DATE: January 19, 2010
STAFF: Steve Catanach

AGENDA ITEM SUMMARY
FORT COLLINS CITY COUNCIL

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SUBJECT

Items Relating to Net Metered Electric Service and Interconnection Standards of Electric Generation Facilities to the Fort Collins Electric Distribution System.

A. Hearing and First Reading of Ordinance No. 003, 2010, Amending Chapter 26, Article VI of the City Code Relating to Net Metered Electric Service.

B. Hearing and First Reading of Ordinance No. 004, 2010, Adopting Standards for Interconnection of Electric Generation Facilities to the Fort Collins Electric Distribution System.

EXECUTIVE SUMMARY

The proposed net metering rate and interconnection standards have been developed with the goal of establishing rates and standards that encourage and facilitate the installation of renewable generation within our community.

As requested, staff is proposing net metering language that establishes limits similar to those established by the Colorado Legislature through Colorado Revised Statute §40-2-124, and subsequently by the Colorado Public Utilities Commission (PUC) for customers served by investor owned utilities. The PUC has established net metering limits at 120% of annual consumption. The PUC also enacted language limiting the installation to the capacity of the service entrance.

The proposed interconnection standards have been developed to support the adoption of a net metering rate that enables customers to install renewable generation capable of supplying up to 120% of their annual kilowatt-hour consumption. The standards define the requirements of the connection between the utility and the customer's generator to insure a safe connection that protects the distribution system, adjacent customers, the generator and the customer.

BACKGROUND / DISCUSSION

At the May 19, 2009, Fort Collins City Council meeting, Council adopted on First Reading, a net metering ordinance. However, at that meeting, Council asked staff to add language that more clearly defined generation limits. On June 2, 2009, Council tabled the Second Reading of a proposed net metering rate ordinance. Prior to the Council meeting on June 2, 2009, Council expressed a desire to adopt net metering levels similar to those that were adopted by the State of Colorado through C.R.S. §40-2-124. The PUC set limits at 120% of consumption in the Colorado Code of Regulations §723-3-3664. Consideration of the net metering rate ordinance was postponed to allow staff to develop interconnection standards that would define interconnection requirements specific to the Fort Collins distribution system and define settings that considered the level of potential generation defined in C.R.S. §40-2-124. Staff is presenting the attached optional net metering language and interconnection standards for City Council consideration.

The specific language as adopted by the PUC in response to C.R.S. §40-2-124 is provided below:

3664. Net Metering.

(a) All investor owned QRUs *(Qualified Retail Utility)* shall allow the customer's retail electricity consumption to be offset by the electricity generated from eligible energy resources on the customer's side of the meter that are interconnected with the QRU, provided that the generating capacity of the customer's facility meets the following two criteria:

(I) The generator shall be sized to supply no more than 120 percent of the customer's average annual electricity consumption at that site, where the site includes all contiguous property

owned or leased by the consumer, without regard to interruptions in contiguity caused by easements, public thoroughfares, transportation rights-of-way, or utility rights-of-way; and

(II) The rated capacity of the generator does not exceed the customer's service entrance capacity.

Staff is proposing adoption of the same limits as defined in (I) and (II) above.

Staff has developed and is proposing adoption of the Standards for Interconnection of Electric Generation Facilities to the Fort Collins Electric Distribution System (the "Standards"). The Standards provide a guideline for customers who want to connect a generator to the Fort Collins electrical distribution system. The Standards have been developed to enable connection of different types of electric generation, including inverter based, such as solar photovoltaic and small wind generation, induction and synchronous generators. The Standards insure a safe connection that protects the customer, the generator, adjacent customers and the distribution system. Additionally, the Standards facilitate the installation of distributed generators by providing clear requirements to customers.

Historically, Light and Power has applied the Institute of Electrical and Electronics Engineers (IEEE) standard 1547 as the guideline for existing interconnection requirements. In order to maximize the level of distributed generation on the system and ensure the continued safe operation of the system, Light and Power staff worked with NEI Engineering, specifically Dr. Keith Malmedal and Dr. P.K. Sen, to develop interconnection standards specific to the Fort Collins distribution system.

FINANCIAL IMPACT

The proposed net metering rate requires Fort Collins Utilities to purchase excess annual kilowatt-hour production generated by the customer's generator at the customer's retail energy rate. As the number and size of net metered customers grows, the financial impact the rate is having on Light and Power revenues will need to be reviewed. Currently the City has less than 50 net metered customers and has made payment to two.

SUSTAINABILITY: ECONOMIC, ENVIRONMENTAL AND SOCIAL IMPACTS

The overarching goal in the development of the net metering rate and the Standards is to develop rates and standards that facilitate the installation of renewable generation in the community. The intent of providing net metering to customers is to ensure that customers are given the full value for the energy generated and are allowed credit for any excess energy generated. Ensuring that customers can obtain the maximum value from the utility towards their investment in renewable generation encourages installation. This benefits both the customer and the environment. Approximately 1.61 pounds of CO2 are avoided for each kilowatt-hour saved.

STAFF RECOMMENDATION

Staff recommends that the adoption of the net metering rate setting the maximum qualified generation to 120% of consumption, not exceed the capacity of the customer's service entrance. Staff also recommends adoption of the Standards.

BOARD / COMMISSION RECOMMENDATION

At its November 9, 2009 meeting, the Electric Board voted unanimously to recommend adoption of the Interconnection Standards for Generating Facilities to the Fort Collins distribution system, along with the recommendation to adopt the option proposed net metering limits, setting the maximum generation to 120 percent of consumption, but not to exceed the capacity of the customer's service entrance.

At its January 6, 2010 meeting, the Electric Board reviewed the net metering ordinance language and voted unanimously to recommend adoption of Ordinance No. 004, 2010. Minutes from the January 6, 2010 Electric Board meeting will be provided to Council before the January 19, 2010 meeting.

PUBLIC OUTREACH

Staff provided draft copies of the interconnection standards to local solar installers and installation instructors for comment. Comments were incorporated into the Standards.

On December 18, 2009, the Fort Collins Utilities mailed 244 notifications to out-of-City customers, notifying them of the proposed changes to the Utility's rate code, and making them aware of the time and date of the City Council meeting when the changes would be considered. Public notice of the changes and of the time and date they would be considered was published in the *Coloradoan* on December 20, 2009.

ATTACHMENTS

1. Electric Board minutes, November 9, 2009
2. PowerPoint presentation

Excerpt from approved November 9, 2009 Electric Board Minutes

Interconnection Standards

Light and Power Manager Steve Catanach sought feedback about the interconnection standards information shared with the Board at the October 7 meeting. The intent as these standards and net metering are moved forward is to position ourselves for installation of the maximum allowable amount of renewable resources in the community. These standards insure we're operating safely and that we understand the maximum allowable for our specific system. Mr. Catanach expressed confidence the standards have been accurately identified. As the implementation of smart grid technology commences, and better, more intelligent information on operating the system becomes available, our ability to manage a higher level of renewables on the system is enhanced.

Public feedback from local solar installers and installation instructors was sought during this process and will be incorporated in an updated version to be sent out at a future time. The following recommendations were received from this group:

- Periodic maintenance tests (7.2) – consultant felt these were typical requirements. Under a megawatt, there is no requirement for such tests.
- The 120 percent (prior year/annual) consumption model is unique to investor-owned utilities in Colorado. There was general concensus that neither the 120 percent of energy consumption nor the 125 percent of peak demand limit to the amount of net metering would deter the size of installations, because the costs of such large systems would be prohibitive for many years. The 120 percent of consumption limit was preferred at this time, because it matched the common limit in Colorado and would thus avoid confusion with consumers.
- Recommendation to eliminate the disconnect switch. If the disconnect requirement is eliminated, staff will bring back to the Board.

Motion:
Board Member Wolley moved the Electric Board recommend to City Council to adopt the Interconnection Standards for Generating Facilities (GF) to the Fort Collins distribution system, along with the recommendation to adopt the optional proposed Net Metering limits, setting the maximum generation to 120 percent of consumption, but not to exceed the capacity of the customer's service entrance. Board Member Bihn seconded the motion.

A vote was taken, and it passed unanimously.

Net Metering

Steve Catanach, PE
Light & Power Manager

City of Fort Collins

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Net metering
Ordinance History

- May 19, 2009 - Adopted on 1st reading
- June 2, 2009, - Requested to mirror levels established for the investor owned utilities in the State.
  - State levels at 120% of consumption or service entrance size
  - Staff requested time to develop interconnection standards that anticipated requirements for generation sized to provide 120% of consumption.

City of Fort Collins

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Net metering

- Net metering is only required for “eligible energy resources”
- Examples:
  - » Solar
  - » Fuel Cell
  - » Wind
  - » Geothermal
  - » Combined Heat & Power
  - » Biomass

City of Fort Collins

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Net metering

- The Net metering ordinance defines how energy produced by a customers qualifying renewable resource will be handled financially
- Compensation for “netted" customer generation
  - For amounts offset from the customers consumption - the payment is effectively at the customers retail rate

City of Fort Collins

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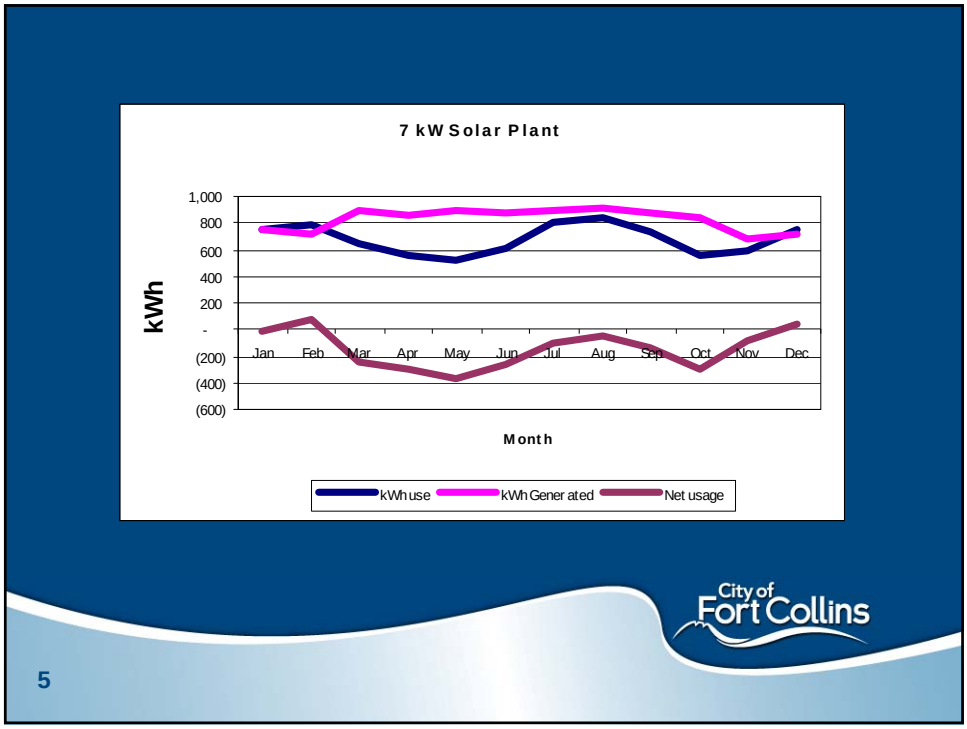

City of Fort Collins

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7kW plant

Month	Bill	kWh Use	kWh Gen	Net	New Bill
Jan	$ 52.53	748	756	(8)	$ 3.91
Feb	$ 55.59	795	715	80	$ 9.13
Mar	$ 45.43	639	889	(250)	$ 3.91
Apr	$ 40.17	558	849	(291)	$ 3.91
May	$ 37.95	524	885	(361)	$ 3.91
Jun	$ 43.79	614	883	(269)	$ 3.91
Jul	$ 55.69	797	898	(101)	$ 3.91
Aug	$ 59.00	848	903	(55)	$ 3.91
Sep	$ 52.08	741	871	(130)	$ 3.91
Oct	$ 40.22	559	848	(289)	$ 3.91
Nov	$ 42.82	599	686	(87)	$ 3.91
Dec	$ 53.01	756	710	46	$ 6.87
Totals	$ 578.27	8,177	9,893	(1,716)	55.10

City of Fort Collins

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Net metering

If generation exceeds customer consumption, “excess generation” carried forward for annual period.

