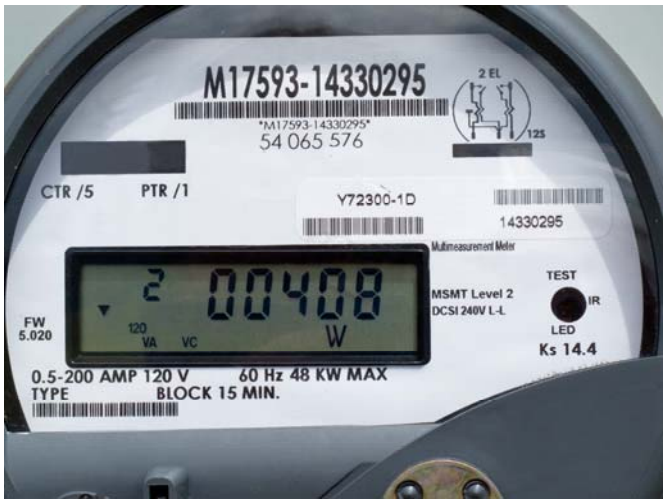
Sweek Consulting Engineers

TECH BRIEF: ENERGY METERING

OVERVIEW

Washington State and Seattle Energy Codes now require energy metering beyond a single utility meter for commercial construction projects over 50,000 square feet (state code) and 20,000 square feet (in the city of Seattle). This brief provides an overview of Sweek Engineers' recommendations on effective approaches to energy metering.

CODE REQUIREMENTS



Energy code requires that energy metering systems are included in the commissioning process. Beyond just meeting code, projects should design and install metering systems that have a low first cost and serve the long-term needs of facilities professionals. Long term needs include monitoring energy use, identifying potential waste, and controlling energy cost.

Code requirements for energy metering include:

- End-use metering for HVAC and domestic hot water[1], separate from whole-building metering.
- Data acquisition with storage for a minimum of 3 years of hourly data.
- Converting units of measure to a single total (e.g. BTUs)
- A graphical energy display[1] showing all metered energy that is accessible to the facility team either on a PC or via the web

[1] These requirements are taken from the 2015 Washington State Energy Code Section C409. They are not comprehensive. Seattle Energy Code 2015 Section C409 also contains energy metering requirements; while similar to Washington State Energy Code requirements, the City of Seattle Code has many additional elements.

ENERGY METERING PROJECT CHALLENGES

Since end-use energy metering is a relatively new code requirement, it has not been common practice for many electrical designers and contractors. As a result, Sweek Engineers has encountered a lack of understanding of the reasoning for metering designs, costly and complex systems sold by vendors, technology challenges with meter integration, and last-minute change orders to integrate data acquisition systems.

On recent projects, Sweek Engineers have identified the following issues during commissioning:

- Vendor meters that have insufficient storage capacity to meet project requirements.
- A design that relied upon the use of the utility website for total building energy consumption.
- A vendor-integrated solution that used standalone PCs with complex trending and a poor user interface. Neither the installer nor the facilities team knew how to access or manage the system.
- An inability to view multiple meters due to long data runs and a poorly planned IT infrastructure.

DESIGN APPROACHES

This brief focuses on buildings without comprehensive automation systems (BAS). If the design has a BAS, we recommend a design that integrates appropriate energy meters (including gas, electric, and whole building) into the BAS. Several of the recommendations below apply to this design approach.

The Construction document drawings and specifications should contain a detailed design that:

- specifies which end uses are metered, such as showing the meters on electrical and natural gas single line diagrams;
- identifies metering for all fuels and exceptions, including electric, gas, hot / chilled water, and on-site renewable energy;
- identifies graphical display requirements, including combining meter data together into a single graphical display;
- identifies data retention requirements, such as 1-hour recording of all meter readings;
- establishes a single unit of measure for totalizing energy meters, such as kBTU; and
- provides minimum requirements for on-site hardware and low voltage data connections.

Beware of design documents that list code requirements but do not contain a metering design. This is a red flag that metering has not been adequately considered.

CONSTRUCTION APPROACHES

Assuming there is a thoughtful design, construction can follow typical practice to deliver effective metering that meets code requirements. Care should be paid to any in-field circuiting changes to ensure that there is no impact on metering design.

On the other hand, commencing construction using documents that don't follow the design approaches listed above introduces unnecessary uncertainty and risk. To ensure a code-compliant and functionally operational design, review and coordinate the elements of the metering package to:

- The first step is to develop an integrated contractor submittal package that shows all portions of the metering system. In many buildings, this will include plumbing, electrical, and low-voltage components. In buildings without BAS, this submittal must include the computer that will acquire and graphically display the data, even if this computer is provided by the building owner.
- Confirm whether metering infrastructure has sufficient graphical capabilities and storage capacity to meet project requirements. ***Most vendors are not familiar with Washington's data acquisition and storage requirements, and their meters are insufficient to meet requirements as a standalone system.*** In our experience, integral meters without a separate networked data acquisition system are insufficient to store hourly meter data for 3 years (over 7,500 records per meter), and do not meet graphical display requirements.
- Establish and plan for data and networking requirements for connecting meters. When there are multiple buildings, or long distances between meters and computers, advance planning is required to ensure connectivity. Network infrastructure (wired or wireless) and internet security protocols are essential to ensure success.
- Test wireless infrastructure prior to wall cover. If a project relies on wireless communication for metering, especially using low-powered mesh networks, testing should be performed to ensure that wireless communication will not be hindered by signal interference or physical obstructions. Having backup repeaters or wired options available can save significant time and cost, if problems are not identified before finishes are applied.
- Review and approval by the owner of the metering system that is being selected. This includes mockups of the metering screens, input on hardware requirements, and review from the owner's IT staff regarding the networking infrastructure for the metering. Many projects run into last-minute issues when hardware and IT requirements are not discussed and approved early.

COMMISSIONING APPROACHES

Sweek Engineers works with all parties through the design and construction process to improve the quality of buildings and their systems.

- Starting with design, Sweek Engineers will review and comment on the metering design to ensure it meets the owner's requirements and is detailed enough to be constructed in the field.
- We will work with the general contractor and sub-contractors to identify information gaps, and work with the design and construction team to resolve them.
- Finally, we perform code-required functional checks to ensure the energy metering system meets the owner's acceptance criteria and project requirements.