SECTION 260913 ELECTRICAL POWER & GAS/WATER MONITORING
PART 1.0 - GENERAL

1.1 DOCUMENTS

1. Please note: that this section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts listed by the appropriate parties below.

1.2 SYSTEM DESCRIPTION

1. The products specified herein are intended to provide a complete sub-metering solution. This solution shall be utilized to measure and monitor owner provided utilities including, but not limited to, electricity, gas, water, and steam. System will also allow for compliance with national and local energy codes and provide equipment needed to meet specific LEED M&V credits.

1.3 SECTION INCLUDES

1. Electrical sub-metering equipment, data collection systems, and data management software systems including:
   a. Standard single point kWh electrical sub-meters
   b. Advanced single point kWh electrical sub-meters
   c. Multi-point electrical sub-meters
   d. Data collection hubs
   e. High density pulse modules
   f. Open protocol data communication network
   g. Wireless communication devices
   h. Energy monitoring and tenant billing software

1.4 STANDARDS

1. Provide equipment of this Section in full compliance with the following applicable portions of the latest revisions of the following standards:
   a. ANSI C12.1 & C12.20 at 0.5 Accuracy Class
   b. UL Certified to IEC/EN/UL/CSA 61010-1 2nd Edition.
   c. UL916:
      i. These requirements cover energy management equipment and associated sensing devices rated 600 volts or less and intended for installation in accordance with the National Electrical Code, NFPA 70.

1.5 SHOP DRAWINGS

1. Installation and Shop Drawings to include the following:
   a. Manufacturer’s literature and specification
   b. Component connection wiring diagrams
   c. Communications system specification

1.6 INSTALLATION, OPERATION, AND MAINTENANCE MANUALS

1. Submit installation, operation, and maintenance manuals for the electrical sub-metering system data collection system, and data management software.
1.7 TECHNICAL PERFORMANCE

1. Minimum measured technical performance of each piece of installed equipment shall meet the specifications published by the manufacturer.

2. Optimize technical performance of all systems to produce the highest achievable technical performance to the satisfaction of consultant and/or client.

3. Any deficiencies in the system, particularly information communication errors or operational deficiencies, shall be cause for rejection. Rectify any such deficiencies prior to calling for substantial completion review.

1.8 WARRANTY

1. Manufacturer shall provide a comprehensive warranty for all products.

2. All electrical sub-meters included in this specification to be free from defects in materials and workmanship from the date of substantial completion for a period of 5 Years.

3. All data collection system components included in this specification to be free from defects in materials and workmanship from the date of substantial completion for a period of 5 Years.

PART 2.0 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

1. Acceptable Manufacturer: Leviton Manufacturing Co. Inc.


3. Substitutions [Permitted] [Not Permitted]:

   a. Show all substitutions as an add or deduct from base bid pricing.

   b. Provide Manufacturer’s reference list.

   c. Clearly delineate all propose substitutions as such and submit in writing for approval by the engineer a minimum of 10 working days prior to the bid date.

   d. Prior to rough-in, provide complete engineered shop drawings, including power wiring, with deviations for the original design highlighted in an alternate color, to the engineer for review and approval.

   e. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.
2.2 METERS AND CURRENT TRANSFORMERS


2. Advanced single point metering devices: Leviton EMH+ OR A8814, Series 3500, Series 4000 & Series 4100

3. Multipoint metering devices: Leviton Series 7000, 7100 or 8000

4. Leviton solid or split core current transformers with full scale output of 0.1A or 0.333v

5. Leviton Rogowski coil current transformers.

6. Solid Core current transformers available for 100-400A and split core current transformers available from 50A - 5,000A.

7. Current transformer secondary conductor wires can be extended:
   a. 500’ for 0.1A CT’s
   b. 300’ for 0.333V CT’s
   c. 20’ for Rogowski Coil CT’s

2.3 SYSTEM DESCRIPTION – SINGLE POINT METERING DEVICES

1. Provide single point metering devices capable of metering 1PH/2W, 2PH/3W, 3PH/3W, and/or 3PH/4W loads.

2. Meters must be capable of directly metering North American 120/208/240v, 277/480V and 347/600V.

3. Metering units must be capable of metering loads between 100A and 5000A. Provide meters specific to each project as indicated on construction drawings.

4. Metering Units must have the capability of paralleling up to 3 (three) sets of CTs per phase. Not applicable to Rogowski coil meters.

5. Must meet all ISO 9001 standards for quality control where all meters test to a minimum of +/- 0.2% or 0.5% accuracy, dependent on stated accuracy class.

