TECHNICAL REQUIREMENTS FOR NEW INTERCONNECTIONS OF MIDAMERICAN JURISDICTIONAL GENERATION FACILITIES (RATED AT 501 – 20,000 kW) AND MIDAMERICAN JURISDICTIONAL LINE FACILITY / END USER INTERCONNECTIONS (RATED AT 4.16 – 99 kV) TO THE MIDAMERICAN ELECTRIC SYSTEM

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MIDAMERICAN ENERGY COMPANY

Technical Requirements for New Interconnections of NERC / FERC Jurisdictional Generation, Transmission Line, and End User Facility Interconnections to the MidAmerican Electric System

1.0 Introduction

1.1 These technical requirements became effective for specific generation, line, and end-user interconnections beginning on July 1, 2006. These technical requirements were revised to incorporate necessary changes to conform to new regulatory procedures including the NERC Version 0 standards, the FERC Large Generation Interconnection and Agreement procedures, the FERC Small Generation Interconnection and Agreement procedures, and the Midwest Reliability Organization procedures.

1.2 To the extent that there is a conflict between these requirements and the current FERC, NERC, or Open Access Transmission Tariff (OATT) requirements, the FERC, NERC and OATT requirements will govern. These requirements are considered to be supplemental technical requirements to the procedures and requirements set forth in the applicable OATT. These revised technical requirements are intended to:

1.2.1. Document interconnection requirements and procedures for generation, transmission, and end user facilities (referred to here after as "Interconnection Customer")

1.2.2. Provide a written summary of MidAmerican's plans to achieve required system performance according to the NERC, the Midwest Reliability Organization (MRO), and MidAmerican criteria.

1.2.3. Document procedures for coordinated joint studies of new facilities and for determining Interconnection Customer (IC) impacts on the MidAmerican and adjoining bulk power systems.

1.2.4. Document notification procedures to other entities responsible for bulk power reliability.

1.3 In addition to the interconnection requirements provided here, the IC shall comply with all applicable federal, state, and local requirements, environmental regulations, siting requirements, and Good Utility Practices. Where federal (FERC), national Reliability Council (NERC), state, or local codes and regulations are in conflict with these technical requirements, federal requirements will take precedence. Any NERC standards adopted by FERC will take precedence. Where state or local codes and regulations are not in conflict, the IC will be aware of and will follow all applicable standards. Since these technical requirements are subject to various regulatory authorities and requirements, which

are subject to change, MidAmerican Energy reserves the right to revise these technical requirements from time-to-time without advanced notice.

1.4 Through the application of the following system performance criteria, industry standards, and annual MISO / MRO assessments, both near and long term, MidAmerican will achieve the required system performance throughout the planning horizon.

1.5 An IC shall not violate nor cause the MidAmerican electric system to violate the MidAmerican technical requirements for new interconnections of NERC / FERC jurisdictional generation, transmission line, and end user facility interconnections shown in **Appendix A (included)**.

1.6 An IC shall not violate nor cause the MidAmerican electric system to violate the MidAmerican Electric Facility Rating Criteria shown in **Appendix B (available upon request)**, including those systems below 100 kV.

1.7 An IC shall meet the requirements in the MidAmerican OATT Process for Small Interconnections shown in **Appendix C (available upon request)**.

1.8 An IC shall not violate nor cause the MidAmerican electric system to violate the applicable NERC reliability standards as documented in **Appendix D (available upon request)**.

1.9 An IC shall not violate nor cause the MidAmerican electric system to violate the applicable MAPP / MRO Performance Standards as documented in **Appendix E (available upon request)**.

1.10 An IC shall not violate nor cause the MidAmerican electric system to violate MidAmerican Flicker Standards as documented in **Appendix F (available upon request)**.

1.11 An IC shall not violate nor cause the MidAmerican electric system to violate MidAmerican Harmonic Standards as documented in **Appendix G (available upon request)**.

2.0 Interconnection Process Summary

2.1 This section summarizes the interconnection requirements for various generation, transmission, and end-user facilities according to size and purpose. Any conflicts between these standards and the latest OATT, federal, or state requirements are governed by the most recent OATT, federal, and state requirements or the more stringent criteria.

2.2 There are four (4) basic classifications for interconnection criteria and procedures. There are (See the table on the next page):

- 2.2.1 NERC and FERC jurisdictional
- 2.2.2 NERC and Non-FERC jurisdictional
- 2.2.3 Non-NERC and FERC jurisdictional
- 2.2.4 Non-NERC and Non-FERC jurisdictional

Interconnecting Entity	**FERC Jurisdictional** Those entities connected to lines classified as transmission by using the FERC 7 Factor Test (usually 100 kV and greater lines) or entities selling power to the bulk power market and / or taking unbundled service (usually means generation and ancillary services are billed separately).		**Non-FERC Jurisdictional** Those entities not connected to lines classified as transmission by using the FERC 7 Factor Test (usually lines at 69 kV or less) or entities not selling power to the bulk power or taking bundled service.	
	NERC Jurisdictional Entities connected to lines rated at 100 kV and greater.	**Non-NERC Jurisdictional** Entities connected to lines rated at less than 100 kV.	**NERC Jurisdictional** Entities connected to lines rated at 100 kV and greater.	**Non-NERC Jurisdictional** Entities connected to lines rated at less than 100 kV.
Generators rated at 20 MW and greater	Use FERC LGIP / LGIA requirements / procedures and follow all NERC stds.	Use FERC LGIP / LGIA requirements / procedures and follow Transmission Operator stds.	Use Transmission Operator procedures / requirements and follow all NERC stds.	Use Transmission Operator procedures / requirements and follow all Transmission Operator stds
Generators rated at 10 kW - 20,000 kW.	Use FERC SGIP / SGIA requirements / procedures and follow all NERC stds.	Use FERC SGIP / SGIA requirements / procedures and follow Transmission Operator stds.	Use Transmission Operator procedures / requirements and follow all NERC stds.	Use Transmission Operator procedures / requirements and follow all Transmission Operator stds
Generators rated at less than 10 kW	-	-	Use Transmission Operator procedures / requirements and follow all NERC stds.	Use Transmission Operator procedures / requirements and follow all Transmission Operator stds
Transmission Interconnections	Use FERC LGIP / LGIA requirements and follow all NERC stds.	Use FERC SGIP / SGIA requirements and follow Transmission Operator stds.	Use Transmission Operator procedures / requirements and follow all NERC stds.	Use Transmission Operator procedures / requirements and follow all Transmission Operator stds
End User Interconnections	Use FERC LGIP / LGIA requirements / procedures and follow all NERC stds.	Use FERC SGIP / SGIA requirements / procedures and follow Transmission Operator stds.	Use Transmission Operator procedures / requirements and follow all NERC stds.	Use Transmission Operator procedures / requirements and follow all Transmission Operator stds

2.3 NERC provides reliability standards for facilities that connect to transmission which is defined as all facilities rated at 100 kV and greater. Generators, Transmission Line, and End Users must follow all NERC reliability standards when interconnecting with NERC jurisdictional transmission which is defined as all facilities rated at 100 kV and greater.

2.4 The NERC reliability standards may be accessed on the NERC website (nerc.org). If the Generator, Transmission Line, and End User are not NERC jurisdictional, they must follow MidAmerican criteria, which are covered in another technical interconnection requirement document.

2.5 FERC provides procedures that govern interconnections where a generator chooses to sell power to the bulk power market or a transmission customer / end user chooses to take unbundled or wholesale electric service from a FERC jurisdictional transmission line. A FERC jurisdictional line is a line or interconnection that is classified as FERC transmission by the host utility or by using the FERC 7 Factor Test. Generators, Transmission customers, and End Users must follow all FERC procedures when using or interconnecting with FERC jurisdictional transmission.

2.6 The FERC processes and procedures may be accessed through the Transmission Operator's OATT (http://mapp.oasis.mapp.org/documents/MEC/FERCFilings.html) or from the FERC website (http://www.ferc.gov/industries/electric/indus-act/gi/small-gen.asp). If the Generator, Transmission Line, and End User are not FERC jurisdictional, they must follow MidAmerican processes and procedures, which are covered in another technical interconnection requirement document.

2.7 Generators, Transmission Line, and End Users must follow all FERC interconnection procedures and processes when they are FERC jurisdictional. The following FERC Orders govern the interconnection processes and procedures for:

2.7.1 Generators rated at 20 MW and greater are governed by the FERC Large Generator Interconnection Procedures and Agreements (LGIP /LGIA) process.
http://www.ferc.gov/industries/electric/indus-act/gi/stnd-gen/2003-C-LGIP.doc

2.7.2 Generators rated from 10 kW to 20,000 kW (20 MW) are governed by FERC Small Generator Interconnection Procedures and Agreements (SGIP /SGIA) process when that access the bulk power market and / or engage in sales for resale.
http://www.ferc.gov/industries/electric/indus-act/gi/small-gen/05-12-05-order2006.doc

2.7.3 Line / End User that choose to take Unbundled or Wholesale electric service is governed by the MidAmerican Open Access Transmission Tariffs (OATT).
http://mapp.oasis.mapp.org/documents/MEC/FERCFilings.html

2.8 Those generators not governed by FERC procedures and agreements would be governed by MidAmerican procedures and agreements. Those Line / End Users not governed by the MidAmerican OATT, would be governed the corresponding MidAmerican state tariffs (bundled electric service) and procedures.

3.0 Coordinated Joint Studies

3.1 Procedures for Coordinated Joint Studies. Unless there are conflicts with FERC or State standards, such as Critical Energy Infrastructure Information (CEII) and / or Standards or Code of Conduct issues, MidAmerican will form Ad Hoc groups, distribute results and facilitate any required meetings between ICs, MidAmerican, potentially affected electric systems, and any required governing authorities in accordance with the FERC Large Generation Interconnection Procedures / Agreements (SGIP / SGIA). This includes requesting potentially affected parties to participate in joint studies and following accepted MAPP / MRO regional planning practices. If a potential CEII conflict arises such as an unknown consultant requesting critical system data, MidAmerican would require FERC approval and a confidentiality agreement. If in the opinion of MidAmerican, a potential Standard or Code of Conduct issue arises which may involve parties that (1) are not FERC-jurisdictional public utilities or (2) decline to sign a confidentiality agreement, MidAmerican will provide system criteria violations (thermal, voltage, or stability) specific to affected system only.

3.2 An example procedural guide for study preparation may include:

3.2.1 The IC and MidAmerican will meet to review the study assumptions, criteria, methodology, objectives and study procedures.

3.2.2 The IC shall supply all data describing their generation / load including reactive capability, load demands, and interconnection facilities required as System Impact Study input.

3.2.3 MidAmerican will prepare existing and proposed MidAmerican electric system data.

3.2.4 MidAmerican or its agent will perform the System Impact Study.

3.2.5 MidAmerican or its agent will perform, if necessary, the Facilities Study.

3.2.6 MidAmerican will provide the IC a copy of the System Impact Study and, if required, the Facilities Study prior to submitting a final study report to the Design Review Subcommittee or other applicable authority for approval of any system additions.

4.0 Glossary

4.1 **Acceptance Test** - A test performed or witnessed once for a specific protection package or device to determine whether specified requirements are met.

