# Omaha Public Power District

## Distributed Generation (DG) Manual

A Guide to the Interconnection
of Distributed Generation with the OPPD System

This document is subject to change without notice. Please contact OPPD for the latest requirements.

# Table of Contents

## TABLE OF CONTENTS (CONTINUED)

# 1.0 Introduction

## Objective

This document is an administrative and technical manual that specifies the requirements of the Omaha Public Power District (OPPD) for the interconnection of Distributed Generation (DG) facilities to OPPD's electric system. The primary objective of this manual is to ensure a safe, efficient and consistent approach for all interconnections.

The requirements stated in this manual are applicable for all DG facilities operated in parallel (also known as closed transition) with the electrical transmission and distribution facilities owned and/or operated by OPPD. The interconnection requirements of this manual do not apply to generation that is physically and mechanically incapable of closed transition operation (parallel operation) with the utility. OPPD requirements for service with such standby generation are included in the OPPD Metering Manual. A traditional emergency engine-generator installed with an open transition automatic transfer switch is an example of equipment for which the requirements of this manual do not apply.

These requirements are intended to achieve the following:

1. Ensure the safety of the general public and OPPD personnel.
2. Minimize possible damage to the property of the general public, OPPD customers, and OPPD's system.
3. Permit the DG facility Owner (or 'Owner') to install and operate generating equipment in parallel with the OPPD electric system in a manner that is safe and reliable.
4. Minimize adverse operating conditions on the OPPD electric system.

OPPD reserves the right to revise this manual at any time, and the DG facility Owner shall comply with any such revised manual.

## Regulatory Compliance and Interconnection Requirements

It is the responsibility of the Owner to obtain any and all permits and jurisdictional approvals and to comply with all applicable codes.

The Owner needs to work closely with OPPD to keep up-to-date on the interconnection requirements.

The requirements to interconnect generation vary depending upon:

1. The interconnection voltage
2. Direction of power flow at the interconnection
3. Classification of the proposed generation

In most cases, OPPD requires a Professional Electrical Engineer to certify drawings, tests, settings, or other documentation. The Professional Engineer's seal shall be valid for the state in which the project is being constructed. The Owner should review this manual and coordinate with OPPD to determine all certification requirements to avoid unnecessary delays.

This manual does not provide specific interconnection expense cost data to the DG facility Owner, as proposed DG facilities must be evaluated on a case-by-case basis. OPPD will examine the impact of a proposed facility and evaluate costs for OPPD system modifications, DG facility service modifications, or other required action during the 'application' phase. Specific interconnection expense cost data will be addressed during this process.

## Responsibility

The application process described in this manual concludes with OPPD approving or disapproving a parallel generation interconnection. Prior to issuing its decision, OPPD shall complete an engineering and operational review of the interconnection to ensure the OPPD system will be protected and can be maintained and OPPD does not anticipate other OPPD customers will be adversely affected by operation of the parallel generation.

OPPD is not liable or responsible for DG Owner's equipment or the DG facility electrical system (or the protection of either). The DG facility Owner is solely responsible for protecting its equipment to prevent damage from faults, imbalances, out-of-phase reclosing, or other disturbances on the OPPD system. Additionally, the DG Owner shall be responsible to protect OPPD property, public safety, and OPPD personnel due to failure of the DG system.

## Enforcement

By entering into the process of obtaining approval of the parallel generation of its DG facility from OPPD, the DG facility Owner agrees to comply strictly and completely with all requirements of this manual and all applicable laws, regulations, and industry codes related to the DG facility. OPPD shall be entitled to enforce the requirements of this manual and to obtain relief from any breach by the DG facility Owner of its requirements in any manner provided by law and shall be entitled to all available remedies, including money damages and equitable relief.

## 2.0 General

Adverse Effect

The utility-DG interconnection shall not adversely affect the utility's other customers. Possible adverse effects to other utility customers include (but are not limited to):

1. Reduction in quality of electric service.
2. Higher cost of electricity.
3. Expenditure of OPPD capital for interconnection without benefit to other customers.

Accreditation of Generation

To ensure service reliability, the net available accredited generation capacity must exceed the connected load. Accreditation provides a uniform accounting method that assures the use of consistently attainable data for utility system planning and operations. Interconnected generation Owner(s) may accredit the generation with the regional transmission operator (RTO).

Accredited DG facilities are required to operate under additional rules and regulations that are beyond the scope of this manual. The requirements for accredited DG facilities should be explored further in the OPPD document '**Facilities Connection Guide'** and by contacting the regional authority charged with regulation of power transactions between utilities and independent power producers.

Interconnection Hazards

Proper operation of two independent power sources such as the utility source and a nonutility generation source in closed transition results in a parallel operation of the two systems. The electrical attributes of both systems must be identical prior to and during the period of parallel operation. Any attempt to interconnect the two power systems while they do not share identical attributes will result in problems ranging from tripping of the circuit breaker at the interconnection point to severe equipment damage and hazardous conditions for personnel on both sides of the interconnection. The requirements of this manual apply to all distributed generation, except those physically and mechanically incapable of closed transition operation with the utility.

Islanding

Automatic and manual switching arrangements on the OPPD transmission and distribution system are based on the premise that, upon opening a line or section of the OPPD system, it becomes de-energized. Distributed generation equipment that remains energized and interconnected to the isolated portion of the system or reconnects before service restoration, creates a hazardous condition for utility employees and for this reason, OPPD does not allow DG facilities to operate as an 'island' on the OPPD system. The DG facility must automatically isolate itself from the de-energized portion of the OPPD system in the event of an OPPD outage.

Protective Equipment

OPPD requires the installation of protective equipment that shall be designed and tested to protect the electrical systems and personnel of the DG facility, OPPD, and the general public under all operating and maintenance conditions. These requirements are also applicable to

automated open transition switchgear capable of closed transition operations via programming or logic changes.

For the reasons outlined above, the interconnection of generation with a utility for parallel operation is required to meet specific technical requirements. Several site-specific factors will determine the technical requirements unique to the proposed DG installation.

Descriptions of agreements between OPPD and the DG Owner within this manual shall not be construed as modifying any existing agreements that establish rights and obligations for both OPPD and the DG Owner.

## 3.0 Classification of the DG Interconnection

OPPD categorizes interconnected (parallel) generation into three general classifications. These are Class I, II, and III.

The major factors to be considered in the determination of the interconnection class include the point of utility interconnection, the generator ratings, the generation type, and the number of generators interconnected on the electrical service. Classification of the facility shall be determined by OPPD, based upon DG facility application information provided by the facility Owner.

### Class I

This interconnection classification includes induction generators, line commutated power converters, and any other generating equipment that must be energized by the utility system to operate (excluding microturbine type generation). The VAR requirements of any induction generator interconnected to the OPPD system shall be supplied locally by the DG facility. OPPD may, at its option, charge the DG facility for VAR impacts on the OPPD system (see 'Generation Equipment', 'Induction Generators').

The DG facility Owner shall purchase, install, and maintain the required protective equipment for Class I interconnections where the protective equipment integral to the generation unit does not meet OPPD requirements (see 'Protective Equipment' in this manual). The equipment requirements are dependent upon the 'type' of Class I interconnection. OPPD has two 'types' of Class I interconnection. The corresponding 'type' equipment requirements are as follows:

Class I 'Type A' Interconnections:

This classification includes induction generators or generators with line commutated power converters rated 50 kW or below, single-phase or three-phase.

OPPD **does not** require a separate interconnection disconnect or interconnection breaker for devices classified as Class IA, **provided** each generation unit has an OPPD-accessible, outdoor unit disconnect switch and a unit mounted output breaker operated by the required protective relays. OPPD will determine requirements for protective functions/relaying on a site-specific or equipment-specific basis.

> **Note should OPPD operate (open) the unit disconnect switch during an OPPD circuit outage, the opening of this switch should not affect the generator, as the utility source is required for generator operation.**

Class I 'Type B' Interconnections:

Consist of all other induction generators or generators with line commuted power converters rated greater than 50 kW, except those determined to require a Class II interconnection, and any other generating equipment that must be energized by the utility system to operate (excluding microturbine type generation). DG Owner shall furnish VARS equal to a minimum of 80% of the estimated reactive requirement of the generator installation.

OPPD will determine requirements for protective functions/relaying on a site-specific basis. An interconnection disconnect and an interconnection breaker shall be required.

## Class II

Class II interconnections include generation equipment that operates independent of the utility, with rated capacity at or below 5 MW, and is interconnected to the utility at or below 15,000 volts.

Interconnections with synchronous generators or generators with self-commutating power converters are typically defined as Class II interconnections. Class II interconnections also typically apply to the interconnection of direct energy converters, most inverters, induction generators with an adequate local VAR supply, and all microturbines (whether capable of operation independent of the utility or not).

The DG facility Owner shall purchase, install, and maintain the required protective equipment (see 'Protective Equipment' in this manual) for all Class II interconnections. This equipment includes:

- an interconnection disconnect at each interconnection point.
- an interconnection breaker for each interconnection point.
- protective functions/relaying in accordance with OPPD requirements.

OPPD may waive the interconnection breaker and protective relaying requirements for 'momentary' closed transition interconnections - refer to the 'Duration of Parallel Operation' section of this manual to determine if the load transfer equipment meets the 'momentary' classification.

## Class III

Class III interconnections are for any interconnection in excess of 15,000 volts, are typical for generation in excess of 5 MW, and may also apply where medium and high voltage generation equipment (>600V) is used. OPPD will evaluate and specify the requirements for Class III interconnections on a site-specific basis. Class III interconnections may require, as a minimum, all requirements for a Class II interconnection. Class III facilities will often require an interconnection directly into the OPPD transmission system. Class III DG facilities are typically intended to be 'accredited' generation facilities, if so, see the OPPD document 'Facility Connection Guide' for additional requirements.

Requirements included in the OPPD 'Facility Connection Guide' shall be in addition to the Class III requirements for any DG facilities that are or will be 'accredited'.

## 4.0 Listing and Description of the Various OPPD Forms

OPPD uses several forms to facilitate the application process for Distributed Generation Interconnection between an Owner and the Omaha Public Power District. The various forms are listed below with a short description. A copy of each is included in a later section of this manual. Note a copy of the 'OPPD Agreement for Closed Transition Operation of Distributed Generation' is not included in this manual; interested parties should obtain a copy of this agreement from OPPD for review.

**Application for OPPD Approval to Construct Distributed Generation (DG) Interconnection**

This is the form to be used by an Owner to notify OPPD of the desire to install generation that will operate in closed transition with the OPPD electric system. The Owner uses this form to transmit information about the intended installation.

**DG Corrective Action Notice / Red Tag**

This is the form that would be used by OPPD personnel to notify the DG facility Owner of deficiencies in the DG installation.

**Temporary DG Certificate**

This is returned to the applicant for posting at the job site following OPPD review of the Application for OPPD Approval to Construct Distributed Generation (DG) Interconnection. It is intended to indicate the applicant has begun the approval process that will result in a DG Certificate of Permission.

**DG Certificate of Permission**

This is the form used to indicate the approval of the DG facility for closed transition operation with the OPPD electric system.

## 5.0 Requirements for Closed Transition Operation

### General

Any operation of generation in closed transition with the OPPD system requires a signed and executed '**OPPD Agreement for Closed Transition Operation of Distributed Generation'** between OPPD and the DG Owner and Owner's receipt of **'DG Certificate of Permission'**. The agreement stipulates the terms of the interconnection; such as the class of interconnection, types of power transaction, duration of interconnection, protection requirements, etc. Prior to execution of the agreement, the DG Owner must have obtained an OPPD-approved '**Application for OPPD Approval to Construct DG Interconnection**'. The installation must be inspected and approved by OPPD for parallel operation. Parallel operation without a signed agreement, or failure to comply with the terms of the agreement, may result in termination of the utility service.

Upon review of the DG applicant's design for the proposed parallel installation, OPPD may require changes to the protection scheme, interconnection point, or other items. OPPD may not allow the use of certain equipment grades or manufacturer's products. OPPD will notify the applicant, in writing, of OPPD approval of the 'Application for OPPD Approval to Construct DG Interconnection'. **The applicant should not release DG equipment for manufacture or begin installation of DG equipment until this approval has been received.**

### Periodic Testing

See 'Protective Equipment' in this manual for testing and verification schedules for protective equipment.

OPPD requires periodic testing and verification of all DG-utility interconnections. The test(s) shall verify the interconnection functions as originally approved by OPPD. The interconnection equipment shall be tested for conformity with the initial, 'as installed' test requirements.

Except where exempted by OPPD, the testing shall be certified by a Professional Electrical Engineer registered in the state where the project is being constructed. The engineer shall be selected by the DG facility Owner and all engineering services shall be performed at the Owner's expense. The DG facility Owner shall also reimburse OPPD for the direct, actual expenses incurred by OPPD as a result of testing. An example of such expenses would be reimbursement for an OPPD crew or technician to 'stand by' during testing to be available in the event problems arise.

The DG facility Owner shall keep all test results on file for review by OPPD. These tests may be required to be submitted as part of the 'OPPD Agreement for Closed Transition Operation of Distributed Generation'/'DG Certificate of Permission' renewal process, so files should be maintained for a minimum of the period between renewals. Refer to 'The Approval Process for DG Installations' renewal requirements.

### OPPD Access to DG Facility Equipment

By submitting a completed 'Application for OPPD Approval to Construct DG Interconnection' (and as part of the terms of the 'OPPD Agreement for Closed Transition Operation of Distributed Generation') the DG facility Owner agrees to allow OPPD access to the DG facility under both normal and emergency conditions for the purpose of inspection and witness testing of the interconnection equipment.

