SECTION 25 10 10
ADVANCED UTILITY METERING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes the following for the connection to, and the expansion of the existing advanced metering system of the facility. The metered systems include the electrical power, steam, steam condensate, chilled water, heating water, domestic water, and makeup water systems. The metering systems in each facility are part of a Corporate-Wide utility metering system, rendering the VA accurate and automated metering of its facilities' energy and water flows. Metering systems are comprised of:

3. Electric meters.

4. Volumetric flowmeters, temperature sensors and pressure transducers.

5. Mass flowmeters.

1.2 RELATED WORK

A. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Requirements for seismic restraint of nonstructural components. //

B. Section 22 05 19 METERS AND GAGES FOR PLUMBING PIPING: meters and gages.

E. Section 22 35 00 DOMESTIC WATER HEATER EXCHANGERS: references meters.

F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION: General mechanical requirements, common to more than one section in mechanical.

H. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Flowmeters and communications

I. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.

J. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage cable.

K. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

L. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

M. Section 26 11 16, SECONDARY UNIT SUBSTATIONS: Unit secondary substation.

N. Section 26 13 00, MEDIUM-VOLTAGE SWITCHGEAR: High voltage switchgear.

O. Section 26 18 41, MEDIUM-VOLTAGE SWITCHES: High voltage switches.

p. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Secondary distribution switchgear.

Q. Section 26 24 11, DISTRIBUTION SWITCHBOARDS: Secondary distribution switchboards.

CC. Reporting Accuracy: this is the root-mean-square sum of all of the metering devices' inaccuracies: measurement inaccuracy, mechanical inaccuracy, analog-to-digital or pulse integration inaccuracy, etc., up to the meter's data head.

JJ. Turn-down: the maximum flow divided by the minimum flow through a meter; used along with accuracy requirements. For example, a meter shall be accurate to within 2% of actual flow with throughout a 20:1 turndown

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Manufacturer Qualifications: A firm experienced at least three years in manufacturing and installing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency, and marked for intended use.

1.5 PERFORMANCE

A. The advanced utility metering system shall conform to the following:

1. Reporting Accuracy: Listed below are minimum acceptable reporting accuracies for all values within the below minimum turn-down envelope reported by the meters:

Measured Variable	**Units Measured**	**Minimum Turn-Down of Meter**	**Reporting Accuracy (Note 1)**
Electricity	V, A, W, etc.	n/a	±0.5% of measured value
	l/s (CFH)	10:1	±2%

Liquefied Petroleum Gas	l/s (CFH)	10:1	±2%
Steam	kW (MBH)	20:1	±2%
Condensate	kW (MBH)	20:1	±2%
Domestic Water flow	l/s (GPH)	20:1	±2%
Make-up Water to Cooling Towers flow	l/s (GPH)	10:1	±2%
Heating Water	kW (MBH)	20:1	±2%
Chilled Water	kW (MBH)	20:1	±2%
Outside Air Temperature	°C (°F)	n/a	±2%
Outside Air Relative Humidity	% rh	n/a	±2.5%

Table 1.5: Meter Performance Criteria

Table Notes:

1. This table shows reporting accuracy, not merely the meter's accuracy. Reporting accuracy includes meter accuracy and data conversion accuracy. See Article 1.3 in this Section for definition. Accuracy is shown against the measured value, not against the full range of the meter.
2. l/s: liter per second
   CFH: cubic feet per hour
   kW: kilowatt
   MBH: 1000's British Thermal Units per hour
   GPH: gallons per hour

1.7 SUBMITTALS

A. Product Data: for each type of product indicated, Attach copies of approved Product Data submittals for products (such as flowmeters, temperature sensors and pressure transmitters, switchboards and switchgear) that describe advance utility metering features to illustrate coordination among related equipment and utility metering and control.

B. Shop Drawings: include plans, elevations, sections, details, and attachments to other work.

1. Outline Drawings: Indicate arrangement of meters, components and clearance and access requirements. Clearly identify system components, internal connections, and all field connections.