- Recommendation is April through March to cover seasonal differences.

- Compensation for “cash out” amounts:
  - Recommendation is compensation at the retail energy rate.

City of Fort Collins

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Interconnection Standards

- Developed with the assistance of NEI Engineering
- Modeled after the Institute of Electrical and Electronics Engineers (IEEE) standard 1547
- IEEE Standard adapted to address specifics related to Fort Collins system.
  - » 99% underground system
  - » Renewable generation
  - » Significant parallel generation
  - » FortZED – RDSI project

City of Fort Collins

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ORDINANCE NO. 003, 2010
OF THE COUNCIL OF THE CITY OF FORT COLLINS
AMENDING CHAPTER 26, ARTICLE VI OF THE CODE OF THE CITY OF FORT COLLINS RELATING TO NET METERED ELECTRIC SERVICE

WHEREAS, new forms of renewable energy are routinely becoming available to the City's electric utility customers as well as the City; and

WHEREAS, in 2005, the City developed a pilot net metering service program designed to allow customers who meet certain requirements to generate renewable energy and to use that energy to reduce the amount of energy they purchase from the City; and

WHEREAS, the City currently has approximately 40 approved customers receiving net metering service; and

WHEREAS, Colorado Revised Statutes, Section 40-2-124 requires each municipally owned utility in the state of Colorado to allow a customer-generator's retail electricity consumption to be offset by the electricity generated from eligible energy resources on the customer-generator's side of the meter for such generator's that are interconnections with the facilities of the municipal utility; and

WHEREAS, staff believes that the City should offer net metering service beyond the minimum threshold set by the State statute and offer such service to its customers at limits consistent with those established by the Colorado Public Utilities Commission; and

WHEREAS, in view of the fact that the City Council recognizes and places high value on the viability of the City's electric utility and on allowing City property owners to provide electric service to their own properties under certain conditions, the Council has determined that the amendments accomplished by this Ordinance are in the best interests of the City.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF FORT COLLINS as follows:

Section 1. That Section 26-391 of the Code of the City of Fort Collins is hereby amended by the deletion of the definition of "*IEEE 1547*" in its entirety as follows:

~~*IEEE 1547* shall mean the International Electric and Electronic Engineers Standard 1547 for Interconnecting Distributed Resources with Electric Power Systems as approved in June 2003.~~

Section 2. That the definition of "*Parallel generation*" contained in Section 26-391of the Code of the City of Fort Collins is hereby amended to read as follows:

Parallel generation shall mean the operation of qualifying facilities when interconnected with the utility system in accordance with the provisions of this Chapter, the electric utility rules and regulations, and the ~~IEEE 1547~~City of Fort

Collins Utility Services Interconnection Standards for Generating Facilities Connected to the Fort Collins Distribution System.

Section 3. That the definition of "*Qualifying facility*" contained in Section 26-391 of the Code of the City of Fort Collins is hereby amended to read as follows:

Qualifying facility shall mean an electric-generating facility operated in parallel with the City of Fort Collins electric distribution system that has been inspected for compliance with the ~~IEEE 1547~~City of Fort Collins Utility Services Interconnection Standards for Generating Facilities Connected to the Fort Collins Distribution System, has been issued a "Permit to Operate" by the City, and is operated under a valid "Interconnection Agreement" with the City of Fort Collins.

Section 4. That Section 26-391 of the Code of the City of Fort Collins is hereby amended by the addition of a new definition "Net metering service" which reads in its entirety as follows:

Net metering service shall mean that service available to a customer-generator operating a qualifying facility that is interconnected to the electric utility so that any electric energy generated by the qualifying facility in excess of that used by the qualifying facility is delivered to the electric utility system and used to offset metered energy received by the customer-generator during the billing period.

Section 5. That Section 26-464 of the Code of the City of Fort Collins is hereby amended to read as follows:

Sec. 26-464. Residential energy service, schedule R.

. . .

(j) *Parallel generation.* Operation or connection of any electric generator in parallel with the utility system is not permitted under this schedule unless authorized by the General Manager. See appropriate alternate schedules for this service. If a customer is receiving net metering service, such customer's service shall also be governed by the net metering service terms and conditions described in subsection (o) below.

. . .

(o) *Net metering.*

(1) Net metering service is available to a customer-generator producing electric energy exclusively with a qualifying facility when the generating capacity of the customer-generator's qualifying facility meets the following two criteria:

(a) the qualifying facility is sized to supply no more than one hundred twenty (120) percent of the customer-generator's average annual electricity consumption at that site, including all contiguous property

owned or leased by the customer-generator, without regard to interruptions in contiguity caused by easements, public thoroughfares, transportation rights-of-way, or utility rights-of-way; and

(b) the rated capacity of the qualifying facility does not exceed the customer-generator's service entrance capacity.

(2) The energy generated by an on-site qualifying facility and delivered to the utility's electric distribution facility shall be used to offset energy provided by the utility to the customer-generator during the applicable billing period.

(3) The customer-generator and electric service arrangements shall be subject to the requirements and conditions described in the City of Fort Collins Utility Services Interconnection Standards for Generating Facilities Connected to the Fort Collins Distribution System.

(4) A customer-generator who receives approval from the electric utility to obtain net metering service shall be subject to the monthly rates described above in this rate schedule section.

(5) The customer-generator's consumption of energy from the utility shall be measured on a monthly basis and in the event that the qualifying facility has produced more electricity than the customer-generator has consumed, the customer-generator shall receive a monthly credit for such production. During the second calendar quarter of each year, the customer-generator shall receive payment for the net excess generation accrued for the preceding twelve (12) months.

Section 6. That Section 26-465 of the Code of the City of Fort Collins is hereby amended to read as follows:

Sec. 26-465. Residential demand service, schedule RD.

. . .

(k) *Parallel generation.* Customers may operate all or part of their instantaneous energy or capacity needs by operation of a qualifying facility in parallel with the utility system, provided that electric service is being rendered under the special services provisions of this schedule, and provided further that such facility is constructed, operated and maintained in accordance with the provisions of the electric service rules and regulations. If a customer is receiving net metering service, such customer's service shall also be governed by the net metering service terms and conditions described in subsection (q) below.

. . .

(q) *Net metering.*

(1) Net metering service is available to a customer-generator producing electric energy exclusively with a qualifying facility when the generating capacity of the customer-generator's qualifying facility meets the following two criteria:

(a) the qualifying facility is sized to supply no more than one hundred twenty (120) percent of the customer-generator's average annual electricity consumption at that site, including all contiguous property owned or leased by the customer-generator, without regard to interruptions in contiguity caused by easements, public thoroughfares, transportation rights-of-way, or utility rights-of-way; and

(b) the rated capacity of the qualifying facility does not exceed the customer-generator's service entrance capacity.

(2) The energy generated by an on-site qualifying facility and delivered to the utility's electric distribution facility shall be used to offset energy provided by the utility to the customer-generator during the applicable billing period.

(3) The customer-generator and electric service arrangements shall be subject to the requirements and conditions described in the City of Fort Collins Utility Services Interconnection Standards for Generating Facilities Connected to the Fort Collins Distribution System.

(4) A customer-generator who receives approval from the electric utility to obtain net metering service shall be subject to the monthly rates described above in this rate schedule section.

(5) The customer-generator's consumption of energy from the utility shall be measured on a monthly basis and in the event that the qualifying facility has produced more electricity than the customer-generator has consumed, the customer-generator shall receive a monthly credit for such production. During the second calendar quarter of each year, the customer-generator shall receive payment for the net excess generation accrued for the preceding twelve (12) months.

Section 7. That Section 26-466 of the Code of the City of Fort Collins is hereby amended to read as follows:

Sec. 26-466. General service, schedule GS.

. . .

(m) *Parallel generation.* Customers may operate all or part of their instantaneous energy or capacity needs by operation of a qualifying facility in parallel with the utility system, provided that electric service is being rendered under the special services provisions of this schedule, and provided further that such facility is constructed, operated and maintained in accordance with the provisions of the electric service rules and regulations. If a customer is receiving net metering service, such customer's service shall also governed by the net metering service terms and conditions described in subsection (r) below.

. . .

(r) *Net metering.*

(1) Net metering service is available to a customer-generator producing electric energy exclusively with a qualifying facility when the generating capacity of the customer-generator's qualifying facility meets the following two criteria:

(a) the qualifying facility is sized to supply no more than one hundred twenty (120) percent of the customer-generator's average annual electricity consumption at that site, including all contiguous property owned or leased by the customer-generator, without regard to interruptions in contiguity caused by easements, public thoroughfares, transportation rights-of-way, or utility rights-of-way; and

(b) the rated capacity of the qualifying facility does not exceed the customer-generator's service entrance capacity.

(2) The energy generated by an on-site qualifying facility and delivered to the utility's electric distribution facility shall be used to offset energy provided by the utility to the customer-generator during the applicable billing period.

(3) The customer-generator and electric service arrangements shall be subject to the requirements and conditions described in the City of Fort Collins Utility Services Interconnection Standards for Generating Facilities Connected to the Fort Collins Distribution System.

(4) A customer-generator who receives approval from the electric utility to obtain net metering service shall be subject to the monthly rates described above in this rate schedule section.

(5) The customer-generator's consumption of energy from the utility shall be measured on a monthly basis and in the event that the qualifying facility has produced more electricity than the customer-generator has consumed, the customer-generator shall receive a monthly credit for such production.

During the second calendar quarter of each year, the customer-generator shall receive payment for the net excess generation accrued for the preceding twelve (12) months.

Section 8. That Section 26-467 of the Code of the City of Fort Collins is hereby amended to read as follows:

Sec. 26-467. General service 50, schedule GS50.

. . .

(p) *Parallel generation.* Customers may operate all or part of their instantaneous energy or capacity needs by operation of a qualifying facility in parallel with the utility system, provided that electric service is being rendered under the special services provisions of this schedule, and provided further that such facility is constructed, operated and maintained in accordance with the provisions of the electric service rules and regulations. Parallel generation will be provided consistent with all of the requirements contained in ~~under the terms and conditions of~~ Platte River Power Authority's Tariff Schedule 3: Parallel Generation Purchases, as may be amended from time to time, ~~or other applicable provisions of Platte River power Authority Tariffs~~. All charges incurred by the utility under this tariff will be billed to the customer. If a customer is receiving net metering service, such customer's service shall also be governed by the net metering service terms and conditions described in subsection (u) below.

. . .

(u) *Net metering.*

(1) Net metering service is available to a customer-generator producing electric energy exclusively with a qualifying facility when the generating capacity of the customer-generator's qualifying facility meets the following two criteria:

(a) the qualifying facility is sized to supply no more than one hundred twenty (120) percent of the customer-generator's average annual electricity consumption at that site, including all contiguous property owned or leased by the customer-generator, without regard to interruptions in contiguity caused by easements, public thoroughfares, transportation rights-of-way, or utility rights-of-way; and

(b) the rated capacity of the qualifying facility does not exceed the customer-generator's service entrance capacity.

(2) The energy generated by an on-site qualifying facility and delivered to the utility's electric distribution facility shall be used to offset energy provided

by the utility to the customer-generator during the applicable billing period.

(3) The customer-generator and electric service arrangements shall be subject to the requirements and conditions described in the City of Fort Collins Utility Services Interconnection Standards for Generating Facilities Connected to the Fort Collins Distribution System.

(4) A customer-generator who receives approval from the electric utility to obtain net metering service shall be subject to the monthly rates described above in this rate schedule section.

(5) The customer-generator's consumption of energy from the utility shall be measured on a monthly basis and in the event that the qualifying facility has produced more electricity than the customer-generator has consumed, the customer-generator shall receive a monthly credit for such production. During the second calendar quarter of each year, the customer-generator shall receive payment for the net excess generation accrued for the preceding twelve (12) months.

Section 9. That Section 26-468 of the Code of the City of Fort Collins is hereby amended to read as follows:

Sec. 26-468. General service 750, schedule GS750.

. . .