6. The system shall be as described below:
   a. To consist of electronic meters with embedded communications capability, and solid core, split-core or Rogowski coil current transformer technology. The current transformers shall have a full scale output of 0.1A or .333v and secondary voltage clamps for safety purposes.
   b. Meters to be used for Energy Monitoring and Tenant Billing applications
   c. The meters will be capable of remote communication from each metering device.
   d. Standard meters shall have isolated pulse output with output ranges from 10Wh to 1kWh.
e. Advanced meters shall transmit data via one of the following communication protocols:

   i. Isolated Pulse Output
   ii. Modbus TCP/IP
   iii. BACNet IP
   iv. Modbus RTU
   v. BACNet MS/TP

f. Backup power provided by on-board battery maintains the real time clock through power loss (Advanced Meters Only). Energy data is stored in non-volatile memory to maintain value through power loss. Device is capable of holding 65 days of historical data in default settings (Advanced Meters Only)

g. Failure of the building electrical normal power system shall not result in loss of data and will not require manual restarting of the metering system

7. The electronic energy monitoring system shall be fully automated microprocessor-based electrical energy measurement system for Measurement and Verification and Tenant Billing purposes. The system shall incorporate complete metering, communications, reporting functions; energy monitoring and threshold limit capabilities.

2.4 SYSTEM MEASUREMENTS – SINGLE POINT METERING DEVICES

1. Meters to be complete with a Liquid Crystal Display (LCD) to access all energy measurements and phase diagnostics when needed

2. Standard Meter Energy Parameters:
   a. kWh real consumption
   b. kW peak resettable kW peak (optional)

3. Advanced Meter Energy Parameters:
   a. Bi-directional Energy Measurements
   b. kWh real consumption
   c. kW peak resettable kW peak
   d. kW instantaneous consumption
   e. kVAh apparent energy consumption
   f. kVA total apparent power
   g. kVARh reactive consumption
   h. kVAR total reactive power
   i. PF power Factor Total
   j. Maximum kW peak demand with time and date stamp
   k. Line Frequency Hz

4. Advanced Meter Phase Diagnostics: Parameters to be displayed for each individual phase of each metered load:
   a. Voltage Phase to neutral or phase to phase
   b. Amps Instantaneous amperage for each phase
   c. kW Instantaneous real energy
   d. PF Power factor
   e. kVA Instantaneous apparent energy
2.5 SYSTEM DESCRIPTION – MULTIPROJECT METERING DEVICES

1. The system shall be as described below:

a. To consist of electronic multiple point meters with embedded communications capability, and solid core, split-core or Rogowski coil current transformer technology. The current transformers shall have a full-scale output of 0.1A or .333v A/C outputs and secondary voltage clamps for safety purposes.

b. Meters to be used for Energy Monitoring and Tenant Billing applications

c. Meters shall be capable of external mounting in a NEMA 1 enclosure or internal mounting in electrical panels or switchgear.

d. The meters will be capable of remote communication from each metering device. Each device shall have IP sockets and RS-485 terminals to accommodate data transmission via Modbus RTU, Modbus TCP/IP, BACNet MS/TP, BACNet IP and standard Ethernet. Data shall be transmitted by one or a combination of the following:

   i. Standard Ethernet interface
   ii. Ethernet connection to PC or laptop via crossover cable.
   iii. RS-485 Network-Modbus RTU & BACNet MS/TP

e. Systems to have backup storage power to key components so no data is lost during power outages. Device must be capable of holding 2 years of interval data for a 20 year period. The system shall continue to function after resumption of power.

f. Failure of the building electrical normal power system shall not result in loss of data and will not require manual restarting of the metering system

2. The electronic energy monitoring system shall be fully automated microprocessor-based electrical energy measurement system for Measurement and Verification and Tenant Billing purposes. The system shall incorporate the following:

   a. Complete metering
   b. Communications
   c. Reporting functions
   d. Energy monitoring
   e. Threshold limits capabilities.

3. Meters must be capable of directly metering on board, North American 120/208/240v, 277/480V and 347/600V.

4. Meters may require PT cabinets in 480v Delta and 347/600v applications.

5. Meters may be capable of two distinct and independent reference voltage input to allow for monitoring two separate electrical systems. Meter must allow any CT input to be referenced against either input voltage channel.

6. Metering Units must have the capability of a Wiring Harness, single incoming cable containing 25 pairs of 22 AWG wire with associated current transformers (CT’s) or optional Terminal Strips, screw terminal
connections for CTs. Metering Units may also be configured with individual input channels for CT's secondary wires.

7. Must meet all ISO 9001 standards for quality control where all meters test to a minimum of +/- 0.2% or 0.5% accuracy, dependent on accuracy class.

8. Metering unit(s) must be configurable to meter 24 single-pole circuits, 12 two-pole circuits, or 8 three-pole circuits.

9. Metering unit(s) must be configurable to meter 48 single pole circuits, 24 two pole circuits or 16 three-pole circuits.