4.2 **Ancillary Services** - Those services necessary to support the transmission of energy from resources to loads while maintaining, reliable operation of the Transmission Provider's transmission system in accordance with Good Utility Practice.

4.3 **Annual Transmission Costs** - The total annual cost of the Transmission System shall be the amount specified in Schedule 1 until amended by the Transmission Provider or modified by the Commission.

4.4 **ANSI** - American National Standards Institute

4.5 **Automatic Disconnect Device -** An electronic or mechanical device used to isolate a circuit or piece of equipment from a source of power without the need for human intervention.

4.6 **Circuit -** A conducting part through which an electric current is intended to flow.

4.7 **Circuit Interrupting Device -** A device designed to open and close a circuit automatically as a result of a system excursion without damage to itself when properly applied within its rating.

4.8 **Cogeneration** - The sequential production of electricity, heat, steam, or useful work from the same fuel source.

4.9 **Coordinated Interconnection Review** - Any studies performed by utilities to ensure that the safety and reliability of the electric grid with respect to the interconnection.

4.10 **Bulk Power Network** - The MidAmerican “Bulk Power Network” is defined in this document as lines and substations (usually rated at 100 kV and greater) defined as transmission by use of the FERC Seven Factor Test.

4.11 **Bundled Electric Service -** Means all electric services are governed by a single state tariff that covers pricing for generation demand and energy, transmission service, ancillary transmission services, and electric system losses.

4.12 **CEII or Critical Energy Infrastructure Information** - Critical Energy Infrastructure Information means information about proposed or existing critical infrastructure that (i) relates to the production, generation, transportation, transmission, or distribution of energy, (ii) could be useful to a person in planning

an attack on critical infrastructure, (iii) is exempt from mandatory disclosure under the Freedom of Information Act, 5 U.S.C 552 (iv) existing or proposed assets, whether physical or virtual, where the incapacity or destruction of which would negatively affect security, economic security, public health or safety, or any combination of those matters.

4.13 **Standards of Conduct / FERC Orders 888 and 889 and 2004** - The Federal Energy Regulatory Commission (FERC) issued Order Nos. 888 and 889 in April 1996, which required jurisdictional electric utilities to provide open transmission access for *wholesale* power transactions on a non-discriminatory basis. FERC Order No. 889 established standards of conduct intended to functionally segregate the transmission operations and merchant functions of utilities and mandated that transmission access information for energy transactions be displayed on electronic bulletin board systems called Open Access Same-time Information Systems (OASIS). FERC Order No. 2004 clarifies the responsibilities of jurisidictional electric utilities (Transmission Providers) to ensure that access to transmission information is provided on a non-discriminatory basis and that Transmission Provider units function independently of their marketing arms.

4.14 **Control Area** - An electric power system or combination of electric power systems to which a common automatic control scheme is applied in order to: (1) match, at all times, the power output of the generators within the electric power system(s) and capacity and energy purchased from entities outside the electric power system(s), with the load in the electric power system(s); (2) maintain, within the limits of Good Utility Practice, scheduled interchange with other Control Areas; (3) maintain the frequency of the electric power system(s) within reasonable limits in accordance with Good Utility Practice; and (4) provide sufficient generating capacity to maintain operating reserves in accordance with Good Utility Practice.

4.15 **Dedicated Transformer -** A transformer that provides electrical service to only one customer. The customer may or may not have a generation facility. The word “Dedicated” does not imply ownership or exclusive use by the Interconnection Customer.

4.16 **Delivering Party** - The entity supplying the capacity and/or energy to be transmitted at Point(s) of Receipt.

4.17 **Designated Agent** - Any entity that performs actions or functions on behalf of the Transmission Provider, an eligible Customer or the Transmission Customer required under the Tariff.

4.18 **Direct Transfer Trip** - Remote operation of a circuit interrupting device by means of a communication channel.

4.19 **Disconnect (verb)** - To isolate a circuit or equipment from a source of power. If isolation is accomplished with a solid-state device, "Disconnect" shall mean to cease the transfer of power.

4.20 **Disconnect Device -** A mechanical device used for isolating a circuit or equipment from a source of power.

4.21 **Disturbance** - Trouble on the electrical system normally referring to fluctuation of frequency or voltage values.

4.22 **Electric Generator -** A machine or device that transforms energy into electrical power.

4.23 **Energy Conversion Device -** A machine or solid state circuit for changing direct current to alternating current or a machine that changes shaft horsepower to electrical power.

4.24 **Energize -** To apply voltage to a circuit or piece of equipment.

4.25 **Equipment** - A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used as a part of, or in connection with, an electrical installation.

4.26 **Fault –** An electrical short circuit between elements of potential difference.

4.27 **Feeder –** All circuit conductors between the utility distribution substation, or other power supply source, and the final point of interconnection with a customer or Generator.

4.28 **FERC –** The Federal Energy Regulatory Commission

4.29 **Firm Transmission Service** - Point-to-point transmission service under this tariff that is reserved and/or scheduled for a term of one year or more and that is of the same priority as that of the Transmission Provider's firm use of the transmission system.

4.30 **Forced Outage –** Any electrical outage resulting from a design defect, inadequate construction, operator error, or a breakdown of the mechanical or electrical equipment that fully or partially curtails the electrical output of the generating facility.

4.31 **Frequency –** The number of cycles occurring in a given interval of time (usually in seconds) in an electric current. Frequency is commonly expressed in Hertz.

4.32 **Generating Facility -** A plant wherein electrical energy is produced from some other form of energy by means of suitable converting apparatus, including the generation apparatus and all associated equipment owned, maintained, and operated by the Generator.

4.33 **Good Utility Practice** - Any of the practices, methods and acts engaged in or approved by a significant portion of the electric utility industry during the relevant time period, or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result of the lowest reasonable cost consistent with good business practices, reliability, safety and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in the region and consistently adhered to by the Transmission Provider.

4.34 **Ground -** A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth (zero potential).

4.35 **Hertz -** The term denoting cycles per second or frequency.

4.36 **Hourly Non-Firm Transmission Service** - Point-to-point transmission under this tariff that is scheduled and paid for on an as available basis and is subject to interruption.

4.37 **IEEE** - Institute of Electrical and Electronics Engineers

4.38 **Interconnection -** The physical electrical connection that allows the transfer of electrical energy between a generating facility and the utility.

4.39 **Interconnection Customer or IC -** Refers to the new generation, transmission, and end user facilities requesting authorization to interconnect with the MidAmerican electric system.

4.40 **Interconnection Equipment -** The equipment required by prudent electrical utility practice and applicable electrical and safety codes to interconnect, operate, and safely deliver energy from the Generator to the utility system.

4.41 **Islanding -** A condition in which a portion of the IPC system that contains both load and distributed generation is isolated from the remainder of the IPC system.

4.42 **Kilovolt (kV) -** An electrical unit of potential that equals 1,000 volts.

4.43 **Kilovolt-Amperes (kVA) -** The product of kilovolts and amperes that defines equipment and/or circuit ratings.

4.44 **Kilowatt (kW) -** An electrical unit of power that equals 1,000 watts

4.45 **Kilowatt-hour (kWh) -** 1,000 watts of energy supplied for 1 hour.

4.46 **Megawatt (MW) -** An electrical unit of power that equals 1,000,000 watts.

4.47 **Maintenance Test** - A test performed upon initial installation and repeated periodically to determine that there is continued acceptable performance.

4.48 **MAPP** - Means the Mid-Continent Area Power Pool, a Regional Transmission Group (RTG), which is a voluntary organization of transmission owners, transmission users, and other entities approved by the FERC to efficiently coordinate transmission planning (and expansion), operation, and use on a regional (and interregional) basis. MAPP is responsible for regional planning and operating guidelines and policies designed to maintain adequate reliability in the Midwest and parts of Canada. MAPP also serves as a generation reserve sharing pool.

4.49 **MISO** - Means the Midwest Independent System Operator, a regional electric grid operator responsible for day-to-day operation of the Midwest bulk power electric grid.

4.50 **MRO** - Means the Midwest Reliability Organization (MRO), a Regional Reliability Organization (RRO) responsible for the development of regional reliability planning and operating standards for the MRO portion of the midwest bulk electric power grid.

4.51 **Nameplate Rating -** Output rating information appearing on a generator nameplate in accordance with applicable industry standards.

4.52 **Native Load Customers** - The wholesale and retail customers on whose behalf the Transmission Provider, by statute, franchise, regulatory requirements, or contract, has undertaken an obligation to construct and operate the Transmission Provider's system to meet the reliable electric needs of such customers.

4.53 **NEMA** - National Electrical Manufacturers Association

4.54 **NERC -** North American Reliability Council

4.55 **Network Customers** - Entities receiving transmission service pursuant to the terms of the Transmission Provider's Network Integration Tariff.

4.56 **Network Upgrades -** Those additions and modifications to the electrical system that are integrated with and support the overall system for the general benefit of all users of the electrical system, and are needed to accept delivery of energy from the Generator. Network upgrades are generally owned and maintained by the utility at the Generator's request and expense. Network upgrades are often referred to as "special facilities".

4.57 **Network Integration Transmission Service** - Network Integration Transmission Service allows a Transmission Customer to integrate, plan, economically dispatch and regulate its Network Resources to serve its Network Load in a manner comparable to that in which the Transmission Provider utilizes its Transmission System to serve its Native Load customers. Network Integration transmission Service also may be used by the Transmission Customer to deliver non-firm energy purchases to its Network Load without additional charge.

4.58 **Network Load** - The designated load of a Transmission Customer, including the entire load of all Member Systems. A Transmission Customer's Network Load shall not be reduced to reflect any portion of such load served by the output of any generating facilities owned, or generation purchased, by the Transmission Customer or its Member Systems.

4.59 **Non-Firm Transmission Service** - Point-to-point transmission service under this Tariff that is reserved and/or scheduled on an as available basis and is subject to interruption. Non-firm Transmission service is available on a stand alone basis as either Hourly Non-firm Transmission Service or Short-Term Non-firm Transmission service. Non-firm transmission Service is also available in conjunction with reservations of Firm Transmission Service for any term subject to the conditions set forth in Section 14.1 under this Tariff.

4.60 **OATT** - Means an Open Access Transmission Tariff or a set of rules filed by every FERC jurisdictional electric utility defining the processes and criteria required for interconnection to the owner's electric facilities.

4.61 **OSHA -** Occupational Safety & Health Administration

4.62 **Outage -** A condition existing when a circuit is de-energized.

4.63 **Overload -** A load in amperes greater than an electric device or circuit is designed to carry or operate.

4.64 **Overvoltage -** Voltage higher than that desired or for which equipment is designed.

4.65 **Parallel -** To electrically connect a generator or energized source, operating at an acceptable frequency and voltage, with an adjacent generator or energized system, after matching frequency, voltage, and phase angle.

4.66 **Parallel Operation -** The operation of a non-utility generator while connected to the utility's grid. Parallel operation may be solely for the Generator's operating convenience or for the purpose of delivering power to the utilities grid.

4.67 **Parties -** The Transmission Provider and the Interconnection Customer receiving service.

4.68 **Point of Interconnection -** The point where the Interconnection Customer and the utility conductors meet (point of ownership change).

