OHIO VALLEY ELECTRIC CORPORATION

Requirements for Connection of Non-Generation Facilities and End Use-Users to the OVEC Transmission System

2001

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1. INTRODUCTION

American Electric Power Service Corporation, acting on behalf of the Ohio Valley Electric Corporation (OVEC) and its wholly owned subsidiary, Indiana/Kentucky Electric Corporation, has prepared this document which outlines the minimum requirements for all Transmission Interconnection or Transmission End-User facilities connecting to the OVEC Transmission System, or to transmission owned by others connected to the OVEC Transmission System. **Transmission Interconnections** refer to transmission connections between OVEC and other utilities. All other facility connections, except generation facilities, are considered **Transmission End-Users**.[1]

1.1. Background

In the present electric utility environment characterized by deregulation, open access to the transmission network, wholesale and retail competition, etc., there is wide recognition that electric system reliability, safety and quality of service are to be maintained. Maintaining reliability, safety and quality of service in this changing environment places additional challenges in the planning and operation of electric systems.

As a result of this new environment, there is an increasing interest in connecting to and using the OVEC Transmission System. The purpose of this document is to facilitate meeting the demands of this competitive environment. Each request is reviewed to identify the impacts and necessary system improvements on the OVEC system. These reviews ensure that comparable treatment is given to all users, and that reliability, safety, and quality of service are maintained.

1.2. Scope

This document informs entities seeking facility connections to the OVEC Transmission System of the transmission connection requirements. The requirements are applicable to all facilities connecting to the OVEC Transmission System. The scope of this document satisfies the NERC Planning Standards by identifying requirements for connections to the bulk transmission system at voltages generally 100 kV and above. The scope of these documents is limited to the technical requirements for connected facility design and operation. **Generation Facility Owners** interested in the terms of transmission service should refer to the OVEC Open Access Transmission Tariff.

1.3. Objectives

OVEC, in its role as a transmission provider, has prepared this document based on the following objectives:

a) Provide information to entities requesting generation facility interconnection with the OVEC Transmission System. This document describes technical requirements to

[1] **Transmission End-User** is hereinafter referred to as **End-User**.

maintain system reliability, personnel and equipment safety, and quality of service as new generating facilities are added to the transmission network and existing generating facilities are modified.

b) Satisfy compliance with NERC Standards pertaining to documentation of facility connection requirements by those entities responsible for system reliability.

c) Facilitate uniform and compatible equipment specification, design, engineering, and installation practices to promote safety and uniformity of service.

2. PROCEDURES FOR COORDINATED JOINT STUDIES

Procedures for coordinated joint studies of new facilities and their impacts on the interconnected transmission system shall include:

2.1. Coordination with Affected Systems

OVEC will coordinate the conduct of any studies required to determine the impact of the Interconnection Request on Affected Systems with Affected System Operators and, if possible, include those results (if available) in its applicable Interconnection Study. OVEC will offer to include such Affected System Operators in all meetings held with Interconnection Customer. Interconnection Customer will cooperate with OVEC in all matters related to the conduct of studies and the determination of modifications to Affected Systems. A Transmission Provider which may be an Affected System shall cooperate with OVEC in all matters related to the conduct of studies and the determination of modifications to Affected Systems.

2.2. System Impact and Facilities Studies

In order to assess the impact of a proposed facility connection on system reliability, system impact studies need to be conducted. These system impact studies, as a minimum, examine the transmission line and transformer loading, voltage profiles and schedules, and power quality impacts of the proposed facility for a range of expected seasonal loading and power transfer conditions. The effect of the proposed facility on short circuit duties is examined for all proposed transmission connections. A multi-step approach to the proposed facility may be considered where the impact of each step is assessed separately. Alternative plans of service may be considered.

2.2.1. Power Flow Analyses

Power flow analyses are conducted to examine the impact of the proposed facility on transmission lines and transformers, and voltage profiles. These analyses may typically determine the maximum load demand in the case of **End-User** facilities or through flow in the case of a **Transmission Interconnection** that can be accommodated with minimal or no upgrades to the transmission system. Contingencies consisting of single or multiple outages of lines and/or transformers are considered in these analyses. Where the analyses indicate that transmission upgrades are necessary, alternative reinforcement plans may be devised and evaluated for their capability to accommodate the proposed facility. These analyses may also indicate a need to perform system dynamic studies.

2.2.2. Short Circuit Analyses

Short circuit analyses are conducted to examine the impact of the proposed facility on equipment duties. These analyses are primarily concerned with **Transmission Interconnection** facilities. Increased fault duties may require upgrading existing circuit breakers and other equipment.

The criteria OVEC uses to determine what constitutes acceptable performance in the above system impact studies is readily available from OVEC's FERC Form 715 filing.

The results of these studies will be shared with adjacent entities including Control Areas and Regional Transmission Organization. AEP will provide base case study data to these organizations in order to allow them to conduct studies to determine if the contemplated facilities have an adverse impact on neighboring system. If these studies indicated a problem, OVEC shall notify the requesting entity and provide contact information to enable the parties to come to a resolution.

2.2.3. Additional Analyses

Other analyses may be required as part of system impact studies based on power flow analysis and depending on the nature of the proposed connected facility and its location within the transmission network:

a) Power quality analyses are undertaken for all **End-User** load that could potentially cause harmonic current or voltage, voltage flicker, and/or telephone interference.

b) The possibility of adverse subsynchronous torsional interaction is investigated wherever the end-user's equipment such as arc-furnaces and/or cycloconverters is to be located in close electrical proximity to existing generation.

Criteria for harmonic interference, voltage flicker, and telephone interference are included in the document appendices. As for adverse torsional interaction, the criteria are wholly dependent on the specifics of any nearby generation.

The scope of all the above system impact studies will be determined by OVEC based on the type, location, and power level of the proposed facility. Normally, American Electric Power Service Corporation (AEPSC), on behalf of OVEC, will perform the system impact studies. The cost of these studies will be chargeable to the **Transmission Interconnection** or **End-User** in accordance with the applicable tariff. A report documenting the assumptions, results, and conclusions of the system impact studies is made available to the **Transmission Interconnection** or **End-User**.

OVEC must be notified of new facilities, upgrades, or additions such as an increase in load or generating capability of existing facilities connected to the transmission system within the OVEC Balancing Area. System impact studies are to be conducted to determine the need for any upgrades of transmission equipment or transmission reinforcements to the OVEC system to accommodate the changes in the connected facility.

3. PROCEDURES FOR NOTIFICATION OF NEW OR MODIFIED FACILITIES

The following table outlines the OVEC personnel to be contacted with regard to any request for a new facility connection or significant change to an existing connected facility. Requests for transmission service may be made simultaneously with a connection request.

Entities seeking to connect their **Transmission Interconnection** or **End-User** facilities to the OVEC Transmission System should contract:

Superintendent of Electrical Operations
or
System Operations Supervisor

Following the initial contact regarding a proposed **Transmission Interconnection** or **End-User** facility connection, when the proposed location and power level are established, a plan of service is prepared and system impact studies are undertaken by AEPSC on behalf of OVEC. The information needed to develop a plan of service and to conduct the system impact studies is identified in this document and should be provided to OVEC at this point. The system impact studies may, as noted above, identify additional requirements for reliability beyond the minimum requirements covered by this document.

OVEC approval of a proposed facility or facility change is contingent upon a design review of the proposed connected facility. Operation of a connected facility is also subject to continuing compliance with all applicable construction, maintenance, testing, protection, monitoring, and documentation requirements described herein, as well as the applicable NERC and Regional Reliability Organization Planning Standards noted herein.

OVEC's facility connection requirements are organized into two separate documents titled "Requirements for Connection of Non-Generation Facilities to the OVEC Transmission System" covering **End-User** and **Transmission Interconnection** facilities, and " Requirements for Connection of Generation Facilities to the OVEC Transmission System" for generation. This is because many requirements applicable to generation do not apply to end-user or transmission interconnection facilities. Likewise, requirements applicable to **End-User** facilities and **Transmission Interconnections** do not always pertain to generation. However, when a proposed facility includes both generation and **End-User** or **Transmission Interconnection** facilities, these entities will need to consult both documents.