(p) *Parallel generation.* Customers may operate all or part of their instantaneous energy or capacity needs by operation of a qualifying facility in parallel with the utility system, provided that electric service is being rendered under the special services provisions of the schedule, and provided further that such facility is constructed, operated and maintained in accordance with the provisions of the electric service rules and regulations. Parallel generation in excess of one (1) megawatt will be provided consistent with all of the requirements contained in Platte River Power Authority's Tariff Schedule 3: Parallel Generation Purchases, as amended from time to time ~~under the terms and conditions of Platte River Power Authority's Tariff -- Schedule 10: Back-Up Service~~. All charges incurred by the utility under this tariff will be billed to the customer. If a customer is receiving net metering service, such customer's service shall also be governed by the net metering service terms and conditions described in subsection (v) below.

. . .

(v) *Net metering.*

(1) Net metering service is available to a customer-generator producing electric energy exclusively with a qualifying facility when the generating capacity of the customer-generator's qualifying facility meets the following two criteria:

(a) the qualifying facility is sized to supply no more than one hundred (120) percent of the customer-generator's average annual electricity consumption at that site, including all contiguous property owned or leased by the customer-generator, without regard to interruptions in contiguity caused by easements, public thoroughfares, transportation rights-of-way, or utility rights-of-way; and

(b) the rated capacity of the qualifying facility does not exceed the customer-generator's service entrance capacity.

(2) The energy generated by an on-site qualifying facility and delivered to the utility's electric distribution facility shall be used to offset energy provided by the utility to the customer-generator during the applicable billing period.

(3) The customer-generator and electric service arrangements shall be subject to the requirements and conditions described in the City of Fort Collins Utility Services Interconnection Standards for Generating Facilities Connected to the Fort Collins Distribution System.

(4) A customer-generator who receives approval from the electric utility to obtain net metering service shall be subject to the monthly rates described above for this rate schedule.

(5) The customer-generator's consumption of energy from the utility shall be measured on a monthly basis and in the event that the qualifying facility has produced more electricity than the customer-generator has consumed, the customer-generator shall receive a monthly credit for such production. During the second calendar quarter of each year, the customer-generator shall receive payment for the net excess generation accrued for the preceding twelve (12) months.

Introduced, considered favorably on first reading, and ordered published this 19th day of January, A.D. 2010, and to be presented for final passage on the 2nd day of February, A.D. 2010.

_____
Mayor

ATTEST:

_____
City Clerk

Passed and adopted on final reading on the 2nd day of February, A.D. 2010.

_____
Mayor

ATTEST:

_____
City Clerk

ORDINANCE NO. 004, 2010
OF THE COUNCIL OF THE CITY OF FORT COLLINS
ADOPTING STANDARDS FOR INTERCONNECTION OF
ELECTRIC GENERATION FACILITIES TO THE FORT COLLINS
ELECTRIC DISTRIBUTION SYSTEM

WHEREAS, in view of the fact that the City Council recognizes and places high value on the viability of the City's electric utility and on allowing City property owners to provide electric service to their own properties under certain conditions; and

WHEREAS, the connection of customer-owned generating facilities to the Fort Collins electric distribution system entails complex technical and safety issues; and

WHEREAS, staff believes that requiring customers and their generating facilities to meet certain terms and conditions will serve to protect the viability and safe operation of the Fort Collins electric distribution system; and

WHEREAS, staff has worked with a consultant to develop certain Standards for Interconnection of Electric Generation Facilities to the Fort Collins Electric Distribution System (the "Standards"), a copy of which is attached hereto and incorporated herein by this reference as Exhibit "A"; and

WHEREAS, on November 9, 2009, the Fort Collins Electric Board reviewed and considered proposed standards in a form substantially similar to those contained in Exhibit "A" and voted unanimously to recommend that the City Council adopt such standards; and

WHEREAS, modifications made to the standards presented to the Electric Board are reflected in Exhibit "A" and include corrections of typographical errors, some corrections to mathematical equations and revisions suggested by citizen comments; and

WHEREAS, the adoption of the Standards will protect the viability and security of the Fort Collins electric distribution system, promote safety of electric service customers, staff, and interconnected generators, and establish baseline technical requirements for interconnection.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF FORT COLLINS as follows:

Section 1. That adoption of the Standards is necessary to encourage City property owners to provide electric service to their own properties under certain conditions.

Section 2. That adoption of the Standards is necessary to protect the viability of the Fort Collins electric distribution system.

Section 3. That adoption of the Standards is necessary to promote safety of electric service customers, staff, and interconnected generators.

Section 4. That the Standards are hereby approved and adopted.

Introduced, considered favorably on first reading, and ordered published this 19th day of January, A.D. 2010, and to be presented for final passage on the 2nd day of February, A.D. 2010.

Mayor

ATTEST:

City Clerk

Passed and adopted on final reading on the 2nd day of February, A.D. 2010.

Mayor

ATTEST:

City Clerk

City of Fort Collins Utility Services

INTERCONNECTION STANDARDS FOR GENERATING FACILITIES (GF) CONNECTED TO THE FORT COLLINS DISTRIBUTION SYSTEM

January 2010~~November 2009~~

TABLE OF CONTENTS

1.0 Scope and General Requirements

1.1 Scope and Intent

The requirements contained in this document apply to all generation sources connected to the FCU distribution system 5MW and below at any one location. Any and all connections to the FCU distribution system and any aspect of such connection are subject to FCU review and such connections shall not be permitted ~~if FCU does not approve them~~unless approved by FCU. The operation and design of any GF must meet all of the requirements contained in this document, any written agreement between FCU and the Operator, as well as any applicable requirements contained in Chapter 26 of the Fort Collins Municipal Code and Fort Collins Utilities Electric Service Rules and Regulations.

Any location where the aggregate total generation exceeds 5MW may require additional study by FCU. This study will consider the specific feeder where the GF is proposed to be connected. If the addition of any GF causes the total amount of generation by all sources on that feeder to exceed 50% of the minimum load on that feeder, additional study by FCU is required and the requirements produced as a result of that study may exceed those in ~~the~~this document. If the GF source to be added is highly variable such as wind or solar, and the total amount of wind or solar generation by all sources on that feeder exceeds 13.3% of the feeder capacity, or if the total of all the wind or solar generation on any substation exceeds 13.3% of the substation transformer size, additional study by FCU is required and the requirements produced as a result of that study may exceed those in this document.

Protection and safety devices are intended to provide protection for the FCU distribution system, FCU utility workers, FCU customers and the general public. Protective devices installed on the GF are designed to ensure that the fault current supplied by the GF will be interrupted in the event a fault occurs on the FCU distribution system. When a fault occurs, the GF must be designed to automatically disconnect from the FCU distribution system until the distribution system is restored to normal operation.

Any source not explicitly described in this document will require special study before ~~its interconnection to FCU allowed~~it is allowed to interconnect to FCU.

1.2 System Phase and Voltage

The GF may interconnect to the system at any service voltage available at the site. Additional voltages may be arranged with FCU on a case-by-case basis, subject to FCU approval. If the site contains a three-phase system the GF equipment must be three-phase. If only a single phase service is available, a single-phase GF may be allowed. The maximum nameplate rating of all the single-phase generators at any GF shall not exceed 20 kVA if connected line-line. When the site contains a center-tapped single-phase service, machines may be connected between phase and the center-tapped neutral providing the maximum nameplate rating of the generator connected does not exceed 5 kVA.

1.3 System Reclosing

Automatic reclosing is generally not utilized on the FCU distribution systems to clear temporary faults; however, in the cases and locations where automatic reclosing is used, the GF must be designed to ~~insure~~ ensure that the GF will disconnect from the distribution system in the event an automatic reclose occurs. Normally the GF will not be allowed to interfere with automatic reclosing where it exists; however, industry standards require that a GF must automatically disconnect from an islanded system within two seconds. If the existing reclosing interval is faster than two seconds FCU will reset it to accommodate the GF.

1.4 Islanding

Islanding occurs when a GF becomes separated from the main generation source on a distribution system, but continues to independently serve a portion of the distribution system. GF's shall be equipped with protective devices and controls designed to prevent the generator from being connected to a de-energized distribution system. Islanding is not permitted on the FCU distribution system.

1.5 Synchronizing

Synchronization of the GF with the FCU system must be done automatically. Any proposal to allow manual synchronization is subject to review and approval by FCU. All GF's must use protective devices that prevent electrically closing a GF that is out of synchronization with the distribution system. FCU will under no circumstances be responsible or liable for any damage done due to an out of synchronization closure of a GF onto the system. Additionally, the Operator is responsible and liable for any damage done to the FCU system by any type of improper closing onto the system.

1.6 Improper Operation of the GF

Operation and design of the GF must meet all the requirements contained in this document as well as any applicable requirements contained in the Fort Collins Municipal Code and the Fort Collins Utilities Electric Service Rules and Regulations and any written agreement between FCU and the Operator. Also, no GF operation will at any time be allowed to adversely impact the operation of the FCU system in any way. The GF must not produce adverse amounts of unbalanced currents or voltages; produce high or low voltages, or unacceptable frequencies; it must not inject DC or harmonics into the system beyond what is allowed by this document; or cause~~ing~~ excessive operations of system voltage regulating devices such as load tap changers and voltage regulators. The GF must not adversely affect system grounding or ground fault protection.

FCU will not normally interfere with the operation of any GF. However, when requested by FCU by telephone, in person, or in writing, the Operator must immediately stop operation and not resume operation until cleared by FCU to do so. If the Operator begins to operate the GF out of the ranges or conditions listed herein, the Operator must agree to cease operation until such a time as the GF Operator can demonstrate to FCU that it has remedied the problem and can once again operate the GF in compliance with these requirements.

If usage of the GF causes unusual fluctuations or disturbances on, or ~~inductive~~ interference with FCU's system or other FCU customers, FCU shall have the right to require the GF to install suitable apparatus to reasonably correct or limit such fluctuation, disturbance or interference at not expense to FCU or other customers.

1.7 System Capacity Limitations

The equipment installed by FCU to distribute power is limited in size and is normally sized for safe and efficient delivery of power. Adding generation to this system, especially generation supplied by renewable sources which normally have low capacity factors, may quickly overload the existing equipment. Care must be taken when adding generation to avoid damaging FCU equipment. Also, when system penetration levels of distributed generation becomes large enough, accidental islanding of sections of the system becomes possible, and additional protective devices or systems, such as transfer trip equipment, may be needed for safe operation of the FCU system. Whenever one or more of the following limitations are exceeded, FCU may need to conduct an additional study and FCU may require additional equipment. Additional study is required if:

a) The rated aggregate generation ~~KVA~~ kVA on any distribution transformer after the addition of the new GF equals or exceeds 100% of the rating of the transformer
b) The rated aggregate generation kVA on any protective device or feeder from the point of interconnection to the substation transformer exceeds 13.3% of the rating of that protective device or feeder

c) The rated aggregate generation kVA on any feeder or portion of a feeder equals or exceeds 50% of the existing ~~yearly~~annual minimum load on that feeder or feeder section
d) The proposed GF results in more than 90kW of single-phase generation on one phase of a feeder when both the new and existing generation are included
e) The proposed GF includes an induction machine 300kW or greater, or an aggregate of 300kW of induction generators

1.8 Submittal Requirement

The Operator shall submit in a timely manner, sufficient design and specification information relating to the facilities to be installed by the Operator. FCU shall be entitled to review and approve or disapprove these facilities prior to their installation and energization. The Operator agrees to incorporate any reasonable design changes requested by FCU prior to, during, or after installation of the GF's facilities. FCU's approval or acceptance of any design and specification information related to the GF to be installed shall not be construed as an endorsement of such engineering plans, specifications, or other information.

The following drawings and other documents must be submitted to FCU for approval before any construction is begun.

a) Single-line diagram of the facility showing the sizes of all equipment and the system protection planned
b) Cut sheets on all equipment planned including inverters, generators, fuse~~d~~s, circuit breakers, switches, etc.
c) Capability curves on all synchronous and doubly fed induction generators.
d) Short circuit calculations.