4.69 **Point(s) of Delivery** - Point(s) of interconnection on the Transmission Provider's Transmission System where capacity and/or energy transmitted by the Transmission Provider will be made available to the Receiving Party. The Point(s) of Delivery shall be specified in the Service Agreement.

4.70 **Point-to-Point Transmission Service Tariff** - The Transmission Provider's Point-to-Point Transmission Service Tariff as such tariff may be amended and/or superseded from time to time.

4.71 **Point(s) of Receipt** - Point(s) of interconnection on the Transmission Provider's Transmission System where capacity and/or energy will be made available to the Transmission Provider by the Delivering Party. The Point(s) of Delivery shall be specified in the Service Agreement.

4.72 **Point-to-Point Transmission Service** - The reservation and/or transmission of energy on either a firm basis and/or a non-firm basis from Point(s) of Receipt to Point(s) of Delivery under this Tariff, including any Ancillary Services that are provided by the Transmission Provider in conjunction with such service.

4.73 **Power -** The time rate at which electrical energy is emitted, transferred, or received; usually expressed in watts.

4.74 **Power Factor -** The ratio of actual power to apparent power.

4.75 **Power System Stabilizer or PSS -** A control system applied to a generator that monitors generator variables such as current, voltage, and shaft speed and sends the appropriate control signals to the voltage regulator to damp system oscillations.

4.76 **Primary -** Normally considered as the high voltage winding of a substation or distribution transformer.

4.77 **Protection Equipment –** Circuit interrupting device, protective relaying, and associated instrument transformers (if applicable).

4.78 **Radial Feeder -** A distribution line that branches out from a substation and is normally not connected to another substation or another circuit sharing a common supply.

4.79 **Receiving Party** - The entity receiving the capacity and/or energy transmitted by the Transmission Provider to the Point(s) of Delivery.

4.80 **Regional Transmission Group** - A voluntary organization of transmission owners, transmission users and other entities approved by the Commission to efficiently coordinate transmission planning (and expansion), operation and use on a regional (and interregional) basis.

4.81 **Relay –** A device that is operative by a variation in the condition of one electric circuit to affect the operation of another device in the same or in another electric circuit.

4.82 **RRO -** Means a Regional Reliability Organization that is responsible for the development of regional planning and operating reliability standards.

4.83 **Secondary –** The winding of a transformer that is normally operated at a lower voltage than the primary winding.

4.84 **Self-Excited –** An electric machine in which the field current is secured from its own armature current.

4.85 **Service Agreement** - The initial agreement and any supplements thereto entered into by the Transmission Customer and the Transmission Provider for service under this Tariff.

4.86 **Service Commencement Date** - The date the transmission Provider begins to provide service pursuant to the terms of an executed Service Agreement, or the date the Transmission Provider begins to provide service in accordance with the provisions of section 4.3 of this Tariff.

4.87 **Short-Term Firm Transmission Service** - Firm point-to-point transmission service under this Tariff that is reserved and/or scheduled for a term of less than one year and that is of the same priority as that of the Transmission Provider's firm use of the transmission system.

4.88 **Short-Term Non-Firm Transmission Service** - Non-firm point-to-point transmission service under this Tariff that is reserved and/or scheduled on a daily, weekly, or monthly basis for a renewable term of not more than thirty (30) days each and is subject to interruption.

4.89 **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 without phase angle differences.

4.90 **System –** The entire generating, transmitting, and distributing facilities of an electric company.

4.91 **System Operator –** A generic term used to describe the individuals responsible for the integrity or the operational control of the Transmission Owner's System and any successor thereto.

4.92 **Transmission Customer** - Any Eligible Customer (or its designated agent) that executes a service agreement and/or receives transmission service under this Tariff.

4.93 **Transmission Owner's System –** The integrated system of electrical generation, transmission, and distribution facilities, and all equipment and facilities ancillary thereto, owned and/or operated by the Transmission Owner.

4.94 **Transmission Provider (TP)** - The public utility (or its designated agent) that owns or controls facilities used for the transmission of electric energy in interstate commerce and provides service under this Tariff.

4.95 **Transmission Service** - Point-to-point transmission service provided under this Tariff. Transmission service will be provided on a firm and/or non-firm basis.

4.96 **Transmission System** - The facilities owned, controlled, operated or supported by the Transmission Provider that are used to provide transmission service under this Tariff.

4.97 **UL** – Underwriters Laboratories

4.98 **Unbundled and Wholesale Electric Service** - Means that generation demand and energy are market based and the OATT covers pricing for transmission service, ancillary transmission services, and electric system losses.

4.99 **Valid Request** - A completed Application that satisfies on an ongoing basis all the requirements of this Tariff.

Appendix A

MidAmerican Technical Interconnection Requirements for New Interconnections of NERC / FERC Jurisdictional Generation Facilities (Rated at 501 – 20,000 kW), and Transmission Line / End User Transmission Facility Interconnections (Rated at 4.16 – 99 kV) to the MidAmerican Electric System

The MidAmerican Technical Requirements may be accessed via the web at (www.midamericanenergy.com) or upon request to the Electric System Planning department at 106 E 2nd Street, Davenport, IA. 52801. Telephone contact (563-333-8329)

A.1.0 Introduction / Purpose

A.1.1 These Technical Requirements became effective beginning on July 1, 2006 and apply to MidAmerican or non-FERC and non-NERC jurisdictional facilities.

A.1.2 FERC jurisdictional facilities are those facilities (generators, transmission customers and lines, and end users) connected to electric lines classified as transmission by the host utility or by using the FERC 7 Factor Test (usually 100 kV and greater lines) or entities selling power to the bulk power market and / or taking unbundled service as specified in the Transmission Provider's Open Access Transmission Tariff (OATT). FERC procedures and requirements, of which this document is a part, govern the interconnection process. Since this document addresses facilities connected at less than 100 kV, it is most likely that the Interconnection Customer (IC) has requested access the bulk power market

A.1.3 The IC must not cause MidAmerican to violate NERC reliability requirements. NERC reliability standards may be accessed on the web at (http://www.nerc.com/~filez/standards/Reliability_Standards.html).

BAL	Resource and Demand Balancing	MOD	Modeling, Data, and Analysis
CIP	Critical Infrastructure Protection	ORG	Organization Certification
COM	Communications	PER	Personnel Performance, Training, and Qualifications
EOP	Emergency Preparedness and Operations	PRC	Protection and Control
FAC	Facilities Design, Connections and Maintenance	TOP	Transmission Operations
INT	Interchange Scheduling and Coordination	TPL	Transmission Planning
IRO	Interconnection Reliability Operations and Coordination	VAR	Voltage and Reactive

A.1.4 If the IC's interconnection point changes to the 100 kV and greater electric system the IC must then comply with the NERC reliability standards.

A.1.5 MidAmerican may revise the Technical Requirements periodically to comply with new requirements from FERC, NERC, state, other governmental authorities. MidAmerican may require that all generation, line, and end user interconnections comply with new regulations by implementing similar procedures and / or upgrades as would be expected on the MidAmerican facilities in a non-discriminatory manner. If the generation, line, or end user interconnection does not comply, MidAmerican may upgrade IC facilities as necessary to be compliant at the IC's expense or may disconnect the IC after proper notification according to OATT requirements and procedures.

A.1.6 The MidAmerican "Bulk Power Network" is defined in this document as all 100 kV and greater lines that do more than serve local load such as participation in the transport of long distance power transfers according to the FERC Seven Factor Tests.

A.1.7 The term "Interconnection Customer" refers to the new generation, transmission, and end user facilities requesting authorization to interconnect with the MidAmerican electric system where FERC has jurisdiction.

A.1.8 Generators interconnecting to the MidAmerican electric system for the purpose of power and energy sales to MidAmerican or sale for resale to another party are governed by the most current version of the MidAmerican Open Access Transmission Tariff (OATT). Nothing in this document should be construed as authorizing interconnection of any type for retail wheeling purposes.

A.1.9 This document complies with NERC requirements to document, maintain, and publish facility connection requirements for NERC / FERC jurisdictional generation facilities (rated at 501 – 20,000 kW), and Transmission / End-User facilities to ensure compliance with:

NERC Reliability Standards
FERC Small Generator Interconnection Procedures and Agreements
Applicable Regional Reliability Organization Requirements
Subregional, Power Pool Requirements
MidAmerican Requirements

A.2.0 Scope

A.2.1 These Technical Requirements specify the minimum technical requirements intended to ensure a safe, effective and reliable interconnection. These Technical Requirements are intended to supplement, but not replace, information contained in regulatory codes, MidAmerican's Open Access Transmission Tariff (OATT), MidAmerican electric service tariffs, and specific interconnection agreements. The requirements outlined in this document may not cover all details in specific cases.

A.2.2 Additional information regarding parallel operation of generation with the MidAmerican system can be obtained by contacting, the Manager of Electric System Planning, MidAmerican Energy Company, 106 East Second Street, Davenport, Iowa, 52801.

A.2.3 This document may be revised from time to time and it may be withdrawn without notification. The IC may contact the Manager of Electric System Planning for the latest version of the interconnection requirements.

A.3.0 General Conditions and Obligations

A.3.1 The IC will follow all FERC, NERC, and Regional Reliability Organization (RRO) requirements for review and approval of the interconnection and any required system changes or upgrades. This may include the development of such studies and data as a MAPP / MRO subcommittee shall reasonably request.

A.3.2 All IC's and generation interconnections (rated up to 100 kW) shall be constructed and capable of operating in accordance with the following IEEE standards:

A3.2.1	IEEE Standard 1547 for Interconnecting Distributed Resources with Electric Power Systems
A3.2.2	IEEE Std 929-2000 IEEE Recommended Practice for Utility Interface of Photovoltaic (PV) Systems
A3.2.3	IEEE Std 519-1992, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
A3.2.4	IEEE / ANSI C84.1-2006 American National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hz)
A3.2.5	IEEE 1543, Recommended Practice for Measurement and Limits of Voltage Fluctuations and Associated Light Flicker on AC Power Systems
A3.2.6.	IEEE Std C37.108-1989 (R2002), IEEE Guide for the Protection of Network Transformers
A3.2.7.	IEEE C57.12.44-2000, IEEE Standard Requirements for Secondary Network Protectors
A3.2.8	ANSI C84.1-1995 Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)
A3.2.9	IEEE Std 100-2000, IEEE Standard Dictionary of Electrical and Electronic Terms
A3.2.10	NEMA MG 1-1998, Motors and Small Resources, Revision 3
A3.2.11	NFPA 70 (2002), National Electrical Code
A3.2.12	NEMA MG 1-2003(Rev 2004), Motors and Generators, Revision1

A3.3 All IC's and generation interconnections rated from 101 kW to 500 kW must be constructed and capable of operating in accordance with the following IEEE standards:

A3.3.1	Those items for units rated up to 100 kW listed above
A3.3.2	ANSI/IEEE C37.91, Guide for Protective Relay Applications to Power Transformers
A3.3.3	ANSI/IEEE C37.95, Guide for Protective Relaying of

Utility-Customer Interconnections

A3.3.4 ANSI/IEEE C37.97, Guide for Protective Relay Applications to Power System Busses

A3.3.5 ANSI/IEEE C37.101, Guide for Generator Ground Protection

A3.3.6 ANSI/IEEE C37.102, Guide for AC Generator Protection

A3.3.7 ANSI/IEEE C37.106, Guide for Abnormal Frequency Protection for Power Generating Plants