3.1. Responsibilities

Transmission Interconnection and **End-Users** may be responsible for the costs associated with connecting to the OVEC Transmission System in accordance with the applicable tariff.

4. VOLTAGE LEVEL AND MW AND MVAR CAPACITY AT POINT OF INTERCONNECTION

The **Transmission Requester's**[2] facility will be supplied from OVEC's Transmission System, which generally under system normal conditions and single transmission element outage conditions can range between 92% and 105% of nominal. If the **Requester's** supply voltage requirements are more restrictive than the 92% to 105% range, OVEC recommends that the **Requester** consider the addition of voltage regulation equipment in their facility. Nominal transmission system voltage presently on the OVEC system is 345 kV.

Under certain emergency conditions, the OVEC Transmission System may operate for a period of time outside of the 92% to 105% range. The **Requester** is responsible for providing any voltage sensing equipment required to protect their equipment during abnormal voltage operation.

Any connection to the OVEC Transmission System that allows bi-directional energy and/or fault current flow between otherwise independent transmission systems is considered a network connection. This is considered a special circumstance, which requires a detailed system impact study to determine the acceptability of the proposed transmission interconnection and the specific interconnection requirements. Transmission interconnection requests on the OVEC Transmission System will be considered on a case-by-case basis. The **Transmission Interconnection Requester**[3] will be responsible for reimbursement of the cost for these studies. In addition, the cost of facilities to establish and reliably integrate the new network connection will be at the expense of the **Transmission Interconnection Requester** to the extent allowed by OVEC's Open Access Transmission Tariff.

5. BREAKER DUTY AND SURGE PROTECTION

The following estimated short circuit levels will be provided by OVEC at the point of common coupling.

Estimated Initial Short Circuit Levels (Year)

3 Phase Fault = ____ MVA ANSI X/R Ratio = _____
Phase-to-Ground Fault*= ____ MVA ANSI X/R Ratio = _____

Estimated Future Short Circuit Levels (Year)

[2] **Transmission Requester –** can refer to either a **Transmission Interconnection Requester** or a **Transmission End-User Requester** and hereinafter is referred to as a **Requester**.
[3] **Transmission Interconnection Requester –** refers to the entity requesting a network transmission interconnection to the OVEC transmission system.

3 Phase Fault = ____ MVA ANSI X/R Ratio = _____
Phase-to-Ground Fault*= ____ MVA ANSI X/R Ratio = _____

*Note: Phase-to-ground fault values are calculated assuming the **Requester's** transformers have either a wye-ungrounded or delta connected high side. For wye-grounded transformers, the transformer contribution to the total fault current will have to be taken into account and the fault values recalculated.

Transmission Interconnection and **End-Users** equipment should have adequate interrupting and momentary ratings for the future short circuit conditions listed above.

While OVEC will endeavor, where possible, to anticipate system changes which may affect these values, it does not assume responsibility or liability with respect to such protective devices, nor guarantee their continuing adequacy against increased interrupting capacity requirements resulting from system changes. **Transmission Interconnection** and **End-Users** who use this information should periodically review existing and future fault conditions and equipment ratings for adequacy. Any equipment replacements or upgrades to maintain adequacy of the **Transmission Interconnection** or **End-Users'** facilities will be at the **Transmission Interconnection** or **End-Users'** expense.

All gas insulated protective devices within the **Requester's** facility having a direct connection to an OVEC transmission line shall be equipped with a low gas pressure alarming/tripping/lockout scheme as appropriate for the particular device.

6. SYSTEM PROTECTION AND COORDINATION

6.1. Transmission Protection

OVEC will provide functional specifications and relay settings for all protective relays at the **Requester's** facility that have a potential impact on the reliability of the OVEC transmission system. The criteria for these functional specifications and settings will be based on existing OVEC protection practices. OVEC reserves the right to specify the type and manufacturer for these protective relays to ensure compatibility with existing relays. The specific recommendations and requirements for protection will be made by OVEC based on the individual substation location, voltage and configuration.

6.2. Requester Protection

It is the **Requester's** responsibility to assure protection, coordination and equipment adequacy within their facility for conditions including but not limited to:

1. single phasing of supply,
2. system faults,
3. equipment failures,
4. deviations from nominal voltage or frequency,
5. lightning and switching surges,
6. harmonic voltages,
7. negative sequence voltages,

8. separation from OVEC supply,
9. synchronizing generation.

6.3. Automatic Underfrequency Load Shedding

OVEC may require automatic underfrequency load shedding relaying on connected loads to comply with Regional Reliablity Organization requirements or other system stability considerations.

7. METERING AND TELECOMMUNICATIONS

7.1. Revenue Metering

OVEC approved revenue class metering equipment shall be installed at the delivery point to meter the aggregated load of the connected facility consisting of instantaneous bi-directional real and reactive power and integrated hourly real and reactive energy metering.

The metering equipment will include potential and current transformers, meters and test switches. The accuracy of the instrument transformers and meters will be 0.3 percent or better. The secondary wiring and burdens of the instrument transformers will be configured so that they do not degrade the total accuracy by more than 0.3 percent. The metering equipment will be tested periodically as defined in the service agreement and the test results will be available to all involved parties. The meters, test switches and wiring termination equipment will be sealed and the seal may be broken only when the meters are to be tested, adjusted or repaired. Proper authorities from both parties will be notified when seals are broken.

At least (N-1) metering elements will be used to measure all real and reactive power crossing the metering point, where N is the number of wires in service including the ground wire. Bi-directional energy flows including watt-hour and var-hour will be separately measured on an hourly basis. Depending on the tariffs to be applied, appropriate demand quantities will be metered in terms of kilowatts, kilovars or kilovolt-amperes. If required, voltage measurements will be provided.

The instrument transformers used for revenue metering shall be installed on the high voltage side of the **Requester's** step-down transformer. Under special circumstances and with written approval granted by OVEC, revenue metering may be performed on the low voltage side of the step-down transformer. Written approval shall only be given if the **Requester** can demonstrate that accurate transformer loss compensation will be programmed into the revenue metering when instrument transformers are installed on the low voltage side of the step-down transformer.

7.2. Telemetry

Suitable telemetry equipment will be installed at the metering point to provide real-time telemetry data to OVEC and to all other participating parties.

Telemetry equipment will include transducers, remote terminal units, modems, telecommunication lines, and any other equipment of the same or better function. The remote terminal unit, or equivalent device, must have multiple communication ports to allow simultaneous communications with all participating parties. That device will accommodate data communication requirements specified by each participating parties control center, including communication protocol, rate and mode (either synchronous or asynchronous). All metered values provided to the telemetry equipment will originate from common metering equipment. All transducers used for telemetry will have at least 0.2 percent accuracy. As part of real-time data to be provided, OVEC has the right to require the status and remote control of switching devices at the Receipt and/or Delivery Points.

A continuous, accumulating record of megawatt-hours and megavar-hours will be provided by means of the registers on the meter. Freezing accumulation data for transmission will be taken every clock hour. The freezing signals synchronized to within 2 seconds of Universal Coordinated Time must be provided by only one of the agreed-upon participating parties. If the freeze signal is not received within a predefined time window, the remote terminal unit, or equivalent device, will be capable of freezing data with its own internal clock.

The metering, if external power supply is required, and telemetry equipment will be powered from a reliable power source, such as a station control battery, in order to allow the equipment to be continuously operational under any abnormal power supply situations. Proper surge protection and isolation will be provided for each communication link to protect communication hardware from ground-potential-rise due to any fault conditions. A separate communication media shall be provided to allow OVEC to remotely retrieve billing quantities from the meters. When real-time telemetry is required, a back-up data link must be provided in case of the outage of the primary telemetry line. The back-up link can be a data communication link between involved control centers; the party requesting service is responsible for furnishing the back-up link.