2.0 Standards and ~~Acronyms~~Definitions

2.1 Standards

In all cases the current edition of the following standards should be referred to in design of the power plant, choice of equipment, and interconnection design.

a) ANSI C84.1 American National Standard for Electric Power Systems and Equipment-Voltage ratings (60 Hertz)
b) IEEE Std. 18 IEEE Standard for Shunt Capacitors
c) IEEE Std. 32 IEEE Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices
d) IEEE Std. 141: IEEE Recommended Practice for Electric Power Distribution for Industrial Plants
e) IEEE Std. 142: IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
f) IEEE Std. 242: IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
g) IEEE Std. 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
h) IEEE Std. 665: IEEE Standard for Generation Station Grounding
i) IEEE Std. 1015: IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
j) IEEE Std. 1036: IEEE Standard for Application of Shunt Power Capacitors
~~a)~~k) IEEE 1547 IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
~~b)~~l) IEEE 1547.1 IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

~~c)~~m) IEEE 1547.2 IEEE Application Guide for IEEE Std. 1547, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems

n) IEEE Std. C2: National Electrical Safety Code

~~d)IEEE Std. 242 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems~~

o) IEEE Std. C37.06: IEEE Standard for AC High-Voltage Circuit Breakers rated on a Symmetrical Current Basis-Preferred Ratings and Required Capabilities.

p) IEEE C37.012: IEEE Application Guide for Capacitor Current Switching for AC High-Voltage Circuit Breakers

q) IEEE C37.66: IEEE Standard Requirements for Capacitor Switches for AC Systems (1kV thru 38kV).

r) IEEE C37.90 IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

s) IEEE C37.90.1 IEEE Standard for Surge Withstand capability (SWC) Tests for Relay and Relay Systems Associated with Electric Power Apparatus.

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

u) IEEE C37.90.3 IEEE Standard Electrostatic Discharge Tests for Protective Relays

v) IEEE C37.95 IEEE Guide for Protective Relaying of Utility-Consumer Interconnections

w) IEEE Std. C37.102 IEEE Guide for AC Generator Protection

x) IEEE Std C62.41: IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

y) NERC PRC-024-1: Generator Frequency and Voltage Protective Relays

z) NFPA 70: National Electrical Code

aa) UL 1741: Inverters, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources

~~e)IEEE Std. C37.102 IEEE Guide for AC Generator Protection~~

~~f)UL1741 Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources~~

~~f)IEEE C37.95 IEEE Guide for Protective Relaying of Utility-Consumer Interconnections~~

~~g)IEEE C2 National Electrical Safety Code~~

~~h)NFPA 70 National Electrical Code~~

~~i)IEEE 519 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems~~

~~j)ANSI C84.1 American National Standard for Electric Power Systems and Equipment-Voltage ratings (60 Hertz)~~

~~k)IEEE C37.90 IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus~~

~~l)IEEE C37.90.1 IEEE Standard for Surge Withstand capability (SWC) Tests for Relay and Relay Systems Associated with Electric Power Apparatus.~~

~~m)IEEE C37.90.2 IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers~~

~~n)IEEE C37.90.3 IEEE Standard Electrostatic Discharge Tests for Protective Relays~~

~~o)IEEE Std. 142 IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.~~

~~p)IEEE Std. 32 IEEE Standard Requirements, Terminology, and Test Procedure for Neutral Grounding Devices.~~

~~q)IEEE Std. 141: IEEE Recommended Practice for Electric Power Distribution for Industrial Plants.~~

~~r)IEEE Std. 665: IEEE Standard for Generating Station Grounding~~

~~s)IEEE Std. 18: IEEE Standard for Shunt Power Capacitors~~

~~t)IEEE Std. 1036: IEEE Standard for Application of Shunt Power Capacitors.~~

~~u)IEEE Std. C37.06: IEEE Standard for AC High-Voltage Circuit Breakers rated on a Symmetrical Current Basis-Preferred Ratings and Required Capabilities.~~

~~v)IEEE C37.012: IEEE Application Guide for Capacitor Current Switching for AC High-Voltage Circuit Breakers~~

~~w)IEEE C37.66: IEEE Standard Requirements for Capacitor Switches for AC Systems (1kV thru 38kV).~~
~~y)IEEE Std. 1015: IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems~~.
~~x)IEEE Std C62.41: IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits~~

2.2 Definitions~~Acronyms~~

The following ~~acronyms~~ definitions will be used throughout this document.

- ANSI-American National Standards Institute
- FCU-Fort Collins Utility Services
- GF-Generating facility
- IEEE-Institute of Electrical and Electronic Engineers
- KVA-Kilovolt-amps
- KW-Kilowatt
- MW-Megawatt
- NEC-National Electrical Code
- NEMA-National Electrical Manufacturers Association
- NESC-National Electrical Safety Code
- Operator-Generating facility owner and operator, successors, heirs, agents, employees, and assigns
- PCC-Point of common coupling
- UL-Underwriters Laboratories
- VAR-Volt-Amps reactive (reactive power)

3.0 GF Equipment and Installation Requirements

3.1 General Requirements

The installation of any GF shall meet the relevant requirements of the National Electrical Code (NEC) and the National Electrical Safety Code (NESC). Where required by the municipality, the Operator cleared to move forward with the installation must obtain all necessary building permits, pass all applicable building department inspections, and meet other applicable requirements including but not limited to municipal code and Fort Collins Electric Service Rules and Regulations.

Unless otherwise modified in this document, the interconnection must meet the requirements of IEEE Std. 1547. Where the requirements of this document vary from the requirements of IEEE Std. 1547, this document governs.

The Operator shall be solely responsible for protecting the GF and all associated equipment from abnormal distribution system conditions such as outages, short circuits, voltage or frequency variations, or other disturbances. FCU will not install equipment for the protection of the GF generator or other equipment. The GF equipment must be designed and operated so that it is capable of properly synchronizing the generator to the system, maintaining safe operation of the generation equipment, detecting any unusual operating condition, and disconnecting the generator from the system anytime damage to the generator or other equipment may occur. The equipment protection provided by the Operator will prevent the GF from adversely affecting the distribution system's capability of providing reliable service to other FCU customers. The GF must automatically disconnect itself from the system anytime system conditions are outside the ranges described in this document and is not permitted to reconnect to the system until system conditions return to normal and are maintained within the normal range for a minimum of five (5) minutes.

3.2 Interconnection Disconnect Switch

Each GF installation must include a manually operated, lockable, disconnect switch with a visual break. The disconnect switch must be visible and accessible at all times by FCU personnel to allow the GF to be disconnected safely during maintenance or outage conditions. In the case of a PV system this disconnect switch must be located next to the FCU electric meter. In all cases the disconnect switch must be rated to interrupt the maximum output of the generator and must be rated for the voltage and fault current requirements of the GF and must meet all applicable NEMA, UL, ANSI, IEEE, and NEC standards as well as local and state electrical codes. The disconnect switch shall be permanently labeled with text indicating that the switch is for the GF. The labeling shall also clearly indicate the open and closed position of the switch. The disconnect switch must be located on the output or load side of the GF such that the entire GF can be isolated from FCU distribution system. If the site contains several generators, a single disconnect switch may be used providing its rating is sufficient for all generators and opening it produces a visible open point between all generators and the FCU system.

Other devices such as circuit breakers or fuses may be considered as a substitute for a disconnect switch if each of the following conditions is met:

a) If a circuit breaker is used it is draw-out and capable of being locked into the disconnected position
b) If a fuse is used it is capable of being removed from the bus to provide a visual open point
c) The Operator or Operator's agents are available at all times to disconnect and remove this breaker or fuses whenever requested by FCU

All lock-out and tag-out capabilities must also be available for the devices used and must be assessable to FCU personnel.

3.3 Dedicated Transformer and Additional Primary Protection

If the GF rating is greater ~~then~~ than 50kW the GF must be connected to the FCU by a dedicated transformer. The transformer must meet FCU standards and design criteria. The transformer must be labeled according to FCU practices.

Most interconnecting transformers on the FCU system are protected with fuses. ~~However,~~However, if a GF is rated ~~FCU may require that if a GF is~~ at 1500 kVA or above, FCU may determine the fuse protection is insufficient to properly protect the FCU system. In this case, FCU may require that ~~then~~ a dedicated three-phase interrupting device such as a recloser must be added to the transformer high-voltage side along with necessary relaying~~, if it is determined by FCU that this is necessary to properly protect the system~~. Moreover, A~~a~~ny GF whose connection to the FCU distribution system increases the aggregate generation on any feeder, transformer, or portion of a feeder to 1500 kVA or above is subject to a separate study by FCU, and FCU may require the addition of a three-phase protective device on the primary side of the system.

3.4 Interrupting Devices Required

Circuit breakers or other interrupting devices located at the Point of Common Coupling (PCC) must be certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. The Operator's GF Facility and associated interconnection equipment must be designed so that the failure of any single device will not potentially compromise the safety and reliability of FCU's distribution system.

3.5 System Protective Functions

The protective functions and requirements contained in this document are designed to protect FCU's distribution system and not specifically the Operator's GF. The Operator is solely responsible for providing adequate protection for the GF and all associated equipment. The Operator's protective devices must not impact the operation of other protective devices utilized on the FCU distribution system in a manner that would affect FCU's ability to provide reliable service to its customers.

The GF's protective functions must sense abnormal conditions and disconnect the GF from the FCU distribution system during abnormal conditions. All GFs must be capable of sensing line-line-line, line-line, and line-ground faults on the distribution feeder supplying the GF and must disconnect from the line to protect both the line from further damage and the generator from damage due to excessive currents or unusual voltages. The settings of these relays will be coordinated with FCU substation relaying.

For induction machines speed matching must be done automatically and shall match speed to less that 5% before closing the associated breaker.

The minimum protective functions needed for various types of generators, and other requirements for system protection are shown below. Any machine that ~~does not come~~ is not included ~~under~~ in one of the following categories must be individually considered by FCU.

3.5.1 Synchronous Machines above 50kW to 100kW

a) Over and under voltage functions (27/59)
b) Over current trip functions. (50/51) which may be included in a breaker trip-unit or a fuse.
c) Ground fault protection (50/51G)
d) Over and under frequency functions. (81O/U)
e) Sync Check (25)
f) Phase-sequence or negative sequence voltage (47)
g) A function to prevent the GF from contributing to the formation of an unintended island and to prevent the GF from reconnecting with the distribution system under abnormal conditions is required.
h) Relay settings and test reports will be submitted to FCU for review. FCU will determine if an on-site inspection is required.

3.5.2 Synchronous Machines 100kW to and including 1000kW

a) Interrupting devices must be 3-phase circuit breakers with electrical operation.
b) Relays must be utility grade (must meet IEEE Std.C37.90, C37.91, C37.92 and C37.93) and must be independent from the generator control devices.
c) Over and under voltage functions (27/59)
d) Voltage restrained over current trip functions. (50/51V)
e) Ground fault protection (50/51G)
f) Over and under frequency functions. (81O/U)
g) Sync Check (25)
h) Phase-sequence or negative sequence voltage (47)
i) Reverse power (32)
j) A function to prevent the GF from contributing to the formation of an unintended island and to prevent the GF from reconnecting with the distribution system under abnormal conditions is required.
k) Relay settings and test reports will be submitted to FCU for review. FCU will determine if an on-site inspection is required.

3.5.3 Synchronous Machines 1000kW to and including 5000kW

a) Interrupting devices must be 3-phase circuit breakers with electrical operation.
b) Relays must be utility grade (must meet IEEE Std.C37.90, C37.91, C37.92 and C37.93) and must be independent from the generator control devices.
c) Over and under voltage functions (27/59)
d) Voltage restrained over current trip functions. (50/51V)
e) Ground fault protection (50/51G)

f) Over and under frequency functions. (81O/U)
g) Negative Sequence Current (46)
h) Loss of Field (40)
i) Sync Check (25)
j) Phase-sequence or negative sequence voltage (47)
k) Reverse power (32)
l) A function to prevent the GF from contributing to the formation of an unintended island and to prevent the GF from reconnecting with the distribution system under abnormal conditions is required.
m) Relay settings and test reports will be submitted to FCU for review.