2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For advanced utility metering system components and meters, to include in emergency, operation, and maintenance manuals. Include the following:

1. Operating and applications software documentation.
2. Software licenses.
3. Software service agreement.

1.9 LICENSING AGREEMENT

A. Licenses procured as part of this work become the property of the government upon acceptance of the work. Licenses shall have no expiration.

B. Technical Support: Beginning with Government Acceptance, provide software support for // //two// // // years.

1.10 MAINTENANCE AND SERVICE

A. Preventive Maintenance Requirements: provide a preventative maintenance plan with attached procedures indicated by meter and component manufacturers. Perform maintenance procedures for a period of 1 year after government acceptance, at frequencies and using procedures required by the meter and component manufacturers. At a minimum and if the manufacturer is silent on its preventative maintenance requirements, frequencies, deliverables and activities shall comply with the following:

1. Preventive Maintenance Work Plan: prepare a Preventive Maintenance Work Plan to schedule all required preventive maintenance. VA approval of the Work Plan shall be obtained. Adhere to the approved work plan to facilitate VA verification of work. If the Contractor finds it necessary to reschedule maintenance, a written request shall be made to the VA detailing the reasons for the proposed change at least five days prior to the originally scheduled date. Scheduled dates shall be changed only with the prior written approval of the REO.

1.12 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the

extent referenced, unless otherwise noted. Publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME):

B16.1-1998.....Cast Iron Pipe Flanges and Flanged Fittings

B31.1-2007.....Power Piping

B31.9-2008.....Building Services Piping

B40.100-1998.....Pressure Gauges and Gauge Attachments

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASHRAE 135-2008.....A Data Communication Protocol for Building Automation and Control Networks (ANSI)

D. American Society for Testing and Materials (ASTM)

A53-2006.....Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106-2006.....Seamless Carbon Steel Pipe for High Temperature Service

E. Consumer Electronics Association (CEA)

709.1B-2002.....Control Network Protocol Specification

709.3-1999.....Free-Topology Twisted-Pair Channel Specification

852-A-2004.....Tunneling Component Network Protocols Over Internet Protocol Channels

F. Federal Communications Commission (FCC)

EMC-2002.....FCC Electromagnetic Compliance Requirements

G. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

81-1983.....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

100-2000.....The Authoritative Dictionary of IEEE Standards Terms

802.1D-2004.....Media Access Control Bridges

802.2-2003.....Standards for Local Area Networks: Logical Link Control

802.3-2005.....Information Technology - Telecommunications and Information Exchange between Systems. Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple

Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications (ANSI)

1100-2005.....Recommended Practice for Powering and Grounding Electronic Equipment (ANSI)

C37.90.1-2002.....Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

C57.13-2008.....Standard Requirements for Instrument Transformers

C62.41.1-2002.....Guide on the Surges Environment in Low-Voltage(1000 V and Less) AC Power Circuits

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

H. International Electrotechnical Commission (IEC)

IEC 61000-2005.....Electromagnetic Compatibility (EMC)- Part 4-5: Testing and Measurement Techniques; Surge Immunity Test

I. National Electrical Contractors Association

NECA 1-2006.....Good Workmanship in Electrical Construction

J. National Electrical Manufacturers Association (NEMA)

250-2008.....Enclosures for Electrical Equipment (1000 Volts Maximum)

C12.1-2008.....Electric Meters; Code for Electricity Metering

C12.20-2002.....Electricity Meter - 0.2 and 0.5 Accuracy Classes

C62.61-1993.....Gas Tube Surge Arresters on Wire Line Telephone Circuits

ICS 1-2008.....Standard for Industrial Control and Systems General Requirements

K. National Institute of Standards and Technology (NIST)

800, Part 39-2008.....[DRAFT] Managing Risk from Information Systems: An Organizational Perspective

800, Part 46-2009.....Guide to Enterprise Telework and Remote Access Security

800, Part 52-2009.....Recommended Security Controls for Federal Information Systems and Organizations

(FIPS) 200-2006.....Minimum Security Requirements for Federal Information and Information Systems

L. National Fire Protection Association (NFPA)

30-08.....Flammable and Combustible Liquids Code

70-2008.....National Electrical Code (NEC)