8. GROUNDING AND SAFETY

8.1. Ground System Resistance

The grounding system should be designed in accordance with IEEE Standard 80 - latest revision, "IEEE Guide for Safety in AC Substation Grounding." In evaluating the step and touch potential the target body weight value should be set to 50 kg. If a reasonable grounding design is unobtainable using the 50 kgs, then consider a body weight of 70 kg as the absolute minimum allowable.

Ground fault levels from OVEC sources are listed in Section 11.2, Short Circuit Data & Interrupting Device Ratings. **Requester** equipment ground sources can contribute significant fault current independent of the ground fault values in Section 11.2. These **Requester** ground sources should be considered in the design of the grounding system.

8.2. Air Break Switch(es) and Disconnect Switch(es)

A group operated switch shall be installed on each transmission line supply entrance to the **Requester's** facility and accessible to OVEC personnel at all times. The switch shall be mechanically lockable in the open position with an OVEC padlock in order to provide for a visible electric isolation of the **Requester's** facility and shall be identified with an OVEC designated equipment number.

All air break switches shall be three phase, single throw, group operated. Disconnect switches shall be a three pole, single throw device. Characteristics for all air break switches and disconnect switches including voltage and BIL ratings, clearances and pole spacing shall meet the requirements shown in the table in Appendix C. Facilities in areas with significant airborne pollution may require a higher BIL level. There shall be no braids in the current carrying parts of the switch. Group operated switches shall be complete with a horizontal, rotating-type operating handle. A grounding device is to be furnished for the operating shaft and shall consist of a tin coated, flexible copper braid, located as close as possible to the operating handle. The braid shall have a cross-sectional area equivalent to 4/0 copper cable, or greater. The braid shall be secured to the shaft by means of a galvanized steel U-bolt clamp and associated cradle-type galvanized steel hardware. The opposite end of the braid shall have two (2) 9/16 inch holes at 1-3/4 inch spacing. Both ends of the braid shall be stiffened and protected by a ferrule or additional tinning.

As a minimum, a protective grounding loop shall be provided around all group operated switches as illustrated in Appendix D. This table applies to areas where native soil resistivity does not exceed 500 Ohm-meters. When the above condition is exceeded a detailed engineering assessment study must be undertaken by OVEC.

All workers, who are using the operating handles on air break switches and disconnects on energized lines and equipment shall use protective headgear, insulating gloves and approved protective footwear. Before operating, the switch and ground arrangement shall be visually checked.

All switches are to be manufactured and tested in accordance with the latest revision of ANSI C37.30, ANSI C37.32, and ANSI C37.34.

8.3. Facility Fence Safety Clearances

The fence safety clearances in the **Requester's** facility shall comply with Section 11 of ANSI C2-1997, "National Electrical Safety Code."

9. INUSLATION AND INSULATION COORDINATION

9.1. Equipment Basic Insulation Levels

The minimum required Basic Insulation Levels (BIL) for stations are listed in Table 1 of Appendix C. Facilities in areas with significant airborne pollution may require a higher insulation level.

9.2. Insulators for Station

The required station post insulator types are listed in the table in Appendix C. Facilities in areas with significant airborne pollution may require a higher insulation level. Higher strength insulators are available and should be used if needed to meet bus momentary short circuit withstand values.

10. VOLTAGE, REACTIVE POWER, AND POWER FACTOR CONTROL

10.1. Voltage Levels

The **Transmission Requester's**[4] facility will be supplied from OVEC's Transmission System, which generally under system normal conditions and single transmission element outage conditions can range between 92% and 105% of nominal. If the **Requester's** supply voltage requirements are more restrictive than the 92% to 105% range, OVEC recommends that the **Requester** consider the addition of voltage regulation equipment in their facility. Nominal transmission system voltage presently on the OVEC system is 345 kV.

Under certain emergency conditions, the OVEC Transmission System may operate for a period of time outside of the 92% to 105% range. The **Requester** is responsible for providing any voltage sensing equipment required to protect their equipment during abnormal voltage operation.

10.2. Power Factor Requirements

Distribution entities and customers connected directly to the transmission systems should plan and design their systems to operate at close to unity power factor to minimize the reactive power burden on the transmission systems. The OVEC interpretation of "close to unity power factor" is that the power factor of the connected load should be within the range of approximately 0.98 lagging to 0.98 leading.

Unless otherwise specified by written agreement, the maximum hourly reactive power (kVAr) demand, both leading and lagging, will be identified each month at the delivery point(s). A **End-User** will incur no charges for power factor if the maximum leading and lagging kVAr demands do not exceed 20% of the real power (kW) demand in the same hour(s). If the maximum hourly leading and/or lagging kVAr demand exceeds 20% of the corresponding kW demand, charges will be assessed.

Capacitors generally provide an effective means of controlling the power factor of a **Requester's** facility. However, there are several factors that should be addressed in applying capacitors. These factors can include, but are not limited to, transient voltages due to capacitor switching and voltage amplification due to resonance conditions. The services of a qualified consultant should be obtained to review the specific application and provide recommendations in regard to control of these phenomena.

[4] **Transmission Requester –** can refer to either a **Transmission Interconnection Requester** or a **Transmission End-User Requester** and hereinafter is referred to as a **Requester**.

11. POWER QUALITY IMPACTS

11.1. Harmonics and Flicker

Certain electrical equipment located at the **End-User's** facility (arc furnaces, cycloconverters, etc.) will generate voltage flicker[5] and harmonic distortion which can negatively impact other **End-Users**. Should this be the case, the **End User** shall take responsibility, initially or in the future, for limiting interfering levels of harmonic voltage and current distortion and/or voltage flicker. Limits for harmonic distortion (including inductive telephone influence factors) are as published in the latest issues of ANSI/IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems." Specific OVEC harmonics and flicker criteria are given in Appendix B. The criteria, adopted from AEP requires that flicker occurring at the point of compliance shall remain below the Border Line of Visibility curve on the IEEE/GE curve for fluctuations less than 1 per second or greater than 10 per second. However, in the range of 1 to 10 fluctuations per second, voltage flicker shall remain below 0.4% (see Appendix B, Exhibit 1). OVEC may, initially or in the future, require the installation of a monitoring system to permit ongoing assessment of compliance with these criteria. The monitoring system, if required, will be installed at the **End-User's** expense.

Situations where high harmonic voltages and/or currents originate from the transmission system are to be addressed in the Connection Agreement.

11.2. Sensitive Electrical Equipment

Certain electrical equipment in the **Requester's** facility may be sensitive to normally occurring electric interference from nearby connected loads in the **Requester's** facility, from other **End-Users** connected to the power system, from natural causes, and system switching, etc. If sensitive electrical equipment is to be supplied directly from the electric power system, it is recommended that the equipment grounding requirements and power supply requirements be examined by the **Requester** or the **Requester's** consultant prior to installation. Attention should be given to equipment tolerance to various forms of electric interference, including voltage sags and surges, momentary outages, transients, current and voltage harmonic distortion, or other electrical and electromechanical noise. When electrical disturbances to sensitive electrical equipment such as computers, electronics, controls, and communication equipment cannot be tolerated, the **End-User** shall install additional equipment as may be necessary to prevent equipment malfunctions and protect against equipment failure. The **End-User** should consult the supplier of such sensitive electrical equipment regarding the power supply requirements or the remedial measures to be taken to alleviate potential misoperation or failure of the equipment. The **End-User** may need to hire a power quality consultant to also perform a site survey of the electric power supply environment and furnish recommendations to provide the acceptable levels of reliability and quality of service.

[5] Flicker is an objectionable, low frequency, voltage fluctuation which can be observed through changes in intensity or color of illumination.

11.3. Unbalanced Electric Conditions

11.3.1. Voltage Balance

Voltage unbalance attributable to the **End-User** facilities shall not exceed 1.0% measured at the point-of-service. Voltage unbalance is defined as the maximum phase deviation from average as specified in ANSI C84.1, "American National Standard for Electric Power Systems and Equipment – Voltage Ratings, 60 Hertz."

11.3.2. Current Balance

Phase current unbalance attributable to the **End-User** facility shall not exceed that which would exist with balanced equipment in service, measured at the point-of-common coupling.