### 2.6 SYSTEM MEASUREMENTS – MULITPOINT METERING DEVICES

1. Meters to be complete with a Liquid Crystal Display (LCD) to access energy measurements and phase diagnostics when needed.

2. Energy Parameters:
   a. kWh real consumption
   b. kW instantaneous consumption
   c. kVAh apparent consumption
   d. kVA apparent power
   e. kVArh reactive consumption
   f. kVAR reactive power

3. Phase Diagnostics: Parameters to be displayed for each individual phase of each metered load:
   a. Voltage Phase to neutral or phase to phase
   b. Amps Instantaneous amperage for each phase
   c. kW Instantaneous real energy
   d. PF Power factor
   e. PA Phase angle
   f. kVA Instantaneous apparent energy
   g. KVAR Instantaneous reactive energy
   h. THD Total Harmonic Distortion-Theta

### 2.7 METER DATA COLLECTION AND COMMUNICATION

1. Data acquisition sever: Leviton Energy Monitoring HUB
2. Pulse data collection: Leviton High Density Pulse Module
3. Wireless data transmission: Leviton ModHopper

### 2.8 SYSTEM DESCRIPTION - METER COMMUNICATIONS AND DATA COLLECTION

1. The system shall be as described below:
   a. To consist of energy management hubs, pulse modules, wireless communication devices, and software used to transmit, collect, and display data provided by sub-metering equipment used to capture measurements from utilities that include, but are not limited to, electrical, gas, water, and steam.
b. System to allow all data collected to be connected to IP based applications including Third Party Billing Companies/Software, Enterprise Energy Management Software, Demand Response, and Smart Grid Collection for use in power Measurement and tenant billing.

c. Data collection system shall be all non-proprietary and compatible with industry standard M&V software applications. Open protocols such as Modbus, pulse outputs, analog, resistive inputs, etc. shall be utilized. No proprietary or manufacturer specific protocols between meter and data collectors shall be accepted.

2.9 PRODUCT REQUIREMENTS - DATA ACQUISITION SERVER

1. Provide data acquisition servers that measure and verify data from electrical meters, water and gas meters and other compatible environmental sensors.

2. Server shall comply with the following codes and standards:
   a. FCC CFR 47 Part 15, Class A
   b. EN 610000
   c. EN 61326
   d. CE

3. Server shall be equipped with an ARMg embedded CPU, an ARM7 I/O co-processor, 32MB of onboard RAM, 16MB of NOR flash memory, and a USB expansion port.

4. Server shall operate under the following conditions:
   a. 32°F to 122°F (0°C to 50°C), 0-90% RH, non-condensing
   b. 41°F to 104°F (5°C to 40°C), 0-90% RH, non-condensing

5. Server shall have the capability to collect and log information at intervals from one (1) to sixty (60) minutes.

6. Server shall timestamp all acquired data and store it in a non-volatile memory.

7. Server shall use modem and/or Ethernet connections for internet access allowing either static IP (internet protocol) or DHCP (Dynamic Host Control Protocol) addressing.

8. Server shall communicate with metering data points via wired or wireless connections over the following protocols:
   a. Wired communications:
      i. Pulse
      ii. Ethernet-Modbus TCP/IP
      iii. RS-485-Modbus RTU
          a. Modbus devices to be connected via Belden 1120A or equivalent 18g twisted shielded pair.
   b. Wireless Communications:
      i. Wireless Modbus

9. Server shall communicate with external devices via -wired or wireless connections over the following protocols:
   a. Wired communications:
      i. Ethernet LAN (Local Area Network) or WAN (Wide Area Network)
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ELECTRICITY METERING

2.10 PRODUCT REQUIREMENTS – HIGH DENSITY PULSE MODULES

1. Provide high density pulse module for collection and distribution of pulse output data generated by electric, gas, water, steam, BTU meters, and environmental sensors (humidity, temperature, etc.).

2. Module shall have on-board, adjustable Modbus addressing via dip switches with addresses from 1-128.

3. Module shall comply with the following codes and standards:

4. Module shall be equipped with an ARM7 I/O processor with field-upgradable firmware.
5. Module shall communicate over a Modbus / RTU RS-485, two wire network with the following network speeds
   a. 19200 Baud
   b. 9600 Baud

6. Module shall operate under the following conditions
   a. -22°F to 158°F (-30°C to 70°C), 0-90% RH, non-condensing

7. Module shall have a 32-bit pulse counter which rolls over at 4.295 billion pulses per channel and store pulse data in a non-volatile memory. Pulse rate shall be user selectable.