A3.4 All IC's and generation interconnections rated greater than 501 kW must be constructed and capable of operating in accordance with the following IEEE standards:

A3.4.1 Those items for units rated up to 100 kW and 500 kW listed above

A3.4.2 ANSI C50.10-1990, General Requirements for Synchronous Machines

A3.4.3 ANSI C50.12-1982, Requirements for Salient Pole Synchronous Generators and Condensers

A3.4.4 ANSI C50.13-1982, Requirements for Cylindrical-Rotor Synchronous Generators

A3.4.5 ANSI C50.14-1977, Requirements for Combustion Gas Turbine Driven Cylindrical-Rotor Synchronous Generators

A3.4.6 ANSI/IEEE Std 1001, Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems

A3.4.7 IEEE 1547, Standard for Interconnecting Distributed Resources with Electric Power Systems,

A3.4.8 IEEE Std C62.41.2-2002, IEEE Recommended Practice on Characterization of Surges in Low Voltage (1000V and Less) AC Power Circuits

A3.4.9 IEEE Std C62.45-1992 (R2002), IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits

A3.4.10 ANSI / IEEE Std C37.90.1-1989 (R1994), IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

A3.4.11 ANSI / IEEE Std. C37.90.2 (1995), Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

A3.4.12 IEEE 80, IEEE Guide for Safety in AC Substation Grounding Document Number

A3.4.13 IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems

A3.4.14 ANSI/IEEE C37.2, Device Numbers

A3.4.15 IEEE Standard 421.2-1990, IEEE Guide for Identification, Testing, and Evaluation of the Dynamic Performance of

Excitation Control Systems

A.3.5 MidAmerican and / or its consultant shall conduct all electric system studies and issue reports required by FERC, NERC, the RRO, MidAmerican, and any other pool or regulatory body for authorization and justification of the proposed interconnection to the MidAmerican electric system. The IC shall reimburse MidAmerican for all costs incurred for these studies and reports according to OATT requirements and procedures.

A.3.6 The IC shall comply with MidAmerican, MRO, and industry design construction / operating standards and procedures.

A.3.7 The IC's installation shall meet all applicable national, state and local construction / safety codes.

A.3.8 The interconnection design shall be capable of accommodating MidAmerican electric system reclosing practices.

A.3.9 The interconnection design shall incorporate equipment to detect system abnormalities or disturbances in either the IC's system or the MidAmerican system. This equipment shall have the capability to isolate the sources of the disturbance.

A.3.10 The interconnection design shall be such that the generator, transformer and other auxiliary equipment shall be protected such that failure of that equipment shall result in the automatic isolation of the affected equipment.

A.3.11 The Interconnection Customer shall provide the required one-line diagram(s) as required. The functional one-line diagram shall be a single engineering drawing that shows the schematic one-line representation of the proposed facility. For multiple distributed generators an equivalent installation can be provided. For wind generation, it is helpful to provide the main substation configuration, step-up transformers, feeders, and a presentation of the expected number of collector circuits. All of the following equipment shall be shown (if applicable to the installation):

A.3.11.1 The generator(s), including the rated voltage, kW and kVA of the generator, configuration of the generator neutral, the value of any neutral grounding impedance used, the kVA rating, turns ratio, and winding configuration of any grounding transformer used on the neutral of the generator.

A.3.11.2 The Generator Step-Up Transformer (GSU) including, the transformer kVA rating(s), the primary and secondary voltages, the percent impedance specified at the transformer base rating, the winding configuration of the

primary and secondary windings.

A.3.11.3 The utility transformer including, the transformer kVA rating(s), the primary and secondary voltages, the percent impedance specified at the transformer base rating, the winding configuration of the primary and secondary windings.

A.3.11.4 Any interconnection breaker(s) between the generator and the MidAmerican point-of-interconnection including, the continuous current rating and the interrupting current rating for symmetrical faults.

A.3.11.5 Any generator output breaker between the generator and the MidAmerican point-of-interconnection including, the continuous current rating and the interrupting current rating for symmetrical faults.

A.3.11.6 Any automatic transfer switch(s) including, the time of transfer for the switch.

A.3.11.7 Any revenue metering including present or proposed location of MidAmerican revenue metering.

A.3.11.8 Any generator interconnection protective relaying including, each functional element of the protective relay scheme shall be shown with a circle inscribed with its IEEE device function number, any lockout relays with a circle inscribed with the number “86”, all current and potential instrument transformer inputs of the protective relaying shall be shown in single-line format, and shall be connected to the functional element circle it is serving with a solid line, the current and potential transformation ratios, along with polarity markings and secondary connection configuration, of all instrument transformers serving the protective relaying shall be specified, breakers that the protective relaying trips either directly or indirectly through a lockout relay shall be indicated with a dashed line, breakers for which the protective relaying provides supervisory synchronism checks shall be indicated with a dotted line.

A.3.11.9 Any interlocks that inhibit the closing or opening of breakers at the installation shall be shown.

A.3.11.10 Generally, it is not necessary to include a detailed

schematic of the loads at the facility, i.e. 480V and below switchboards, unless the loads can be connected in such a way as to create additional interconnection issues. An arrow representing the connection of facility load in relation to the bus tying together the utility source with the interconnection customer generation source is usually sufficient.

A.3.12 The Interconnection Customer shall conform with MidAmerican and any regional Under Frequency Load Shed (UFLS) plans as necessary. This may include the installation of relays with UFLS elements that would trip load during under frequency events according to MidAmerican and regional guidelines. It may also required generation to ride through under voltage and under frequency events according to MidAmerican and regional guidelines. Underfrequency relaying protects generation from excessive loss of life and settings and time delays must also be coordinated with load shedding to allow the UFLS program a reasonable time to play out and to restore frequency. Companies that are unable to meet the following minimum time delay standard will be required to trip additional load to compensate. Such load must be a reasonable match to the amount of generation tripped, tripped at essentially the same time and in the same general location.

A.4.0 Feasibility, System Impact, and Facility Studies

A.4.1 The IC shall specify the maximum amount of real and reactive power capable of being delivered to or drawn from the MidAmerican system at the Point of Interconnection. The IC shall control the electrical real (MW) and reactive (MVAR) power output such that it will not exceed the capacity of the interconnection facilities.

A.4.2 The IC shall interconnect to the MidAmerican electric system at the nominal voltage at the agreed to point of interconnection. MidAmerican, at its sole discretion, may elect to upgrade or change the voltage level of the MidAmerican electric system serving the IC's interconnecting facilities. Any costs to upgrade or change the IC's interconnecting facilities to maintain an interconnection with MidAmerican shall be paid in accordance with OATT requirements and procedures.

A.4.3 The IC shall obtain MidAmerican's acceptance of those portions of design documents that apply to protection and security of the MidAmerican electric system according to OATT requirements and procedures. The IC is solely responsible for the design that affects the facility. Protection of the IC's overall

electrical system, including generation and connected load, is the sole responsibility of the IC.

A.4.4 Prior to proceeding with an interconnection plan, the IC shall identify all services which will be required of the MidAmerican electric system upon completion of the interconnection. By agreeing to provisions for an interconnection arrangement, MidAmerican assumes no obligation for other services without prior agreement for such services.

A.4.5 The IC shall design the facility to meet all current MidAmerican reliability standards as accessed at (www.midamericanenergy.com).

A.4.6 The IC shall design the facility to meet all current MAPP / MRO reliability standards (Appendix E) as accessed on the MAPP / MRO website (http://www.mapp.org/content/reliabilityhandbook.shtml), or upon request from MidAmerican.

A.4.7 The IC shall design the facility to meet these technical requirements and facility rating standards (Appendix B) as accessed on the MEC website (www.midamericanenergy.com), or upon request from MidAmerican.

A.5.0 Reserved for Future Use

A.6.0 General Technical Requirements for Interconnections

A.6.1 Reserved for Future Use

A.6.2 The IC shall design the facility to meet all current MAPP / MRO reliability standards (Appendix E) including the MAPP / MRO System Performance Table as accessed on the MAPP / MRO website (see section A.4.6), or upon request from MidAmerican.

A.6.3 The IC shall design the facility to meet these technical requirements and facility rating standards (Appendix B) as accessed on the MEC website (www.midamerican.com), or upon request from MidAmerican.

A.6.4 The IC shall not cause the MidAmerican electric system to violate NERC voltage criteria or voltage ranges defined in ANSI Std C84.1 Range A (plus or minus 5% of nominal).

A.6.5 The IC shall interconnect to the MidAmerican electric system at the nominal voltage at the agreed to point of interconnection. MidAmerican, at its sole discretion, may elect to upgrade or change the voltage level of the MidAmerican electric system serving the IC's interconnecting facilities. The IC shall pay MidAmerican for any such upgrades according to OATT requirements and procedures.

A.6.6 The IC shall control the electrical real (MW) and reactive (MVAR) power output such that it will not exceed the capacity of the interconnection facilities.

A.6.7 The IC's three-phase generation shall be connected to the MidAmerican power system with three-phase automatic disconnecting devices (circuit breakers), which are intended to significantly reduce the possibility of damaging the IC's generation equipment due to single-phase operation. These disconnecting devices shall be equipped with auxiliary contacts that indicate the actual status of the devices' main contacts.

A.6.8 A disconnect device (circuit breaker or switch) must be installed and designated to isolate the IC and MidAmerican systems. The disconnect will serve as a point of interconnection between the IC and MidAmerican and will be labeled as such both on drawings and through signs. The disconnect shall be installed by the IC and be accessible to both MidAmerican and the IC at all times with the ability to be padlocked open by either party. The disconnect shall be owned and operated by MidAmerican to provide a visible air gap with adequate clearances for adequate grounding, maintenance, and repairs of the MidAmerican electric system. MidAmerican may require the capability to apply safety grounds on the MidAmerican side of the disconnect. The IC shall not remove any MidAmerican padlocks or safety tags. OSHA lockout / tagout requirements

A.6.9 System flows as a result of the interconnection shall not overload, or adversely affect, the MidAmerican electric system. Where the IC's generation or transmission facilities supplies fault currents to the MidAmerican electric system that are in excess of breaker or other interrupting device maximum rated interrupting capability, the IC shall be required to install and pay for fault limiting equipment or pay for breaker or other interrupting device replacements according to OATT requirements and procedures.

A.6.10 The harmonic content of the voltage and current wave forms of both the IC's and MidAmerican's systems shall comply with the latest version of the IEEE Std 519, IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

A.6.11 Industry standard Basic Insulation Level (BIL) ratings shall be used for electric system additions and electric system interface equipment. The electric equipment shall meet IEEE C62.41 or C37.90.1 V&I withstand requirements.

A.6.12 The IC shall be able to withstand Electromagnetic Interference (EMI) environments in accordance with ANSI / IEEE Std. C37.90.2. The interconnection system and protection system shall not mis-operate due to EMI, including hand held communication devices.

A.6.13 MidAmerican may install disturbance recording equipment at the system

interface according to NERC, OATT, or regional requirements and procedures.