Situations where high unbalance in voltage and/or current originate from the transmission system are to be addressed in the Connection Agreement.

11.3.3. Subsynchronous Torsional Interaction

Certain **End-User** equipment, in particular electric arc furnaces and cycloconverters, may cause adverse interactions and possible damage to existing turbine-generators located in close electrical proximity. These situations will be analyzed by OVEC's consultant, and appropriate corrective or preventive measures identified as needed. Corrective and preventive measures may consist of torsional current monitoring at a defined point of compliance, special protective relaying on the turbine-generator shaft(s), or constrained operation of the **End-User** equipment under certain system configurations. Costs of studies and the design and installation of protective and/or monitoring equipment shall be the responsibility of the **Requester**.

12. EQUIPMENT RATINGS

For tap and looped connections, the **Requester's** high voltage bus and associated equipment, such as switches, connectors, and other conductors shall have minimum continuous current and momentary asymmetrical current ratings which: (1) do not limit the OVEC transmission system network capability and (2) have adequate capability for the initial and future system conditions identified by OVEC.

12.1. Size and Take-Off Tension of Line Conductors and Overhead Ground Wires

The **Requester's** structure shall be designed for (# of) incoming (size and type of) phase conductors and (# of) incoming (size and type of) overhead ground wire(s). The

approximate take-off or dead-end tension will be (#) lbs. for each phase conductor and (#) lbs. for each overhead ground wire in accordance with Rule 250 of the National Electric Safety Code (NESC). The exact take-off tensions will be determined after the facility plans are finalized.
The line terminal connectors furnished by the **Requester** should be (copper or aluminum) wire-and-pad connector to bolt to and be materially compatible with the air switch terminal pad. The overhead ground wire shall be grounded using aluminum compression wire and a pad type connector furnished by the **Requester**.

If the incoming high voltage lines will cross road ways or railroad tracks, such as a siding or main line, to reach the **Requester's** facility, it may be necessary to increase the above tensions or provide additional height on the structure to meet appropriate crossing requirements.

The point of attachment of the line entrance conductors shall be of sufficient height to provide the basic vertical clearance requirements for lines crossing over public streets, alleys, or roads in urban or rural districts, as outlined in the NESC.

12.2. Short Circuit Data & Interrupting Device Ratings

The following estimated short circuit levels will be provided by OVEC at the point of common coupling.

Estimated Initial Short Circuit Levels (Year)

3 Phase Fault = ____ MVA ANSI X/R Ratio = _____
Phase-to-Ground Fault* = ____ MVA ANSI X/R Ratio = _____

Estimated Future Short Circuit Levels (Year)

3 Phase Fault = ____ MVA ANSI X/R Ratio = _____
Phase-to-Ground Fault* = ____ MVA ANSI X/R Ratio = _____

*Note: Phase-to-ground fault values are calculated assuming the **Requester's** transformers have either a wye-ungrounded or delta connected high side. For wye-grounded transformers, the transformer contribution to the total fault current will have to be taken into account and the fault values recalculated.

Transmission Interconnection and **End-Users** equipment should have adequate interrupting and momentary ratings for the future short circuit conditions listed above.

While OVEC will endeavor, where possible, to anticipate system changes which may affect these values, it does not assume responsibility or liability with respect to such protective devices, nor guarantee their continuing adequacy against increased interrupting capacity requirements resulting from system changes. **Transmission Interconnection** and **End-Users** who use this information should periodically review existing and future fault conditions and equipment ratings for adequacy. Any equipment replacements or upgrades to maintain adequacy of the **Transmission Interconnection** or **End-Users'** facilities will be at the **Transmission Interconnection** or **End-Users'** expense.

All gas insulated protective devices within the **Requester's** facility having a direct connection to an OVEC transmission line shall be equipped with a low gas pressure alarming/tripping/lockout scheme as appropriate for the particular device.

13. SYNCHRONIZING OF FACILITIES

The **Transmission Interconnection** or **End-User** shall assume all responsibility for properly synchronizing their facility for parallel operation with the OVEC Transmission System. Upon loss of the interconnection to the OVEC Transmission System, the **Transmission Interconnection** or **End-User** shall immediately and positively cause the facility to remain separated from the OVEC Transmission System until such time the OVEC System Operations Center authorizes the restoration of the interconnection. Synchronizing of facilities to the OVEC Transmission System may be, at OVEC's discretion, performed under the direction of the OVEC System Operations Center.

14. MAINTENANCE COORDINATION

All **Requester** owned equipment up to and including the first protective fault interrupting device is to be maintained to OVEC standards. This may include circuit breakers, circuit switchers, power fuses, instrument transformers, switches, surge arresters, bushings, relays, and associated equipment (including battery and battery charger). Maintenance procedures are detailed in the AEP "Guidelines for Transmission and Distribution Maintenance and Frequencies" as adopted by OVEC.

The **Requester** shall have an organization approved by OVEC test and maintain all devices and control schemes provided by the **Requester** for the protection of the OVEC system. Included in the testing and maintenance will be any initial set up, calibration, and check out of the required protective devices, periodic routine testing and maintenance, and any testing and maintenance caused by a **Requester** or OVEC change to the protective devices.

If the **Requester's** testing and maintenance program is not performed in accordance with AEP's "Guidelines for Transmission and Distribution Maintenance and Frequencies," as adopted by OVEC, OVEC reserves the right to inspect, test, or maintain the protective devices required for the protection of the OVEC System.

All costs associated with the testing and maintenance of devices provided by the **Requester** for the protection of the OVEC system, including costs incurred by OVEC in performing any necessary tests or inspections, shall be the responsibility of the **Requester**.

OVEC reserves the right to approve the testing and maintenance practices of a **Requester** when the **End-User's** system is operated as a network with the OVEC transmission system.

15. OPERATIONAL ISSUES (Abnormal Frequency and Voltages)

The generation facility must be capable of continuous, non-interrupted operation in the frequency range of 59.5 to 60.5 Hz. Limited time, non-interrupted operation is also expected outside this frequency range in accordance with the generator manufacturer's recommendation.

The generation facility must be capable of continuous, non-interrupted operation in the frequency range of 59.5 to 60.5 Hz. Limited time, non-interrupted operation is also expected outside this frequency range in accordance with the generator manufacturer's recommendation.

16. INSPECTION REQUIREMENTS

Before a **Requester** owned facility can be energized, it must pass a final inspection by OVEC personnel. OVEC will inspect all substation equipment from the point of interconnection to the first protective fault interrupting device and the ground system. This may include circuit breakers, circuit switchers, power fuses, instrument transformers, switches, surge arresters, bushings, and relays and associated equipment (including battery and battery chargers). The inspection will consist of a visual inspection of all major equipment as well as review of required test results.

The ground system must be checked by using the resistance measurement procedures in accordance with IEEE Standard 81 "Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth."

The inspection will be performed by OVEC personnel, or their represnative, who will document the inspection by completing a site specific form supplied by Transmission System Analysis and Planning, or Transmission System Engineering at AEPSC. An example of the form, showing the types of information required is shown in Appendix E.

17. COMMUNICATIONS AND PROCEDURES DURING NORMAL AND EMERGENCY OPERATING CONDITIONS

17.1. Normal

At OVEC's request, the **Requester** shall provide an appropriately protected and isolated dedicated voice communication circuit to the OVEC System Operations Center (SOC). Such a dedicated voice communication circuit would originate from the **Requester's** office staffed 24 hours a day and would be typically required for connected transmission facilities that significantly affect the OVEC transmission network capacity and operations.

All other normal voice communication concerning facility operations shall be conducted through the public telephone network to the SOC phone number(s) issued by OVEC.

17.2. Emergency

Voice communications in the event of a transmission facility emergency shall use the appropriately protected and isolated dedicated voice circuits, if available, or public telephone network and phone number(s) designated for emergency use.