Under normal conditions, OPPD intends to provide advance notice of all site visits and will coordinate such visits with the facility Owner or the Owner's representative. Emergency conditions may require OPPD access the DG facility without advance notice.

## Utility Service Termination Clause

By submitting a completed 'Application for OPPD Approval to Construct DG Interconnection' and as part of the terms of the 'OPPD Agreement for Closed Transition Operation of Distributed Generation', the DG facility Owner agrees to the following:

OPPD shall have the right to require the DG Owner to immediately disconnect the generation facility without advance notice or liability if:

- there are any changes or alterations to the DG facility equipment unapproved by OPPD
- in OPPD's sole judgment, the facility has not incorporated necessary features for automatically counteracting the effect of anticipated possible sources of failure (fail-safe design)
- it causes any electrical problem(s) with other OPPD customers
- may pose a risk to OPPD employees, customers or the general public

The failure of the DG Owner to comply with any of the covenants or obligations contained herein shall give OPPD the right to terminate its agreement with the DG Owner and to recover from the DG Owner the cost and expenses incurred by OPPD. The agreement shall be subject to all of the OPPD service regulations, rate schedules, and written policies regarding interconnection (except as modified by the agreement) and shall be subject to such changes or modifications as OPPD Management or Board of Directors may from time to time make in the service regulations, rate schedules, and interconnection policies.

**The above clause is applicable to all distributed generation operating in parallel with the OPPD system, including generation discovered to exist on the OPPD system without the DG Owner having initiated or successfully completed the OPPD approval process for DG installations.**

## Nontransferable Agreements for Change of Ownership or Modified Facilities

Executed 'Application for OPPD Approval to Construct DG Interconnection', 'Temporary DG Certificate', 'OPPD Agreement for Closed Transition Operation of Distributed Generation', and 'DG Certificate of Permission' documents are not transferable to parties, DG facilities or DG equipment other than those identified in the documents.

If the DG facility undergoes a change of Ownership, or the facility is modified, any existing agreements between the previous facility Owner and OPPD are considered null and void. The new DG facility Owner, or the Owner of a modified DG facility, does not have OPPD permission for closed transition operation and shall be subject to the terms of the 'Utility Service Termination Clause'. Such circumstances will require the execution of new forms of the above documents. Refer to 'The Approval Process for DG Installations' renewal requirements for additional information.

## Interconnection Expenses

OPPD maintenance and operation procedures are based on a single source serving the electric distribution system. Interconnection of additional generation or other modifications to the electric system will necessitate modification to these procedures. Often, the introduction of DGs to the utility system requires capital expenditures for additional utility equipment. The modified

procedures and additional utility equipment increase utility costs without providing benefits to other utility customers. In such cases, the expenses for additional OPPD procedures, equipment, maintenance, labor, and other related costs that are over and above the expenses for a nongenerating customer shall be paid to OPPD by the Owner of the DG facility.

These reimbursable costs are separate from DG Owner obligations to purchase, install, and maintain OPPD required interconnection equipment installed at the DG facility, as well as the cost of professional engineering services and maintenance testing to satisfy OPPD requirements.

The following expense categories are examples of items reimbursable to OPPD:

1. Meter installation, tests, maintenance, parts, and related labor
2. Meter reading and scheduling, billing
3. Telemetry installation, tests, maintenance, parts, and related labor
4. Operating expenses, including communication circuits
5. Study, analysis, and related expenses
6. OPPD assistance in securing regional regulatory authority acceptance of the DG facility
7. Modifications to the OPPD system including related material and labor
8. Protective device (OPPD owned) installation/equipment cost and related labor
9. OPPD costs for DG facility design review, equipment inspections, and witness testing
10. Programming costs to incorporate generation data into OPPD's energy management system

Note changes to the OPPD system or the addition of other DG facilities in the vicinity may require modifications to the existing DG facility interconnection. If such changes are required, the existing DG facility shall be subject to future charges for these modifications.

Also, note a DG installation results in increased utility maintenance costs in the event of an extended outage on the utility circuit serves the DG facility to safeguard OPPD repair crews. OPPD will isolate the DG facility from the OPPD system by opening the interconnection disconnect(s) before restoring service to the disabled circuit. OPPD will return to the DG facility and close the interconnection disconnect(s) after the utility circuit is restored. These additional steps are only required for facilities with interconnected generation, but potentially delay restoration of service to all customers of the utility circuit.

The DG facility Owner is also responsible for any ongoing monthly charges (such as telephone bills associated with DG facility-to-OPPD voice or data communications) incidental to operation of the DG facility.

Upon receipt and review of the 'Application for OPPD Approval to Construct DG Interconnection' application, OPPD will inform the DG facility applicant of potential OPPD expenses requiring reimbursement. In most cases, OPPD will require 100% of requested reimbursement funds in the form of a front-end deposit, prior to the execution of OPPD work. Unused funds will be refunded to the depositor at project completion.

Please refer to Appendix C – 'Interconnection Expenses Schedule' for additional information.

## Contact Information

With interconnected generation, DG facility equipment events may impact the OPPD system and/or OPPD system events may impact the DG facility. Consequently, communication between the two parties becomes very important.

For Class I 'type A', some Class I 'type B', and smaller Class II installations, OPPD requires daytime and nighttime phone numbers for emergency contact purposes. Minimal additional

generation Owner contact information is required. The contact person(s) should contact the OPPD call center at 402-554-6773 whenever the OPPD electric system has a service interruption affecting their generation equipment.

For some Class I 'type B', larger Class II, and Class III installations, OPPD requires a 24 hour/day, 365 day/year phone number for after hours and emergency contact purposes. The designated DG facility contact person(s) should have responsibility for and authority over operation of the generation and be able to provide information regarding facility events, equipment status, and relay target and alarm information upon OPPD request. Also, the contact person(s) should notify OPPD whenever:

1. Problems with generation equipment are detected that could result in mis-operation of generation protection or other generation equipment.
2. The generation has tripped off-line during parallel operation with the OPPD system.
3. Generation equipment problems are believed to have resulted in an outage to a portion of the OPPD system.
4. The DG facility intends to initiate abnormal switching to parallel the generation with the OPPD system.

Under certain circumstances, OPPD may determine additional contacts are required.

## 6.0 Procedure for New Class IA Interconnection

In this section, the process for connecting a Class IA generator to the OPPD electric system is summarized. Prospective Owners are encouraged to familiarize themselves with the complete Manual. This section applies only to those DG facilities with induction generation and a maximum rating of 50 kW, (or other device that must be energized by the utility to operate).

**OPPD utilizes a two-step approval process for any DG that will operate in parallel with the OPPD electric system. The DG Owner must obtain two authorizations from OPPD prior to beginning operation of the generation equipment:**

- **OPPD Approval to Construct DG Interconnection**
- **DG Certificate of Permission**

For the DG Owner, or their representative, the following steps are involved in the DG approval process for new installations (for 'accredited' generation facilities, see 'General Policy' in this manual, additional steps required for such facilities are not addressed below):

1. Obtain current copies of the OPPD DG Manual and the 'OPPD Agreement for Closed Transition Operation of Distributed Generation' and review the documents to become familiar with all requirements.
2. Contact your OPPD Electric Service Designer or Account Executive. If you do not know your OPPD contact, please call 402-636-3535. Discuss with your representative the proposed generation installation and application process to include: submittal requirements, protective equipment (including relay) requirements, metering requirements and for possible preapproval of a manufactured system. Professional Electrical Engineer certification may be required on submittals. The engineer must have a license valid for the state where the project is being constructed. **Early discussions with OPPD can avoid misunderstandings and delays in processing of the 'Approval to Construct' application.**
3. Assemble all requested DG equipment information, installation drawings, and other information. Complete and sign an 'Application for OPPD Approval to Construct DG Interconnection', submit the application with all material assembled, and await OPPD response. **Review of this application should normally be completed within 15 working days.**
4. Supply any additional materials or respond to any questions regarding the installation as requested by OPPD.
5. Classification of the facility shall be determined by OPPD, based upon DG facility application information provided by the facility Owner.
6. **If further OPPD studies are not required, protective equipment, metering, and other requirements may be finalized – the process continues below. If further OPPD studies are required (typical of larger installations), the approval process is delayed at this point until the completion of the study phase. Note such studies, if required, may require months for completion, and will usually require execution of study agreements between the applicant and OPPD. Study agreements and study results will address issues of reimbursement of OPPD by the DG applicant (see 'Requirements for Closed Transition Operation, Interconnection Expenses').**
7. Obtain authorized '..OPPD Approval to Construct..' application and 'Temporary DG Certificate'.
8. Purchase any switchgear and or DG equipment to be purchased for the installation upon receipt of OPPD 'Approval to Construct'.
9. Post the 'Temporary DG Certificate' at the job site.
10. Submit DG facility relay settings to OPPD for review, if not already submitted.
11. Complete construction of the DG facility and any required preoperational tests.
12. Notify all parties and OPPD that facility is ready for parallel witness test and arrange date and time, as required.
13. At the required OPPD 'Witness Test', perform/demonstrate tests outlined in the 'OPPD Agreement for Closed Transition Operation of Distributed Generation'.

14. Complete successful OPPD witness test.
15. Submit copies of the final protective device settings and final one-line/power riser diagram to OPPD as required (Professional Engineer stamp may be required).
16. Execute 'OPPD Agreement for Closed Transition Operation of Distributed Generation' and reimburse OPPD for any unpaid Interconnection Expenses.

Receive from OPPD 'DG Certificate of Permission' and permanently post it as required.

## Metering

OPPD uses two styles of metering equipment for traditional utility 'revenue' metering: socket meters and instrument transformer meters. Socket meters are a series-connected measurement device and, therefore, are an integral part of the power circuit - removal of the meter interrupts the power flow. Socket meters usually are not rated over 320 Amps.

The pricing difference between import and export transactions leads to special metering requirements. Import/export interconnections require metering equipment is capable of separately recording the import and export transactions.

Meters used on closed transitions have a detent mechanism that only allows energy measurement in one direction, import or export. OPPD automatically installs the import-detent meter for typical electric service and closed transition installations. Export-detent meters are only installed for customers that want to sell the excess generation back to the utility.

The customer is responsible for the installation of the import and export meter sockets (adjacent to one another) for socket metering installations, or for the installation of the import and export meter test cabinet(s) (adjacent to one another) for instrument transformer metering installations. OPPD will determine meter requirements for facilities on a case-by-case basis.

At the discretion of OPPD, advanced, multi-function, bi-directional (import/export) socket meters may be installed in place of the separate import and export socket meters described above.

OPPD does not install 'net metering' for DG facilities operating in closed transition.

OPPD will not install traditional 'revenue' metering at locations other than the facility service entrance location(s). Import and export revenue metering will be installed only at the service entrance interconnection point.

## Rates

OPPD rates for electric service are established in OPPD rate schedules, which are compiled in the 'OPPD Rate Manual'.

Contact your OPPD Account Executive or Electric Service Designer for additional rate information.

## Service Transformers

All new, and most existing OPPD three-phase service transformers, are wye–wye type (installed grounded wye - grounded wye). OPPD will typically own and install wye-wye transformers for service to three-phase Class I DG interconnections (refer to 'Classification of the DG Interconnection' in this manual). OPPD prefers wye-wye service transformers for DG facilities for

technical reasons, and will often want to replace or reconfigure transformers that are not wye-wye configuration.

Existing delta-delta or ungrounded wye-delta service transformers for DG facilities will usually require reconfiguration of the transformers to wye-wye or the installation of utility side voltage unbalance protection equipment. In some cases, upgrading of OPPD transformer insulation levels and lightning arrester ratings to a higher voltage may be required. The DG facility Owner is responsible for the installation and material costs of such equipment (see 'Requirements for Closed Transition Operation', 'Interconnection Expenses' in this manual).

**To provide isolation and minimize possible adverse effects on other OPPD customers from DG facility generation, all DG facilities with three-phase electric service require a dedicated service transformer.**

**Three-phase DG facilities may not share the secondary or load side of the OPPD service transformer with other OPPD customers.**

**DG facilities with single-phase electric service where the DG is utilizing nonsynchronous inverter technology requiring connection with the utility to maintain synchronous operation will not require a dedicated service transformer. All other single-phase DG installations will require a dedicated service transformer.**

It is OPPD's responsibility to determine the transformer connection and grounding configuration required. While in the facility design stage, the DG facility Owner should always verify (with OPPD), the details of the electric service (voltage, phase, ampere rating, etc.) and the OPPD service transformer winding configuration.

## Single-phase Devices

Replacement of single-phase overcurrent devices (line fuses, single-phase automatic circuit reclosers, single-phase line switches) may be required on the OPPD circuit between the OPPD substation and the DG facility service entrance.

**Regardless of whether any single-phase devices are replaced with three-phase devices, the DG Owner is solely responsible for protecting DG equipment from the effects of excessive negative sequence currents, system imbalance effects, or loss of utility phase/ utility single-phase conditions. OPPD is not responsible for damage to DG equipment due to these or similar effects.**

## Protective Equipment - General

For Class I 'type A' interconnections, OPPD **does not** require a separate interconnection disconnect or interconnection breaker, **provided** each generation unit has an OPPD-accessible, outdoor unit disconnect switch and a unit mounted output breaker operated by the required protective relays. Protective functions and relaying to protect the OPPD electric system from failure of the DG facility shall be determined by OPPD. Note should OPPD operate (open) the unit disconnect switch during an OPPD circuit outage, the opening of this switch should not affect the generator, as the utility source is required for generator operation.