8. Module shall have the following input and output connections
   a. Input
      i. Non isolated pulse and power inputs
      ii. Modbus RS485 connection
      iii. Twenty-three (23) independent pulse count inputs designed for use with dry contact outputs. The pulse rate shall be user selectable between the following:
         a. 10Hz: Minimum pulse width to be 50ms
         b. 50Hz: Minimum pulse width to be 10ms
         c. 100Hz: Minimum pulse width to be 5ms

2.11 PRODUCT REQUIREMENTS – WIRELESS TRANSCEIVER

1. Provide OPTIONAL wireless transceiver for collection and distribution of pulse outputs generated by electrical meters, other energy and water meters and environmental sensors.

2. Transceiver shall comply with the following codes and standards:
   b. FCC ID to be OUR-9XTREAM
   c. Industry Canada ID to be 4214A-9XTREAM

3. Transceiver shall be equipped with a 60 MHz ARM7 embedded CPU.

4. Transceiver firmware to be field upgradable.

5. Transceiver shall communicate over a self-healing, self-optimizing wireless mesh network. Network shall utilize frequency hopping, spread-spectrum radio transmission and reception over 900MHz band.

6. Transceiver shall have a range of 3000 feet indoors and 14 miles outdoor line of sight.

7. Transceiver broadcast power shall be 1 watt.

8. Transceiver shall operate under the following conditions
   a. 32°F to 122°F (0°C to 50°C), 0-90% RH, non-condensing
   b. 1.24 miles (2000m) maximum altitude, degree 2 pollution

9. Transceiver shall have a pulse counter with pulse data stored in a non-volatile memory.
10. Transceiver shall have the following input and output connections. Modbus addresses to be adjustable via DIP switches with addresses between 1 and 247.
   a. Input
      i. Two (2) Pulse inputs with user selectable pulse rates of 10, 50, 100, or 250 Hz.
      ii. Modbus RS485 input
      iii. Connect a maximum of 32 Modbus devices to transceiver input
   b. Outputs to be user selectable between 100 Ohms and 2.5 kOhms.
      iv. Two (2) opto-FET dry contact relays rated at 30VDC, 150mA max.

2.12 PRODUCT REQUIREMENTS-NATURAL GAS METERS

1. Meter shall be a diaphragm type vessel designed for compact applications to accurately measure gas consumption of appliances.
2. Meters shall have the following accuracy approvals:
   a. NTEP-National Type Approval (NIST)
   b. CTEP-California Type Approval
3. Meter shall be composed of a lightweight aluminum alloy.
4. Meter shall be capable of accurately measuring:
   a. Natural Gas
   b. LPG
5. Meter shall have ¾” NPT connections
6. Meter shall have a throughput capacity of 200CFH
7. Meter shall operate from -4 to +122 Degrees F.
8. Meter shall have a maximum operating pressure of 7.25 PSI
9. Meter shall have a sealed register with minimum values to 1CF.
10. Meter shall have a pulse output (contact closure) for integration with AMR systems. Pulse value shall be 1CF per pulse.

2.13 PRODUCT REQUIREMENTS-WATER METERS

1. Meters shall be either brass or polymer construction
2. Meters shall be either Multi-Jet or Positive Displacement type measuring technologies.
3. Meters shall meet AWWA C708 accuracy standards in both horizontal and vertical positions
4. Meters shall be NSF/ANSI 61 & 372 Certified
5. Meters shall have the following accuracy certifications:
   a. NTEP-National Type Approval
   b. CTEP-California Type Approval
6. Meters shall operate with the following characteristics:
   a. Max Flow rate - 30gpm
   b. Normal Flow rate - 2-25gpm
   c. Min Flow Rate 0.50gpm
   d. Max Working Pressure -- 150PSI
   e. Max Work Temp:
      i. Cold Water Meter - 105 Degrees F
      ii. Hot Water Meter – 194 Degrees F
7. Meters shall have a pulse output connection with a minimum value of 1 pulse/10 gallons
8. Meter couplings and spacer tubes will be a part of the pre-construction offering for 3/4" meters to allow for water system flushing prior to the installation of the actual meter.