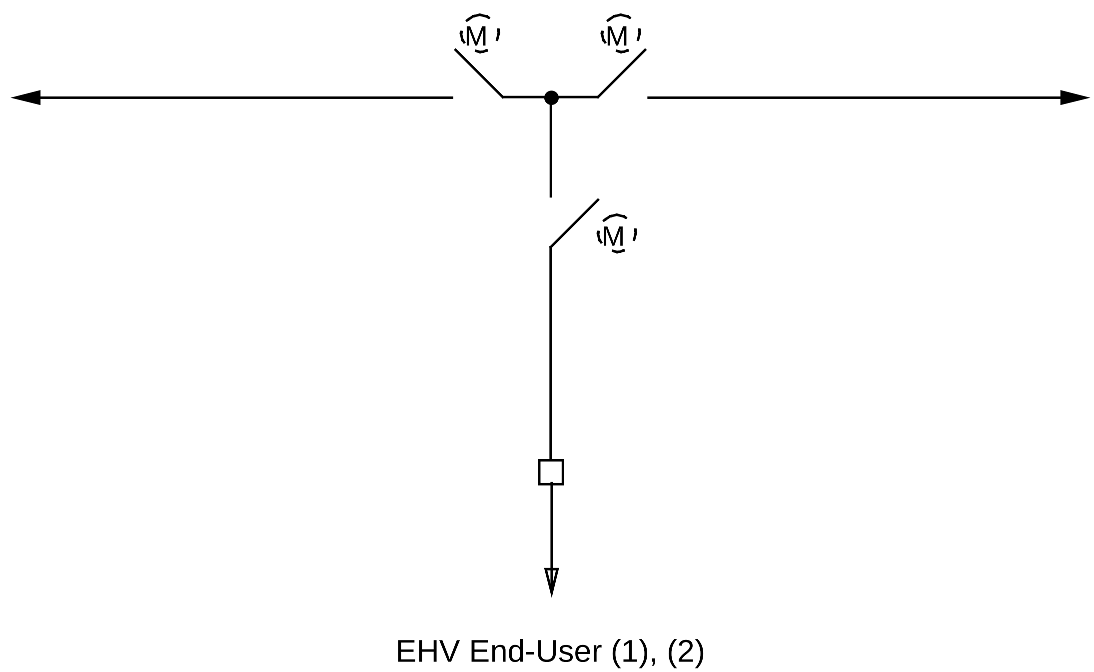
It is the **Requester's** responsibility to take prudent steps when an area or system wide capacity emergency is declared. Load reductions shall be implemented by reducing non-essential loads. This type of reduction is usually conveyed through the local media. Interruptible customer load reductions may already be in effect depending on the nature of the emergency. The **End-User's** OVEC representative is responsible for providing OVEC a "customer contact list." This listing contains the **End-User's** OVEC representative and backup person as well as their business, home and pager numbers.

These **End-Users** shall be provided an unlisted phone number to be used for emergency or routine operations. Operational emergencies (equipment) warrant a direct call either way. OVC will advise the OVEC representative of problems that they should handle directly with the **End-Users**.

REVISION	DATE	REVISED/REVIEWED BY	PURPOSE
	1/31/2001	RJM	Initial Document
	10/22/2004	RJM	Incorporate FERC Pro Forma
	10/27/2008	RJM	Include NERC Compliance Items
	6/23/2009	RJM	Clarify NERC Compliance Items

APPENDIX A

FIGURE 2 Typical Transmission Tap Line Supply Configurations (for 230 kV through 765 kV)



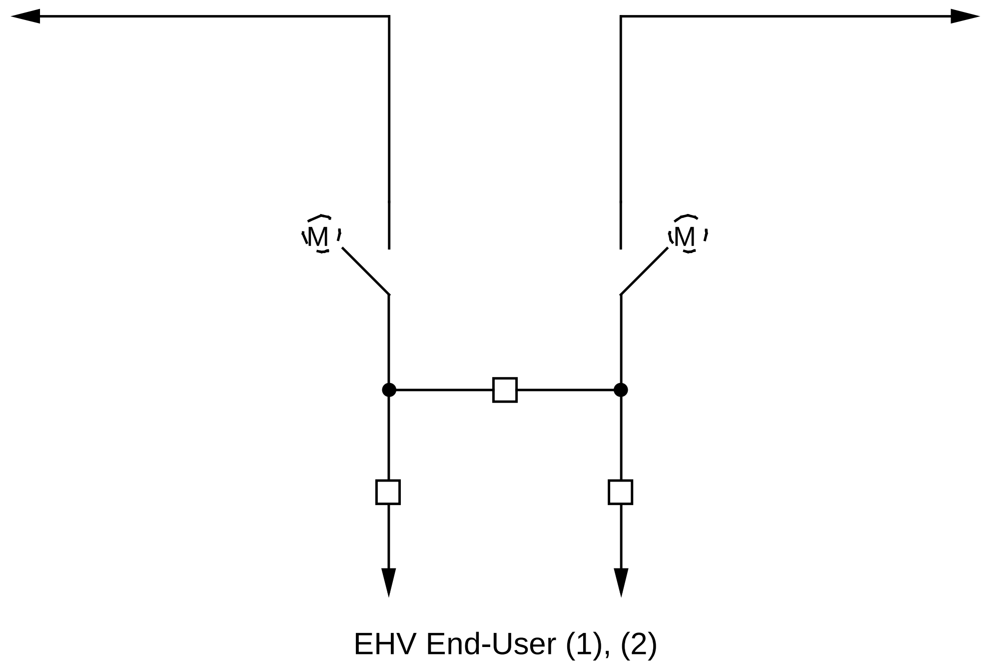
- - - - - - Optional or Future

Ⓜ Motor Operated Air Break Switch

(1) EHV End-User generally owns the step-down transformer

(2) EHV End-User Metering is typically installed on the low-side of the step-down transformer and compensated to the high-side to cover losses.

FIGURE4 Typical Transmission Looped Supply Configurations (for 230 kV through 765 kV)



- - - - - - Optional or Future

(M) Motor Operated Air Break Switch

(1) EHV End-User generally owns the step-down transformer

(2) EHV End-User Metering is typically installed on the low-side of the step-down transformer and compensated to the high-side to cover losses.

APPENDIX B

AEP Voltage Flicker Criteria and Harmonic Distortion Criteria

AEP Voltage Flicker Criteria and Harmonic Distortion Criteria

This document summarizes AEP's policy, adopted by OVEC, on voltage flicker and harmonic distortion for customers connected to the electrical system via a Company dedicated transformer or a Customer owned transformer. The term Company is defined as OVEC. The term Customer is defined as the party connected to the OVEC System.

I. POINT OF COMPLIANCE – The point where the Company dedicated transformer or Customer owned transformer connects to the Company system will be the point where compliance with the voltage flicker and harmonic distortion requirements are evaluated.

II. VOLTAGE FLICKER CRITERIA – The Company requires that the voltage flicker occurring at the point of compliance shall remain below the Border Line of Visibility curve on the IEEE/GE curve for fluctuations less than 1 per second or greater than 10 per second (see Exhibit 1). In the range of 1 to 10 fluctuations per second, the voltage flicker shall remain below 0.4%.

The Customer agrees that under no circumstances will it permit the voltage flicker to exceed the Company criteria, whether or not complaints are received or service/operational problems are experienced on the Company subtransmission or transmission system. Should complaints be received by the Company or other operating problems arise, or should the Customer flicker exceed the borderline of visibility curve, the Customer agrees to take immediate action to reduce its flicker to a level at which flicker complaints and service/operational problems are eliminated.

Corrective measures could include, but are not limited to, modifying production methods/ materials or installing, at the Customer's expense, voltage flicker mitigation equipment such as a static var compensator. The Company will work collaboratively with the Customer to assess problems, identify solutions and implement mutually agreed to corrective measures.