101-06.....Life Safety Code

262-2007.....Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

M. NSF International

14-03.....Plastics Piping Components and Related Materials

61-02.....Drinking Water System Components-Health Effects (Sections 1-9)

N. Telecommunications Industry Association, (TIA/EIA)

H-088C3.....Pathway Design Handbook

232-F-2002.....Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

485-A-2003.....Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint System

568-C.1-2009.....Commercial Building Telecommunications Cabling Standard

606-A-2002.....Administration Standard for the Telecommunications Infrastructure

607-A-2002.....Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

O. Underwriters Laboratories, Inc. (UL):

916-2007.....Energy Management Equipment

5085-3-2007.....UL Standard for Safety Standard Low Voltage

1244-2000.....Electrical and Electronic Measuring and Testing Equipment

1581-2006.....Electrical Wires, Cables, and Flexible Cords

PART 2 - PRODUCTS

2.1 ADVANCED UTILITY METERING SYSTEM

A. Functional Description

1. Meter and record load profiles. Chart energy and water consumption patterns.

a. Calculate and record the following:

1) Load factor.

2) Peak demand periods.

3) Consumption correlated with facility activities.

b. Measure and record metering data for the following:

1) Electricity.

2) Steam and condensate

3) Domestic water.

8) Chilled water

9) Heating water

2) Verify utility bills and analyze alternate energy rates.

d. Electric Power Quality Monitoring: Identify power system anomalies and measure, display, capture waveforms, and record trends and alarms of the following power quality parameters:

1) Voltage regulation and unbalance.

2) Continuous three-phase rms voltage.

3) Periodic max./min./avg. samples.

4) Harmonics.

5) Voltage excursions.

2.2 SITE DATA AGGREGATION DEVICE – PERSONAL COMPUTER WORKSTATION

A. Hardware

2.5 METER COMMUNICATION

A. Provide a BACNet network allowing communication from the meters' data heads to the Site Data Aggregation Device.

B. Provide data heads at each meter, converting analog and pulsed information to digital information. Data heads shall allow for up to 24 hours of data storage (including time stamp, measured value, and scaling factor).

1. Each data head shall reside on a BACnet network using the MS/TP Data Link/Physical layer protocol. Each data head shall have a communication port for connection to an operator interface.
2. Environment: Data Head hardware shall be suitable for the conditions ranging from -29°C to 60°C (-20°F to 140°F). Data Heads used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at conditions ranging from -29°C to 60°C (-20°F to 140°F).
3. Provide a local keypad and display for interrogating and editing data. An optional system security password shall be available to prevent unauthorized use of the keypad and display.
4. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
5. Memory. The building controller shall maintain all BIOS and data in the event of a power loss for at least 72 hours.
6. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

2.6 ELECTRICAL POWER METERS AND SUB-METERS

A. ELECTRICAL METER APPLICATIONS

1. Energy meters in the advanced utility metering system shall have models available for amperage ranges of 100-2400 amperes.
   a. The RS-485 communications shall provide communications links up to 10,000 feet long.

2. Power meters shall be installed as part of the existing advanced utility metering systemand shall be squared power logio PM800 series.
   a. All setup parameters required by the power meter shall be stored in nonvolatile memory and retained in the event of a control power interruption.
   b. The power meter may be applied in three-phase, three- or four-wire systems.
   c. The power meter shall be capable of being applied without modification at nominal frequencies of 50, 60, or 400 Hz.
   d. The power meter shall provide for onboard data logging, able to log data, alarms, waveforms and events.

B. Physical and Common Requirements
   1. Electrical power meters shall be separately mounted, and enclosed in a NEMA 250, Type 1 enclosure. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
      a. Ambient conditions of 0 to 140 deg F dry bulb and 20 to 95 percent relative humidity, noncondensing.

C. Current and voltage ratings:
   1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
   2. Withstand ratings shall be not less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
   3. Voltage inputs from standard instrument potential transformers with 120 volt secondary output. The power meter shall support PT primaries through 3.2 MV.
   4. The power meter shall operate properly over a wide range of control power including 90-457 VAC or 100-300 VDC.