3.5.4 Doubly-Fed Induction Machines above 50kW to 100kW

a) Over and under voltage functions (27/59)
b) Over current trip functions. (50/51) which may be included in a breaker trip-unit or a fuse.
c) Ground fault protection (50/51G) which may be included in a breaker trip-unit or a fuse
d) Phase-sequence or negative sequence voltage (47)
e) Speed matching to within 5% (15)
f) If it is determined that it is possible for the machine to self-excite in this installation, the GF must include a function to prevent the GF from contributing to the formation of an unintended island and to prevent the GF from reconnecting with the distribution system under abnormal conditions. If it is determined that the machine cannot self-excite, evidence must be provided to FCU proving that this is the case and anti-islanding protection is not required. If such evidence does not meet FCU approval, anti-islanding protection is required.
g) Relay settings and test reports must be submitted to FCU for review. FCU will determine if an on-site inspection is required.

3.5.5 Doubly-Fed Induction Machines 100kW to 5000kW

a) Interrupting devices must be 3-phase circuit breakers with electrical operation.
b) Relays must be utility grade (must meet IEEE Std.C37.90, C37.91, C37.92 and C37.93) and must be independent from the generator control devices.
c) Over and under voltage functions (27/59)
d) Over current trip functions. (50/51) which may be included in a breaker trip-unit or a fuse.
e) Ground fault protection (50/51G) which may be included in a breaker trip-unit or a fuse
f) Phase-sequence or negative sequence voltage (47)
g) Negative sequence current (46)
h) Over and under frequency (81 O/U)
i) Reverse power (32)
j) Speed matching to within 5% (15)
k) If it is determined that it is possible for the machine to self-excite in this installation the GF must include a function to prevent the GF from contributing to the formation of an unintended island and to prevent the GF from reconnecting with the distribution system under abnormal conditions. If it is determined that the machine cannot self-excite, evidence must be provided to FCU proving that this is the case and anti-islanding protection is not required. If such evidence does not meet FCU approval, anti-islanding protection is required.
l) Relay settings and test reports must be submitted to FCU for review. FCU will determine if an on-site inspection is required.

3.5.6 Induction Machines above 50kW to 100kW

a) Over and under voltage functions (27/59)
b) Over current trip functions. (50/51) which may be included in a breaker trip-unit or a fuse.

c) Ground fault protection (50/51G) which may be included in a breaker trip-unit or a fuse
d) Phase-sequence or negative sequence voltage (47)
e) Speed matching to within 5% (15)
f) If it is determined that it is possible for the machine to self-excite in this installation the GF must include a function to detect and trip the unit during a self excited condition. This will prevent system over voltages and also prevent the GF from contributing to the formation of an unintended island. If it is determined that the machine cannot self-excite, evidence must be provided to FCU proving that this is the case and this protection is not required. If such evidence does not meet FCU approval, anti-islanding protection is required.
g) Relay settings and test reports must be submitted to FCU for approval. FCU will determine if an on-site inspection is required.

3.5.7 Induction Machines 100kW to 5000kW

a) Interrupting devices must be 3-phase circuit breakers with electrical operation.
b) Relays must be utility grade (must meet IEEE Std.C37.90, C37.91, C37.92 and C37.93) and must be independent from the generator control devices.
c) Over and under voltage functions (27/59)
d) Over current trip functions. (50/51) which may be included in a breaker trip-unit or a fuse.
e) Ground fault protection (50/51G) which may be included in a breaker trip-unit or a fuse
f) Phase-sequence or negative sequence voltage (47)
g) Negative sequence current (46)
h) Over and under frequency (81 O/U)
i) Reverse power (32)
j) Speed matching to within 5% (15)
k) If it is determined that it is possible for the machine to self-excite in this installation the GF must include a function to detect and trip the unit during a self excited condition. This will prevent system over voltages and also prevent the GF from contributing to the formation of an unintended island. If it is determined that the machine cannot self-excite, evidence must be provided to FCU proving that this is the case and this protection is not required. If such evidence does not meet FCU approval, anti-islanding protection is required.
l) Relay settings and test reports will be submitted to FCU for review. FCU will determine if an on-site inspection is required.

3.5.8 Inverter Connected Systems 1000 kW and Below

This may include photovoltaic systems (PV), some wind turbines, fuel cells, microturbines and all other machines that deliver their power to the utility system via an inverter or converter utilizing power electronics.

a) The Inverter must be tested to meet IEEE 1547, and IEEE 1547.1. One way to meet this requirement is to be tested to UL1741. However, it is not required that this testing be done by Underwriters Laboratories. Any recognized testing lab which confirms that the inverter meets IEEE 1547, and IEEE 1547.1 is satisfactory. If the inverter does not carry a UL sticker, FCU must be supplied with a letter from the manufacturer or an independent testing laboratory stating the inverter has been tested and meets the above IEEE standards.
b) FCU will require ~~O~~over current trip functions (50/51) which may be included in a breaker trip-unit or a fuse. This device must be separate from the inverter control system and internal disconnect device.
c) FCU will determine if an on-site inspection is required to observe calibration and testing of the inverter functions.

3.5.9 Inverter Connected Systems above 1000 kW to 5000kW

This may include photovoltaic systems (PV) some wind turbines, fuel cells, microturbines and all other machines that deliver their power to the utility system via an inverter or converter utilizing power electronics.

a) The Inverter must be tested to meet IEEE 1547, and IEEE 1547.1. One way to meet this requirement is to be tested to UL1741. However, it is not required that this testing be done by Underwriters Laboratories. Any recognized testing lab which confirms that the inverter meets IEEE 1547, and IEEE 1547.1 is satisfactory. If the inverter does not carry a UL sticker, FCU must be supplied with a letter from the manufacturer or an independent testing laboratory stating the inverter has been tested and meets the above IEEE standards.
b) FCU will require ~~O~~over current trip functions (50/51) which may be included in a breaker trip-unit or a fuse. This device must be separate from the inverter control system and internal disconnect device.
c) Ground fault protection (50/51G) which may be included in a breaker trip unit. This device must be separate from the inverter control system and internal disconnect device.
d) Over and under frequency (81 O/U). This device must be separate from the inverter control system and internal disconnect device.
e) Over and under voltage functions (27/59). This device must be separate from the inverter control system and internal disconnect device.
f) FCU will determine if an on-site inspection is required to observe calibration and testing of the inverter and relay functions.

3.5.10 All machines above 5000kW

Any type of GF of this size must be studied and considered individually by FCU.

3.6 Momentary Paralleling Generation Facilities

At times an Operator may decide to install a system that may operate parallel to the FCU system only momentarily (normally less than 0.1 seconds). With FCU's approval, the transfer switch or system used to transfer the Operator's loads from FCU's distribution system to the Operator's GF may be used in lieu of the protective functions required for parallel operation.

4.0 Facility Grounding

In all cases the GF grounding system must not adversely impact FCU grounding or ground fault protective relaying. The GF grounding must not cause high voltages to occur under any condition either normally occurring or occurring during a system fault such as allowing high voltages to exist on the un-faulted phases during a single-line-to-ground fault.

4.1 Equipment Bonding Conductor

The Operator must install an equipment ~~–~~grounding conductor, in addition to the ungrounded conductors and grounded conductor (neutral), between the GF and the distribution system. The grounding conductor~~s~~ must be permanent, electrically continuous, and must be capable of safely carrying the maximum fault current that could be imposed ~~on them~~ it by the systems to which ~~they~~ it is ~~are~~ connected., ~~and must have~~ Additionally, the equipment ~~–~~grounding conductor must be of sufficiently low impedance to facilitate the operation of over current protection devices under fault conditions. ~~This~~ All conductors shall comply with the National Electrical Code (NEC). The GF must not be designed or implemented such that the earth becomes the sole fault current path.

4.2 Surge Protection

It is strongly recommended but not required that a surge protective device (SPD) be utilized to protect GF equipment.

4.3 System Grounding

FCU maintains an effectively grounded distribution system and requires that all GFs be designed to contribute to an effectively grounded system. Effective grounding prevents the occurrence of excessively high voltages during ground faults and protects existing FCU equipment. Effective grounding of the GF may desensitize existing FCU ground fault protection, which could require FCU ground fault relay settings changes or modifications in the design of the GF. The transformer supplied to interconnect the GF voltage to the FCU system will normally be a grounded-wye to grounded-wye transformer. This connection will not provide a grounding source by itself and will not provide an effectively grounded system from the GF side of the interconnection unless effective grounding of GF is ~~done~~ provided. When designing the grounding system for the GF, the designer should consider the condition that will result when a ground fault occurs on the line ~~feeding~~serving the GF. This ground fault would be cleared on the FCU side of the line by opening a breaker or recloser in the FCU substation. This will result in momentarily islanding the line on the GF until it opens its breaker. Under this condition, where the line is islanded and being supplied by the GF, the system must remain effectively grounded.

Effective grounding shall be defined by IEEE Std.142 which states that to be considered effectively grounded both of the following two conditions must be met:

a) The ratio of zero-sequence reactance to positive-sequence reactance (X_0/X_1) must be positive and three or less.
b) The ratio of zero-sequence resistance to positive-sequence reactance (R_0/X_1) must be positive and less than 1.

The GF system equivalent (Thevenin equivalent) impedance must meet the criteria for effective grounding stated above. The networks used in determining this impedance, and other fault current calculations for the plant, will include the positive, negative, and zero sequence networks of the step-up transformer connected to the FCU system, all other transformers between the generator and the point of common coupling, the generator subtransient, positive, negative and zero sequence values, the neutral grounding device for the generator, the grounding transformer and neutral grounding device (if used) and any significant cable runs. The GF shall maintain an effectively grounded system under normal operating conditions while operating in connection with FCU lines.

The short circuit contribution ratio (SCCR) of the GF is defined as the ratio of the GF short circuit contribution to FCU's contribution to a short circuit (I_{scGF}/I_{scFCU}) for either a three-phase or single-line-to ground fault measured at the high voltage side of the transformer stepping up from the generation voltage to the FCU voltage.

The GF must be grounded in such a way that the SCCR for a line-ground fault calculated at the high voltage side of the transformer connecting the GF to FCU is less than 3% while still achieving effective grounding as defined above. If this SCCR ratio is greater than 3% FCU must do a study to determine if re-setting ground fault relays on the existing FCU system is required. In rare cases connecting a certain GF to a particular feeder may not be practical due to protection issues or special protection techniques may be needed to make the connection safe.

Proper grounding of the GF can be achieved in a number of ways. FCU may at its discretion accept any of the following methods:

a) Solidly grounding the generator or installing a solidly grounded grounding transformer (zig-zag or grounded wye-delta transformer). While a solidly grounded generator is acceptable to FCU if all other requirements are met, it must be used with care. ANSI standards generally require that for a synchronous generator the ground fault current must be limited to the three-phase fault current. This usually requires a resistance or reactance be used for grounding the generator neutral. Also, a solidly grounded generator may conduct large amounts of harmonic currents. There may be some unbalanced voltage at the terminals of the generator. This can cause circulating current

through the generator if it is solidly grounded which may make de-rating of the generator necessary. If a solidly grounded system is used the designer must consider and plan for all issues that may result.

b) Resistance grounding. A resistance grounded generator or grounding transformer with a resistance placed between neutral and ground may be used if it meets the requirements of effective grounding.

c) Reactance grounding. A reactance grounded generator or grounding transformer with a reactor between the transformer neutral and ground may be used if it meets the requirements of effective grounding.

d) Other methods may be suggested for consideration by FCU.

If the Operator desires to generate at the FCU primary voltage and to connect the generators directly to the FCU system without the use of an interconnecting transformer, FCU must first conduct a study of the connection. FCU will determine, as a result of the study, the grounding and other requirements necessary for this type of connection.