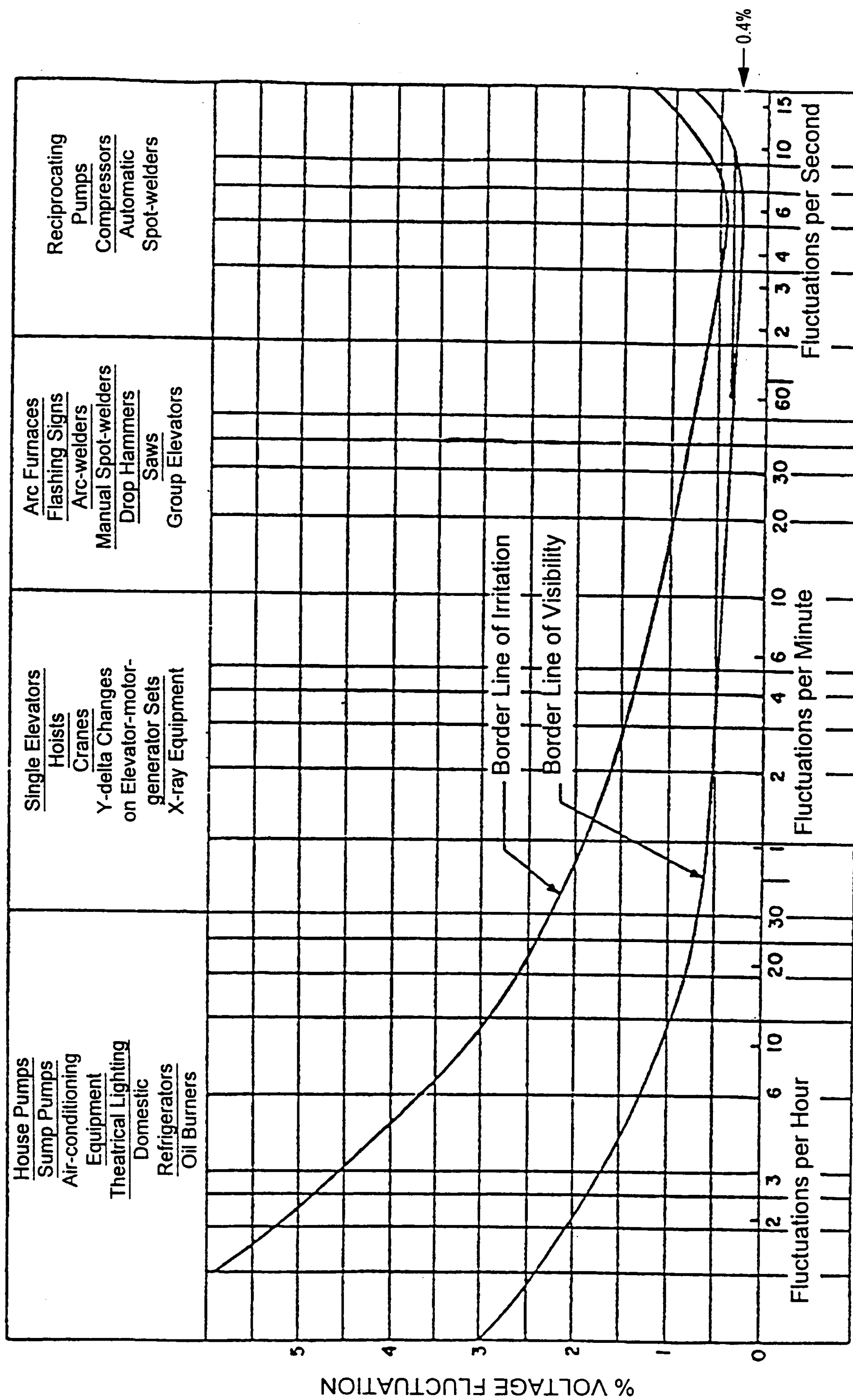
If the Customer fails to take corrective action after notice by the Company, the Company shall have such rights as currently provided for under its tariffs, which may include discontinuing service, until such time as the problem is corrected.

III. HARMONIC DISTORTION CRITERIA - The Company also requires that the Customer's operation be in compliance with the Company's Harmonic Distortion Guidelines (see Exhibit 2). These requirements are based on IEEE Standard 519, "IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems".

The Customer agrees that the operation of motors, appliances, devices or apparatus served by its system and resulting in harmonic distortions in excess of the Company's Requirements will be the Customer's responsibility to take immediate action, at the Customer's expense, to comply with the Company's Harmonic Distortion Requirements. The Company will work collaboratively with the Customer to assess problems, identify solutions and implement mutually agreed to corrective measures.

If the Customer fails to take corrective action after notice by the Company, the Company shall have such rights as currently provided for under its tariffs, which may include discontinuing service, until such time as the problem is corrected.

Exhibit 1



Composite curve of voltage flicker studies by General Electric Company, *General Electric Review*, August 1925; Kansas City Power & Light Company, *Electrical World*, May 19, 1934; T&D Committee, EEI, October 24, 1934, Chicago; Detroit Edison Company; West Pennsylvania Power Company; Public Service Company of Northern Illinois.

Relations of Voltage Fluctuations to Frequency of Their Occurrence (Incandescent Lamps)

Exhibit 2

AEP HARMONIC DISTORTION REQUIREMENTS

The AEP Harmonic Distortion Requirements shown below are based on the information presented in the IEEE Standard 519, approved in 1992 and titled, "IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems." The voltage limits are intended to be used to gauge the acceptability of harmonic magnitudes on the transmission systems, while the current limits are applicable to individual customers injecting harmonic currents at the point of common coupling (PCC).

HARMONIC VOLTAGE DISTORTION (THD_V) LIMITS

Bus Voltage at PCC	Individual Harmonic Voltage Distortion (%)	Total Voltage Distortion THD_V (%)
≤ 69 kV	3.0	5.0
69 kV < v ≤ 161 kV	1.5	2.5
Above 161 kV	1.0	1.5

HARMONIC CURRENT DEMAND DISTORTION (TDD) LIMITS

MAXIMUM HARMONIC CURRENT DISTORTION IN % OF BASE QUANTITY
Harmonic Order (Odd Harmonics)

I_{SC}/I_L	<11	11≤h<17	17≤h<23	23≤h<35	35≤h	TDD
v ≤ 69 kV						
<20	4.0	2.0	1.5	0.5	0.3	5.0
20-50	7.0	3.5	2.5	1.0	0.5	8.0
50-100	10.0	4.5	4.0	1.5	0.7	12.0
100-1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0
69 kV < v ≤ 161 kV						
<20*	2.0	1.0	0.75	0.3	0.15	2.5
20-50	3.5	1.75	1.25	0.5	0.25	4.0
50-100	5.0	2.25	2.0	0.75	0.35	6.0
100-1000	6.0	2.75	2.5	1.0	0.5	7.5
>1000	7.5	3.5	3.0	1.25	0.7	10.0
161 kV < v						
<50	2.0	1.0	0.75	0.3	0.15	2.5
≥50	3.0	1.5	1.15	0.45	0.22	3.75

Where I_{SC} = Maximum short circuit at PCC
I_L = Load current at the time of the maximum metered amount

*All power generation equipment is limited to these values of current distortion, regardless of actual I_{SC}/I_L.

Even harmonics are limited to 25% of the odd harmonic limits above.

RDR2-12.LWP

Definitions EXHIBIT 3

o **Harmonic Voltage Distortion** is to be normalized to the nominal system voltage and calculated using Equation 1.

TOTAL VOLTAGE HARMONIC DISTORTION (THD_V) in percent:

$$THD_V = \frac{\sqrt{\sum_{n=2}^{\infty} V_n^2}}{V_s} \times 100\% \qquad (Eq.1)$$

Where:

V_n = Magnitude of Individual Harmonics (RMS)
V_s = Nominal System Voltage (RMS)
n = Number of Harmonic Order

o **Harmonic Current Distortion** is to be normalized to the customer's load current at the time of the maximum metered demand which occurred over the preceding twelve months for existing customers and the customer's anticipated peak demand for new customers. For existing customers who are increasing their load, the projected demand should be used. The harmonic current demand distortion (TDD) should be calculated using Equation 2.