D. Electrical measurements and calculated values
   1. Power meters shall include the following rms Real-Time Measurements:
      a. Current: Each phase, neutral, average of three phases, percent unbalance.

b. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
c. Power: Per phase and three-phase total.
d. Reactive Power: Per phase and three-phase total.
e. Apparent Power: Per phase and three-phase total.
f. True Power Factor: Per phase and three-phase total.
g. Displacement Power Factor: Per phase and three-phase total.
h. Frequency.
i. THD: Current and voltage.
j. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
k. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
l. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

2. Power meters shall perform the following demand current calculations, per phase, three-phase average and neutral:
a. Present.
b. Running average.
c. Last completed interval.
d. Peak.

3. Power meters shall perform the following demand real power calculations, three-phase total:
a. Present.
b. Running average.
c. Last completed interval.
d. Predicted.
e. Peak.
f. Coincident with peak kVA demand.
g. Coincident with kVAR demand.

4. Power meters shall perform the following demand reactive power calculations, three-phase total:
a. Present.
b. Running average.
c. Last completed interval.
d. Predicted.

e. Peak.

f. Coincident with peak kVA demand.

g. Coincident with kVAR demand.

5. Power meters shall perform the following demand apparent power calculations, three-phase total:

a. Present.

b. Running average.

c. Last completed interval.

d. Predicted.

e. Peak.

f. Coincident with peak kVA demand.

g. Coincident with kVAR demand.

6. Power meters shall perform the following average true power factor calculations, demand coincident, three-phase total:

a. Last completed interval.

b. Coincident with kW peak.

c. Coincident with kVAR peak.

d. Coincident with kVA peak.

7. Power Analysis Values:

a. THD, Voltage and Current: Per phase, three phase, and neutral.

b. Displacement Power Factor: Per phase, three phase.

c. Fundamental Voltage, Magnitude and Angle: Per phase.

d. Fundamental Currents, Magnitude and Angle: Per phase.

e. Fundamental Real Power: Per phase, three phase.

f. Fundamental Reactive Power: Per phase.

g. Harmonic Power: Per phase, three phase.

h. Phase rotation.

i Unbalance: Current and voltage.

j. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 31st harmonic.

8. Power meters shall perform one of the following demand calculations, selectable by the User; meters shall be capable of performance of all of the following demand calculations.

a. Block interval with optional subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:

1) Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
2) Fixed block that calculates demand at end of the interval.
3) Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.

c. Minimum and maximum values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:
1) Line-to-line voltage.
2) Line-to-neutral voltage.
3) Current per phase.
4) Line-to-line voltage unbalance.
5) Line-to-neutral voltage unbalance.
6) Power factor.
7) Displacement power factor.
8) Total power.
9) Total reactive power.
10) Total apparent power.
11) THD voltage L-L.
12) THD voltage L-N.
13) THD current.
14) Frequency.

d. Harmonic calculation: display and record the following:
1) Harmonic magnitudes and angles for each phase voltage and current through 31st harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
2) Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by the VA.

E. Waveform Capture:
1. Capture and store steady-state waveforms of voltage and current channels; initiated manually. Each capture shall be for 3 cycles, 128 data points for each cycle, allowing resolution of harmonics to 31st harmonic of basic 60 Hz.

2. Capture and store disturbance waveform captures of voltage and current channels, initiated automatically based on an alarm event. Each capture shall be fully configurable for duration with resolution of at least 128 data points per cycle, for all channels simultaneously. Waveform shall be configurable to capture pre-event cycles for analysis.
3. Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.

F. Meter accuracy:
1. Comply with ANSI C12.20, Class 0.5; and IEC 60687, Class 0.5 for revenue meters.
2. Accuracy from Light to Full Rating:
a. Power: Accurate to 0.5 percent of reading.
b. Voltage and Current: Accurate to 0.5 percent of reading.
c. Power Factor: Plus or minus 0.005, from 0.5 leading to 0.5 lagging.
d. Frequency: Plus or minus 0.01 Hz at 45 to 67 Hz.

G. Meter input, sampling, display, output, recording and reading Capabilities
1. Input: One digital input signal.
a. Normal mode for on/off signal.
b. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
c. Conditional energy signal to control conditional energy accumulation.
d. GPS time synchronization.
2. Sampling:
a. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.
b. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.