## Network Service

**OPPD does not allow DG operation in closed transition where the DG facility is served from any secondary network system, spot or grid (see glossary).**

**Interconnection Expense**

Often, the introduction of DGs to the utility system will require capital expenditures for additional utility equipment and services. In such cases, the Owner of the DG facility shall pay the expenses for additional OPPD procedures, equipment, maintenance, labor and other related costs to OPPD.

The payment of these expenses is in addition to DG Owner obligations to purchase, install, and maintain OPPD-required interconnection equipment installed at the DG facility, as well as, the cost of professional engineering services and maintenance testing to satisfy OPPD requirements.

The following expense categories are examples of expenses that must be paid by Owner to OPPD, for Class 1A interconnections:

1. Meter installation, tests, maintenance, parts, and related labor
2. Meter reading and scheduling, billing

## 7.0 The Detailed Approval Process for DG Installations

This section clarifies the process for connecting Class I, Class II, and/or Class III generators to the OPPD electric system.

**New Installations**

**OPPD utilizes a two-step approval process for any DG that will operate in parallel with the OPPD electric system. The DG Owner must obtain two authorizations from OPPD prior to beginning operation of the generation equipment:**

- **OPPD Approval to Construct DG Interconnection**
- **DG Certificate of Permission**

For the DG Owner, or their representative, the following steps are involved in the DG approval process for new installations (for 'accredited' generation facilities, see 'General Policy' in this manual – additional steps required for such facilities are not addressed below):

1. Obtain current copies of the OPPD DG Manual and the 'OPPD Agreement for Closed Transition Operation of Distributed Generation' and review the documents to become familiar with all requirements.
2. Contact your OPPD Electric Service Designer or Account Executive. If you do not know your OPPD contact please call 402-636-3535. Discuss with your representative the proposed generation installation and application process to include: submittal requirements, protective equipment (including relay) requirements, metering and/or telemetry requirements (typical of Class II and III). Professional Electrical Engineer certification is normally required on submittals. The engineer must have a valid license for the state where the project is being constructed, and for possible preapproval of a manufactured system. **Early discussions with OPPD can avoid misunderstandings and delays in processing of the 'Approval to Construct' application.**
3. Assemble all DG equipment information, installation drawings, and other information. Complete and sign an 'Application for OPPD Approval to Construct DG Interconnection', submit the application with all material assembled, and await OPPD response. **Allow a minimum of 30 days for OPPD review of this application.**
4. Supply any additional materials or respond to any questions regarding the installation as requested by OPPD.
5. Classification of the facility shall be determined by OPPD, based upon DG facility application information provided by the facility Owner.
6. **If further OPPD studies are not required, protective equipment, metering, and other requirements may be finalized – the process continues below. If further OPPD studies are required (typical of larger installations), the approval process is delayed at this point until the completion of the study phase. Note such studies, if required, may require months for completion, and will usually require execution of study agreements between the applicant and OPPD. Study agreements and study results will address issues of reimbursement of OPPD by the DG applicant (see 'Requirements for Closed Transition Operation, Interconnection Expenses').**
7. Receive approval of '..OPPD Approval to Construct..' application and 'Temporary DG Certificate'.
8. Release orders for any switchgear or DG equipment to be purchased for the installation upon receipt of OPPD 'Approval to Construct'.
9. Post the 'Temporary DG Certificate' at the job location.
10. Submit DG facility relay settings to OPPD for review, if not already submitted.
11. Complete construction of the DG facility and any required preoperational tests.

12. Notify all parties and OPPD that facility is ready for parallel witness test and arrange date and time.
13. At the required OPPD 'Witness Test', perform/demonstrate tests outlined in the 'OPPD Agreement for Closed Transition Operation of Distributed Generation'.
14. Complete successful OPPD witness test.
15. Submit copies of the final protective device settings and final one-line/power riser diagram to OPPD (PE stamp typically required).
16. Execute 'OPPD Agreement for Closed Transition Operation of Distributed Generation' and reimburse OPPD for any unpaid interconnection expenses.
17. Receive 'DG Certificate of Permission' and permanently post it as required.

## Renewals

Renewals are required for expired 'DG Certificate of Permission' certificates (usually every **5 years**), for modified DG facilities, and for new DG facility Owners as follows:

### Simple Renewal

If no modifications have been made to the DG equipment or facility electric service entrance, and the facility has not had a change of Ownership or control, contact OPPD (if OPPD has not contacted the facility), and:

- Obtain current copies of the OPPD DG Manual and the 'OPPD Agreement for Closed Transition Operation of Distributed Generation' and review the documents to become familiar with all requirements.
- Submit documentation (with PE seal) of required periodic tests, see 'Requirements for Closed Transition Operation, Periodic Testing' in this manual.
- Be prepared to perform an OPPD Witness Test as outlined in the 'OPPD Agreement for Closed Transition Operation of Distributed Generation'.
- Be aware OPPD may require the existing DG equipment or facility be modified to meet the requirements of the latest DG Manual.

Upon meeting all OPPD requirements, OPPD will forward a new 'DG Certificate of Permission'. When it is received, it shall be permanently posted as required.

### Renewals for Modified DG Equipment, Facilities or New DG Owners

If the facility electric service or DG equipment has been or will be modified, or if the facility will undergo a change of Ownership or control, OPPD should be contacted at the earliest possible date. This will allow a joint review of the facility to determine what revisions, if any, will be required to allow the DG to continue operation.

If the facility electric service or DG equipment will be or has been modified, it will be necessary for OPPD to review all modifications for compliance with current OPPD requirements. For minor modifications, OPPD will evaluate the impact of the modifications against OPPD DG requirements. If the modifications involve expansion of the existing DG capacity or major modifications to the facility electric service or DG equipment, OPPD will evaluate the changes in a similar manner to the approach taken for 'New Installations' above.

If the facility or DG equipment has or will undergo a change of Ownership or control, but has not and will not be modified, the new facility Owner shall apply for an 'OPPD Agreement for Closed Transition Operation of Distributed Generation'. This will require the new Owner to complete the following items:

- Obtain current copies of the OPPD DG Manual and the 'OPPD Agreement for Closed Transition Operation of Distributed Generation' and review the documents to become familiar with all requirements.
- Have OPPD verify the previous Classification of the DG equipment as defined in the DG Manual (Class I, II, or III, import only or export, kW level) and any existing operating restrictions, by examination of previous approvals/records.
- Verify with OPPD the existing installation and classification, any submittal and periodic testing requirements and PE certification. Submit documentation (with PE seal) of required periodic tests. Periodic tests are discussed in the section 'Requirements for Closed Transition Operation, Periodic Testing' in this manual.
- Supply any additional materials or respond to any questions regarding the installation as requested by OPPD.
- Verify DG facility protection equipment matches facility and OPPD records, and such records are in the possession of the new Owner.
- Be aware OPPD may require a Witness Test as outlined in the 'OPPD Agreement for Closed Transition Operation of Distributed Generation'.
- Be aware OPPD may require the existing DG equipment or facility be modified to meet the requirements of the current DG Manual.

Upon meeting all OPPD requirements, OPPD will forward to the DG Owner a new 'DG Certificate of Permission'. When it is received, it shall be permanently posted as required.

## 8.0 Interconnection Point

The interconnection point of OPPD to any DG facility is the point at which the OPPD system connects to devices, conductors, or equipment of the DG facility, as determined by OPPD. This point will normally be the 'point of common coupling' as defined in 'IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems', IEEE Standard 519. The service entrance voltage is typically defined by the voltage at this point.

Note DG facilities may not be able to meet OPPD DG requirements if the generation is interconnected at points in the DG facility system other than the service entrance. The DG facility Owner must verify the interconnection point with OPPD during the design stage.

## 9.0 Duration of Parallel Operation

The amount of time electric generation will operate in parallel (or 'closed transition') with the utility system will help determine the OPPD requirements for the DG facility. For the purpose of this manual, closed transition operation is either momentary or sustained. Momentary closed transition - used only for synchronized closed transition transfer of DG facility load from one source to another source - interconnects the two power systems only during the brief load transfer period. Sustained closed transitions allow the two systems to remain interconnected indefinitely, as long as synchronous operation is maintained.

| TYPE OF CLOSED TRANSITION OPERATION | DURATION OF PARALLEL OPERATION | OPPD REQUIREMENTS FOR THE DG FACILITY |
|---|---|---|
| Momentary* | < 100 milliseconds | Synchronism check on transfers interconnection disconnect |
| Sustained | > 100 milliseconds | All OPPD DG Manual requirements and additional requirements, as determined by OPPD |

*Determination as to whether the DG equipment to be installed is the 'momentary' type above or not shall be made by OPPD. A DG facility design proposal using a 'closed transition transfer switch' may be approved as 'momentary'. DG transfer equipment approved as 'momentary' shall be designed, manufactured and listed for use as 'momentary' transfer equipment, and is not designed for 'sustained' parallel operation. DG transfer equipment which meets the 'momentary' requirements above, but which relies on programmable electronic control means, and is capable of being re-programmed or otherwise altered to be capable of 'sustained' parallel operation, shall be considered 'sustained' type. Note 'momentary' type of operation is still closed transition operation, and as such is not approved for applications involving OPPD network service (see 'OPPD System Issues, Network Service' in this manual). Automated switchgear capable of closed transition operations via programming or logic changes shall meet the protective requirements and stipulations for sustained interconnections.

The 'momentary' interconnection, or closed transition transfer, can result in a large load suddenly being applied to the DG facility generation. This 'step-loading' can result in frequency and voltage disturbances that may be unacceptable to the DG facility load - the generator should be properly sized and selected to help prevent such power quality problems.

## 10.0 Generation Equipment

OPPD requirements for the interconnection are dependent on many factors, including the technology or method of electric power production. Common types of electric generation equipment are discussed below.

### Direct Energy Converters

Direct energy converters (DECs) are usually semiconductor-based devices that convert energy into DC (direct current) electricity.

Examples of direct energy converters include **photovoltaic solar cells** (converting sunlight directly into DC electricity), fuel cells and **thermionic cells** (converting heat energy directly into DC electricity).

Because the DC output of these devices is not compatible with AC (alternating current) electrical systems, an inverter is usually required for DC to AC conversion– see 'Inverters' below.

### Inverters

Inverters are typically solid-state microprocessor-controlled devices used to convert DC electricity into AC electricity of a desired voltage and frequency (usually 60Hz utility system frequency).

The inverter synthesizes the AC output waveform, which raises the following concerns for OPPD:

- The stability and quality of the inverter output waveform varies with inverter design. OPPD is interested in the output characteristics of inverters operating in closed transition with the OPPD system. Poor waveform quality from an inverter output can introduce undesirable harmonics to the electrical system of both the DG facility and OPPD.
- Where the inverter gets its 'clock' signal for waveform synthesis can affect how the inverter reacts under certain conditions. An inverter with internal clock signal can operate independent of the utility, and issues of synchronism and operation as an island are raised. Voltage controlled inverters using the utility voltage waveform for timing do not usually create synchronism concerns, and usually cannot function independent of the utility.

### Static Power Converters

Static Power Converters (SPCs) are typically solid-state microprocessor-controlled devices used to convert AC voltage at a frequency other than 60Hz to AC voltage at 60Hz system frequency. The devices usually consist of a rectifier input stage for AC to DC conversion, then an inverter output stage (see 'inverter' above) for conversion of the DC into 60Hz AC system voltage.

OPPD concerns regarding SPCs usually include the concerns for inverters above.

**Microturbine** generators and some **wind turbine** generators typically utilize a SPC for conversion of high frequency AC power to 60 Hz AC power.

### Generators

Generators convert mechanical, rotating shaft horsepower into electricity. The supply of shaft horsepower (or the 'prime mover') for a generator can be a turbine or a combustion engine. A source of mechanical power for a turbine might be **steam, ignited gas (jet engine), water,** or

**wind**. A typical combustion engine fuel source might be **oil, diesel, gasoline, methane, or natural gas**.

The electrical output of a generator is either AC (alternating current) or DC (direct current).

DC generators with inverters (see 'inverter' above) are used when the shaft RPM is not constant, as in some **wind turbine** and some **water turbine** applications.

AC generators can be single-phase or three-phase. AC generators are one of two types, induction or synchronous:

Induction Generators

Induction generators are very similar to induction motors- in fact; they are often started as a motor using utility power. Once started, the mechanical power source rotates the shaft of the generator in excess of the unit's 'motoring' speed, thus producing electrical energy. These units are typically smaller than 500 kW, and do not usually require synchronizing equipment for starting (because they are started as a motor, they achieve synchronous speed).

A typical application of an induction generator is for **wind turbine** use. Once the wind speed is high enough for generation, the turbine is started like a motor (using the generator). Next, the wind is allowed to try to drive the generator to produce power.

Induction generators can supply real power (watts) to the utility but require a reactive power source (VARs) for excitation. Utility supply of these leading VARs affects the utility voltage and results in unrecovered energy losses. See 'Power Quality Restrictions for Generation' in this manual for OPPD VAR source and power factor requirements. Capacitors installed by the DG facility Owner and located on the generator side of the generator breaker are preferred for VAR support. VAR supply from location(s) other than the induction generator may impact the OPPD protection requirements. Where VARs are supplied locally, the time required for decay of a generator's output for the OPPD 'Loss of Utility' witness test may exceed OPPD requirements.