A.6.14 The interconnection design shall incorporate adequate facilities to enable the on-site generation to be synchronized with the MidAmerican electric system. The IC shall be solely responsible for synchronizing the generator to the system. At MidAmerican's discretion, all occurrences of synchronizing the generator to the system shall be preceded with advance notification, of not less than one full clock hour, provided to the MidAmerican Des Moines Control Center.

A.6.15 All points at which the generator can be paralleled with the MidAmerican electric distribution system must be clearly defined as *synchronization points* in the submittal documentation. A given installation may be designed such that there are several *synchronization points*.

A.6.16 Every circuit opening or closing device such as circuit breakers or disconnect switches in the circuit path between MidAmerican and the on-site generation shall be either:

A.6.16.1 Designated as a *synchronization point* and be equipped with its own dedicated synchronizing equipment or

A.6.16.2 Electrically or mechanically interlocked with the synchronizing device at the clearly defined *synchronization point* such that the synchronizing device will be automatically tripped and blocked from closing any time the interlocked circuit opening or closing device is opened.

A.6.17 A separate, independent, single-phase synchronism check relay shall be installed to supervise all manual and automatic synchronizing attempts. The synchronism check relay shall adhere to the following criteria.

A.6.17.1 The output of the synchronism check relay must be wired directly in the breaker close path. Wiring the output of the synchronism check relay to supervise the breaker via a *Programmable Logic Controller* (*PLC)* is prohibited.

A.6.17.2 The generator synchronism check relay shall be set to the manufacturer recommended settings

A.6.18 Each of the following protective relay functions is required at the point-of-interconnection between the MEC system and the owner's facility similar to IEEE 1547. The protective relay functions may be implemented through several single-function protective relays or a single multi-function protective relay. In either case, operation of any of the following protective functions shall result in the immediate separation of the on-site generation source from the MEC feeder. The following interconnection relays would be required at a minimum:

A.6.18.1 The interconnection relay system shall have undervoltage (IEEE Device Function Number 27) element(s) that shall adhere to the following criteria:

A.6.18.1.1 An undervoltage element shall be provided for each phase. Phase-to-phase undervoltage elements are prohibited.

A.6.18.1.2 Single set point undervoltage elements shall operate if the monitored voltage drops below 88% of nominal for 0.5 seconds.

A.6.18.1.3 Multiple set point undervoltage elements shall operate in 2 seconds if the monitored voltage drops below 88% of nominal and in 0.1 second if the monitored voltage drops below 50% of nominal.

A.6.18.1.4 All new generation starting in 2008 shall be required to remain on-line and ride through a zero voltage fault condition for up to 9 cycles according to the latest FERC standards.

A.6.18.2 The interconnection relay system shall have overvoltage (IEEE Device Function Number 59) element(s) that shall adhere to the following criteria:

A.6.18.2.1 An overvoltage element shall be provided for each phase. Phase-to-phase overvoltage elements are prohibited.

A.6.18.2.2 Single set point overvoltage elements shall operate if the monitored voltage rises above 115% of nominal for 0.5 seconds.

A.6.18.2.3 Multiple set point overvoltage elements shall operate in 1 second if the monitored voltage rises above 110% of nominal and in 0.1 seconds if the monitored voltage rises above 120% of nominal.

A.6.18.3 The interconnection relay system shall have a single overfrequency (IEEE Device Function Number 81O) element that shall adhere to the following criteria:

A.6.18.3.1 The overfrequency element shall be set to operate if the frequency rises above 60.5 Hz.

A.6.18.3.2 The trip output of the overfrequency

element shall be delayed by no more than 0.1 second.

A.6.18.4 The interconnection relay system shall have underfrequency (IEEE Device Function Number 81U) element(s) that shall adhere to the following criteria:

A.6.18.4.1 Single set point underfrequency elements shall operate if the frequency drops below 59.3 Hz for 0.25 seconds.

A.6.18.4.2 Multiple set point underfrequency elements shall operate in 1 second if the frequency drops below 59.3 Hz and in 0.1 second if the frequency drops below 57.0 Hz.

A.6.18.5 If the on-site generation at the facility has the capability to contribute 10% or more of the fault current available for a fault at the point of interconnection, the interconnection relay shall have instantaneous directional overcurrent (IEEE Device Function Number 67I) element(s) designed to sense and clear faults that occur on the MEC feeder. These instantaneous directional overcurrent element(s) shall comply with the following criteria:

A.6.18.5.1 An instantaneous directional overcurrent element shall be provided for each phase.

A.6.18.5.2 The instantaneous directional overcurrent elements shall be set to operate at 150% percent of generation full load amps at the appropriate voltage.

A.6.18.5.3 The trip output of the instantaneous overcurrent elements shall be delayed by no more than 0.4 seconds.

A.6.18.6 If the installation is interconnected with the MEC distribution system with a delta-wye transformer with the delta winding on the utility side (Note that this type of connection shall only be allowed in extraordinary circumstances as determined on a case-by-case basis by MidAmerican), the interconnection relay shall have a single zero sequence overvoltage (ANSI-IEEE Relay Function Number 59G or 59N) element that shall comply with the following criteria:

A.6.18.6.1 The zero sequence overvoltage element's sensing inputs shall be connected to monitor

the 3V0 voltage on the utility side of the interconnection transformer, i.e. the delta side.

A.6.18.6.2 The sensing inputs to the zero sequence overvoltage element shall be a set of three instrument potential transformers that shall be connected grounded wye on the primary and broken corner delta on the secondary. The use of a single instrument transformer to provide zero sequence voltage sensing is prohibited.

A.6.18.6.3 The zero sequence overvoltage element shall be frequency compensated to respond only to the 60 Hz fundamental frequency.

A.6.18.6.4 The zero sequence overvoltage element shall be set to operate at 20% of nominal phase to ground potential.

A.6.18.6.5 The trip output of the zero sequence overvoltage element shall be delayed by no more than 0.5 seconds.

Table 1 – Summary of setting in A.6.18

Element	Set Point	Time Delay
27-1	88%*	0.5 seconds **
		2.0 seconds
27-2	50% *	2 seconds
59-1	115% * **	0.5 seconds **
	110% *	1.0 seconds
59-2	120%	0.1 seconds
81O	60.5 Hz	0.1 seconds
81U-1	59.3 Hz	0.25 seconds **
		1.0 seconds
81U-2	57.0 Hz	0.1 seconds
32	5% ***	2.0 seconds or less
671	150% ****	0.4 seconds or less
59N or 59G	20% *	0.5 seconds or less

* This setting is in percent of nominal phase-to-ground potential.

** This setting applies to single set point relays only.

*** This setting is in percent of the three phase kW rating of the total aggregate generation capacity.

**** This setting is in percent of generation full load amps at the appropriate voltage.

A.6.19 Communication facilities shall be provided by the IC according to OATT requirements and procedures for communications between the IC's generating facility and MidAmerican.

A.6.20 If required, the IC shall install, own, and maintain Remote Terminal Unit (RTU) equipment and associated communications that is compatible with

MidAmerican equipment. The IC shall be responsible for RTU installation and subject to MidAmerican approval according to OATT requirements and procedures.

A.6.21 If required, the MidAmerican Des Moines Control Center shall be provided with breaker control to allow non-MidAmerican generation facilities to be disconnected from MidAmerican transmission facilities. As necessary, during emergencies, MidAmerican reserves the right to disconnect the IC's generation facilities from the MidAmerican electric system without prior notification.

A.6.21 The IC must design their equipment to provide adequate grounding. The ground grid must be designed according to IEEE 80. The IC shall provide MidAmerican data on soil resistivity and a ground grid design prior to the construction of the ground grid.

A.6.22 The IC shall provide a ground current path from the IC that is acceptable to MidAmerican. The IC grounding scheme shall not cause overvoltages that exceed MidAmerican equipment ratings or interconnection equipment ratings. The IC grounding scheme shall not disrupt ground fault protection coordination.

A.6.23 Where required, the ground path shall be effectively grounded according to IEEE 142 which specifies that the positive zero sequence reactance is greater than the zero sequence resistance ($X1 > R0$) and zero sequence reactance is less than or equal to three (3) times the positive sequence reactance ($X1 \leq 3*X0$).

A.6.24 The interconnection design shall be such that MidAmerican will be able to ground and test any MidAmerican owned or serviced equipment. This may require the IC to pay for and install approved grounding equipment at the facility according to OATT requirements and procedures.

A.7.0. System Protection Requirements

A.7.1 The components of an electrical utility system are subject to a variety of natural and man-made hazards. It is essential that a suitable protection system be used which minimizes hazards to the public, MidAmerican, MidAmerican's customers, and the IC's facilities. Protective devices installed by MidAmerican can function properly only if all sources of energy and fault current are taken into consideration. Generation, grounded equipment, capacitor banks, or other special devices operated in parallel with the MidAmerican electric system may cause additional fault current energy during a disturbance on the MidAmerican electric system.

A.7.2 Equipment shall be provided to detect system abnormalities in the IC's or MidAmerican's system, and shall have the capability to isolate the sources of the disturbance. At a minimum, the IC shall provide adequate protective devices to:

A.7.2.1. Detect and clear short circuits on MidAmerican facilities serving the interconnecting facilities

A.7.2.2 Detect the voltage and frequency changes which can occur if MidAmerican facilities serving the interconnecting facilities are disconnected from the main system, and clear any IC generation / load from the isolated system if necessary.

A.7.2.3 Prevent reclosing the IC's generation to MidAmerican, after an incident of trouble, until authorized by MidAmerican's Des Moines Control Center.

A.7.2.4 Isolate the IC's generation from the MidAmerican electric system upon:

A.7.2.4.1 Receipt of a direct trip signal from an upstream MidAmerican substation.

A.7.2.4.2 Failure of the communications channel used for direct tripping

A.7.2.4.3 Receipt of a trip command from the MidAmerican Des Moines Control Center via SCADA.

A.7.3 The generator, transformer and other auxiliary equipment shall be protected so failure of any equipment, or a disturbance, in the IC's plant shall result in isolation of the affected equipment.

A.7.4 The equipment associated with the IC's interconnection facilities should be protected in accordance with the practices described in the latest revision of the following ANSI/IEEE Standards or Guides. There may be special requirements imposed by MidAmerican due to the specific project or application.

A7.4.1 ANSI/IEEE C37.91, Guide for Protective Relay Applications to Power Transformers

A7.4.2 ANSI/IEEE C37.95, Guide for Protective Relaying of Utility-Customer Interconnections

A7.4.3 ANSI/IEEE C37.97, Guide for Protective Relay Applications to Power System Busses

A7.4.4 ANSI/IEEE C37.101, Guide for Generator Ground Protection

A7.4.5 ANSI/IEEE C37.102, Guide for AC Generator Protection

A7.4.6 ANSI/IEEE C37.106, Guide for Abnormal Frequency Protection for Power Generating Plants

A7.4.7 ANSI/IEEE Std 1001, Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems

A.7.5 One-line and three-line diagrams shall be provided. A single engineering drawing that shows the schematic one-line representation of the proposed facility.