4. Outputs:
a. Operated either by user command sent via communication link, or set to operate in response to user-defined alarm or event.
b. Closed in either a momentary or latched mode as defined by user.

c. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.

d. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.

e. One relay output module, providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.

f. Output Relay Control:

1) Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.

2) Normally open and normally closed contacts, field configured to operate as follows:

a) Normal contact closure where contacts change state for as long as signal exists.

b) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.

c) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.

d) End of power demand interval when relay operates as synchronization pulse for other devices.

e) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.

f) Output controlled by multiple alarms using Boolean-type logic.

5. Onboard Data Logging:

a. Store logged data, alarms, events, and waveforms in 2 MB of onboard nonvolatile memory.

b. Stored Data:

1) Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data,

and between 2 to 52 days of 15-minute interval data, depending on number of quantities selected.

2) Custom Data Logs: three user-defined log(s) holding up to 96 parameters. Date and time stamp each entry to the second and include the following user definitions:
   a) Schedule interval.
   b) Event definition.
   c) Configured as "fill-and-hold" or "circular, first-in first-out."
3) Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
4) Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."

c. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

6. Alarms.

a. User Options:
   1) Define pickup, dropout, and delay.
   2) Assign one of four severity levels to make it easier for user to respond to the most important events first.
   3) Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.

b. Alarm Events:
   1) Over/undercurrent.
   2) Over/undervoltage.
   3) Current imbalance.
   4) Phase loss, current.
   5) Phase loss, voltage.
   6) Voltage imbalance.
   7) Over kW demand.
   8) Phase reversal.
   9) Digital input off/on.
   10) End of incremental energy interval.
   11) End of demand interval.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Cabling

1. Install 4 conductor cables as described on drawings.
2. Screw terminals shall not be used except where specifically indicated on plans.
3. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations.
5. Provide service loop on each end of the cable, (12 inches) at the meter.
6. Do not exceed manufacturers' cable pull tensions for copper cables.
7. Provide a device to monitor cable pull tensions. Do not exceed 110 N (25 pounds) pull tension for four pair copper cables.
8. Do not chafe or damage outer jacket materials.
9. Use only lubricants approved by cable manufacturer.
12. Cables shall be terminated; no cable shall contain unterminated elements.
13. Cables shall not be spliced.
14. Label cabling in accordance with paragraph Labeling in this section.

B. Labeling

1. Labels: Provide labeling in accordance with TIA/EIA-606-A. Handwritten labeling is unacceptable. Stenciled lettering for all circuits shall be provided using laser printer.
2. Cables: Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA/EIA-606-A.

C. Grounding: ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in

metallic raceways, telecommunications system grounds, , as well as equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Comply with VA 27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS and with VA 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

H. Electrical Meters
   1. Power monitoring and control components shall all be factory installed, wired and tested prior to shipment to the job site.
   2. All control power, CT, PT and data communications wire shall be factory wired and harnessed within the equipment enclosure.
   3. Where external circuit connections are required, terminal blocks shall be provided and the manufacturer’s drawings must clearly identify the interconnection requirements including wire type to be used.
   4. All wiring required to externally connect separate equipment lineups shall be furnished and installed at the site as part of the contractor’s responsibility.
   5. Contractor interconnection wiring requirements shall be clearly identified on the power monitoring and control system shop drawings.

3.2 ADJUSTING AND IDENTIFICATION

A. Install a permanent wire marker on each wire at each termination.
B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
C. Wire markers shall retain their markings after cleaning.

3.3 FIELD QUALITY CONTROL

A. The power monitoring and control system vendor must be able to provide development, integration and installation services required to complete and turn over a fully functional system including:
   1. Project management to coordinate personnel, information and on-site supervision for the various levels and functions of suppliers required for completion of the project.
   2. All technical coordination, installation, integration, and testing of all components.
   3. Detailed system design and system drawings.

B. Cabling, equipment and hardware manufacturers shall have a minimum of 5 years experience in the manufacturing, assembly, and factory testing of components which comply with EIA TIA/EIA-568-B.1, EIA TIA/EIA-568-B.2 and EIA TIA/EIA-568-B.3.

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