Synchronous Generators

Synchronous generators use a DC field winding to provide the magnetic field in which the machine rotor will spin, thus generating electricity, and can supply both watts and VARs to their load (or to the utility system while operating in closed transition). They are capable of generating stable AC power while independent of and isolated from the utility system. The frequency of the generated electricity is determined by the shaft speed of the generator. The generated voltage, real power, and reactive power are dependent on the combination of shaft speed and field winding excitation.

Emergency generators using fossil fuel combustion engines are typically synchronous machines. The majority of distributed generation interconnected for parallel operation is three-phase, synchronous machines.

The real power (kW) output of the generator influences the protective relay scheme and the fault current rating of the switchgear.

The total power (kVA) output of the generator and the excitation of the field winding determine the power factor of the generator.

The reactive power (kVAR) from the generator can affect system voltages.

The armature winding of three-phase generators can be wye or delta connected. This connection may influence a generator's fault current contribution.

The fault current available from the generator is a function of the rated power and the generator impedance during a fault (i.e. reactance's, the sub-transient reactance, X''d is typically used in calculations).

## 11.0 Power Quality Restrictions for Generation

**Operating Limits**

The following restrictions are provided for information only, and do not necessarily represent OPPD's requirements for a specific DG facility. OPPD will determine specific operating limits during the course of the OPPD facility approval process. OPPD may change the operating limit requirements for a facility at any time to prevent operation of the facility in a manner which is objectionable to OPPD or its customers. In most cases, OPPD requirements will be consistent with the latest version of IEEE P1547 "Standard for Interconnecting Distributed Resources with Electric Power Systems", other applicable standards, and the following:

Voltage

The voltage regulation of the DG must be adequate to ensure any out-of-bound condition will be corrected to within the control limit within 2 seconds. The voltage control limits for the DG are the ANSI C84.1 'A' range limits (+/- 5%) for the service voltage (see Point of Common Coupling – PCC in glossary). The DG shall automatically disconnect from the OPPD system after 2 seconds of operation outside of the voltage control limits.

Voltage Flicker

The DG operation shall not result in voltage flicker greater than 2% on the utility system at the point of common coupling.

Frequency Control

The frequency of the DG shall not deviate more than +/- 0.5 Hertz from the 60 Hertz base (59.5 Hz minimum – 60.5 Hz maximum). The DG shall automatically disconnect from the OPPD system within 1 second if the frequency exceeds the 0.5 Hz limit.

Power Factor

DG facilities shall provide for their own reactive power needs. Non-exporting DG facilities shall operate the combined generation and load within a range of +85% to –85% power factor. Power factor charges specified in the OPPD Rate Schedules will apply to power factors outside of this range.

All exporting DG facilities shall operate at unity power factor unless otherwise specified by OPPD.

Harmonics

The total harmonic distortion (THD) of the current of an exporting DG shall not exceed 5%, measured at the point of common coupling. The harmonic spectrum shall not exceed the IEEE 519 limits specified in table 10.3 for the 5% THD category.

The total harmonic distortion of the voltage of a DG shall not exceed 5% at the point of common coupling.

The DG facility Owner is responsible for the installation and expense of any additional equipment needed to prevent an objectionable increase in the utility system voltage THD due to operation of the DG.

Export Power Requirements

The quality of the generated AC power depends on the construction of the generator or static power converter. Certain DG types may produce electrical waveforms that are not clean sinusoidal waveshapes. Low quality power is unacceptable for export to the utility.

Electrical generation exporting power to the utility must not contain more than 5% total harmonic distortion of current.

Where DG facilities intend to export power utilizing rotary type AC generators, the generators shall have a skewed rotor or winding pitch of approximately 2/3 to ensure clean AC production and low third harmonic generation. Generators exporting power through an Owner's delta-wye transformer (delta on the generator side) may be allowed to sue other winding pitches as the delta winding should trap triple-n harmonics.) (This situation is most common with larger Class II or Class III DG facilities.)

## 12.0 Power Transfer

**Determination of kW Levels**

All parallel operation power levels are measured on a per service/ per OPPD circuit basis, with adjustment for power factor.

Parallel operation power levels are calculated based on the maximum generation scenario: all available DG facility generation (including possible future generation) operating in parallel with the OPPD system.

Should a facility increase their generation capacity or begin to export power in the future, a new 'Agreement for Closed Transition Operation' must be reached with OPPD - see 'The Approval Process for DG Installations', or 'Renewals for Modified DG Equipment or Facilities' sections. Where future DG facility modifications are anticipated, OPPD will strongly recommend any DG equipment installed at present meet all requirements for the future DG facility – it will often be more cost effective for the DG Owner to install the required equipment initially than to add the necessary equipment later.

**Once power levels are determined and approved by OPPD for a DG facility, the facility will be restricted from operation outside the established power transfer boundaries.**

**Import-only, Import/Export or Export-only**

Power transfers between a DG facility and a utility can be import, export, or a combination of these types. 'Import' is the typical power transfer from utility to a customer (a customer 'imports' power from the utility). 'Export' is power transfer from a DG facility to utility (the facility 'exports' to the utility). The majority of the utility/customer interconnections are import only, where there is no on-site generation or only open-transition load transfer to a generator. 'Import/export' arrangements are typical of parallel-capable generation facilities with on-site generation that may exceed the load requirements of that facility.

Examples of import/export arrangements include wind or solar power generation for residences. This type of arrangement will import power during heavy load periods when the on-site generation is unable to supply all the power requirements. During lightly loaded or no-load periods, portion of the on-site generation not used by the facility will be exported to the utility.

The DG Owner and OPPD must come to an understanding on the issue of whether the DG facility is to be used for import-only, import/export, or export-only power transfers with OPPD. The type of power exchange intended to occur between the DG facility and OPPD will determine the protection and metering requirements for the facility.

**Import-only**

| | | |
|---|---|---|
| DG facility kW capacity | = | Total DG kW capacity |
| DG facility export level | = | 0 kW |

As an example*:

A DG facility has facility load peak of 1800 kW and generation capacity of 1500 kW, but the facility load averages 1400 kW. The facility has plans for future load growth.

With up to 300 kW shortfall between their peak load and available generation, the facility decides to operate such that up to 100% of their load is curtailable (with some load shed under worst case conditions).

Because the facility is designated for import-only, it is restricted electrically and by agreement from exporting power to the OPPD system during those times when their load is less than the 1500 kW of available generation.

**Import/Export**

| | | |
|---|---|---|
| DG facility kW level available for parallel operation | = | Total DG kW capacity less the facility loads |

The determination of the DG facility export power level for import/export facilities often will require economic analysis on the part of the DG facility Owner or their consultant. Participation in different OPPD rate programs, the amount of DG capacity vs. the DG facility load, and the cost of additional OPPD-required DG equipment (based on the export power level) are all determining factors in the export level determination.

| | | |
|---|---|---|
| DG facility export level | = | ? kW (to be determined through economic analysis) |

As an example*:

A DG facility has a peak load of 1500 kW and generation capacity of 2000 kW. The facility has no plans for future load growth. The facility may be capable of an export level of 500 kW, but may opt to limit their export level to 300 kW to avoid the cost of additional protective relay requirements for export levels above 300 kW.

**Export-only**

By definition an export-only facility will export most or all of its DG capacity to the utility, so the facility level for parallel operation and the facility export level are basically equivalent to the DG kW capacity.

Note a DG facility may import power for DG facility load through another service entrance – this power is not included in the kW levels below. DG facility load served through the DG interconnection, as through a generator step-up transformer and generator auxiliary transformer, may be subtracted from the DG kW capacity (this load is usually negligible compared to the DG capacity, however).

| | | |
|---|---|---|
| DG facility kW available for parallel operation | = | Total DG kW capacity (typically) |
| DG facility export level | = | Total DG kW capacity (typically) |

*Note the examples above apply to Class I, II, and III facilities. Changes in power magnitudes do not change the meaning of ‘Import-only’, ‘Import/Export’, and ‘Export-only’.

## 13.0 Metering and Telemetry Equipment

### Metering

OPPD uses two styles of metering equipment for traditional utility 'revenue' metering: socket meters and instrument transformer meters. Socket meters are a series-connected measurement device and, therefore, are an integral part of the power circuit - removal of the meter interrupts the power flow. Socket meters usually are not rated over 320 Amps. For capacities beyond 320 Amps, or voltage in excess of 480 volts instrument transformer meters are typically installed. When instrument transformer meters are used, a current transformer and a potential transformer send an output signal to the peripheral meter - the meter is not an integral part of the power circuit.

The pricing difference between import and export transactions requires special metering to measure energy flows. Import/export interconnections require metering equipment that is capable of separately recording the import and export transactions.

Meters used on closed transitions have a detent mechanism that only allows energy measurement in one direction, import or export. OPPD automatically installs the import-detent meter for typical electric service and closed transition installations. Export-detent meters are only installed for facilities that want to sell generation back to the utility.

The facility Owner is responsible for the installation of the import and export meter sockets (adjacent to one another) for socket metering installations, or for the installation of the import and export meter test cabinet(s) (adjacent to one another) for instrument transformer metering installations. OPPD will determine and advise the Owner of such meter requirements for facilities on a case-by-case basis.

At OPPD's discretion, advanced, multi-function, bi-directional (import/export) socket meters may be installed in place of the separate import and export socket meters described above.

**OPPD does not install 'net metering' for DG facilities operating in closed transition.**

Larger DG installations (above 250 kW) may require additional metering equipment, including recorders, additional metering accuracy CT's (possibly installed at the output of DG generation equipment), and telephone line(s) for OPPD dial-up access to OPPD equipment. Such requirements will be communicated to the Owner during the design stages of the project.

OPPD will not install traditional 'revenue' metering at locations other than the facility service entrance location(s). Import and export revenue metering will be installed only at the service entrance interconnection point.

### Check Metering

OPPD 'check' metering/sub-metering may be required at the generator output location when the DG facility participates in certain OPPD generation credit programs. This type of metering is not considered traditional 'revenue' metering as described above.

### Rates

OPPD rates for electric service are established in OPPD rate schedules, which are compiled in the 'OPPD Rate Manual'.

Participants in special OPPD generation programs operate under and are credited in accordance with the terms of the selected program.

Contact your OPPD Account Executive or Electric Service Designer for additional information. If you do not know your OPPD contact, please call 636-3535.

**Telemetry**

OPPD will determine any telemetry requirements for DG installations between 50 & 300 kW. In most cases, telemetry is only required for DG facilities capable of exporting 300 kW or greater (per interconnection) to the OPPD system, or for any accredited facility intending to sell power over the OPPD system. OPPD will determine whether telemetry is required for a DG facility in the DG design review stage. Telemetry monitoring is not required for Class I 'Type A' facilities.

Telemetry is the real-time, instantaneous monitoring of conditions at the DG facility by OPPD. Telemetry is accomplished by interfacing DG facility equipment or systems with the OPPD Energy Management System ('EMS').

For a DG facility capable of exporting 300KW or more to OPPD, OPPD requires the following values from the DG facility back to the OPPD Energy Management System (EMS):

- the open/closed status of the DG facility's interconnection circuit breaker(s) or switch(es)
- the open/closed status of the DG facility's generation unit circuit breaker(s) and related tie breakers, interposing breakers, or switches
- the status of 'communications failure' alarms for equipment used to send trip signals from OPPD to the DG facility.

For a DG facility capable of exporting one (1)MW or more to OPPD, OPPD typically requires the following additional values from the DG facility back to the OPPD Energy Management System (EMS):

- Instantaneous Amps at each OPPD / DG facility interconnection
- Instantaneous Volts at each OPPD / DG facility interconnection
- Instantaneous, directional MW/MVAR and hour ending MWH IN and OUT at each OPPD/DG facility interconnection
- Instantaneous MW/MVAR and hour ending MWH IN and OUT at each DG facility generator (or alternately a net value for a group of DG facility generators)

Under certain circumstances (usually involving 'accredited' DG facilities), regional or national regulatory authorities may require installation of Automatic Generator Control ('AGC') equipment to permit remote control of DG facility generation. AGC requirements will typically be implemented through the telemetry system.

In some cases, OPPD will require telemetry monitoring be accomplished using CTs, PTs, breaker contacts, and related monitoring equipment dedicated to the purpose. In other cases, OPPD may allow some of the desired data to be supplied by revenue/billing meters, protection systems, check metering systems, or the DG facility's own monitoring and control system.

When telemetry is required, the DG facility Owner and OPPD must coordinate the details of the required communications medium for telemetry. The Owner is responsible (directly or through reimbursement to OPPD) to provide the communications path to OPPD's satisfaction. Some communications medium options (such as lease line telephone) involve ongoing monthly charges. Such charges are the responsibility of the DG facility Owner, see 'Requirements for Closed Transition Operation, Interconnection Expenses' in this manual.