2.14 PRODUCT REQUIREMENTS-RESIDENTIAL MDU RF (Wireless) Automatic Meter Reading System

1. System Shall be composed of Meter Data Transmitters, System Repeaters and Data Concentrator Access Points (DCAP)
2. System shall operate within the 902-928 MHz frequency band. System shall operate as a spread spectrum, frequency agile system.
4. System shall deliver user defined reports in human readable formats such as excel, .csv.
5. System shall have the capability to deliver 15 minute interval data (optional)
6. System will offer both battery operated (5 year battery life) and line powered transmitters.
7. System Components
   a. MDT-Meter Data Transmitter
      i. MDT shall have the ability interface with the following technologies:
         a. Dry contact closure (pulse output)
         b. Encoded Technologies (Neptune, Sensus)
         c. Modbus RTU
      ii. MDT shall transmit over the 902-928 MHz frequency band
      iii. MDT shall operate as frequency hopping device within a defined spread spectrum.
      iv. MDT Shall have an open field range of at least 2500'
      v. MDT shall transmit an alert when cover is removed
      vi. MDT shall operate from -20 to 140 degrees F up to 90% RH, non-condensing
      vii. MDT product shall offer dual pulse input options
      viii. MDT shall derive power from:
         a. On board, changeable AA batteries; 5 year typical battery life.
         b. Line Power Options (9V-15V DC)
            i. Wall Transformers
            ii. Certain Electric Meter Products (Leviton Mini Meter)
   b. Network Diversity Repeater
      i. Repeater shall operate over the 902-928 MHz frequency band.
      ii. Repeater shall create a redundant, self-healing 2-way mesh network between MDT’s and DCAP.
      iii. Repeater shall deliver +28.5dBm transmission power
      iv. Repeater shall have an open field range of 2 miles.
      v. Repeater shall operate from -10 to 140 degrees F up to 90% RH, non condensing.
      vi. Repeater shall be powered by a wall transformer delivering 5V DC, 800mA,
      vii. Repeater shall send an alert message if power is interrupted.
   c. Data Concentration Access Point-DCAP
      i. DCAP shall operate as the Head End of the AMR system
      ii. DCAP shall manage a central database for all system information:
         a. Site specific information
         b. MDT Radio ID’s
         c. Repeater Radio ID’s
         d. Meter Serial Numbers
e. Meter to APT cross reference information  
  f. System Notes  
  g. Maintenance Information  

iii. DCAP shall collect and store all meter readings from system MDT’s.  
iv. DCAP shall have the capacity to manage and store data for 2000 individual meter points  
v. DCAP shall communicate with cloud via 10/100 Ethernet or cellular modem (optional)  
vi. DCAP shall offer data output formats as follows:  
   a. Email with .CSV or .OUT file format  
   b. FTP and Secure FTP  
   c. CIT Software  

vii. DCAP shall be configured using PC based application-CIT (Configuration and Installation) tool. CIT tool will have the following features:  
   a. Readable labeling of all MDT Radio ID’s  
   b. All Site Information to include the site access code.  
   c. Mass upload capability of site configuration information via excel  
   d. Configurable network parameters for reporting  
   e. Network Typology for wireless system troubleshooting  
   f. CheckIn Monitor to map progress of system installation  

viii. DCAP shall operate from -10 to 145 degrees F, up to 90 RH, non condensing  
ix. DCAP shall be powered using wall transformer (5V DC, 1Amp)  
x. DCAP shall allow for programming Initial Meter Reading to match meter odometer and electronic reading.  

2.15 CLOUD BASED ENERGY INFORMATION SOFTWARE  

1. Software package shall consist of one or more of the following WEB based system modules:  
   a. Basic Building Management Software BMO 3.0-Base Module  
   b. Enterprise Energy Management Software: BMO 3.0-Executive Reporting Module  
   c. Code Compliance Software; BMO 3.0-Code Compliance Module  
   d. Tenant Billing Software: BMO 3.0-Tenant Billing Module  

2.16 PRODUCT REQUIREMENTS-BASIC SOFTWARE-BMO 3.0 BASE MODULE  

1. BMO 3.0 Base Module is a basic energy information platform that allows for basic reporting of limited graphing of energy information collected from energy and water meters and environmental sensors.  

2. Provide a web hosted software platform which is fully functional without software other than standard web browsers including, but not limited to, Microsoft Internet Explorer, Google Chrome and Firefox Mozilla  
   a. Software shall support multiple Leviton Energy Monitoring HUBs.  

3. Software shall be used for the collection, analysis, and reporting of energy data from sub-metering equipment used to capture energy usage measurements that include, but are not limited to, electrical, gas, water, steam & BTU values.
4. Software shall collect and report data in intervals 15 minute intervals by default; other user defined intervals available.

5. Software shall produce configurable reports and display data for all engineering units available from the meters incorporated in to the system; kWh, kW, gallons, BTU.hr, etc.

6. Software will allow for graphical representation of up to 4 different metering points compared to each other on the graphical output.

7. Software shall allow for exportable tabular data in all report options; excel, .csv, etc.

8. Software shall allow for graphical representations of data in 15 minute intervals or other intervals as determined by the end user.

9. Software will allow for basic energy consumption and cost reporting.

10. Software shall allow for a Date Picking capability to allow for reports to be selected from the following time options:

    a. Last Hour, 8Hrs, Today, Yesterday, 7 days, Week, 30 days, Month, Last Month, Last 12 Months, This Year, Last Year
    b. User Defined Custom Period including date and time range as narrow as a single 15 minute interval

11. Report Header will display the range of total available data for the meter assigned to the report

12. Software will allow for the creation of user defined alarms for low and high readings for energy metrics reported on meters within the system.