TOTAL CURRENT DEMAND DISTORTION (TDD) in percent:

$$TDD = \frac{\sqrt{\sum_{n=2}^{\infty} I_n^2}}{I_L} \times 100\% \qquad (Eq.2)$$

Where:

I_n = magnitude of Individual Harmonic (RMS)
I_L = Load Current at the Time of the Maximum Metered Demand
n = Harmonic Order

o **PCC - Point of Common Coupling.** The location where the customer accepts delivery of electrical energy from the utility.

Field Measurements

To gauge the acceptability of field measured harmonic distortion, a statistical evaluation of the data is to be performed. Measurements should be taken at five minute intervals or less over a minimum of 24 hours. For the measured data to be considered acceptable, two criteria must be met: 1) 95% of the measured data must fall below the limits stated; 2) no measured data shall exceed the limits specified by more than 50% of the absolute upper limit value.

Communication Interference Limits (I*T)

EXHIBIT 4

As stated in IEEE Standard 519, it is difficult to place specific limits on the telephone influence which the harmonic components of current and voltage can inflict. Hence, IEEE Standard 519 outlines a range of values where problems could occur (refer to the table below). The actual interference to voice communication systems in proximity to the power system is dependent upon a number of factors not under the control of the utility or customer. These factors will vary from location to location and from time to time as the state-of-the-art of inductive coordination progresses.

IEEE Standard 519 - Balanced I*T Guidelines		
Category	Description	I*T
I	Levels most unlikely to cause interference	<10,000
II	Levels that might cause interference	10,000 to 25,000
III	Levels that probably will cause interference	> 50,000

The limit applicable to AEP is the upper bound limit of the I*T levels that might cause interference on telephone systems. Thus, the customer induced harmonics shall not result in an I*T product to exceed 25,000 weighted amperes per phase, applicable to both the transmission and distribution systems. Residual I*T should also be minimized. Residual I*T is I_G*T, where I_G is the earth return current and is defined as the difference between the phasor sum of phase currents and neutral current. The I*T calculation is to be performed using Equation 3. The weighting of harmonic currents should conform to the 1960 TIF curve shown below.

$$I*T = I*TIF = \sqrt{\sum_{n=1}^{K} (I_n * W_n)^2} \text{ weighted amperes} \qquad (Eq.3)$$

Where:

I = Current of individual harmonics, amperes, RMS
T = Telephone Influence Factor (TIF)
W_n = Single frequency TIF weighting at frequency n (refer to table and chart below)
K $\leq$ 42, Maximum harmonic order

FREQ	TIF (W)	FREQ	TIF (W)	FREQ	TIF (W)	FREQ	TIF (W)
60	0.5	1020	5100	1860	7820	3000	9670
180	30	1080	5400	1980	8330	3180	8740
300	225	1140	5630	2100	8830	3300	8090
360	400	1260	6050	2160	9080	3540	6730
420	650	1380	6370	2220	9330	3660	6130
540	1320	1440	6650	2340	9840	3900	4400
660	2260	1500	6680	2460	10340	4020	3700
720	2760	1620	6970	2580	10600	4260	2750
780	3360	1740	7320	2820	10210	4380	2190
900	4350	1800	7570	2940	9820	5000	840
1000	5000						

APPENDIX C

Electrical Clearances and Equipment Ratings

APPENDIX C

ELECTRICAL CLEARANCES

Nominal System Voltage (kV)	Basic Impulse Insulation Level (BIL) (KV crest) (2)		Outdoor Design Clearance (in.)				Air Insulated Switch Design Clearance (in.)		Station Post Insulators Technical Reference Number(1)(2)
			Centerline-Ground		Centerline-Centerline		Air Break	Disconnect	
	Bus & Transformer Winding	Transformer Bushing	Rigid Bus	Strain Bus	Rigid Bus	Strain Bus	Phase Spacing	Phase Spacing	
765	2050	2050	195	240	390	480	480	390	n/a
500	1550	1550	147	180	270	300	300	270	379
345	1050	1050	99	132	150	180	216	150	316
230	900	900	84	120	124	164	192	124	304,308
161	750	750	63	86	86	116	168	86	291,295
138	550	650	46	60	72	84	144	72	286,287
88	450	550	37	44	54	60	108	54	286,287
69	350	350	29	36	42	48	84	42	216
46	250	250	21	24	36	42	72	36	214
34.5	200	200	16	21	30	36	60	30	210
23	150	200	13	18	24	30	60	30	208

(1) The technical reference numbers shown are a widely used identification series for post type insulators and are the AEP standard for the voltage class. Refer to ANSI Standard C29.9-1983, Table 1, for dimensions and characteristics for each insulator. Higher strength insulators with different technical reference numbers are available and should be used if required.
The ANSI Technical Reference (T.R.) numbers refer to insulators with specific mechanical ratings. Higher ratings may be required or may be adequate according to the duty of the specific application.

(2) Substations in heavily contaminated areas may require a higher insulation level than indicated.

APPENDIX D

Protective Loop Installation

Figure 1 -- Ground Protection Loop With Static Wire

Figure 2 - Ground Protection Loop Without Static Wire

APPENDIX D

PROTECTIVE LOOP INSTALLATION
for various line conditions

Air Break Switch on a Line	**Wood Pole Line** **Direct Embedded Steel Pole** **Self Supported Steel Pole**
1. With shield wires grounded at every structure and extending for at least ½ mile in both directions from the air break switch location.	Grounding Protection Loop Fig. 1
2. With ungrounded shield wires extending for at least ½ mile in both directions from the air break switch location.	Grounding Protection Loop Fig. 2
3. With air break switch ground bonded to multi-grounded neutral or to nearby station ground grid.	Grounding Protection Loop Fig. 1
4. With no shield wire or shield wire extending less than ½ mile in both directions, with no multi-grounded neutral and with air break switch not bonded to nearby station ground grid.	Grounding Protection Loop Fig. 2

Design Limits:

$\mathbf{I}_{\Phi\text{-Gnd}}$= 8000A Max.
Soil Resistivity = 500 Ω-Meter Max.
(If exceeded further analysis is required)
Spread 3/4" crushed stone with 10-15% binding material,
4" deep over entire area extending 1'-0" beyond grounding

NOTES FOR FIGURE 1 & 2

A.) For wood pole structures, a minimum 8 foot length of wood or plastic protective molding should be installed to completely cover the 4/0 AWG copper ground wire.

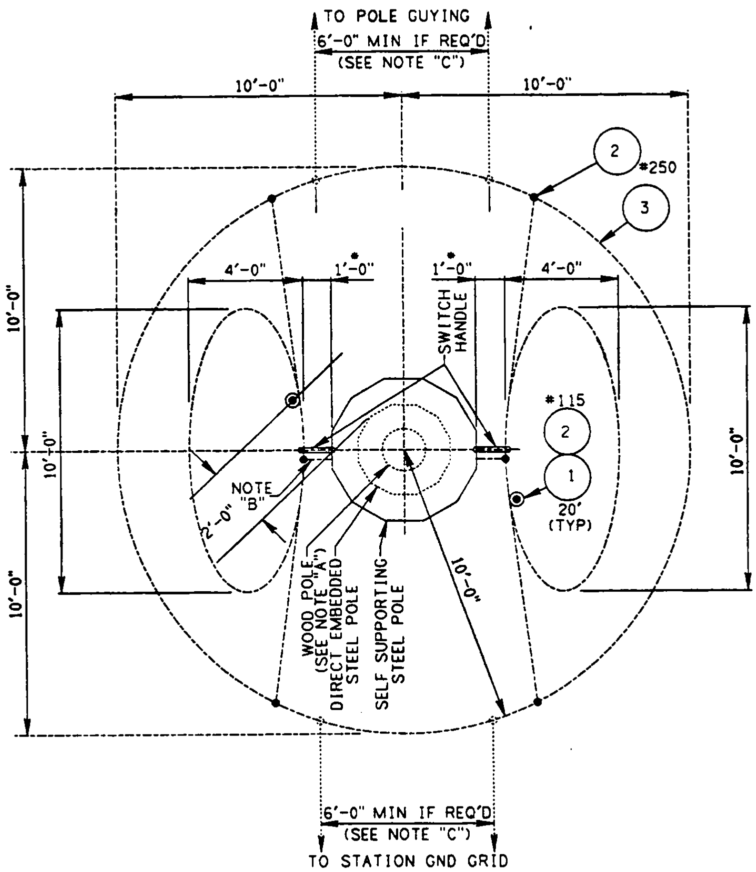
B.) Tie protective grounding loop to 4/0 AWG copper ground wire (Wood Pole) or structure ground pad (Steel Pole). In either case, the switch handle ground must be terminated to this 4/0 AWG copper ground wire.

