct Current)
Unidirectional current in which the changes in value are either zero or so small they may be neglected.

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 of equipment from a source of power. The main disconnect switch will be used by Consumers Energy for tagging purposes and must have a visible open gap and be capable of being locked in the open position.

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.

Generator
Term used throughout this document to refer to the developers, owners, and operators of electric generating equipment.

Harmonic Distortion
Nonlinear distortion of current or voltage causing a deviation from the sinusoidal form. The Consumers Energy Harmonic Distortion Guidelines are established to limit the amount of current harmonic distortion one customer can impose on the electric system.

Industrial Grade Relay
Relay having lesser quality than the Utility Grade Relays used by Consumers Energy to protect its electric system. Industrial grade relays are designed with a lesser degree of reliability.

Instantaneous Reclosing
Reclosing process in which the closing circuit of a circuit breaker or recloser 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.

Interconnection Facilities
The facilities and associated equipment required to electrically interconnect the generation facility to the Consumers Energy electric system and the minimum necessary system upgrades that would not have been required but for the Generator's interconnection request.

DEFINITION OF TERMS

Interconnection Study
The term is used to refer to the technical studies performed by Consumers Energy for the purpose of (1) determining the feasibility of connecting a proposed generation facility to the Consumers Energy electric system and (2) defining the scope, cost and schedule of the required Interconnection Facilities for the proposed generation facility.

Inverter
A machine, device, or system that changes direct-current power to alternating-current power.

Islanding
An abnormal operating condition in which the generator is separated from Consumers Energy's source but remains connected to an unfaulted Consumers Energy line to feed other Consumers Energy's customers.

Non-Sell-Back Mode
The term used to refer to a Generator that has not made arrangements to sell any portion of its electrical output to any other party or to transmit any of its output across the Consumers Energy electric system.

One-Line Diagram
A one-line representation of the three phase electrical system. The one-line diagram required in these Requirements must indicate those electrical system components (e.g. buses, feeders, transformers and generators) that are necessary to show how the generator is to be paralleled with the Consumers Energy electric 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
- Circuit Switchers - Rating, location and normal operating status (open or closed)
- Current Transformers - Overall ratio, connected ratio
- Fuses - Type, fuse size, normal operating status
- Generators - Size, location, type, method of grounding
- Grounding Resistors - Size (ohms)
- Main transformers - Size, location, impedance, voltage ratings, primary and secondary connections and method of grounding
- Potential Transformers - Ratio, connection
- 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), type, rating
- Tagging Point - Location, identification

The Requirements 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 Consumers Energy electric system. The preliminary one-line may exclude this information, since the site specific relaying required to protect the Consumers Energy electric 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. Damage may result.

DEFINITION OF TERMS

Parallel Operation
Mode of operation in which the generation facility is operating under its own power and is connected to the Consumers Energy electric system. Parallel Operation is not intended to include operation where there is only a momentary connection between the generator and the Consumers Energy electric system such as a short transition period (less than one second) from operation of a generator under emergency stand-by generation to operation on its own power when back-flow through the stand-by connection to the Consumers Energy electric system may occur.

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 Consumers Energy Protective Tag. Visible breaks such as open switches or open fused cutouts are required.

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 Terminal Unit (RTU)
A remote station equipment of a supervisory (Telemetering) system.

Remote Trip Channel
A Communication Channel to extend relay tripping circuits to remote circuit breaker locations. Initiating relays and control at Consumers Energy's terminal produce transmission of a trip signal over the Communication Channel. Reception of the trip signal at the remote generator location results in separation of the generation from the Consumers Energy electric 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.

RTU
See "Remote Terminal Unit".

SCADA
See "Telemetering".

Secondary Neutral Overcurrent Relay
An overcurrent relay energized by a current transformer in the neutral of a wye connected secondary winding of a transformer. A ground fault on the Consumers Energy electric system will produce current in the secondary neutral, which can operate the overcurrent relay.

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

DEFINITION OF TERMS

Sell-Back Agreement
A written contract that permits energy or energy plus capacity sales from a Generator to another party.

Sell-Back Mode
The term used to refer to a Generator that has made arrangements to sell any portion of its electrical output to any other party or to transmit any of its output across the Consumers Energy electric system.

Stiffness Ratio
The short circuit contribution in kVA from the electric system plus the short circuit contribution in kVA of the generation facility, divided by the short circuit contribution in kVA of the generating facility. The Stiffness Ratio is calculated at the Connection Point, except when there is an isolating transformer(s) dedicated to the generation facility in which case the Stiffness Ratio is calculated on the high-side of the isolating transformer(s).

Supervisory Control
Supervisory control means the remote control of a monitored device. The functionality is supported by the telemetering equipment. See definition for Telemetering. For Consumers Energy, the controlled device is typically a circuit breaker.

System Load
The total power flow taken through all customers' billing meters plus system losses. The value is monitored by summing power flow into the system from generators and interconnections.

Telemetering
The communication of measurements and/or control data between two locations. In some applications, the term "telemetering" has meant: "to provide a remote reading by using a signal of DC current or AC frequency whose level is proportional to the measured quantity". At Consumers Energy, the majority of telemetering is accomplished by using digital signals that contain a binary representation of the measured quantity.

Power, current and voltage are measured by transducers that provide a low level DC output current which is proportional to the measured quantity. Electronic equipment located at the measuring site converts the DC current to a digital message, which is transmitted via a Data Circuit into a computer, located at the central office of Consumers Energy. 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 or receive 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 Consumers Energy site.

DEFINITION OF TERMS

Utility Grade Relay
Relay having the same quality as those relays used by Consumers Energy 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 the most current 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-V 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 magnitude which may cause a visible dimming and brightening of lights. The resulting light flicker may be objectionable to customers. The Consumers Energy voltage flicker limits are established to limit the amount of flicker one customer can impose on another.

Voltage Restrained Time-Overcurrent Relay
A relay in which the operating value of the overcurrent 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 the line-to-neutral voltages on a three phase circuit. The overvoltage relay is connected across the open corner of delta connected secondary windings of the potential transformers and is arranged to provide contact closure when the voltage applied to its coil is in excess of a preset level. The potential transformers that provide the operating voltage are connected grounded-wye primary and broken-delta secondary.

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

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

PROOF OF SERVICE

STATE OF MICHIGAN)
) SS
COUNTY OF JACKSON)

Sammie B. Dalton, being first duly sworn, deposes and says that she is employed in the Legal Department of Consumers Energy Company; that on May 7, 2001 she served an electronic copy of "**Consumers Energy Company's Response To The Commission's Order Directing The Filing Of Proposed Generator Interconnection Standards Pursuant To MCL 460.10e**" upon:

David M. Gadaleto, Esq.
Assistant Attorney General
Public Service Division
6545 Mercantile Way, Suite 15
Lansing, MI 48911

at gadaletod@ag.state.mi.us and a hard copy of same was mailed to the address listed above by depositing in the United States mail in the City of Jackson, Michigan with first-class postage thereon fully paid.

Sammie B Dalton

Subscribed and sworn to before me this 7th day of May, 2001.

Barbara L Morris

Barbara L. Morris
Notary Public, Jackson County, Michigan
My Commission Expires: 12/22/01