2.17 PRODUCT REQUIREMENTS – EEM SOFTWARE-BMO 3.0 EXECUTIVE REPORTING MODULE

1. Description: BMO 3.0 Executive Reporting Module is an Enterprise Energy Management software platform designed to assist energy and facility managers in the conduct of daily energy management reporting and analysis functions. It is designed for portfolio level use incorporating a wide range of graphical interfaces and an executive dashboard for high level energy information.

2. Provide a web hosted software platform which is fully functional without software other than standard web browsers including, but not limited to, Microsoft Internet Explorer, Google Chrome and Firefox Mozilla

3. Software shall support a minimum of 10 separate facilities with 50 meters per facility; additional facilities/meters added as user requires

4. Software shall allow for unique facility information to be entered on Building Set Up Page to include:

    a. Facility Address Information
    b. Facility Square Footage
    c. Utility Cost Information
5. Software shall be used for the collection, analysis, and reporting of energy data from sub-metering equipment used to capture energy usage measurements that include, but are not limited to, electrical, gas, water, steam & BTU values.

6. Software shall collect and report data in intervals 15 minute intervals by default; other user defined intervals available.

7. Software shall produce configurable reports and display data for all engineering units available from the meters incorporated in to the system; kWh, kW, gallons, BTU.hr, etc.

8. Software shall allow for exportable tabular data in all report options; excel, .csv, etc.

9. Software shall allow for a wide variety of graphical representations of data in the following options:
   a. 2 Dimensional Charts
      i. Area Charts
      ii. Vertical Bar Charts
      iii. Horizontal Bar Charts
      iv. Pie Charts
      v. Donut Charts
      vi. Smooth Area Charts
      vii. Smooth Line Charts
      viii. Scatter Charts
   b. 3 Dimensional Charts
      i. Vertical Bar Charts
      ii. Horizontal Bar Charts
      iii. Pie Charts
      iv. Donut Charts

10. Software shall allow for graphical data to be displayed in the following time interval options:
    a. 15 minute
    b. One day
    c. One week
    d. One month
    e. One year

11. Software shall allow for a Date Picking capability to allow for reports to be selected from the following time options:
    a. Last Hour, 8Hrs, Today, Yesterday, 7 days, Week, 30 days, Month, Last Month, Last 12 Months, This Year, Last Year
    b. User Defined Custom Period including date and time range as narrow as a single 15 minute interval

12. Report Header will display the range of total available date for the meter or virtual meter assigned to the report.
13. Software shall organize all user defined and pre-configured reports to be cataloged on a building specific dashboard including the following basic information:
   a. Street Map pinpointing the buildings geographic location
   b. Local current weather conditions displayed
   c. Building Performance Goal Odometers if configured

14. Software shall allow for the construction of Virtual Meters with the following parameters:
   a. Any number of like kind data points (kWh + kWh, etc)
   b. Combinations of data points from any HUB found in the software license
   c. Combinations of virtual meters to create an additional virtual meter.
   d. Virtual meter point data begins on the date and time the VM is created.

15. Software shall allow the creation of energy information alerts with the following parameters:
   a. Alerts shall be either consumption or demand based
   b. Alerts shall be configured to trip based on a fixed base point value with the following conditions:
      i. Less Than (<)
      ii. Less Than or Equal to (<, =)
      iii. Equal to (=)
      iv. Greater Than or Equal to (> ,=)
      v. Greater Than (>)
   c. Alerts will be configured to allow communications via the following methods:
      i. Text
      ii. Email
      iii. Mobile APP (Must have downloaded and activated BMO 3.0 Mobile APP)
      iv. Option for continuous notification or single notification

16. Software shall allow for the creation of a Base Case Analysis for energy demand, consumption or cost
   a. Base Case can be configured from any physical meter or virtual meter
   b. Base Case date range/period is user selectable
   c. Base Case Type can be selected from the following types:
      i. Cost
      ii. Cost/SqFT
      iii. Demand (Average)
      iv. Demand(Peak)
      v. Usage-Consumption
      vi. Usage-Consumption/Sqft
   d. Base Case can be compared to any other period for the same meter or virtual meter
   e. Base Case Comparison to be an option for display on the Executive Dashboard
   f. Base Case Comparison data to be incorporated into Building Goal calculations

17. Software will allow for creation of specific Building Goals:
   a. Building Goals must be specifically targeted against Base Case Analysis
   b. Goal creation must allow for a buffer zone around the goal to be determined by user +/- 5%, etc
   c. Building Goals must be displayed on specific building dashboard using and odometer type display.
   d. Building Goals will be created for any values found in the Base Case Analysis
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18. Software will allow the creation of a configurable Executive Dashboard. Dashboard will be configurable by end user.
   a. Dashboard will offer multiple layout schemes to offer the end user maximum impact of the displayed data
e b. Dashboard will regularly refresh data every 15 minutes or as directed by the end user
e c. Dashboard will allow for the following items to be displayed:
      i. Reports-Building or Portfolio Level-Graphical or Badge type
      ii. Carbon Footprint
      iii. Comparison Report
      iv. Building Goals
      v. Base Case Comparisons
      vi. Street Map
      vii. Current/Future Weather data
      viii. Photo/Picture
      ix. Time Clock (Time Zone adjustable)
e d. Dashboard will be sharable with other users via email.
e e. Dashboard will be adjustable for use with multiple screen sizes and types.