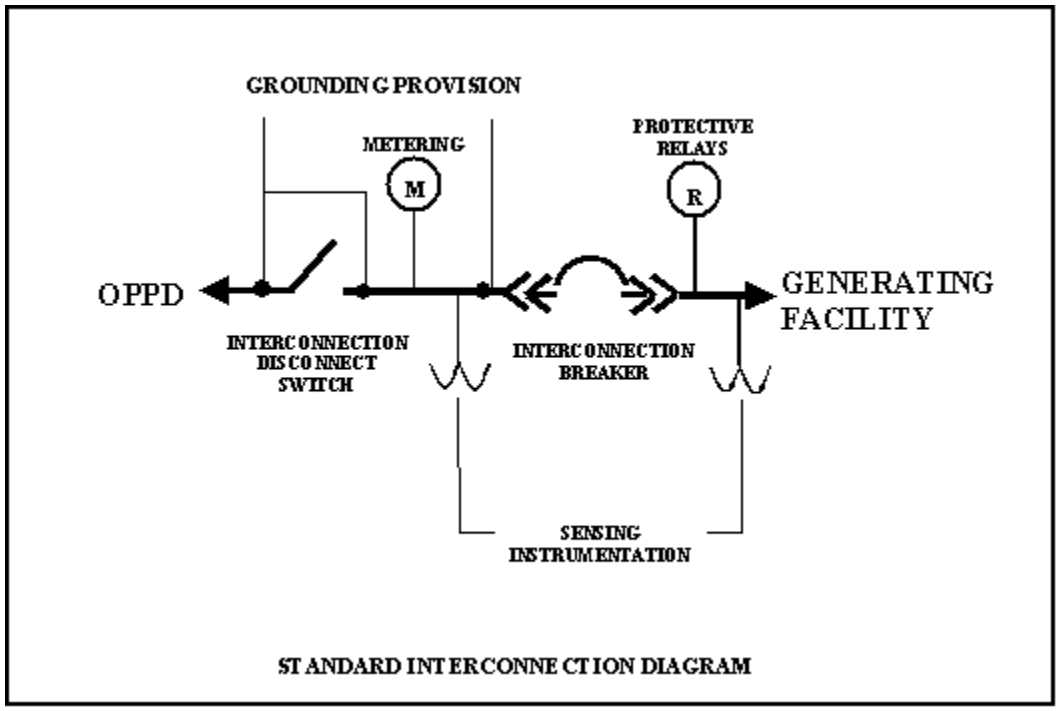
Other technical and contractual issues may arise during the design and implementation of a telemetry system and will be addressed by all parties on a case-by-case basis. Examples of such issues include energy losses; energy scheduling; meter accuracy and reading; and billing and reporting of energy purchases.

## 14.0 Protective Equipment

Closed transition operation of distributed generation (DG) on the OPPD system will normally require the installation of certain 'protective' equipment. This equipment is purchased, installed and maintained by the DG facility Owner. This section does not describe the conditions under which protective equipment is required, refer to 'Classification of the DG Interconnection' for this information, but outlines the requirements for such equipment and the conditions of its use.

The typical installed location of an interconnect disconnect switch, interconnection breaker, OPPD revenue metering, and protective relaying is indicated in the 'Standard Interconnection Diagram' below. As each DG facility is approved on a case-by-case basis, actual installed equipment locations may vary.

Where 'grounding provisions' are indicated in the diagram, OPPD requires a means be provided for temporary installation of OPPD grounding cables. The grounding cables are intended for protection of OPPD personnel during repair or maintenance operations, and consist of clamp and



STANDARD INTERCONNECTION DIAGRAM

cable assemblies used to temporarily connect a conductor to ground. OPPD will review proposed protective equipment for these required features.

Interconnection protective equipment owned by the DG facility should be maintained and inspected by the DG facility Owner according to the equipment manufacturer's recommendations and/or industry standards. Procedures should be established for visual and operational inspections and for equipment maintenance and testing. Equipment maintained and inspected should include, but not be limited to:

- Circuit Breaker(s)
- Protective Relaying
- Control Batteries

OPPD maintains the right to review maintenance, calibration and operation data of all protective equipment for the purpose of protecting the OPPD system and other OPPD customers. The DG facility Owner is responsible for providing the necessary test accessories (such as relay test plug, instruction manuals, wiring diagrams, etc.) required to allow OPPD to test these protective devices.

**Interconnection Disconnect**

Each interconnect disconnect switch must meet the following requirements:

- Be rated for the service voltage and phasing (i.e. single or three-phase).
- Be rated not less than the ampacity rating of the service entrance equipment.
- Be manually operable and simultaneously open all ungrounded conductors.
- The interrupting rating shall be suitable for the available fault current from either the utility or DG source(s) (whichever is greater).
- The switch will be load break type with arc arrestors, and provide a visible means of verifying the switch contacts are in the open position with the switch enclosure open. Switch designs requiring removal of plates, covers or partial disassembly of the switch to provide visual access to the contacts, are not acceptable to OPPD.
- The switch enclosure NEMA rating shall be appropriate for the specific application and installed location.
- The switch shall have provisions for padlocking the switch in the open and closed position and shall accommodate a standard OPPD padlock, to be provided by OPPD.
- The switch must have provisions for grounding all phase conductors and neutrals (on both sides of contacts) to a proper grounding conductor/electrode within the switch enclosure. OPPD must be able to close and secure the disconnect door or cover with the ground jumpers in place.

**Note:** The switch is not required to be fused. Fused switches are not restricted, but removal of the fuses shall not be required to meet the 'visible means of open switch position' described above.

Each interconnect disconnect switch shall be installed as follows:

- The switch enclosure (if conductive) and switch grounding provisions will be grounded in accordance with the NEC and local codes.
- A grounding bar or other grounding point shall be provided within the switch enclosure for termination of OPPD grounding cables. The grounding point shall allow the OPPD grounding cables to be installed with the switch in the open position and the switch door closed and locked.
- The switch shall be installed in a location readily accessible to OPPD personnel (i.e. be erected so as to be a drive-up location). Locked fences or other permanent barriers shall not restrict OPPD access to the switch. Fences may be secured with a chain and series connected OPPD and Owner padlocks, so either OPPD or the Owner has access without the other present. Where OPPD has approved switch locations within dedicated, interior vaults or switch rooms (always with direct exterior access), OPPD will typically provide door lock hardware (keyed for OPPD) with interior panic bar for installation within an Owner-provided steel door. The door construction, location, etc. must meet OPPD approval.
- The switch will normally be installed on the secondary side of the OPPD service transformer. This will be at or before the interconnection point, on the line side of the OPPD revenue metering equipment and the customer main disconnect. In this location, when open, it will electrically separate the DG facility electrical system from the OPPD system (excluding the neutral conductor).

- Where installed in the vicinity of similar disconnect switches, the switch shall be clearly labeled as the Interconnection Disconnect Switch so as to be readily identifiable by OPPD personnel.

Each Interconnect Disconnect Switch is subject to the following conditions:

- Shall not serve a dual role as both the OPPD-required interconnect disconnect switch and the NEC-required service disconnecting means, as additional NEC service entrance overcurrent protection devices will not be allowed to bypass the OPPD interconnection disconnect switch.
- Is under the sole control of OPPD, unless OPPD should release the switch for DG Owner operation. The DG Owner shall not remove any OPPD padlocks or OPPD safety tags. OPPD will be allowed unrestricted access to the switch and will operate the switch under conditions and at times deemed appropriate by OPPD. Examples of conditions under which OPPD may operate the switch include:
  - OPPD performing maintenance work on the OPPD system.
  - OPPD system emergency.
  - Discovery of a condition involving the DG facility's equipment or operation which threatens the OPPD system.
  - Failure of the DG facility to provide maintenance and testing reports when required.
  - The DG facility's generating equipment interferes with other OPPD customers or with the operation of the OPPD system.
  - The DG facility's generating equipment or protective devices are discovered to have been modified without the approval of OPPD.
  - Discovery of parallel operation of unapproved generating equipment.
- Use of the switch is to provide positive separation of the DG source from the OPPD system to effect maintenance or repairs to the OPPD system. OPPD will normally attempt to notify the DG facility Owner or operator prior to operation of the switch, but OPPD reserves the right to operate the switch without Owner notification.
  - If OPPD should not open the Interconnection Disconnect Switch, such act shall not serve to relieve the DG facility Owner of any liability for injury, death or damage attributable to the negligence of the DG facility Owner.
- Desire of the Owner to operate the switch for maintenance, testing, or construction purposes shall require them to contact OPPD for temporary removal of the padlock. The Owner or the Owner's representative will operate the switch for these conditions. Upon completion of their activities, the Owner shall notify OPPD to reinstall the padlock with the switch in either the open or closed position, as left by the Owner. For reoperation of the switch, the Owner shall contact OPPD to repeat the process.

**Interconnection Breaker**

Each interconnection breaker must meet the following requirements:

- Circuit breaker construction is normally required for the interconnection breaker.
- Be draw-out type with provisions for locking the cubicle with the breaker open and in the unracked position. Provisions shall be made to open the voltage sensing circuits when the draw-out breaker is in the open position (i.e. fused cutouts).
- Be rated for the service voltage and phasing.
- Carry an ampacity rating not less than that required, in accordance with the National Electrical Code (NEC).
- Be designed to open all ungrounded conductors simultaneously.
- Be rated for the available fault current from either the utility or DG source(s) (whichever is greater).
- The breaker enclosure shall be suitable for its installed environment.

- The breaker shall have provisions for grounding all phase conductors and neutrals to a proper grounding conductor/electrode, as indicated in the 'Standard Interconnection Diagram'. If a grounding rack is provided (for draw-out breakers) to meet this requirement, the rack should be stored and available at the breaker location.
- For three-phase service, the trip and close coils of the breaker shall be direct current (DC) type.

Each interconnection breaker shall be installed as follows:

- The breaker shall normally be the first breaker on the customer side of the OPPD revenue meter.
- While the actual protective functions/relaying required for each DG facility must be determined, the protective functions/relaying required shall normally monitor conditions at this breaker and operate this breaker in the event a trip is required.

Each interconnection breaker is subject to the following conditions:

- When a trip signal is received from OPPD to open the DG facility interconnection breaker, the signal is intended to supplement, but not replace, protective relaying installed at the DG facility. The failure of the OPPD signal to open the interconnection breaker shall not serve to relieve the DG facility Owner of any liability for injury, death or damage attributable to the negligence of the DG facility Owner.
- Where a draw-out interconnection breaker is installed, if required, a crane shall be provided and available at all times at the breaker location for use with draw out breakers and/or test racks.
- If a draw-out type interconnection breaker is not provided, when OPPD must perform work requiring the breaker path to be visibly open and the breaker grounding provisions utilized (as indicated in the 'Standard Interconnection Diagram'), OPPD may require. 1)All DG facility generation unit disconnects be visibly open and locked (by OPPD) in the open position. Or 2) the interconnection breaker be physically unbolted and removed from its installed location, and later reinstalled at the completion of OPPD work, by a qualified electrician at the expense of the DG facility Owner.
- While the actual protective functions/relaying required for each DG facility must be determined, the breaker is required to have synchronization capability, to open for abnormal frequency conditions, and to open for any loss of utility voltage. These requirements help prevent the electric generation from backfeeding and energizing the utility system in the event of an OPPD outage. The breaker can only be closed if the utility voltage is nominal and stable and the synchronism check relay permits.

**Protective Functions \ Relaying**

DG facility electrical system designs often include two groups of protective relays. One group is assigned the task of protecting the utility system from the DG (these relays usually operate the interconnection or main service breaker). A second group is responsible for the protection of the DG facility generation equipment (these relays usually operate the main generator breaker(s)). Where relay information, settings, drawings, etc. are to be submitted to OPPD for review, only the information pertaining to this first group is required. The DG applicant submits the generator relay settings to OPPD for reference purposes only. The DG Owner or their representative should note careful setting coordination is required between these two relay groups. This coordination ensures proper operation of the customer side system. Some interconnections will not include a separate relay group for utility side protection. The generation protection group will also provide utility-side protection (by tripping the main generator breaker or through shutdown of the inverter output of a direct energy converter).

OPPD protective relay requirements tend to become more stringent in proportion to the potential impact of a DG facility on the OPPD system (and other OPPD customers). **This manual should be considered a guide in regard to protective relaying, OPPD will determine specific protective relay requirements during the DG facility design review stage.** Upon review of the DG applicant's design for the proposed parallel installation, OPPD may require changes to the protection scheme. OPPD may refuse the use of certain protection methods, equipment, equipment grades or manufacturer's products.

**OPPD retains the right to approve or reject the type of protective relays/devices used and the relay settings.** The relays may be microprocessor based, solid-state or electromechanical construction. While not required, OPPD highly recommends consideration is given to microprocessor based relaying in place of electromechanical or solid state relaying, especially microprocessor based relays designed specifically for protection of the utility-DG interconnection point. In many cases multiple protective device functions can be combined in a smaller, less expensive package, resulting in savings for the DG Owner.

OPPD requires the protective functions/relaying operate as intended under all conditions, including for a loss of the normal power source serving the protection scheme. The DG facility protection system shall account for this possibility in its design, and utilize a DC power supply with battery backup or other means of assuring proper operation for all conditions.

Many solid state or microprocessor-based relays are capable of external indication of a relay internal failure or alarm condition. OPPD may require such relays to trip the interconnection (or generation) breaker immediately upon relay alarm or failure indication, or act to prevent parallel operation of generation with OPPD until such time as the alarm or failure condition is corrected.

The relays shall monitor all ungrounded conductors. For example, protection of a three-phase system using single-phase relaying is unacceptable.

**The DG facility Owner is responsible for synchronization of DG facility generation to the OPPD System.** The DG facility must be in synchronism with the utility system just prior to closing the appropriate DG facility sync-protected circuit breaker (often the interconnection breaker) and during the entire period of parallel operation. Protection function 25 (synchronism check) is required below.

OPPD does not allow islanding (see glossary) of DG facilities on the OPPD system. The DG facility must isolate itself from the OPPD system in the event of an OPPD outage. This fact shall be taken into consideration in the setting of DG facility protective relays, so the interconnection breaker opens as soon as possible after sensing the utility source has been lost.

Protective relays can generally be categorized into two major groups: industrial grade and utility grade. Industrial grade may be considered PLC's or protection functions integral to the control system of small generation equipment. **OPPD requires DG facilities with net generation above 50 kW use utility grade relays (meeting IEEE/ANSI C37.90 design standards – see glossary).** Utility type test switches shall be installed in conjunction with utility grade relays.