All of the equipment shall be shown including any generators, step-up transformers, breakers, switches, fuses, wiring to reach the point of interconnection, and utility transformers. All appropriate ratings including generator power factor, any kW, kVAR, KVA, amps, fault capabilities are to be listed next to their respective equipment. All protective devices shall be listed and with appropriate numbering as set forth in the latest revision of ANSI C37.2. This standard numbering shall be used by the IC on all documentation provided to MidAmerican. A few of the more commonly used devices are:

	Number	Description
A7.5.1	2	Time-Delay Starting or Closing Relay
A7.5.2	4	Master Contactor
A7.5.3	21	Distance Relay
A7.5.4	25	Synchronizing or Synchronism-Check Device
A7.5.5	27	Undervoltage Relay
A7.5.6	32	Directional Power Relay
A7.5.7	40	Field Relay
A7.5.8	46	Phase-Balance Current Relay
A7.5.9	47	Phase-Sequence Voltage Relay
A7.5.10	50	Instantaneous Overcurrent Relay
A7.5.11	51	AC Time Overcurrent Relay
A7.5.12	52	AC Circuit Breaker
A7.5.13	59	Overvoltage Relay
A7.5.14	67	ac Directional Overcurrent Relay
A7.5.15	81	Frequency Relay

A.7.6 MidAmerican shall review the generator, main transformer, main breakers, synchronizing and any other interface equipment protection schemes and the setting and certified test records for these protective devices. The proposed settings for these devices shall be submitted no less than 60 days prior to implementation. Acceptance will not be unreasonably withheld. Any changes required by MidAmerican shall be made prior to final acceptance, and MidAmerican shall be provided with final copies of the reviewed drawings and settings.

A.7.7 The IC shall not make any substantial modifications or alterations to its facility or any modifications to the protective devices or setting. All relaying equipment shall be kept under seal, which shall be broken only when the relays are to be tested or adjusted, or subject to inspection by MidAmerican.

A.7.8 All protective devices supplied to satisfy the requirements of section A.7.0 shall be tested by qualified personnel at intervals at least as frequent as those used by MidAmerican for the relays protecting the facilities serving the interconnection facilities. Special tests may also be requested by MidAmerican to investigate apparent misoperations.

A.7.9 Each routine or special test shall include both a calibration check and an actual trip of the circuit breaker from the device being tested. A report of each test shall be prepared and sent to MidAmerican listing the tests made and the "as found" and "as left" calibration values.

A.7.10 MidAmerican complies with the MAPP / MRO underfrequency load shed plan and may install or require the IC to install underfrequency relays which shall be maintained in a functional state at all times. This requirement is site specific and will be determined after the system studies are completed. The underfrequency device setting will be specified by MidAmerican.

A.7.11 MidAmerican facilities serving the interconnection facilities may be equipped with high speed reclosing to expedite returning the facilities to service following a fault of temporary nature. The protective devices installed by the IC and acceptable to MidAmerican are intended to disconnect the generation from faulted or isolated lines before reclosing occurs. Depending on the installation, MidAmerican may require "Hot Line Reclose Blocking" to be installed at the necessary points on MidAmerican's system. If desired by the IC, a breaker auxiliary contact may be provided, at the IC's expense, to initiate transfer trip to protect the IC's generator from out-of-phase reclosing on the MidAmerican system.

A.7.12 All protective relays shall be "Utility Grade" protective relays. These relays have more stringent tolerances and more flexible, widely published characteristics then "industrial quality" relays.

A.7.13 In some cases, protective devices supplied with the IC's equipment will meet some or all of the requirements in this section, provided that it is acceptable to trip the generator whenever the MidAmerican source is lost. If the IC desires to automatically separate from MidAmerican and commence isolated operation upon loss of the MidAmerican source, additional devices may be necessary to effect the separation.

A.7.14 All protective devices supplied to satisfy the requirements of section A.7 shall be equipped with operation indicators (targets) or shall be connected to an annunciator or event recorder so that it will be possible to determine, after the fact, which devices caused a particular trip.

A.8.0. Metering and Indication Requirements

A.8.1 Recording metering with dial up capability and / or SCADA may be required according to MidAmerican requirements. Recording metering with dial up capability is required for installations with generators rated at 2,000 kVA and greater. SCADA is required for installations with generators rated at 4,000 kVA and greater. Suitable SCADA (metering and telemetering) equipment shall be provided to meter and to transmit electrical energy and demand information at

the interface to the MidAmerican Des Moines Control Center according to OATT requirements and procedures.

A.8.2 All metering equipment required for this interconnection shall be installed and maintained by MidAmerican. Metering equipment shall be of the type currently prescribed by the OATT requirements and procedures. Such metering typically includes all watthour meters, VAR hour meters, energy recorders, current and potential transformers and associated equipment at each point of interconnection for billing and system control.

A.8.3 Metering equipment shall be tested periodically by the IC or MidAmerican. All metering equipment shall be owned, maintained, and tested periodically as specified by the more restrictive of NERC or MidAmerican criteria. Accuracy of registration shall be maintained in accordance with prudent utility practices and accepted industry standards. Modern solid-state meters should be calibrated to at least +/- 0.3% and hold that accuracy. Installation of electro-mechanical meters is not allowed. On request of either party, a special test may be made at the expense of the party requesting such special test. Representatives of both parties shall be afforded the opportunity to be present at all routine and special tests. If, as a result of any test, any meter is found to be registering more than one half of one percent (0.5%) above or below one hundred percent (100%) of accuracy, the registration of such meter shall be corrected for a period equal to one-half (1/2) of the elapsed time since the last prior test and adjustment, according to the percentage of inaccuracy so found, except that if the meter shall have become defective or inaccurate at a reasonably ascertainable time since the last prior test and adjustment of such meter, the correction shall extend back to such time. Should metering equipment fail to register, the electrical energy delivered shall be determined from the best available data. All metering equipment shall be kept under seal, which shall be broken only when the metering is to be tested, adjusted, or inspected by MidAmerican.

A.9 – A10 Reserved for Future Use

A.11.0 Operating Requirements

A.11.1 The IC shall not commence parallel operation of generator(s) until final written acceptance has been given by MidAmerican. MidAmerican reserves the right to inspect the IC's facility and witness testing of any equipment or devices associated with the interconnection. The IC shall submit a written, detailed procedure with specific requirements for initial commissioning of the IC's generation and interconnecting facilities for MidAmerican approval. MidAmerican and the IC shall each identify one representative to serve as a coordination contact to be the initial point of contact and coordinate communications between the parties for both normal and emergency conditions. MidAmerican and the IC shall notify each other in writing of the personnel that it has appointed as its coordination contact. MidAmerican and the IC shall abide

by their respective switching and tagging rules for obtaining clearances for work or for switching operations on equipment. Such switching and tagging rules shall be developed in accordance with OSHA standards. MidAmerican and the IC shall develop mutually acceptable switching and tagging rules for MidAmerican's and the IC's facilities that involve common clearance requirements. The IC shall follow MidAmerican directives with regard to emergencies on the MidAmerican system.

A.11.2 The IC shall not be permitted to energize a de-energized MidAmerican circuit and will follow lockout / tagout procedures.

A.11.3 The operation of the IC's on-site equipment shall not result in unacceptable service to other MidAmerican customers, such as voltage and frequency fluctuations or harmonic currents on the MidAmerican system. The IC shall comply with the latest revision of MidAmerican's allowable voltage flicker standards (Appendix F).

A.11.4 The operation of the IC's on-site generation shall not cause the service voltage for other MidAmerican customers to go outside the requirements of ANSI C84.1, Range A.

A.11.5 The operation of the IC's on-site generation shall not adversely affect the voltage regulation of the MidAmerican system.

A.11.6 The operation of the IC's on-site generation shall be conducted in a manner that minimizes reactive flow from the on-site generation to the MidAmerican system, except when requested to assist in voltage control on the MidAmerican system.

A.11.7 Interconnection Customer shall design the Large Generating Facility to maintain a composite power delivery at continuous rated power output measured at the generator terminals at a power factor within the range of 0.90 leading to 0.95 lagging, unless the Transmission Provider has established different requirements that apply to all generators in the Control Area on a comparable basis. This shall apply to all units unless specifically exempted by FERC, NERC, or MidAmerican. The IC's voltage regulation equipment will be designed and operated to limit VAR flow to a power factor between 0.90 leading and 0.95 lagging except for units connected to the MidAmerican distribution system rated at 15 kV and less. These generators are to maintain unity power factor and shall not regulate the distribution system voltage unless requested or required to do so by MidAmerican per the IEEE 1547 Standards.

A.11.8 The operation of the IC's on-site induction machines or other non-synchronous generation shall be required to provide the same VAR support as synchronous machines unless specifically exempted by FERC or other governmental authority.

A.11.9 Operation of the IC's equipment shall not adversely affect the voltage regulation of the MidAmerican system. The IC shall minimize the reactive flow, except when requested to assist in voltage control on the MidAmerican system. The IC shall provide adequate voltage control to minimize voltage regulation on the MidAmerican system caused by generator loading conditions.

A.11.10 In cases where starting or load changing on induction generators will have an adverse impact on MidAmerican system voltage, step-switched capacitors or other techniques may be required to attenuate the voltage changes to acceptable levels.

A.11.11 For synchronous generators, sufficient generator reactive power capability shall be provided to withstand normal voltage changes on the MidAmerican system. The generator voltage-VAR schedule, voltage regulator, and transformer ratio settings will be jointly determined by MidAmerican and the IC to ensure proper coordination of voltages and regulator action. The IC is encouraged to generate their own VAR requirements to minimize power factor adjustment charges and enhance generator stability.

A.11.12 Induction or other non-synchronous generating installations shall provide the same voltage and VAR support as synchronous installations in Section A.11.7 except where specifically exempted by FERC or other governmental authorities.

A.11.12.1 Where the IC's installation does not comply with this requirement, and the existing MidAmerican system can reliably supply the VARs for voltage support without installations of reactive compensation, the IC may either purchase the reactive requirements for voltage support from MidAmerican or supply such requirements with its own compensation. The reactive supply obtained from MidAmerican shall be billed on a tariff to be determined during contract discussions.

A.11.12.2 Where the IC's installation does not comply with this requirement, and the existing MidAmerican system cannot reliably supply the VARs for voltage support, MidAmerican shall install apparatus on the MidAmerican system to supply the required vars. The cost of the apparatus, controls, installation and operation shall be paid according to OATT requirements and procedures.

A.11.13 Reactive power supply requirements for inverter systems are similar to those for induction generators and the preceding comments apply except where specifically exempted by FERC or other governmental authorities.

A.11.14 To avoid self-excitation, care shall be exercised in applying power factor correction capacitors directly to or electrically near induction generator terminals.

A.11.15 The IC shall discontinue parallel operation of the IC when requested by MidAmerican for the following purposes:

A.11.15.1	To facilitate maintenance, tests or repairs of the MidAmerican Electric System
A.11.15.2	During emergencies on the MidAmerican Electric System
A.11.15.3	When the IC generating equipment is interfering with customers on the MidAmerican Electric System
A.11.15.4	When an inspection of the IC reveals a condition hazardous to the MidAmerican Electric System or a lack of scheduled maintenance records is found

A.11.16 The MAPP / MRO require all members to share in an operating reserve or Generation Reserve Sharing Pool. MidAmerican shall require a specific agreement to supply operating reserve to cover the IC's generation to load at that site. The generator will provide or contract for adequate generation to meet MRO or power pool generation reserve, spinning reserve and load following requirements.