19. BMO 3.0 Base module functionality will be enabled in conjunction with this module.

2.18 PRODUCT REQUIREMENTS – CODE COMPLIANCE MODULE - BMO 3.0

1. Description-BMO 3.0 Code Compliance Module is a cloud-based software platform that is designed to allow commercial building/facility operators to meet minimum requirements found in existing and emerging State and Municipal energy codes related to energy metering, data acquisition & storage and reporting.

2. Provide a web hosted software platform which is fully functional without software other than standard web browsers including, but not limited to, Microsoft Internet Explorer, Google Chrome and Firefox Mozilla.

3. Software shall be used for the collection, analysis, and reporting of energy data from sub-metering equipment used to capture energy usage measurements that include, but are not limited to, electrical, gas, water, steam & BTU values for whole Building Energy Sources and End User Energy categories.

4. Software shall collect and report data in intervals 15 minute intervals by default; other user defined intervals available.

5. Software shall produce configurable reports and display data for all engineering units available from the meters incorporated in to the system; kWh, kW, gallons, BTU.hr, etc.
b. Software will allow for the following Code Compliance report options:
   i. Whole Building Energy Sources-Electric, Gas and Steam
   ii. End Use Energy Categories-
       a. Lighting Load
       b. Plug Load
       c. HVAC Load-Electric, Gas, Steam
       d. Process Load-Electric, Gas, Steam
       e. Miscellaneous Load-Electric, Gas, Steam

6. Software shall allow for a Date Picking capability to allow for reports to be selected from the following
time options:
   a. Last Hour, 8Hrs, Today, Yesterday, 7 days, Week, 30 days, Month, Last Month, Last 12
      Months, This Year, Last Year
   b. Defined Custom Period including date and time range as narrow as a single 15 minute
      interval
   c. Report Header will display the range of total available date for the meter or virtual meter
      assigned to the report
   d. Software will allow for the creation of alarms for low and high readings for energy metrics
      reported on incorporated meters.

7. Software shall allow for the construction of Virtual Meters with the following parameters:
   a. Any number of like kind data points (kWh + kWh, etc)
   b. Combinations of data points from any HUB found in the software license
   c. Combinations of virtual meters to create an additional virtual meter.
   d. Virtual meter point data begins on the date and time the VM is created.

8. Software shall allow for exportable tabular data in all report options; excel, .csv, etc.

9. Software shall allow for graphical representations of data in 15 minute intervals or other intervals as
determined by the end user.

10. Software will allow for basic energy consumption, demand and cost reporting.

11. Report Header will display the range of total available date for the meter or virtual meter assigned to
    the report

12. Software will allow for the creation of alarms for low and high readings for energy metrics reported on
    incorporated meters.

13. BMO 3.0 Base Module functionality will be enabled with this software module.

2.19 PRODUCT REQUIREMENTS – TENANT BILLING MODULE-BMO 3.0
1. Description: BMO 3.0 Tenant Billing Module is a cloud based software platform designed to allow multi-unit property operators to collect meter data and create utility invoices for commercial and or residential tenants.

2. Provide a web hosted software platform which is fully functional without software other than standard web browsers including, but not limited to, Microsoft Internet Explorer, Google Chrome and Firefox Mozilla

   a. Software shall support 10 buildings or facilities with up to 50 meters each. Capacity for additional buildings and meter points can be added.

3. Software shall allow for unique facility information to be entered on Building Set Up Page to include:

   a. Facility Address Information
   b. Rate and Tariff Information
   c. Utility Cost Information
   d. Remit to address
   e. Disclaimers
   f. Custom Logo for Utility Invoices

4. Software shall be used for the collection, analysis, and reporting of energy data from sub-metering equipment used to capture energy usage measurements that include, but are not limited to, electrical, gas, water, steam & BTU values

5. Software shall collect and report data in intervals 15 minute intervals by default; other user defined intervals available.

6. Software shall allow for creation of a tenant list which includes all tenant information to include basic contact information for billing purposes. It will allow for assignment to a specific unit/apartment and include move in and move out date information.