Class I interconnections, inverter type generation equipment rated up to 10 kW, single-phase and manufactured and listed for use in parallel with utility electrical service must comply with the requirements of ANSI/IEEE 929. Requirements include minimum 25, 27, 59, 81O, and 81U protection functions (see glossary).

Minimum protection function requirements, regardless of class or size, include minimum 25, 27, 59, 81O, and 81U protection functions (see glossary).

Other functions, which OPPD may require, include (but are not limited to): 21, 32 (three-phase), 46, 67 (all phases), 67G/67N, and 68. OPPD may also require the following items:

- spare dry contacts in the DG generation control system for tripping and/or monitoring of the DG facility
- communications channel(s) with communications equipment
- a remote-trip system (OPPD sends a signal to trip the DG facility interconnection breaker)
- duplicate/redundant/backup relays
- or other specialized equipment

Communications channel(s) may consist of power line carrier, leased telephone line, pilot wire circuit, fiber optic cable, radio, or other means (note this channel may be separate from communications channels required to meet other OPPD requirements, such as metering or telemetry).

'Vector Jump/Step Frequency', 47, 50, 50G, 50N, 51, 51G, 51N functions are not usually required by OPPD, but if installed, settings information and curves are required to be included in submittals for review.

## 15.0 OPPD System Issues

### Service Transformers

Existing delta-delta or ungrounded wye-delta service transformers installed at DG facilities will require reconfiguration of the transformers to wye-wye or the installation of utility side voltage unbalance protection equipment. In some cases, upgrading of OPPD transformer insulation levels and lightning arrester ratings to a higher voltage may be required. The DG facility Owner is responsible for the installation and material costs of such equipment (see 'Requirements for Closed Transition Operation', 'Interconnection Expenses' in this manual).

Class III interconnections typically use a wye-delta step-up transformer (DG facility owned, with delta on the generator side) for connection to the OPPD electric system.

**To provide isolation and minimize possible adverse effects on other OPPD customers from DG facility generation, all DG facilities with three-phase electric service shall be connected to OPPD through a dedicated service transformer. Such DG facilities may not share the secondary or load side of the OPPD service transformer with other OPPD customers. DG facilities with single-phase electric service where the DG is utilizing nonsynchronous inverter technology requiring connection with the utility to maintain synchronous operation shall not be required to have a dedicated service transformer. All other single-phase DG installations will require a dedicated service transformer.**

OPPD will determine the transformer connection and grounding configuration required. While in the facility design stage, the DG facility Owner should always verify with OPPD the details of the electric service (voltage, phase, ampere rating, etc.) and the service transformer winding configuration.

### Automatic Reclosing

It is OPPD practice to apply automatic reclosing of circuit protective devices in the substation (see glossary) to transmission and distribution circuits.

Existing automatic reclosing schemes for OPPD distribution circuits assume the circuit is dead (de-energized) prior to reclosing. The protective relays and other controls do not employ voltage check, synchronization check, or phase checking functions. The introduction of a DG facility to an OPPD circuit may require the addition of equipment and modification of the protection scheme to add these functions. The cost of this additional equipment and its installation are the responsibility of the Owner of the new DG facility (see 'Interconnection Expenses' in this manual). The added functions are intended to prevent reclosing of the OPPD protective devices in the event a DG facility is energizing the OPPD circuit by operating in an 'islanding' condition (see glossary).

Those applying for DG facility approval will be informed when this equipment is required and the DG Owner is responsible for those costs.

**The DG facility shall not energize a de-energized OPPD circuit. It is the responsibility of the DG Owner to ensure the DG equipment does not allow operation in an 'islanding' condition. Should the utility source be lost or a fault occur on the utility side of the interconnection, the local DG generation must disconnect itself from the OPPD system by tripping the interconnection breaker prior to automatic reclosing of the OPPD protective devices. OPPD assumes no responsibility for damage to DG equipment due to out-of-phase reclosing.**

The amount of reclosing time delay on OPPD circuits varies depending on many factors. While in the facility design stage, the DG facility Owner should always verify (with OPPD) reclosing details for each DG facility service.

## ATO Service

ATO ('Automatic Throw Over') service is common to hospitals and some other types of customer facilities requiring a backup OPPD circuit in the event of an OPPD circuit outage. The required 15kV switchgear is typically OPPD owned, pad-mount or 'metal-clad' (90"high sections), located near the facility service entrance, and is of either 'split bus' or 'common bus' design. The ATO is a programmable switch, allowing the transfer of customer load to an alternate 'backup' or 'emergency' circuit upon loss of the 'normal' OPPD circuit.

Many technical issues arise when it is proposed Distributed Generation (DG) operate in closed transition with OPPD while served from an ATO service. The OPPD ATOs in service are not designed for use with DG facilities. OPPD may require removal of an ATO device. The addition/expansion of facility generation may actually reduce the benefit from an ATO service.

ATO service is a complicating factor to the OPPD DG approval process. Should modifications to the OPPD system or equipment be required, the DG facility Owner is responsible for the labor and material costs of such modifications (see 'Requirements for Closed Transition Operation', 'Interconnection Expenses' in this manual).

## Network Service

**OPPD does not allow DG operation in closed transition where the DG facility is served from any secondary network system, spot or grid (see glossary).**

Both spot and grid network service (see glossary) are common in the downtown Omaha area, but can also be found in other parts of the OPPD territory. While in the facility design stage, the DG facility Owner should always verify (with OPPD) whether the facility is served from such a service.

Should modifications to the OPPD system or equipment be required, the DG facility Owner is responsible for the labor and material costs of such modifications (see 'Requirements for Closed Transition Operation', 'Interconnection Expenses' in this manual).

**Single-Phase Devices**

OPPD may require replacement of single-phase over current devices (line fuses, single-phase automatic circuit reclosers, single-phase line switches) on the OPPD circuit between the OPPD substation and the DG facility service entrance. These components would be replaced with three-phase devices to minimize the possibility of single-phasing a three-phase DG facility. If required, the cost of the removal of single-phase devices and the addition of three-phase devices (equipment and installation) are the responsibility of the Owner of the new DG facility (see 'Interconnection Expenses' in this manual). In some cases these single-phase devices will be left in place.

**Regardless of whether any single-phase devices are replaced with three-phase devices, the DG Owner is responsible for protecting DG equipment from the effects of excessive negative sequence currents, system imbalance effects, or loss of utility phase/ utility single-phase conditions. OPPD assumes no responsibility for damage to DG equipment due to these effects.**

## 16.0 Pre-Parallel Requirements

Refer to the terms of the 'OPPD Agreement for Closed Transition Operation of Distributed Generation' for requirements to be met prior to the actual parallel operation of DG facility generation with the OPPD system. Copies of the agreement are available for review. Additional requirements not outlined in that document are as follows:

A copy of the final power riser diagram or one-line diagram indicating the DG installation on the DG facility electrical system shall be in OPPD's possession. The document shall note all bus voltages, conductor properties, generating equipment, interconnection point(s), and interconnection disconnecting device(s). Note: OPPD may require the final version of this document bear the stamp of a Professional Electrical Engineer registered in the state where the project is being constructed.

The following items are also required prior to execution of the 'OPPD Agreement for Closed Transition Operation of Distributed Generation'. All requirements are to be met prior to the OPPD 'Witness Test' outlined in the agreement (Please allow sufficient time for OPPD review prior to witness testing). Where any of the following items/tests have been performed at a pre-approved packaged paralleling equipment manufacturer's facility prior to shipping, documentation supporting this testing shall be submitted (OPPD may accept the documentation in such cases, or may require factory tests be repeated at the installed equipment location). The DG Owner or representative shall complete all preoperational tests not performed by the factory (or factory tests repeated at the installed location). Such tests shall be documented, and if above 25 kW (total DG capacity) shall require the certification of a Professional Electrical Engineer registered in the state where the project is being constructed. The required items/tests are:

- OPPD approved relay/device settings with any corresponding calculations and test points are to be in the possession of OPPD.
- OPPD approved AC and DC elementary drawings showing protective relay/device wiring connections are to be in the possession of OPPD.
- All protective relays/devices shall have been electrically tested and calibrated according to the relay/device manufacturer's instruction manual.
- All protective relays/devices shall have the OPPD-approved settings installed and proven using the submitted test point information to simulate fault conditions. These tests shall also trip the interconnection breaker (load is not required on the breaker) to prove each DC trip path.
- A final, organized copy of all settings with test points shall be in the possession of OPPD and the DG Owner for use during future maintenance tests.
- Sensing instrumentation (current and voltage transformers) shall be ratio checked, polarity checked, continuity tested, and have the insulation integrity tested.

## 17.0 Forms

Refer to the following documents:

**APPLICATION FOR OPPD APPROVAL TO CONSTRUCT DISTRIBUTED GENERATION (DG) INTERCONNECTION**

**SAMPLE DG CORRECTIVE ACTION NOTICE / RED TAG**

**SAMPLE 'TEMPORARY DG CERTIFICATE'**

**SAMPLE 'DG CERTIFICATE OF PERMISSION'**

Omaha Public Power District

# APPLICATION FOR OPPD APPROVAL TO CONSTRUCT DISTRIBUTED GENERATION (DG) INTERCONNECTION

Submit this completed application to your OPPD Electric Service Designer or Account Executive (please call 636-3535 if you do not know your OPPD contact).

The Distributed Generation (DG) Owner (herein described as 'Owner') requests OPPD approval to construct and operate Distributed Generation (DG) equipment in closed transition (parallel) with the OPPD system in accordance with and as defined in the latest version of the OPPD DG Manual.

**DG Facility Owner and/or Operator Information:**

DG Facility Owner _____.
OPPD Service Account Number (if known)_____.
Address _____ City _____ State___ Zip code_____.
Day Phone_____Night Phone_____Fax_____.
Email_____.

DG Facility Operator (if different than above)_____.
Address _____ City _____ State___ Zip code_____.
Day Phone_____Night Phone_____Fax_____.
Email_____.

**Facility Design / Engineering:**

Company _____.
Representative_____.
Address _____ City _____ State___ Zip code_____.
Phone_____Fax_____Email_____.

**Facility Electrical Contractor:**

Company _____.
Representative_____.
Address _____ City _____ State___ Zip code_____.
Phone_____Fax_____Email_____.

**DG Facility Information:**

DG Facility Name_____.
Address _____ City _____ State___ Zip code_____.

Service Entrance Voltage/Phase: _____

**DG Facility Load Information:**

(The following load information will be used for interconnection design purposes. The information is not intended as a commitment or contract for billing purposes)

Minimum anticipated DG facility load (generation not operating)
kW:_____ kVA:_____

Maximum anticipated DG facility load (generation not operating)
kW:_____ kVA:_____

**Distributed Generation / Equipment Information (attach manufacturer's data):**

Description of number and type of generating units:_____
_____
_____
_____
Generator Manufacturer(s)/ Model(s)_____
_____
_____
_____
Generator Ratings (indicate per unit/combined)
Peak rated output _____/_____ kW _____/_____kVA
Continuous rated output _____/_____ kW _____/_____kVA
Power Factor _____ (circle) - lead / lag fixed / variable
Generator unit output voltage:_____ Phase 1__ 3__

**Inverter Data (if applicable):**

Direct Energy Converter/Inverter/Static Power Converter (Circle one) NA/Synchronous/Induction

for synchronous: Grounding Resistor Y / N Resistor size or current limit_____
Generator subtransient reactance: _____

for induction: VAR source and location (if req'd)_____

**Transformer (if applicable):**

If transformer(s) will exist between the generation and the facility service entrance/interconnection point, describe transformer(s) (voltage, windings (wye-wye, etc.), type, taps, ratings) and attach manufacturer's data_____
_____
_____

**Classification:**

Owner requests Classification of Interconnection as (check one):

__Class I Type A __Class I Type B
__Class II __Class III

**Duration of Parallel Operation:**

Owner requests Duration of Parallel Operation (check one):

___Approved as Momentary ___Approved as Sustained

**Power Transfer:**

**Does the DG Facility Owner intend the DG facility to export power to the OPPD system now, or at any time in the future? (circle one): YES / NO**

Owner Requests Description of Power Transfer as (check one and complete kW):

| | | | |
|---|---|---|---|
| ___Import-only | kW level for parallel operation | = | _____kW |
| | kW export level | = | 0 kW |
| ___Import/Export | kW level for parallel operation | = | _____kW |
| | kW export level | = | _____kW |
| ___Export-only | kW level for parallel operation | = | _____kW |
| | kW export level | = | _____kW |

Comments:_____
_____
_____
_____

**Paralleling Equipment:**

Description of number and type of paralleling switchgear or momentary transfer switch(es) (attach manufacturer's data)_____
_____
_____
_____

**Interconnection Disconnect:**

Description of interconnect disconnect(s) and installed location(s) (attach manufacturer's data)
_____
_____
_____
_____

**Interconnection Breaker (if applicable):**

Description of interconnection breaker(s) and installed location(s) (attach manufacturer's data)
_____
_____
_____
_____

**Protective Relaying:**

Description of protective relaying (attach manufacturer's data – see 'submittals' below)
_____
_____
_____
_____

**Schedule:**

Date scheduled for start of DG installation / construction _____
Date scheduled for completion of installation / construction_____

**Submittals:**

Submit the following documents with this application:

- a site plan and floor plan of the proposed DG facility and/or installation indicating installed DG equipment locations.
- a one-line diagram of the proposed generator installation on the Owner's electrical system, noting all bus voltages, conductor properties, generating equipment, interconnection point(s), and interconnection disconnecting device(s). Note: OPPD may require this document bear the stamp of a Professional Electrical Engineer registered in the state where the project is being constructed.
- a schematic diagram of the proposed protective relay scheme indicating CT and PT monitoring points and protective functions provided (when required): Please contact OPPD in advance for assistance in determining OPPD's protective relay requirements for specific applications. If available at time of application, provide AC and DC elementary/wiring drawings and relay settings (with calculations and assumptions).
- Note: OPPD may require these documents bear the stamp of a Professional Electrical Engineer registered in the state where the project is being constructed.
- detail sheets/catalog cuts of information on the generator, interconnection disconnect switch, interconnection breaker, interconnection switchgear, or other related equipment.