A.11.17 The IC shall coordinate with all NERC, MRO, and MidAmerican Under Frequency Load Shedding requirements. During any underfrequency situation, the IC shall agree to immediately make available to MidAmerican any spinning or operating reserves that exist on their generation.

A.11.18 The IC shall adhere to the MAPP / MRO Operating Standards, any MidAmerican Operating Guides, and any additional operating requirements either stated herein or mutually agreed to elsewhere. The latest revision of the following MAPP / MRO documents shall serve as minimum requirements for system operation.

A.11.19 MidAmerican and the IC may, in accordance with good utility practices, remove from service facilities or network upgrades as necessary to perform maintenance, test, and install or replace equipment. MidAmerican and the IC will use reasonable efforts to coordinate outages for maintenance on dates and times mutually acceptable to both parties.

A.11.20 The IC shall compensate MidAmerican for any incremental energy or reactive losses and incremental demand charges resulting from changes in system power flow caused by the IC's system addition in accordance with OATT requirements and procedures.

A.11.21 The IC shall operate the interconnection facilities in compliance with the latest revision of the National Electric Safety Code, applicable state codes, MidAmerican safety rules and IEEE Std 519. Failure to comply with said safety policies and Power Quality Standards will result in the interconnection being opened. The interconnection will not be re-established until compliance has been determined.

A.11.22 The IC shall maintain its interconnection facilities and any generating equipment that could negatively impact the MidAmerican system in good order. MidAmerican reserves the right to inspect the IC's facilities on a periodic basis or whenever it appears that the IC is operating in a manner hazardous to MidAmerican's system integrity.

A.12.0 Specific Generator Interconnection Requirements

A.12.1 The following requirements apply specifically to generation interconnections.

A12.2 The equipment associated with the IC's generation equipment should be protected in accordance with the practices described in the latest revision of the following ANSI/IEEE Standards or Guides. There may be special requirements imposed by MEC due to the specific project or application.

A12.2.1	General Requirements for Synchronous Machines, ANSI C50.10-1990
A12.2.2	Requirements for Salient Pole Synchronous Generators and Condensers, ANSI 50.12-1982
A12.2.3	Requirements for Cylindrical-Rotor Synchronous Generators, ANSI C50.13-1989
A12.2.4	Requirements for Combustion Gas Turbine Driven Cylindrical-Rotor Synchronous Generators, ANSI C50.14-1977
A12.2.5	Guide for Generator Ground Protection, ANSI/IEEE C37.101
A12.2.6	Guide for AC Generator Protection, ANSI/IEEE C37.102
A12.2.7	Guide for Abnormal Frequency Protection for Power Generating Plants, ANSI/IEEE C37.106
A12.2.8	Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems, ANSI/IEEE Std 1001
A12.2.9	Standard for Interconnecting Distributed Resources with Electric Power Systems, IEEE 1547

A.12.3 Any generating unit or line / end user interconnection to the MidAmerican electric system with its output purchased by MidAmerican, or

another Network Customer, shall be considered a “Network Resource” under the terms of Part III of the OATT.

A.12.4 Generator installations requesting MAPP / MRO accreditation must meet all NERC, MAPP / MRO, and MidAmerican requirements including MAPP Generation Reserve Sharing Pool requirements, URGE testing, and any reactive testing requirements.

A.12.5 The MAPP / MRO requires all members to share in an operating reserve or Generation Reserve Sharing Pool. MidAmerican shall require a specific agreement to supply operating reserve to cover the IC's generation to load at that site. The generator will provide or contract for adequate generation to meet MRO or power pool generation reserve, spinning reserve and load following requirements.

A.12.6 The Generator Step-Up (GSU) transformer connection will be determined by the system impact study. In general, the GSU must be effectively grounded on the utility side providing an adequate ground reference and will isolate the generator’s zero sequence current from the MidAmerican system through the use of an ungrounded connection on the generator side. The transformer shall be equipped with a no-load tap changer covering the range of plus or minus 5% in 2.5% steps from the nominal voltage of the interconnection.

A.12.7 The Generator Owner (GO) will coordinate with the Transmission Owner (MidAmerican Energy) on setting its GSU taps in accordance with NERC standards VAR-001-1 (R11) and VAR-002-1 (R5). The Generator Owner will contact MidAmerican at least 90 days in advance of changing GSU taps. The Generator Owner will also work with the Transmission Owner and Balancing Authority (BA) (MidAmerican) to consider if GSU taps need to be changed due to a request from the TO or BA and / or changing system conditions. After consultation with the Generator Owner regarding necessary step-up transformer tap changes, the Transmission Operator shall provide documentation to the Generator Owner specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. After consultation with the Transmission Operator regarding necessary step-up transformer tap changes, the Generator Owner shall ensure that transformer tap positions are changed according to the specifications provided by the Transmission Operator, unless such action would violate safety, an equipment rating, a regulatory requirement, or a statutory requirement

A.12.8 MidAmerican requires synch-check relays to be installed on all circuit breakers interconnecting a generating unit to the MidAmerican electric system.

A.12.9 Induction generators may use a speed matching relay (Device 15) as a means of synchronization and to limit the magnetizing inrush current / voltage drop. The speed matching must keep voltage flicker at the point of interconnection within MidAmerican voltage flicker requirement and within IEEE 519 requirements.

A.12.10 Generation operated in parallel with the MidAmerican electric system may supply additional fault current energy which shall be disconnected in case of a disturbance on MidAmerican's system. The existence of parallel generation may alter the operation of protective devices normally used by MidAmerican to protect the system.

A.12.11 Equipment shall be provided to detect system abnormalities in the IC's or MidAmerican's system, and shall have the capability to isolate the sources of the disturbance. At a minimum, the IC shall provide adequate protective devices to:

- A.12.11.1 Detect and clear the generator(s) from short circuits on MidAmerican facilities serving the interconnecting facilities
- A.12.11.2 Detect the voltage and frequency changes which can occur if MidAmerican facilities serving the interconnecting facilities are disconnected from the main system, and clear any IC generation / load from the isolated system if necessary.
- A.12.11.3 Prevent reclosing the IC's generation to MidAmerican, after an incident of trouble, until authorized by MidAmerican's Des Moines Control Center.
- A.12.11.4 Isolate IC's generation from the MidAmerican electric system upon:
  - A.12.11.4.1 Receipt of a direct trip signal from an upstream MidAmerican substation.
  - A.12.11.4.2 Failure of the communications channel used for direct tripping
  - A.12.11.4.3 Receipt of a trip command from the Des Moines Control Center via SCADA

A.12.12 MidAmerican, at its discretion, may require Out-of-Step protection and/or loss of excitation protection and/or overexcitation protection to trip or block trip the IC's interconnection. The requirement for this protection will be determined during system studies.

A.12.13 The IC should be aware that certain conditions on MidAmerican's system can cause negative sequence currents to flow in the generator. It is the sole responsibility of the IC to protect the IC's equipment from excessive negative sequence currents.

A.12.14 The IC shall design its facilities (generation or otherwise) to avoid causing dynamic voltage excursions above 1.2 and below 0.7 per unit according to the MAPP / MRO performance design standards (See the MAPP / MRO

Reliability Handbook, Section 3, NERC / MAPP Planning Standards, Section IA.M1 – M4 standards, guidelines, and System Performance Table). The MAPP / MRO Reliability Handbook may be accessed via the MAPP / MRO website (http://www.mapp.org/assets/Reliability%20Handbook/2004_Reliability_Handbook.pdf) or may be obtained upon request to the Electric System Planning department at 106 E 2nd Street, Davenport, IA. 52801. Telephone contact (563-333-8329)

A.12.15 The IC shall design its generation to remain on-line for faults and for any resulting in zero and low voltages to maintain system reliability. Generation must remain on-line for the duration of a normally-cleared (single or three phase) fault on the electric system up to a maximum of nine (9) cycles, as well as for the recovery from such a normally cleared fault even where the voltage drops to zero during the clearing of the fault.

A.12.16 Generators must be designed to remain on line for normal clearing system faults within the close proximity to the plant switchyard. Voltage may approach zero at the switchyard bus for nine (9) cycles for some types of faults. Control systems, contactors, motors and auxiliary loads that are critical to the operation of the plant must not drop out under these conditions. Critical 480 volt supply contactors must be provided with ride-through capability where required. Additionally, generator protection systems such as the Load Drop Anticipator, Early Valve Actuator or Power Load Unbalance should not be designed to trip a generator for normal clearing external faults or stable swings.

A.12.17 The IC shall design its generation to remain on-line for off-nominal frequency operation according to the IEEE C.37.106 Standard or the specified following time frames to meet the following MidAmerican and MRO region over / under frequency requirements:

MRO Underfrequency (Hz)	Overfrequency (Hz)	Minimum Time
60.00 – 59.70	60.0 – 60.3	Continuous
59.70 – 59.50	60.4 – 61.5	Continuous - Governor action
59.49 – 59.30		2700 seconds
59.29 – 59.00	61.6 – 61.8	300 seconds
58.99 – 58.40		80 seconds
58.39 – 58.00	61.9 – 62.0	30 seconds
57.99 – 57.60		7.5 seconds
Less than 57.59	Greater than 62.0	0 or Instantaneous trip

A.12.18 Only solid state microprocessor underfrequency relays shall be used on generators to provide off-nominal frequency protection.

A.12.19 Synchronous generators with a nameplate rating greater than 20.0 MVA shall have generator protection set such that it does not result in tripping of the generator for the following conditions;

A.12.20.1 Generator terminal voltages that are within 5 % of the rated nominal design voltage.

A.12.20.2 Generator terminal voltage deviations that exceed 5% but are within 10% of the rated nominal design voltage and persist for less than 10.0 seconds.

A.12.20.3 Generator volts per hertz conditions that are less than 116% (of generator nominal voltage) that last for less than 1.5 seconds.

A.12.20.4 Generator overexcited stator currents (or generator apparent impedance) less than 150% of nameplate rating persisting for less than 5.0 seconds.

A.12.21 Documentation of the generator protection and controls that could respond to these conditions by tripping the generator shall be provided to MidAmerican. In the event the generating equipment owner can not correct or mitigate these potential generator trip conditions, a request for a waiver may be made to MidAmerican. A waiver may be justified in certain special circumstances such as low adverse reliability consequences from generator tripping.

A12.22 All synchronous generators connected to the MidAmerican transmission system are to be equipped with automatic voltage regulators (AVR). Generators must operate with their excitation system in the automatic voltage control mode unless otherwise approved by the MidAmerican system operator. Generating equipment owners shall maintain a log which records the date, time, duration and reason for not being in the automatic voltage control mode when operating in parallel with the MidAmerican system. Generating equipment owners shall make this log available to MidAmerican on request.

A.12.23 All synchronous generators connected to the MidAmerican transmission system must maintain a network voltage or reactive power output as specified by the MidAmerican system operator within the reactive power capability of the generating equipment. Generating equipment owners shall maintain a log which records the date, time, duration, and reason for not meeting the network voltage schedule or desired reactive power output when operating in parallel with the MidAmerican system. Generating equipment owners shall make this log available to MidAmerican on request.

A.12.24 The generator step-up and auxiliary transformer tap settings shall be

coordinated with MidAmerican transmission systems voltage requirements. Generating equipment owners shall provide MidAmerican with generator step-up and auxiliary transformer tap settings and available ranges.