C.) If switch structure is 100 feet or less from existing station ground grid, guy wire anchor grounding is recommended. Also, connect protective ground loop to existing station ground grid as noted.

FIGURE 1

GROUNDING PROTECTIVE LOOP
WITH STATIC WIRE

(MANUAL OPERATION ONLY)



*= MAINTAIN 1'-0" BETWEEN POLE EDGE AND GROUND LOOP REGARDLESS OF POLE TYPE OR DIAMETER

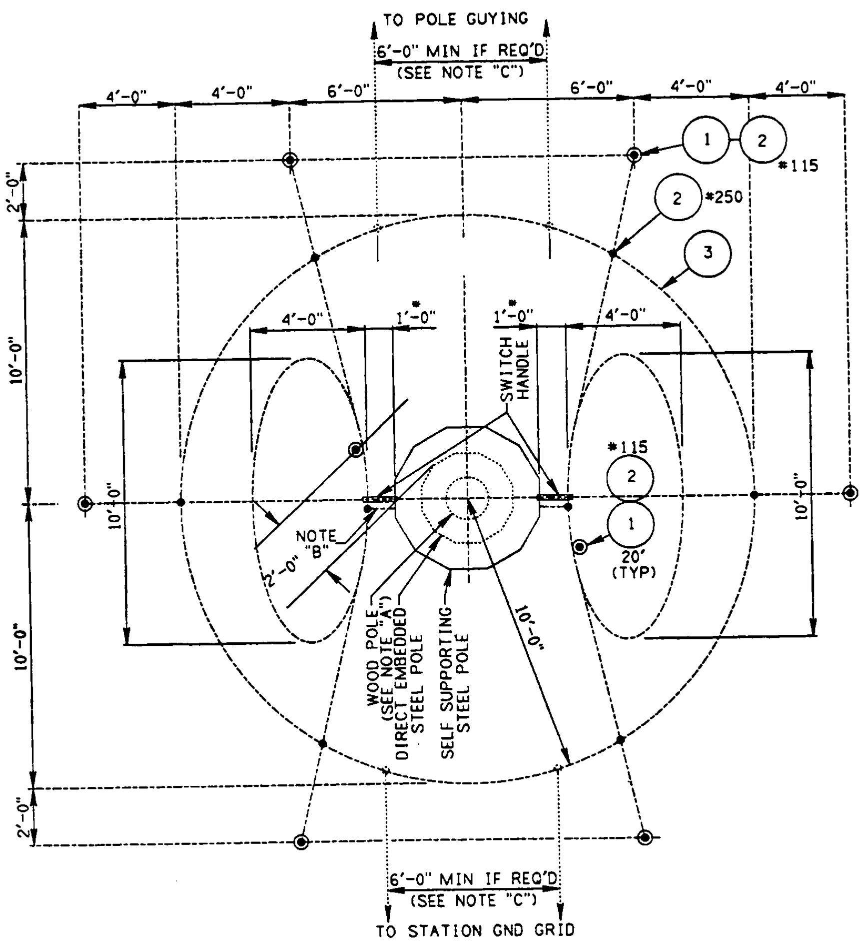
LEGEND

1. 3/4" GROUND ROD (LENGTH AS NOTED)
2. EXOTHERMIC CONNECTION (CART SIZE AS NOTED)
3. 4/0 AWG CU-SOLID SOFT DRAWN

FIGURE 2

GROUNDING PROTECTIVE LOOP WITHOUT STATIC WIRE

(MANUAL OPERATION ONLY)



*= MAINTAIN 1'-0" BETWEEN POLE EDGE AND GROUND LOOP REGARDLESS OF POLE TYPE OR DIAMETER

LEGEND

1. ¾" GROUND ROD (LENGTH AS NOTED)
2. EXOTHERMIC CONNECTION (CART SIZE AS NOTED)
3. 4/0 AWG CU-SOLID SOFT DRAWN

APPENDIX E

Inspection Requirements Form

Appendix E

CONNECTING FACILITY
Electrical Facility Checkout Guide

ITEM	ACTION/INFORMATION	BY	DATE
1. Facility Ground Resistance	Review Test Results	________	________
2. Air break and Disconnect Switch Alignment			
a. *Switch Device Number* ________________	Visual Inspection	________	________
b. *Switch Device Number* ________________	Visual Inspection	________	________
c. *Switch Device Number* ________________	Visual Inspection	________	________
d. *Switch Device Number* ________________	Visual Inspection	________	________
e. *Switch Device Number* ________________	Visual Inspection	________	________
f. *Switch Device Number* ________________	Visual Inspection	________	________
3. Circuit Breakers			
a. ____kV Circuit Breaker *Device Number*			
1. Gas Filled	Visual Inspection	________	________
2. Timing Tests	Review Test Results	________	________
3. Digital Low R Ohmmeter	Review Test Results	________	________
4. Doble Test	Review Test Results	________	________
5. CT Ratio & Polarity	Review Test Results	________	________
6. Breaker Alarms	Detailed Inspection	________	________
4. Circuit Switcher			
a. ____kV Circuit Switcher *Device Number*			
1. Hipot Test	Review Test Results	________	________
2. Timing Test	Review Test Results	________	________
3. Digital Low R Ohmmeter	Review Test Results	________	________
5. Fuses			
a. ____kV Fuses *Device Number*			
1. Rating/Type	Visual Inspection	________	________
2. Air Flow Test	Review Test Results	________	________
6. Power Transformer			
a. ____kV Transformer *Device Number*			
1. CT Ratio & Polarity	Review Test Results	________	________

7. CCVT/VT

a. ____kV *Circuit/Line Name* CCVT/VT *Device Number*

1. Doble Test	Review Test Results	________	________
2. Potential Polarizing Test	Review Test Results	________	________
3. Ratio & Polarity Test	Review Test Results	________	________

b. ____kV CCVT/VT *Device Number*

1. Doble Test	Review Test Results	________	________
2. Potential Polarizing Test	Review Test Results	________	________
3. Ratio & Polarity Test	Review Test Results	________	________

8. Phasing

a. ___kV BUS *Number*	Detailed Inspection	________	________

9.Batteries and Charger

a. ___V DC Battery and Charger

1. Battery Acceptable	Review Test Results	________	________
2. Intercell Resistance Test	Review Test Results	________	________
3. Charger Settings	Visual Inspection	________	________
4. Ground Detector	Detailed Inspection	________	________

10. SCADA

a. Function Test with SCC

1. Control	Detailed Inspection	________	________
2. Indication	Detailed Inspection	________	________
3. Alarms	Detailed Inspection	________	________

b. Metering	Detailed Inspection	________	________

11. Relay and Control Schematics

a. ___kV Circuit Breaker *Device Number*

1. Correct Settings Applied	Review Test Results	________	________
2. Calibration Test	Review Test Results	________	________
3. Trip Test	Detailed Inspection	________	________
4. In-Service Load Angles	Detailed Inspection	________	________
5. Remote Relay Communication	Detailed Inspection	________	________

b. Annunicators and Alarms

1. Set Undervoltage & Time Delay Relays	Review Test Results	________	________
2. Function Tested	Review Test Results	________	________

2. Miscellaneous

a. Arresters

1. Sized Correctly	Visual Inspection	________	________
2. Located Properly	Visual Inspection	________	________

b. Clearance

1. Bus to Ground	Visual Inspection	________	________
2. Bus to Bus	Visual Inspection	________	________
3. Bus to Steel	Visual Inspection	________	________