Comments_____
_____
_____
_____
_____
_____

By submitting this application, the Owner agrees to the following:

- The Owner has reviewed, is familiar with, and agrees to comply with all requirements of the OPPD DG Manual.
- The Owner has reviewed and is familiar with the terms of the 'Utility Service Termination Clause' for failing to meet and maintain requirements for interconnection, as outlined in the DG Manual.
- The Owner has reviewed and is familiar with the 'Interconnection Expenses' section of the OPPD DG Manual, and is aware of and agrees to comply with the Owner's financial obligations to OPPD, incurred by the addition of this new DG capacity.
- At no time will the new DG equipment be allowed to operate in closed transition with the OPPD system until the 'OPPD Agreement for Closed Transition Operation of Distributed Generation' is executed between the Owner and OPPD. This includes momentary closed transitions between the Owner's generation and the OPPD system for testing or calibration purposes. The only exception is if the DG installation is essentially complete, OPPD has been notified in advance of the intention to operate in parallel, and an OPPD representative is present to witness the closed transition operation. Note such witness tests do not necessarily take the place of the final 'Witness Test' outlined in the 'OPPD Agreement for Closed Transition Operation of Distributed Generation'. **Owner shall be liable for any and all damages and expenses incurred by OPPD and its customers due to the unauthorized or improper closed transition operation of Owner generation with the OPPD system.**
- The operation of this Owner equipment during the test period and subsequent normal operation shall not cause objectionable electrical disturbances external to the DG facility.

- All members of the Owner's construction project team (including contractors, engineers, and suppliers) and all DG facility operating personnel will be made aware of the terms of the OPPD DG Manual and this application.

FOR THE CONTRACTOR _____
Printed _____
Signed this _____ Day of _____, _____

FOR THE DG FACILITY OWNER: _____
Printed _____
Title _____
Signed this _____ Day of _____, _____

---

**THIS AREA FOR OPPD USE ONLY**

The Owner has provided the following required documents for OPPD review.

- completed 'Application for Approval to Construct' form rec'd _____
- one-line diagram rec'd _____
- a schematic diagram of the relay scheme (when required) rec'd _____
- data sheets for generator and other equipment rec'd _____
- other _____ rec'd _____

Classification of Interconnection (check one):

__Class I Type A (Interconnection disconnect and interconnection breaker not required, protective relaying required)

__Class I Type B Interconnection disconnect required? (circle) Y / N
Interconnection breaker required? (circle) Y / N
Protective relaying required.

__Class II (Interconnection disconnect, interconnection breaker, and protective relaying required)

__Class III (Interconnection disconnect, interconnection breaker, and protective relaying required)

__N/A (open transition) DG Manual requirements do not apply for open transition

__N/A (rejected) Network service or other

Duration of Parallel Operation (check one):

___Approved as Momentary (Interconnection disconnect required, interconnection breaker not required, minimal protective relaying required)

___Approved as Sustained (Interconnection disconnect required, interconnection breaker required, protective relaying required)

Description of Power Transfer (check one):

___Import-only kW level for parallel operation = _____kW
kW export level = 0 kW

___Import/Export kW level for parallel operation = _____kW
kW export level = _____kW

___Export-only kW level for parallel operation = _____kW
kW export level = _____kW

Interconnection Description/Voltage, Transmission/Distribution, ATO, transformer,_____
_____
_____
_____

OPPD Internal Department Comments:

Additional OPPD studies required? (circle) Y / N
Description of required studies:_____
_____
_____
_____

Modifications to the OPPD system required? (circle) Y / N
Description of required modifications:_____
_____
_____
_____

Does OPPD require reimbursement for Interconnection Expenses? (circle) Y / N
Description of required reimbursement items, with costs:_____
_____
_____
_____
_____

Telemetry required Y / N
Description of telemetry required:_____
_____
_____
_____
_____

Additional information submitted by Owner upon OPPD request Y / N
Description of additional information submitted:_____
_____
_____
_____

**Owner Agreement to OPPD Stipulations**:

OPPD requires the following studies/modifications/reimbursements:
_____
_____
_____

_____
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_____
_____

The Owner agrees to modify the facility design and to reimburse OPPD as requested for studies and OPPD system modifications described above:

FOR THE DG FACILITY OWNER: _____
Printed _____
Title _____
Signed this _____ Day of _____, _____

OPPD hereby grants permission to the above named Owner to proceed with the DG interconnection installation as specified above. Any unapproved changes to the interconnection shall void this agreement. This agreement is nontransferable. This approval is only for the construction of the interconnection and does not convey OPPD approval of the operation, functionality of the design, nor OPPD permission to operate the DG unit(s) in parallel with OPPD.

FOR OPPD:

Reviewed by the following OPPD departments:

(Initial)
___ Communications
___ Customer Sales and Service
___ Distribution Engineering or ___ Transmission Engineering
___ Metering
___ Planning
___ Substation / System Protection
___ T & D Dispatching

_____ Division Manager, Engineering
Signed this _____ Day of _____, _____

## SAMPLE DG CORRECTIVE ACTION NOTICE / RED TAG

DG Project Number/Certificate Number_____

Date _____

**Omaha Public Power District**
**Distributed Generation (DG) CORRECTIVE ACTION NOTICE / RED TAG**

Owner/Project Name_____ Service Account Number_____

Address_____City_____State_____ZIP Code_____

Description of DG equipment requiring action:

Description of Problem/Corrective Action Required:

CEASE OPERATION OF DG EQUIPMENT IN PARALLEL WITH OPPD:
YES NO N/A
'TEMPORARY DG CERTIFICATE' OR 'CERTIFICATE OF PERMISSION' IS REVOKED:
YES NO N/A
IF CORRECTIVE ACTION IS NOT TAKEN, OPPD MAY DISCONNECT ELECTRIC SERVICE:
YES NO N/A
DATE FACILITY IS REQUIRED TO COME INTO COMPLIANCE WITH OPPD REQUIREMENTS:
_____

_____ _____
Signing for OPPD Date

FACILITY HAS COME INTO COMPLIANCE WITH OPPD REQUIREMENTS OUTLINED ABOVE, AS WITNESSED BY OPPD:

_____ _____
Signing for OPPD (Witness to corrective action) Date

oppd.com

## SAMPLE 'TEMPORARY DG CERTIFICATE'

DG Project Number/Certificate Number_____

Expiration Date _____

**Omaha Public Power District**
**Temporary Certificate of Permission To Install Distributed Generation (DG) Equipment with Closed Transition Operation Capability**

**While this Certificate is in effect the DG Equipment shall not be operated in parallel / closed transition with the OPPD system**, unless OPPD has been pre-notified of the intention to operate in parallel and an OPPD representative is present for the purpose of witnessing the attempt at parallel operation. Refer to the OPPD DG manual and the 'Approval to Construct' application for terms of this temporary certificate.

Owner/Project Name_____ Service Account Number_____

Address_____City_____State_____ZIP Code_____

Description of DG Equipment to be Installed:



_____ _____
Signing for DG Owner/Installer Date

_____ _____
Signing for OPPD Date

*Affix to face of paralleling equipment control panel during construction and until 'DG Certificate of Permission' is received. This Certificate shall not be placed 'On File' but shall be prominently displayed on the face of equipment as described. Additional copies may be posted at generation and service entrance locations. Provide weather protection for the certificate(s) as required.*
oppd.com

## SAMPLE 'DG CERTIFICATE OF PERMISSION'

DG Project Number/Certificate Number_____

Expiration Date _____

**Omaha Public Power District**
**Certificate of Permission To Operate Distributed Generation (DG) Equipment with Closed Transition Operation Capability, as per Contract**

While this certificate is in effect the DG equipment may be operated in parallel / closed transition with the OPPD system, in accordance with the terms of the 'Agreement for Closed Transition Operation'. Refer to the Agreement and the OPPD DG manual for annual testing and certificate renewal information.

Modifications to the DG equipment, protective relay settings, or the electric service entrance may void this certificate - contact OPPD for details.

This certificate is not transferable – new DG equipment Owners shall contact OPPD to obtain a new certificate.

Owner/Project Name_____ Service Account Number_____

Address_____City_____State_____ZIP Code_____

Description of DG Equipment to be Operated:

_____ _____
Signing for DG Owner Date

_____ _____
Signing for OPPD Date

*Affix to face of paralleling equipment control panel. Discard 'Temporary DG Certificate' or expired 'DG Certificate of Permission'. This Certificate shall not be placed 'On File' but shall be prominently displayed on the face of equipment as described. Provide weather protection for the certificate as required.*
oppd.com

## Glossary

**Accredited Generation:** Generation capability recognized as meeting requirements for 'accreditation' established by the regional regulating authority charged with regulation of power transactions between utilities and independent power producers. Most generation installed primarily for the export and sale of electrical power (typically DG Class III facilities) meet this definition. See 'Non-Accredited Generation'.

**Cogeneration**: The concurrent production of electricity and heat, steam or useful work from the same fuel source.

**Closed Transition:** For the purpose of this manual, it is operation of two or more separate electrical generation sources while their outputs are tied together – see 'Parallel'.

**Closed Transition Transfer:** In this scheme, a facility's load is transferred from Source 1 to Source 2 and vice-versa while momentarily connecting the two sources together in 'closed transition'. The facility's load is not interrupted during the transfer process.

**Current Transformer (CT):** A transformer intended for metering, protective or control purposes, which is designed to have its primary winding connected in series with a circuit carrying the current to be measured or controlled. A current transformer normally steps down current values to safer levels. A CT secondary circuit must never be open circuited while energized.

**DEC:** Direct Energy Converter – see 'Generation Equipment'.

**Direct DC Tripping:** The wiring from the trip output contacts of the protective relay(s) shall be connected directly to the trip coil of the interconnection circuit breaker, such the protective relay alone can initiate a trip of the breaker. The trip circuit path for utility protection shall not pass through (or be dependent upon) the contacts of a computer, PLC, or other foreign intelligent device not installed for the sole purpose of protection. Test switches, 94/auxiliary tripping relays, and 86/lockout relays are allowed in the trip circuit and are not considered foreign to the protection system. A by-product of direct DC tripping is all relay targets are functional as intended by the relay manufacturer.

**DG:** 'Distributed Generation'. Includes all types of electric generation equipment. This manual is concerned only with DG capable of operating in closed transition (see 'parallel') with the OPPD system.

**Export:** To supply power to the electric utility from distributed generation (DG) – the DG facility 'exports' power to the utility.

**Export-only:** Operation of a DG in closed transition with the utility, in which the entire capacity (or nearly the entire capacity) of the DG facility generation equipment is used for intentional 'export' back into the utility system. This definition would most often apply to Class III DG interconnections.

**Import/Export:** Two-way power transfer between the utility and a DG facility while operating in closed transition. The direction of power transfer is usually dependent upon the level of DG facility load and the level of DG output. If the DG facility generation is not operating, the facility may be importing power from the utility to serve facility load. If the DG facility generation is operating but not generating more than the DG facility load, the facility is still importing utility power. If the DG facility generation is generating power in excess of the DG facility load, the excess power is exported to the utility.

**Import:** To accept power from the electric utility in the traditional fashion to serve customer load- the customer 'imports' power from the utility.

**Import-only:** Operation of a DG facility in a closed transition with the utility in which any excess DG capacity is not allowed to be exported to the utility. Note in some cases the DG capacity may be low relative to the DG facility load, or the DG capacity may exceed the DG facility load, but at no time is power allowed to be intentionally 'exported' back to the utility.

**Interconnection Breaker:** See the 'Protective Equipment' section in this manual.

**Interconnection Disconnect:** See the 'Protective Equipment' section in this manual.

**IPP:** 'Independent Power Producer'

**Island or Islanding:** For the purposes of this manual it is the undesirable condition where the 'normal' utility electrical source has been disconnected from and no longer serves all or part of a utility circuit, and all or part of the utility circuit load is being served for an extended period (beyond a few seconds) by a DG facility. Such a circuit is operating as an electrical 'island', independent from the utility.

**Network, Grid:** For the purpose of this manual, it is defined as a configuration of the OPPD distribution system where the secondary windings of multiple OPPD distribution transformers are tied in parallel, while the transformer primaries are served from more than one OPPD distribution circuit. Each transformer secondary is protected using a 'network protector'. Multiple OPPD customers tap into the same secondary connection, usually at 208V or 480V, three-phase.

**Network, Spot:** See 'Network, Grid' above. For the purpose of this manual, the 'Spot' network is essentially the same as a 'Grid' network, but the 'Spot' network serves only one customer facility.

**Non-Accredited Generation:** Generation which is not 'accredited' by the regional regulating authority charged with regulation of power transactions between utilities and other independent power producers. Most generation installed primarily for local facility load support (and may have export capability) meet this definition. See 'Accredited Generation'.