5.0 Prevention of Interference and Unacceptable Operating Conditions

The Operator must not operate the GF in any way that causes a system disturbance or that superimposes a voltage or current upon FCU's distribution system that results in interference with FCU operations, service to FCU's customers, or other FCU equipment and facilities. When FCU suspects that interference with electric service to other FCU customers is occurring, and such interference exceeds FCU Standards, FCU reserves the right at its expense to install special test equipment as may be required to perform a disturbance analysis and monitor the operation of the GF to evaluate the quality of power produced. If the GF is demonstrated to be the source of the interference, and it is demonstrated that the interference produced exceeds FCU Standards or generally accepted industry standards, FCU may, without liability, disconnect the GF from the FCU distribution system.~~In the event such interference occurs,~~It shall be the responsibility of the Operator to eliminate any interference caused by the GF and t~~t~~he Operator must diligently pursue and take corrective action, at the Operator's own expense, ~~after being given notice and reasonable time to do so by FCU. If the Operator does not take corrective action in a timely manner, or continues to operate the GF causing interference, FCU may, without liability, disconnect the customers GF from the FCU distribution system. T~~to eliminate undesirable interference caused by the GF. ~~operation, each GF shall meet the criteria defined herein.~~The GF will be reconnected to the FCU system only after the Operator demonstrates to the satisfaction of FCU that the cause of the interference has been remedied.

The Operator's protective devices must prevent the GFs from contributing to an island. If the FCU feeder to which the GF is connected is de-energized for any reason, the GF must sense this and disconnect itself within 2 seconds of the de-energization of the feeder.

~~The GF shall not create power system disturbances that exceed the standards specified. When FCU suspects an unreasonable interference with electric service to other FCU customers, and such interference exceeds FCU standards, FCU reserves the right, at its expense, to install special test equipment as may be required to perform a disturbance analysis and monitor the operation of the GF to evaluate the quality of power produced. If the GF is demonstrated to be the source of the interference, and it is demonstrated that the interference produced exceeds FCU standards or, generally accepted industry standards, then the GF shall be disconnected and locked out from the FCU distribution system until corrections have been made to remedy the interference. It shall be the responsibility of the Operator to eliminate any interference problem caused by the GF.~~

5.1 Voltage Regulation

The GF shall not actively regulate the voltage at the point of common coupling (PCC) unless the effects of this are first reviewed and approved by FCU. If a study has been done by FCU which determines that it is advantageous for a GF to actively control its voltage, FCU will inform the Operator and the Operator will be required to control the GF's terminal voltage.

5.2 System Voltage

The voltage operating range limits for GFs~~'s~~ shall be used as a protection function that responds to abnormal conditions on FCU's distribution system. The FCU voltage operating range is normally ~~5% above or below the~~95% to 105% of the nominal voltage at the ~~PCC~~electrical service point, and 92% to 105% of nominal voltage at the utilization point, as required by ANSI C84.1. All GFs must be capable of operating within the voltage range normally experienced on FCU's distribution system. Ocassional excursions outside this range may ~~ocurr~~occur, and tripping of the GF is not suggested until the voltage range is less than 88% or more than 110% of the nominal voltage. The operating range and GF protection shall be selected in a manner that minimizes nuisance tripping between 88% and 110% of nominal voltage. GF~~'~~s must not energize or, after a trip, re-energize FCU's circuits whenever the voltage at the PCC deviates from the allowable voltage operating range allowed by ANSI C84.1 Table 1 voltage range (95-105% of nominal voltage at the service or 92-105% of nominal voltage at the utilization point).

Whenever the FCU distribution system voltage at the PCC varies from normal (nominally 120 volts) by ~~predetermined~~ the amounts as set forth in Table 5-1 the GF's protective functions shall disconnect the generator(s) from the FCU distribution system with delay times no longer than those shown.

Table 5-1: Voltage trip settings.
(Adapted from IEEE 1547-2003 and ANSI C84.1-2006)

Voltage at Point of Common Coupling (% of base Voltage)	Maximum Tripping Time* ~~Allowed~~Delay (seconds/cycles)
V-PCC < 50%	0.16~~7~~ / 10
50% < V-PCC < 88%	2.0 / 120
9~~25~~% < V-PCC < / 105%	Normal operating range
110% < V-PCC < 120%	1.0 / 60
120% < V-PCC	0.16~~7~~ / 10

5.3 System Frequency

The GF shall operate in synchronism with the FCU distribution system. Whenever FCU's distribution system frequency at the PCC varies from normal (nominally 60 Hertz) by ~~predetermined~~ the amounts as set forth in Table 5-2 the GF's protective functions shall disconnect the generator(s) from the FCU distribution system~~.~~ with delay times no longer than those shown.

Table 5-2: Frequency Settings
(Adapted from IEEE 1547-2003 and NERC PRC-024-1)

GF Facility Size	Frequency (Hz)	Maximum Tripping ~~Tripping~~ Time Delay (sec./cycles)
GF 30kW or Less	GF<59.3	0.16~~7~~/10
	59.3 ≤ GF ≤~~<~~ 60.5	Continuous Operation
	GF>60.5	0.16~~7~~/10
GF > 30kW		
	GF<57.8~~0~~	0.16~~7~~/10
	57.8~~0~~ ≤ GF ≤~~<~~ 58.0~~7.3~~	~~40.75~~/240~~45~~
	58.0~~7.3~~ < GF ≤~~<~~ 58.5~~7.8~~	~~407.5~~/2,400~~450~~
	58.5~~7.8~~ < GF ≤~~<~~ 59.0~~8.4~~	200~~30~~/12,000~~1,800~~
	59.0~~8.4~~ < GF <~~≤~~ 59.5~~3~~	1,800/108,000~~10,800~~
	59.5~~3~~ ≤~~<~~ GF ≤~~<~~ 60.5~~6~~	Continuous Operation
	60.5~~6~~ < GF ≤~~<~~ 61.5~~6~~	600~~180~~/36,000~~10,800~~

	61.5~~6~~ < GF	**0.16~~7~~/10**

~~The frequency settings must be adjusted to insure that the GF will disconnect from the FCU system during an islanded condition.~~ Unless some other anti-islanding scheme is employed, the GF should disconnect due to low frequency resulting ~~due~~ from ~~to~~ islanding the feeder load on the GF. The frequency settings must be adjusted to insure that, during the lowest loading level on the feeder, the resulting frequency change of the GF when it is islanded with those feeder loads ~~During the lowest loading level on the feeder~~, ~~the resulting frequency change of the GF~~ should cause the under frequency relaying to disconnect the the generators ~~trip off~~ within two seconds.

5.4 Synchronization

Synchronous machine automatic synchronizers and sync-check relays must be set as shown in Table 5-3.

Table 5-3: Synchronizer/sync check relay settings.
(Adapted from IEEE 1547-2003)

Rating of GF (kVA)	Maximum Slip Rate (Hz)	Maximum Voltage Difference (%V)	Maximum Phase Angle Difference (deg).
0-500	0.3	10	20
500-1500	0.2	5	10
1500 and above	0.1	3	10

5.5 Flicker

Any voltage flicker at the PCC caused by the GF should not exceed the limits defined by the "Maximum Borderline of Irritation Curve" identified in IEEE 519, IEEE 141, and IEE 1453. This limit is shown in Figure 5-1. This requirement is necessary to minimize the adverse voltage effects which may be experienced by other customers on the FCU distribution system due to the operation of the GF. Induction generators may only be connected to the system and brought up to synchronous speed (as an induction motor) ~~provided~~ if these flicker limits are not exceeded.

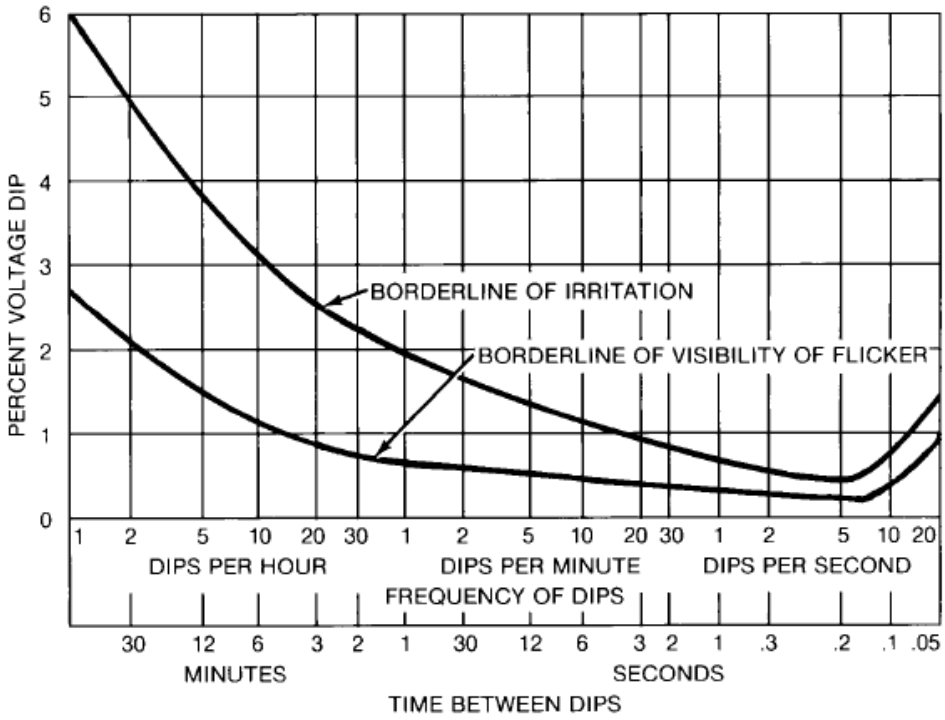


Figure 5-1: Allowable voltage flicker vs. time (reproduced from IEEE Std. 141).

5.6 Harmonics

Harmonic distortion measured at the PCC must be in compliance with IEEE 519 and IEEE 1547. Harmonic current injection limits are shown in Table 5-4.

Table 5-4: Maximum harmonic current distortion as a percentage of fundamental frequency at the point of common coupling.
(Adapted from IEEE 1547-2003)

Individual Harmonic Order h (Odd Harmonics Only)					
h<11	11≤h<17	17≤h<23	23≤h<35	35≤h	TDD
4.0	2.0	1.5	0.6	0.3	5.0

The even harmonic limits must be 25% of those shown in Table 5-4.

GF's must not inject direct current greater than 0.5% of rated output into the FCU distribution system. Any device causing a DC offset such as a half-wave converter shall not be allowed.

5.7 Power Factor

The power factor at the point of common coupling (PCC) with FCU (the low voltage terminals of the transformer connecting the GF to FCU) shall always remain within 0.95 lagging (VARs going into the site) to 0.95 leading (Vars going out of the site). The only exception to this requirement is a GF consisting of an inverter connected generator 10 kW or less. ~~is shown below. For this exception FCU will provide the VARs needed at the site provided the site maintains its power factor so that if the GF were disconnected at any time the power factor would remain within the requirements above.~~ For this exception it is expected that the site power factor will deteriorate anytime the GF is operating, and FCU will provide the VARs needed at the site. However the site power factor must be

maintained such that it would remain within the limits stated above if the GF was not operating and, as a result, the power factor was allowed to revert to the value it had before the GF was added.

a) ~~Inverter connected generators 10kW or less.~~

Each synchronous generator in a GF shall be capable of operating at any point within a power factor range of 0.95 leading (Vars going into the generator) to 0.95 lagging (Vars going out of the generator). Synchronous generators should automatically control power factor and should be set to deliver VARs to the system as needed to keep the power factor at the PCC with FCU to the range required by this section.~~listed.~~

For generators other than synchronous generators, operation outside this power factor range is acceptable provided the cumulative power factor of the customer's entire facility is kept within the range noted. This may be done using capacitor banks, controlling the inverter settings, adding static VAR compensators (SVC) or synchronous condensers, or other means agreeable to both the GF and FCU. If capacitor banks are used they shall be sized and installed per IEEE Stds. 18, 1036, C37.012, C37.06, C37.66, and 1015. Capacitors may need to be stepped and switched to meet the power factor requirements above. Before the addition of capacitors the GF should completely study the effects of the capacitor additions on the resonance conditions and harmonic values that will result. If the GF's addition of capacitors causes adverse resonance or harmonics effects on FCU's system, the GF shall be required to pay for any modifications needed to mitigate the problem.