7. Software shall allow for the construction of Virtual Meters with the following parameters:

   a. Any number of like kind data points (kWh + kWh, etc)
   b. Combinations of data points from any HUB found in the software license
   c. Combinations of virtual meters to create an additional virtual meter.
   d. Virtual meter point data begins on the date and time the VM is created.

8. Software shall allow meters to be assigned directly to apts/units within the database. Multiple utility meters may assigned to an apt/unit from the following list of types:

   i. Electric-kWh
   ii. Electric-kW
   iii. Gas/Propane
   iv. Steam
   v. Water
   vi. BTU
   vii. Common Area Electric-kWh

9. Software shall allow for the creation of the following types of billing tariffs:
a. Simple Tiered Tariff with Demand
   i. Tiered Energy Usage-kWh
   ii. Tiered Energy Demand-Kw
   iii. Custom & Other Utility Charges
b. Time of Use Tariff for Consumption and Demand
   i. TOU for Energy Usage-kWh
   ii. TOU for Energy Demand-kW
   iii. TOU Holiday Schedules
   iv. Peak Demand
   v. Custom and Other Utility Charges
c. Software will allow for creation of multiple tariffs that can be activated and deactivated as required seasonally by the end user.
d. Software will allow for different tariffs to be assigned to different buildings within the database.

10. Software shall allow for the creation of tenant invoices for user defined billing periods.
   a. The tenant invoices will contain the following data:
      i. Tenant Information; Name, Address, etc
      ii. Bill Date
      iii. Bill Period
      iv. Due By Date
      v. Meter Readings
      vi. Energy Usage and Charges
      vii. Custom Charges
      viii. Total Charges
      ix. Remit to Address
   b. Tenant Invoices will be created in .pdf format for download, export or print for delivery to tenants.

11. Software shall allow for Summary Billing Reports for each billing period.
   a. The summary reports available include the following:
      i. Tenant ID Information
      ii. Energy Usage Data
      iii. Rate Structure Summary
      iv. Total Utility Costs
      v. Costs for Custom Charges
      vi. Total Costs for all fields

12. BMO 3.0 Base Module functionality will be enabled with this software module.

PART 3.0 – EXECUTION

3.1 WIRING AND CONNECTIONS

1. All wiring must meet and or exceed local electrical code.

2. Metering points show on submitted drawings only to be connected or installed
3. Install all wiring in conduit.

4. Provide a non-dedicated or Ethernet drop for remote meter reading and diagnostics of the system

5. Perform all necessary system calibration, testing, commissioning, and demonstrations as required

6. Prepare and submit record drawings and installation, operation and maintenance manuals for the energy management system as required.

3.2 TESTING AND COMMISSIONING

1. Perform final testing, adjustment, and commissioning of the systems, report results to the Consultant, and include the results in the installation, operation, and maintenance manuals. Provide qualified technicians for testing and commissioning.

2. Perform sufficient technical and operational tests to ensure the technical performance of the system meets the intent of the Contract Documents. Typical testing to include but not be limited to:
   a. Verification of meter readings and proper installation of meter equipment
   b. Communication system connectivity
   c. Meter communication with all software platforms

3. Provide optional functional testing including end to end verification that all meters are operating properly.

4. Demonstrate the operation of the system to the Owner at a time suitable to them. Such demonstration to include product training on how to program the monitoring system.

3.3 FIELD VERIFICATION, ACCEPTANCE, AND TRAINING

1. Provide all “AS BUILT” DRAWINGS and data showing each meter, serial number, address, cross reference, load and CT ratio prior to field verification.

2. Manufacturer’s representative shall verify, adjust and test the system. Verification of the energy monitoring system is to be carried out with the assistance of an electrical contractor at all times. Upon completion, the manufacturer shall issue a “CERTIFICATE OF ACCEPTANCE” to the owner, electrical consultant, contractor and client.

3. Manufacturer’s representative shall demonstrate operation of the system as follows:
   a. Local and remote meter readings
   b. Phase diagnostics
   c. Provide manual of the installed system

4. Setup of system software as directed by client. Typically executed with end user of software remotely.
5. Provide training and software manual for owner’s staff to review.

3.4 FIELD QUALITY CONTROL

1. Submit a detailed testing and commissioning procedure to the Consultant and Client for review and approval prior to undertaking this Work. The procedure shall indicate all test equipment required and acceptance criteria.

2. Upon completion of all testing and commissioning, submit a copy of the test results and certify the system as acceptable for revenue metering purposes.

3. Undertake the testing and commissioning Work with the manufacturer's factory representative(s).

3.5 INSTRUCTION TO STAFF

1. Upon completion of the installation, a competent instructor representing the system manufacturer shall provide a lecture to the operating and maintenance staff concerning the intent, use, and operation and maintenance of the system.

End of Section