A.12.25 The AVR's control and limiting functions must coordinate with the generator's short time capabilities and protective relay settings. The generating equipment owner shall provide MidAmerican with the AVR's control and limiter settings as well as the protection settings which coordinate with AVR control and limiting functions.

A.12.26 All new synchronous generators connected to the MidAmerican transmission system with a nameplate rating greater than 20 MVA shall be equipped with a speed/load governing control that has a speed droop characteristic in the 3 to 6% range. The preferred droop characteristic setting is 5%. Notification of changes in the status of the speed/load governing controls must be provided to the MidAmerican System Operator.

A.12.27 Prior to commercial operation, the generating equipment owner shall provide MidAmerican with open circuit, step-in voltage test results. Recording of generator terminal voltage and field voltages shall be clearly labeled so that initial and final values can be identified in physical units.

A.12.28 Generating equipment owners shall annually test the gross and net dependable summer and winter capability of their units. These test results shall be provided to MidAmerican.

A.12.29 Generating equipment owners shall annually test the gross and net real and reactive capability of their units according to NERC / FERC requirements, if applicable, or at least every five years. These test results shall be provided to MidAmerican.

A.12.30 Generating equipment owners shall test the AVR control and limit functions of their units according to the latest NERC / FERC / MAPP / MRO standads. An initial test result shall be provided to MidAmerican prior to commercial operation and every five years thereafter. The initial test results shall include documentation of the settings AVR control and limit functions. Typical AVR limit functions are; maximum and minimum excitation limiters and volts per hertz limiters. Documentation of the generator protection that coordinates with these limit functions shall also be provided. Typical generator protection of this type includes over excitation protection, loss of field protection.

A.12.31 The IC generator shall meet all MAPP / MRO requirements for providing an appropriate high response excitation system and make provisions for a Power System Stabilizer (PSS) on all units rated at 70 MW and greater. The exciter shall meet the following requirements:

A.12.31.1. The response ratio less is less than 2.0 as demonstrated through calculations consistent with IEEE Standard 421.2-1990.

A.12.31.2 The response time is less than 0.1 seconds as demonstrated through the completion of a response ratio test.

A.12.31.3 The open circuit step-response test is satisfactory where satisfactory means that the response is not oscillatory in nature.

A.12.32 The IC shall demonstrate that they have the appropriate exciter model by providing P/SSE or other plots of generator response ratio tests and open-circuit step tests that demonstrate the unit meets the criteria in A.12.31.

A.12.33 The IC generator shall meet all MAPP / MRO requirements for the installation and tuning of Power System Stabilizers (PSS) where appropriate long-term dynamic stability and eigen value studies show a positive contribution to the damping torque in the frequency range from 0.25 Hz to 2.0 Hz.

A.12.34 Where stabilizing equipment is installed on generating equipment for the purpose of maintaining generator or transmission system stability, the generating equipment owner is responsible for maintaining the stabilizing equipment in good working order and promptly reporting to the MidAmerican System Operator any problems interfering with its proper operation.

A.12.35 Generation interconnected to the MidAmerican 15 kV system shall have a paralleling device capable of withstanding up to 220% of rated voltage per the IEEE 1547.

A.12.36 Generation interconnected to the MidAmerican 15 kV system shall not inject DC current greater than 0.5% of the full rated output current at the point-of-common coupling.

A.12.37 Generation connected to Secondary Spot networks and Secondary Grids shall not be connected until a detailed powerflow and system protection study has been performed to determine when and how such an interconnection can be safely allowed. The generation shall not use network protectors to separate, switch, serve as breaker failure backup, or in any manner isolate a network or network primary feeder to which generation is connected unless the protectors are rated and tested per IEEE C37.108 and IEEE C57.12.44-2000. Nor shall the generation cause any cycling or operation of the network protectors.

A.13.0 Specific Line Interconnection Requirements

A.13.1 There are no Interconnection requirements specific to just line or transmission customer interconnections at present.

A.14.0 Specific End User Interconnection Requirements

A.14.1 There are no Interconnection requirements specific to End User interconnections at present.

Appendix B

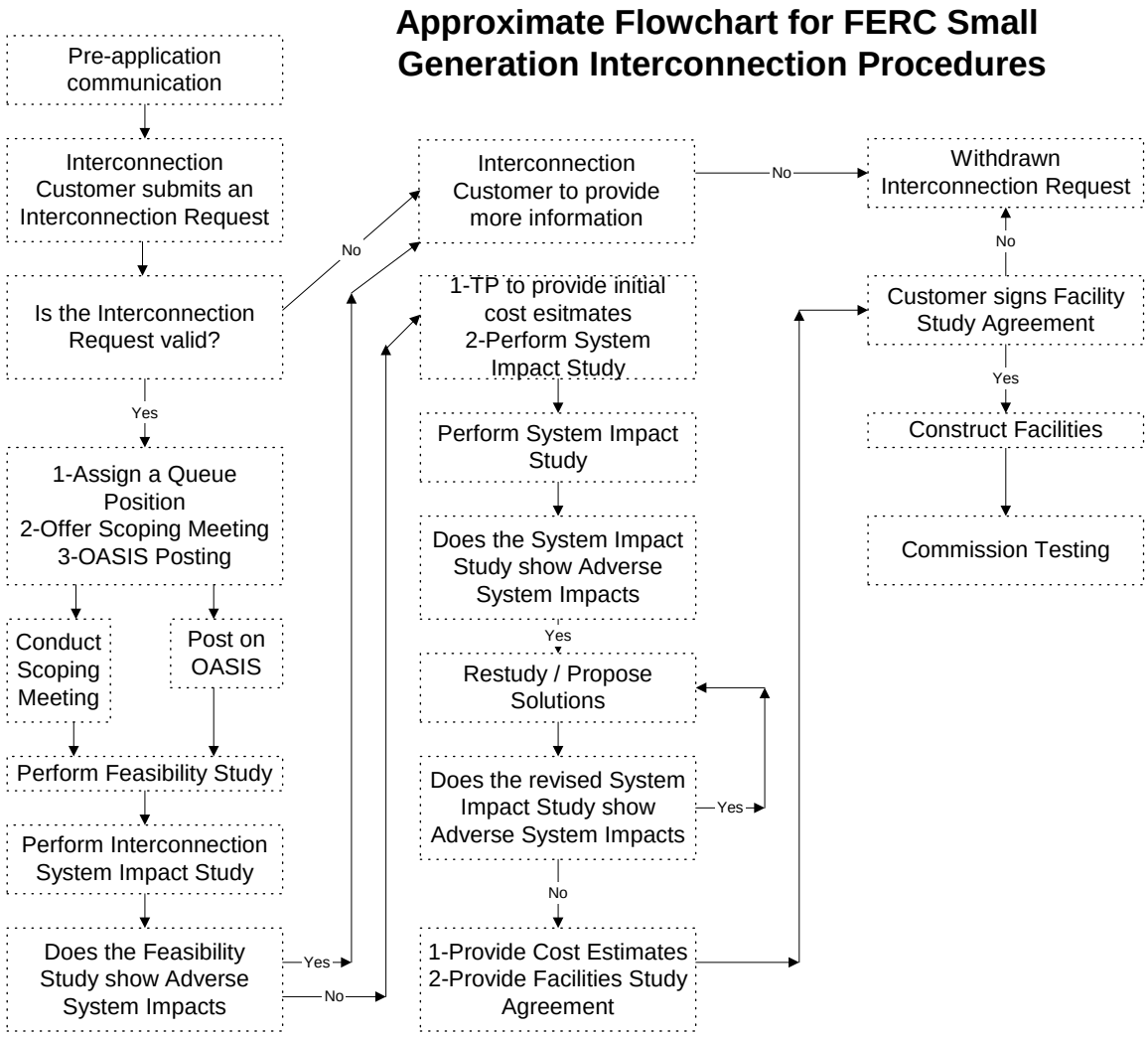
MidAmerican Electric Facility Rating Criteria

The MidAmerican Electric Facility Rating Criteria may be accessed via the web at (www.midamericanenergy.com) or upon request to the Electric System Planning department at 106 E 2nd Street, Davenport, IA. 52801. Telephone contact (563-333-8329)

Appendix C

MidAmerican OATT Process and Small Generation Interconnection Procedures / Agreements

The MidAmerican Open Access Transmission Tariff (OATT) may be accessed via the web at (http://mapp.oasis.mapp.org/documents/MEC/FERCFilings.html) or upon request to the Electric System Planning department at 106 E 2nd Street, Davenport, IA. 52801. Telephone contact (563-333-8329)



Appendix D

NERC Reliability Standards

The NERC Reliability Standards may be accessed via the web at (http://www.nerc.com/~filez/standards/Reliability_Standards.html) or upon request to the Electric System Planning department at 106 E 2nd Street, Davenport, IA. 52801. Telephone contact (563-333-8329)

BAL	Resource and Demand Balancing	**MOD**	Modeling, Data, and Analysis
CIP	Critical Infrastructure Protection	**ORG**	Organization Certification
COM	Communications	**PER**	Personnel Performance, Training, and Qualifications
EOP	Emergency Preparedness and Operations	**PRC**	Protection and Control
FAC	Facilities Design, Connections and Maintenance	**TOP**	Transmission Operations
INT	Interchange Scheduling and Coordination	**TPL**	Transmission Planning
IRO	Interconnection Reliability Operations and Coordination	**VAR**	Voltage and Reactive

Appendix E

MAPP / MRO Planning Standards

The MAPP / MRO Planning Standards may be accessed via the web at (http://www.mapp.org/assets/Reliability%20Handbook/2004_Reliability_Handbook.pdf) or upon request to the Electric System Planning department at 106 E 2nd Street, Davenport, IA. 52801. Telephone contact (563-333-8329)

Appendix F

MidAmerican Voltage Flicker Criteria

The MidAmerican Voltage Flicker Criteria may be accessed via the web at (www.midamericanenergy.com) or upon request to the Electric System Planning department at 106 E 2nd Street, Davenport, IA. 52801. Telephone contact (563-333-8329)

Appendix G

MidAmerican Harmonic Criteria

The MidAmerican Voltage Harmonic Criteria may be accessed via the web at (www.midamericanenergy.com) or upon request to the Electric System Planning department at 106 E 2nd Street, Davenport, IA. 52801. Telephone contact (563-333-8329)

Appendix H

Summary of FERC Seven Factor Test

The FERC Seven Factor Test is summarized below:

(1) Local distribution facilities are normally in close proximity to retail customers.
(2) Local distribution facilities are primarily radial in character.
(3) Power flows into local distribution systems; it rarely, if ever, flows out.
(4) When power enters a local distribution system, it is not reconsigned or transported on to some other market.
(5) Power entering a local distribution system is consumed in a comparatively restricted geographical area.
(6) Meters are based at the transmission/local distribution interface to measure flows in the local distribution system.
(7) Local distribution systems will be of reduced voltage.

More information on the FERC Seven Factor Test may be accessed through FERC Order 888 *See Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities*, Order No. 888, 61 Fed. Reg. 21,540 (May 10, 1996), or upon request to the Electric System Planning department at 106 E 2nd Street, Davenport, IA. 52801. Telephone contact (563-333-8329)