6.0 Monitoring Provisions

The following monitoring and meter~~e~~ting requirements must be met by any Operator connecting a GF to the FCU system. ~~provisions must be provided by the GF.~~

~~If the aggregate generation capacity at one PCC is rated at 50kW or greater the GF must include a provision for FCU to monitor breaker status, real power output, reactive power output, and voltage.~~

~~If the GF is larger than 50kW the operation of the GF shall be monitored remotely by the FCU system operations and control center. Typically, only one monitoring device will be required to be installed on the GF that will monitor the output of the generator and the status of protective and interrupting devices (i.e. circuit breaker). The monitoring device and communication equipment shall be the property of FCU but paid for by the Operator. FCU will work with the Operator to determine the most effective communication medium to obtain the telemetry data~~.

~~GFs 1000kW and above may require additional telemetry that will be discussed after the interconnection application has been reviewed.~~

6.1 Metering

GFs larger than 10kW and less than or equal to ~~5~~100 kW ~~or less~~ require a minimum of a form 9s metering installation.

GFs larger than ~~5~~100 kW will require revenue metering capable of recording the following components:

a) Time of use (TOU)
b) Harmonic measuring capability
c) Four quadrant capability
d) MV90 capable
e) Form 9S
f) The revenue meter must measure the aggregate load of the Operator's facility including the GF.

6.2 Monitoring and Control Requirements

Each non-inverter connected generating facility of 100 kW or larger shall be required, at the discretion of FCU, to have FCU supplied equipment that will be used for monitoring and control of the facility. The Operator shall be responsible for all hardware, software, and any installation costs of FCU provided equipment associated with the co-gen installation. FCU will provide a remote monitoring and control equipment enclosure containing the following equipment at the Operator's expense:

- 900 MHZ spread spectrum radio
- SEL 351 relay
- Terminal blocks as required
- Various control switches, CT blocks, etc as required
- UPS power supply with battery backup

A YAGI antenna will be provided and shall be installed by the Operator at a location designated by FCU. The Operator will be responsible for installing the antenna coax specified by FCU. The Operator must use a certified installer to terminate the coax. The Operator shall also be responsible for mounting the equipment enclosure.

The monitoring and control system shall be designed to allow FCU to perform the following:

- Trip the generator breaker for unstable system conditions such as frequency, voltage and fault conditions
- Place a HOT LINE TAG on the generator breaker that would block its close circuit to prevent its closing
- Initiate a generator startup thru SCADA for future power dispatching by FCU (This would normally be blocked locally unless requested by the Operator.)
- Monitor the generator breaker status to determine if the generator is on or off line
- Monitor generator output power(real and reactive), voltage, harmonics etc. (This will require current and voltage inputs from the GF equipment.)

The GF Operator must provide all the necessary interface design to accomplish the functions listed above. The GF Operator must submit drawings of the proposed design to FCU for review.

7.0 Testing

7.1 Commissioning Tests

In addition to any commissioning tests required by the owner of the GF or manufacturer of equipment used, the following tests must be performed before operation of the GF. The Operator must notify FCU two weeks in advance of the time of the testing so that a FCU representative may observe any tests required by FCU.

a) Visual inspection to ~~i~~ensure proper grounding.
b) Visual inspection shall confirm the presence of the isolation device described in section 3.2 and the device shall be tested for operation.
c) Trip tests must be performed to prove each device which is required to trip any breaker is capable of doing so.
d) Relays or protective functions provided by the generator manufacture must be tested and relay test reports must be made available to FCU. All of the functions required in Section 3.5 must be tested. Inverter connected devices tested by an independent testing laboratory as required in Section 3.5 are not be required to perform this test.
e) In the case of a synchronous generator the Operator must prove that the generator is connected to the system with the proper phase rotation and that all three phases of generator voltage match those of the system at the same instant in time. This test is commonly known as "phasing out" the generator.
f) In the case of a synchronous generator the Operator must prove that the generator synchronizer and sync check relay is capable of connecting the generator to the system

properly and in synchronism. This test must be done before the generator is allowed to actually connect to the system.

~~g)~~g) The ability of the control system to disconnect the generator within two seconds in the event of islanding must be tested.

7.2 Periodic Maintenance Tests

An Operator must maintain his or her equipment in good order and in compliance with all manufacturers suggested periodic maintenance. If it is discovered that an Operator is not properly maintaining his or her equipment, FCU~~, must~~ may ~~be required to~~ disconnect the GF until such time that the Operator can prove that he or she has provided all required maintenance needed to allow the GF to operate properly and safely.

FCU reserves the right to inspect the GF equipment whenever it appears the GF is operating in a manner that is hazardous to the FCU system.

Functional testing must be performed every year to prove the proper operation of the isolation device and all breakers and relays. For all GFs consisting of synchronous machines with aggregate ratings of larger than 1000kW, no less than once every three years all protective functions must be re-tested and calibrated to prove their operation complies with the requirements contained in this document. The Operator must maintain written records of these tests and these records will be made available to FCU on request.

Battery systems used for generator control or protective relaying must be maintained and periodically tested as suggested by the battery manufacturer.

7.3 Qualified Personnel

All testing and calibration shall be done by qualified personnel. FCU will provide a list of contractors qualified to provide this service.

8.0 Design Changes

After the GF begins operation any design changes, such as the addition of more generation, must be submitted to FCU for review. Protective devices or any other requirements listed in this document must not be modified or their settings changed without approval of FCU.

9.0 Liability and Insurance

In no event shall FCU be held responsible for the safety, reliability, design, or protection of the GF. Compliance with these interconnection standards does not mean the GF is safe to operate and the Operator is solely responsible for making a determination about whether the GF is safe to operate.

Nothing herein shall be construed to create any duty to, any standard of care with reference to, or any liability to any person who is not a party to an arrangement or agreement between FCU and the Operator pursuant to these requirements. FCU is not liable for damages caused to the facilities, improvements or equipment of the Operator by reason of the operation, faulty operation or non-operation of FCU facilities.

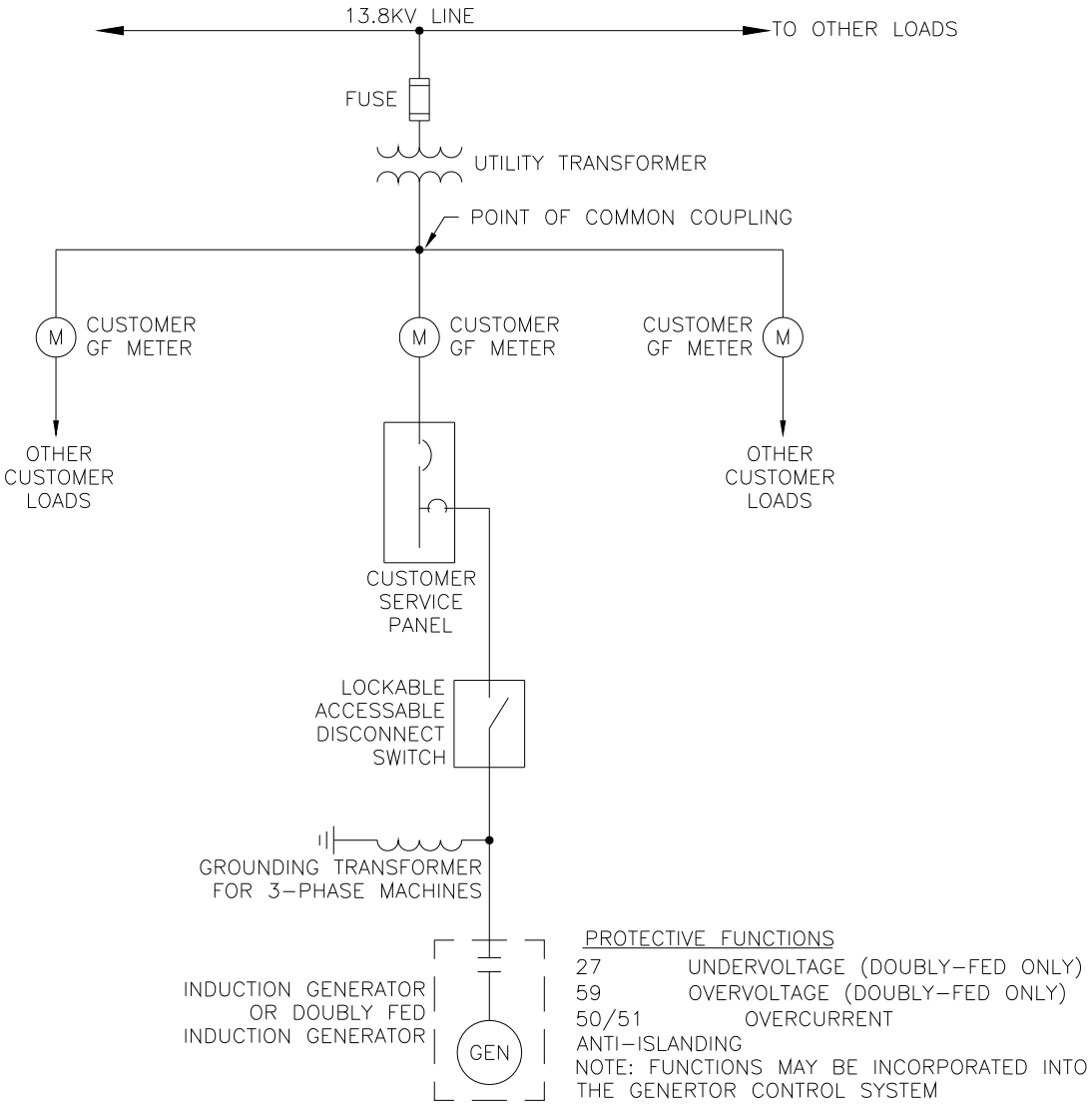
The Operator shall be solely responsible for and shall defend, indemnify and hold FCU harmless from and against any and all claims or causes of action for personal injury, death, property damage, loss or violation of governmental laws, regulations or orders, which injury, death, damage, loss or violations occurs on or is caused by operation of equipment or facilities on the Operator's side of the point of connection. Notwithstanding the above, the Operator shall be solely responsible for and shall

defend, indemnify and hold harmless FCU from and against any and all claims or causes of action for personal injury, death, property damage or loss or violation of governmental laws, regulations or orders, wherever occurring, which injury, death, damage, loss or violation is due solely to the acts of omissions of such Operator, including but not limited to the use of defective equipment or faulty installation or maintenance or equipment by such party. However, nothing contained in this section shall be construed as relieving or releasing either party from liability or personal injury, death, property damage or loss, or violation of governmental laws, regulations or orders, wherever occurring, resulting from its own negligence or the negligence of any of its officers, servants, agents or employees. In the event of concurrent negligence, liability shall be apportioned between the parties according to each party's respective fault. Neither the Operator nor FCU shall be liable to the other or any other third party, in contract or in tort or otherwise, for loss of use of equipment and related expenses, expense involving cost of capital, claims of customers of FCU or the Operator, as applicable, loss of profits or revenues, cost of purchase or replacement power, or any indirect, incidental or consequential loss or damage whatsoever.