**Open Transition:** For the purpose of this manual, it is operation of two or more separate electric generation sources while their outputs are <u>not</u> tied together – they are operating separately from one another, with no electrical tie between the two or more systems (other than ground).

**Open Transition Transfer:** In this scheme, a facility's load (or portion of it) is transferred from Source 1 to Source 2 and vice versa without momentarily connecting the two sources together. Here, the facility's load is interrupted momentarily during the transfer process. Typical emergency standby system automatic transfer switches are open transition type.

**Parallel:** Operation of DG in closed transition ('tied together') with the utility electrical system. Operation in parallel implies the DG and utility sources are tied together electrically, are operating at matching phase rotation with closely matching voltage and frequency, and the DG and utility are synchronized with each other. The DG facility may be importing or exporting power from the utility during parallel operation. Operation of DG in open transition (not tied together) with the utility electrical system is not parallel operation.

**Peak Load:** The maximum electric load consumed or produced in a stated period of time.

**Peak Shaving:** Generation operation which results in reducing a facility's peak load (as seen by the utility) or demand.

**Point of Common Coupling (PCC):** (IEEE P1547 draft 4) The connection point on an electric power system where the electric system is intentionally connected to a public transmission and/or distribution system and at which point performance requirements are defined.

**Potential Transformer (PT):** A transformer intended for metering, protective or control purposes, which is designed to step down voltage values to safer levels.

**Reclosing / Automatic Reclosing:** A common utility practice, it is an attempt to quickly restore electric service to de-energized overhead power lines by re-applying power to the line very soon (0.33 to 5 seconds) after the line has cleared (become de-energized) due to a fault. In sequence: a fault occurs on a line, all line breakers open to clear the fault (de-energizing the line), after a brief delay line breaker(s) close (to re-energize the line), and the line is returned to service. This practice is based on the fact most faults on utility overhead electric lines are of a temporary nature, and as such, the line is clear of faults and ready to be re-energized almost immediately after the fault event.

**SPC:** Static Power Converter – see 'Generation Equipment' in this manual.

**Synchronism:** Expresses the condition across an open circuit wherein the voltage sine wave on one side matches the voltage sine wave on the other side in frequency and amplitude without phase angle difference.

**Utility Grade Relaying:** Relays meeting IEEE/ANSI C37.90 design standards. Generally such devices are designed first and foremost for use as a utility protective relay, are for high-speed use, meet utility standards for construction, and are the product of a recognized utility relay manufacturer.

**Wheeling:** The use of transmission or distribution facilities of utility (or utilities) B to transmit power from utility (or DG facility) plant A to utility (or customer) C load.

**21:** Distance function. The distance relay function operates when the circuit impedance, reactance, or admittance increases or decreases beyond a predetermined value. This relay function is not a standard interconnection relay requirement but may be required by OPPD in certain situations.

**25:** Synchronism or synchronism check function. The function operates to close a breaker when two AC sources are within the desired limits of frequency, phase angle, and voltage to permit or cause the paralleling of the two sources.

**27:** Undervoltage function. This function operates for specified undervoltage conditions. An operation of this relay function usually results in a trip signal to the interconnection breaker(s).

**32:** Directional Power Relay/Reverse Power Function. The directional power relay operates on a desired value of real power flow (watts) in a given direction. This relay will initiate a trip signal once the reverse power setting is exceeded. The reverse power limit of this relay is typically set for the maximum export limit (plus a safety margin) for import-only or import/export installations.

**46:** Reverse-Phase or Phase-Balance Current Relay/ Negative Sequence Overcurrent Function.

**47:** Phase-Sequence or Phase-Balance Voltage Relay/ Negative Sequence Overvoltage Function. Typical DG-side protection for phase sequence and from loss-of-phase.

**50:** Instantaneous overcurrent function.

**50G/50N:** Instantaneous ground/neutral overcurrent function.

**51:** Inverse time overcurrent function – often integral to the interconnection breaker.

**51G/51N:** Inverse time ground/neutral overcurrent function.

**52:** Circuit breaker (ac).

**59:** Overvoltage function - this function operates for specified overvoltage conditions. An operation of this relay function usually results in a trip signal to the interconnection breaker(s).

**67:** Directional overcurrent function - This relay function is intended to operate for a fault on the OPPD system and trip the interconnection breaker.

**67G/67N:** Directional ground/neutral overcurrent function - This relay function is intended to operate for a fault on the OPPD system and trip the interconnection breaker.

**68:** Out-of-step function.

**81:** Frequency function.

**81O/U:** Over/under frequency function - the frequency relay function operates for specified variances from the normal system frequency.

**81R:** Rate-of-change frequency function.

**86:** Lockout relay, either manually or electrically reset. Where references are made to lockout relays, they should be assumed to be manually reset unless indicated otherwise.

**94:** Auxiliary tripping relay.

# Appendix A - References


"National Electrical Safety Code", ANSI C2, Published by The Institute of Electrical and Electronics Engineers, Inc.

"IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems", IEEE P1547.

"IEEE Standard Relays and Relay Systems Associated with Electric Power Apparatus", ANSI/IEEE C37.90.

"Guide for Protective Relaying of Utility – Consumer Interconnection", ANSI/IEEE C37.95.

"IEEE Electric Power Systems and Equipment – Voltage Ratings (60Hz)", C84.1.

"IEEE Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems", IEEE Std. 1001.

"IEEE Recommended Practice for Utility Interconnection of Small Wind Energy Conversion Systems", ANSI/IEEE Std. 1021.

"Intertie Protection of Consumer-Owned Sources of Generation, 3 MVA or Less", IEEE Publication 88 THO224-6-PWR.

"Reliability Considerations for Integrating Nonutility Generating Facilities with the Bulk Electric Systems", North American Electric Reliability Council, Princeton, NJ 8540.

Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems – "Buff Book:", ANSI/IEEE Std. 446.

Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications – "Orange Book", ANSI/IEEE Std. 446.

National Electrical Code, National Fire Protection Association, Quincy, MA 02269.

"IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems", IEEE Standard 519.

OSHA Safety Tagging and Lock-out Procedures.

Network Transformer Protection Guide, ANSI C37, 108.

MAPP (Mid-America Power Pool) Reliability Handbook.

NERC (National Electric Reliability Council) Operating Manual.

# Appendix B – Electric Agreement Requirements for Generation Connections

## Agreements Required for Generators Connected Directly to OPPD's System

'Application for OPPD Approval to Construct DG Interconnection' Agreement: If generation is to be connected in parallel to OPPD's electric system, the responsibilities of each party to make the new interconnection are defined in the OPPD DG Manual and the terms of this application. Upon written OPPD approval of the application, OPPD and Owner will be deemed to have entered into a temporary agreement relating to the DG interconnection, which shall remain in effect until revoked by OPPD or until construction of the new interconnection is complete and the facilities are placed in service under the terms of the OPPD Agreement for Closed Transition Operation of Distributed Generation (see description below).

'OPPD Agreement for Closed Transition Operation of Distributed Generation': If generation is to be connected in parallel to OPPD's electric system, the interconnection must be identified and subject to OPPD's requirements as outlined in the OPPD DG Manual and the terms of this agreement. This is a long-term contractual arrangement required for the duration of the interconnection's existence.

## Agreements Which May Apply

Construction Agreement: For any generation interconnection, if the DG Owner or his/her representative wishes OPPD to do construction work for which the DG Owner is responsible, a construction agreement is required. This contract is in effect until the construction work is complete and payment for work is received.

Operation and Maintenance Agreement: For any generation interconnection, if the DG Owner or his/her representative wishes OPPD to perform operation and/or maintenance service for interconnection facilities for which the DG Owner is responsible, an Operation and Maintenance Agreement is required. This contract can be any term between the interconnection's operational start and termination dates.

Interchange Agreement: If the generation will result in any interchange of energy between OPPD's and the DG facility's respective electric systems, an Interchange Agreement is required to handle issues such as Interchange accounting and services to be rendered by either party to the other. Examples of energy interchange between the systems would be the delivery of the DG facility's generation output to OPPD's system, or OPPD delivery of backup energy to the DG facility's system. The Interchange Agreement is a long-term contractual arrangement required to be in effect as long as there is a possibility of interchange between the systems, usually for the full duration of the interconnection's existence.

Purchase Agreement: In addition to the Interchange Agreement, if the output from the generation is to be purchased by OPPD, a Purchase Agreement is required to define the specifics regarding that purchase, such as the rate, capacity factor, conditions for interruption, etc. This contract can be of any term between the interconnection's operational start and termination dates.

Transmission Service Agreement: In addition to the Interchange Agreement, if the interchange of energy between the OPPD and the DG facility's electric systems involves the delivery of energy through OPPD's Transmission System to or from another entity, a Transmission Service Agreement would be required to define the specifics regarding wheeling transaction. If OPPD electric system facilities other than OPPD's Transmission System are used for the wheeling deliveries, arrangements other than a Transmission Service Agreement are required.

Facilities Agreement: A DG Owner's use of certain OPPD electric system facilities may involve a Facilities Agreement.

**Study Agreements**

Interconnection Study Agreement: This agreement is used for a variety of system study efforts required for an interconnection. This study will determine the DG impact on the OPPD system. The Interconnection study addresses items such as protective equipment requirements, equipment Ownership, additional right-of-way acquisitions, preliminary cost estimates and schedules to construct/modify the OPPD system, and impacts introduced by the proposed generation on system operating conditions (voltage regulation, harmonics, ampacity, increase in short circuit currents, system stability, line losses). Typically all 'accredited' generation applications and Class III interconnections (as well as many Class I or Class II applications) will require the applicant to enter into an Interconnection Study Agreement.

During the analysis, additional details of the proposed facility may be required and will be requested from the DG applicant as necessary. To establish installation details, meetings will usually be held with the OPPD representative, the DG applicant, the applicant's consulting engineer, the contractor, and the equipment manufacturer.

**Please note OPPD may be required to submit the results of this study to regional regulatory authorities.**

System Impact Study Agreement: For large power exporters, Class III, or 'accredited' facilities, the right to interconnect to the OPPD system does not mean the DG facility can use OPPD's system to deliver power and energy at all times and wherever the DG facility so desires.

When a generating entity wishes to deliver power and energy over OPPD transmission facilities, according to regulatory rules, it must request transmission service via the regional regulatory authority. Based on established criteria, OPPD will approve or deny such a request or indicate the need for a System Impact Study. Under regulatory rules, OPPD must respond to such requests in 60 days. If a study is required to determine the ability of the system to provide the transmission service requested, OPPD will enter into a System Impact Study Agreement with the DG facility Owner.

Facilities Study Agreement: This agreement is required once a definite decision by the generation Owner has been made to construct the generation facility, based on the results of the Interconnection Study Agreement. The Facilities Study agreement covers the OPPD design work required (and equipment purchases) for modifications to the OPPD system to accommodate proposed DG facility generation.

OPPD and the DG Owner will enter into a Facilities Study Agreement to perform the required detailed engineering. The scope of the study will be detailed in the agreement. OPPD will charge the DG Owner its costs for this design work and equipment purchases. OPPD's design and construction will be limited to the work required to protect OPPD's system, equipment, personnel, and customers from adverse impacts due to the DG facility generation.

The DG Owner should provide any requested items as soon as practical to facilitate completion of OPPD work. After OPPD has received all of the required information, the Facilities Study will take an estimated 4 to 32 weeks to complete, depending upon the complexity of the installation.

The Facilities Study addresses items such as: fault studies, a stability study (if required), harmonic analysis, protection requirements, and impact to other customers on the OPPD system. The Facilities Study does not include studies for regional regulatory authority acceptance of the generation facility.

Please note OPPD may be required to submit the results of this study to regional regulatory authorities.

# Appendix C - Interconnection Expenses Schedule

| Classification of Installation | Application and Analysis Fee |
|---|---|
| | |
| Class IA | $350.00 |
| Class IB Import Only | $1,000.00 + $1.00/kW of Generation Capacity |
| | |
| Class IB Import/Export Accredited | $1,000.00 + $4.00/kW of Generation Capacity |
| | |
| Class II Import Only | $1,000.00 + $1.00/kW of Generation Capacity |
| Class II Import/Export, Export Non-Accredited DG Units | $1,000.00 + $2.50/kW of Generation Capacity |
| Class II Import/Export, Export Accredited DG Units | $1,000.00 + $4.00/kW of Generation Capacity |
| | |
| Class III | $2,500.00 + $1.00/kW for the first 10,000 kW + $0.10/kW for Remainder of Generation Capacity |

*Import only, Import/Export, Export only, – see 'Power Transfer, Determination of kW Levels' in this manual.

**Reimbursable Costs for OPPD System Modifications****

Class I 'Type A' – modifications not usually required, so typically: $ 0 $ 0 $ 0

Class I 'Type B', Class II, and Class III
Based on internal OPPD estimates, on a case-by-case basis $ To be determined

**Hourly Rates for OPPD Personnel**

For assistance at request of DG facility Owner. Initial testing is included in the above fees. The schedule below applies to subsequent work or testing procedures. These rates are subject to change at any time.

| | | |
|---|---|---|
| | Sr. Engineer | $ 90 / hour |
| | Engineer | $ 75 / hour |
| | Sr. Technician, Sr. line crew, or Sr. switching crew | $ 60 / hour |
| | Technician, line crew or switching crew | $ 50 / hour |
| | Line Truck or Service Truck | |
| | Light Vehicle | |

**OPPD requires 100% of requested funds in the form of a front-end deposit, prior to the execution of OPPD work. Unused funds will be refunded to the depositor at project completion.