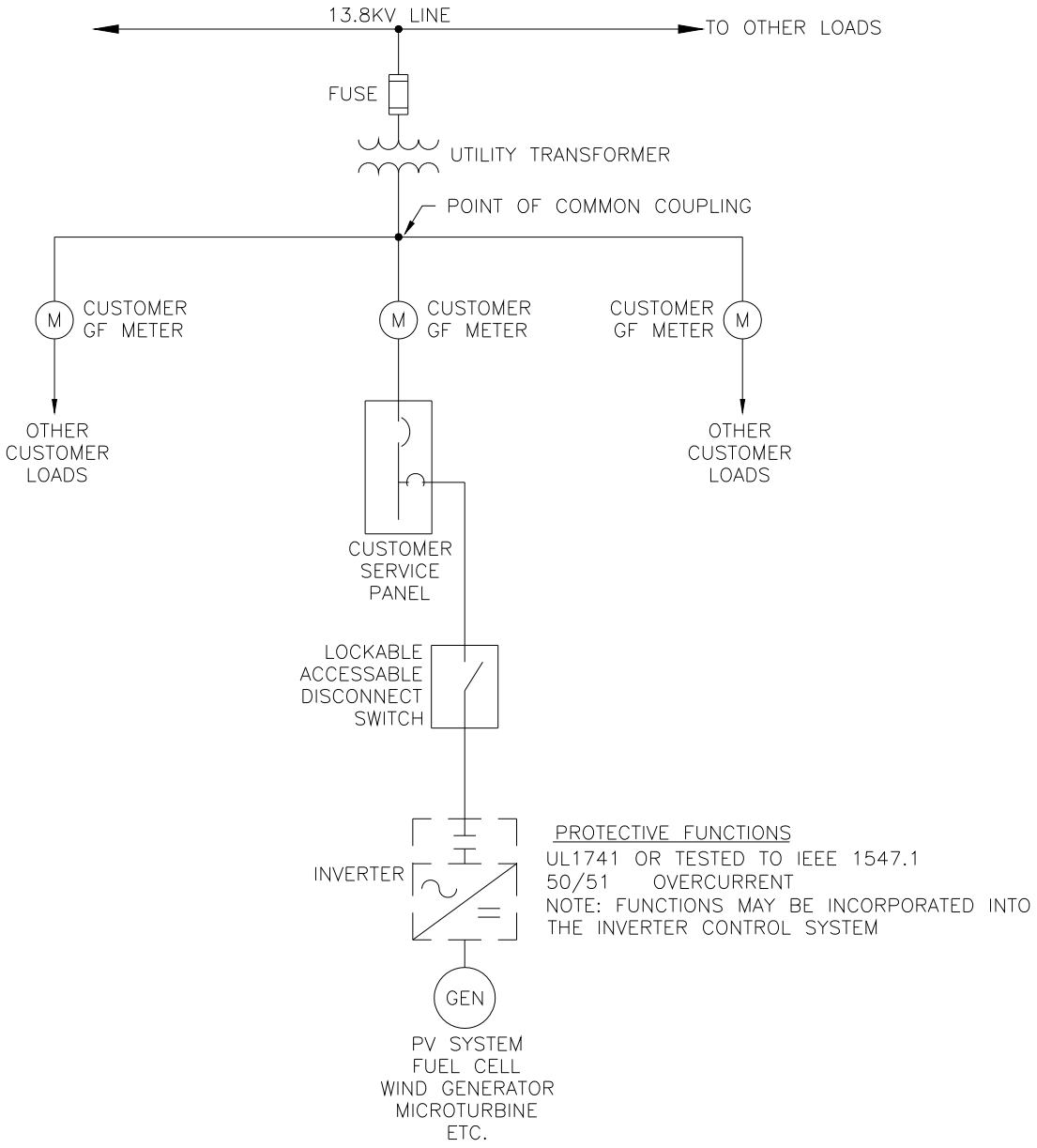
The Operator shall pay all costs that may be incurred by FCU in enforcing the indemnity described herein. Each party's liability to the other party for any loss, cost, claim, injury, liability, or expense, including reasonable attorney's fees, relating to or arising from any act or omission in its performance of this agreement, shall be limited to the amount of direct damage actually incurred. In no event shall either party be liable to the other party for any indirect, incidental, special, consequential, or punitive damages of any kind whatsoever.

For systems of ten kW or ~~less~~more, the Operator, at its own expense, shall secure and maintain in effect during connection of its GF to the FCU system, liability insurance with a combined single limit for bodily injury and property damage of not less than $300,000 (Three Hundred Thousand Dollars) each occurrence. Such liability insurance shall not exclude coverage for any incident related to the subject GF or its operation. FCU shall be named as an additional insured under the liability policy. For systems above 500 kW and up to one megawatt, the Operator, at its own expense, shall secure and maintain in effect during connection of its GC to the FCU system, liability insurance with a combined single limit for bodily injury and property damage of not less than $2,000,000 (Two Million Dollars) for each occurrence. Insurance coverage for systems greater than one megawatt shall be determined on a case-by-case basis by FCU and shall reflect the size of the installation and the potential for system damage. Any insurance policy required herein shall include that written notice be given to FCU at least 30 days prior to any cancellation or reduction of any coverage. Such liability insurance shall provide, by endorsement to the policy, that FCU shall not by reason of its inclusion as an additional insured incur liability to the insurance carrier for the payment of premium of such insurance. A copy of the liability insurance certificate must be received by FCU prior to GF operation. Certificates of insurance evidencing the requisite coverage and provision(s) shall be furnished to FCU prior to date of interconnection of the generation system. FCU shall be permitted to periodically obtain proof of current insurance coverage from the Operator in order to verify proper liability insurance coverage. The Operator will not be allowed to commence or continue interconnected operations unless evidence is provided that satisfactory insurance coverage is in effect at all times.

APPENDIX A-TYPICAL ONE-LINE INDUCTION GENERATOR BETWEEN 50KW AND 100KW

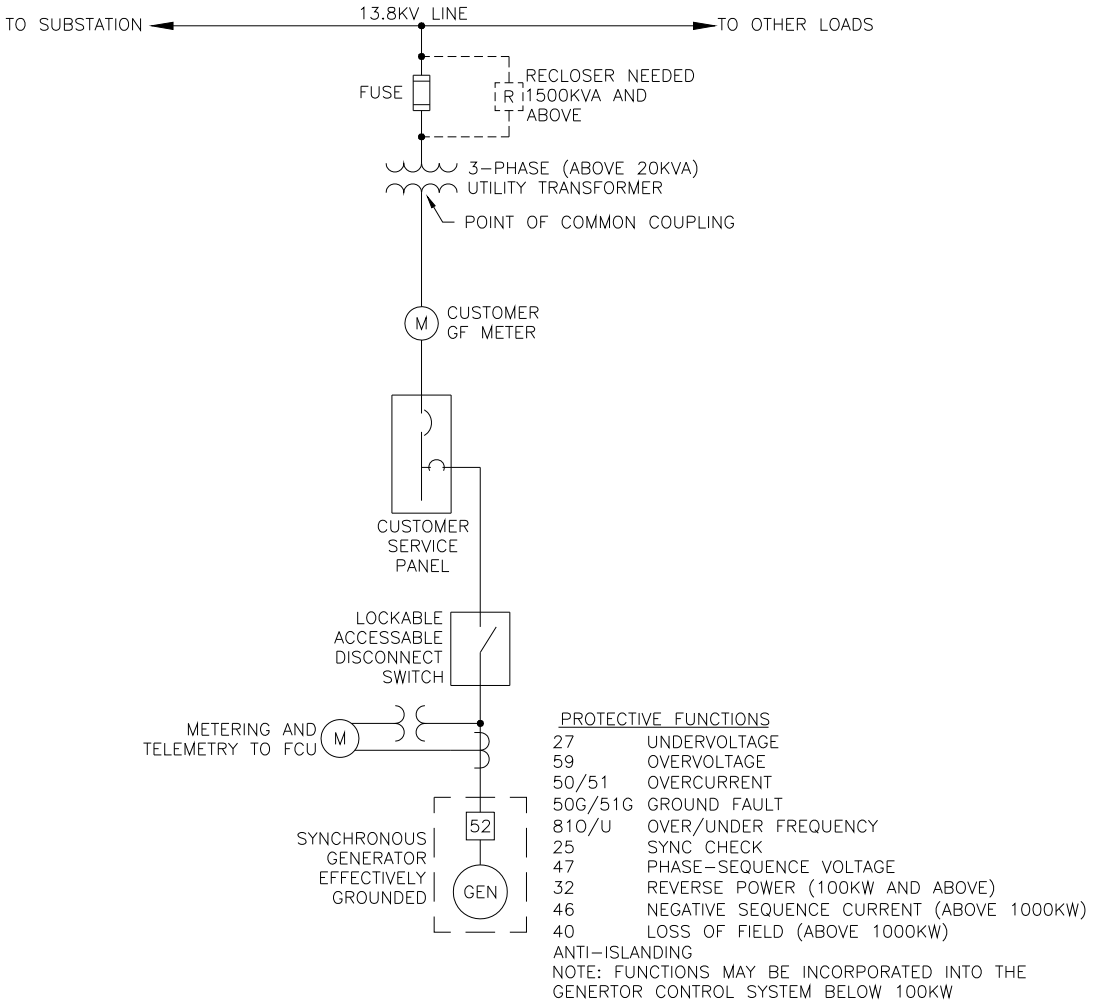


APPENDIX B-TYPICAL ONE-LINE INVERTER CONNECTED GENERATOR ~~50KW TO~~BELOW 1000KW.

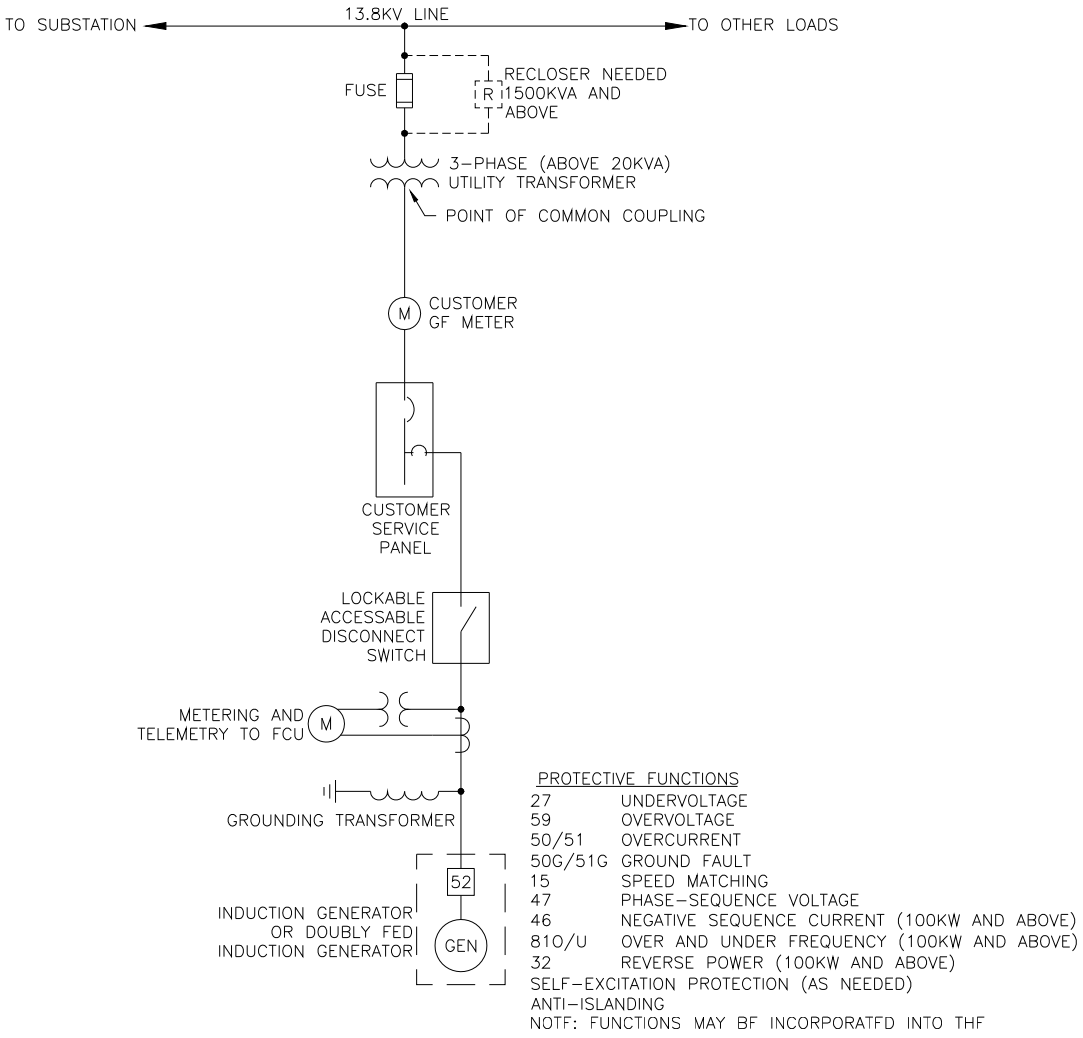


(note: meter was added to drawing similar to Drawing B

APPENDIX C-TYPICAL ONE-LINE SYNCHRONOUS GENERATOR 50KW AND ABOVE



APPENDIX D-TYPICAL ONE-LINE INDUCTION GENERATOR LARGER THAN 100KW



APPENDIX E-TYPICAL ONE-LINE INVERTER CONNECTED GENERATOR LARGER THAN 1000KW