

Metering Plan Sequence of Operation

Metering Plan

Overview

The project metering plan targets capturing and presenting data at 5 different levels.

1. Tier 1 - Incoming Utility and Resource Metering
2. Tier 2 - Metering to Support EnergyStar Benchmarking
3. Tier 3 - Metering to Meet Seattle Energy Code Requirements
4. Tier 4 - Metering to Support Measurement and Verification
5. Tier 5 - Metering to Support Ongoing Commissioning and Diagnostics

MI.6.20 illustrates the tiered metering scheme.

Tier 1 - Incoming Utility and Resource Metering

Physical "smart" utility meters are provided for the following resource streams:

1. Settle Public Utilities Incoming Water
2. Puget Sound Energy Gas
3. Seattle City Light Incoming Power
4. Seattle City Light Solar Power

Data from these meters is picked up by the Siemens Navigator software packaged from the utility website and used in combination meters on the other tiers to automatically update the building's EnergyStar Portfolio Manager Energy Use Intensity (EUI) data.

Tier 2 - Metering to Support EnergyStar Benchmarking

The EnergyStar EUI must only reflect the energy consumed by the building for building operations. Thus, the energy used for vehicle charging and operating the wash rack and exterior lighting needs to be subtracted from the total incoming power.

Virtual meters in the Siemens Navigator package shall be created to use data from the submetering system that is furnished, installed and programmed as part of the electrical distribution system gear by the electrical contractor. The electrical distribution gear meters are integrated with the Siemens system via a network level interface provided by Siemens.

These meters monitor the non-building functions to adjust the incoming power consumption for use in the Energy Star EUI to reflect these non-building energy use functions. Data is fed to the EnergyStar Application Program Interface (API) by the Siemens Navigator software package.

Tier 3 - Metering to Meet Seattle Energy Code Requirements

The Seattle Energy Code requires that resource consumption be monitored and displayed on an energy dashboard for the following categories.

1. HVAC electrical energy
2. Lighting electrical energy
3. Plug load electrical energy
4. Emergency generator fuel
5. HVAC thermal energy
6. Domestic hot water thermal energy
7. Domestic water consumption

The metering at this level will also identify the domestic water consumed by the wash rack process and the rain water recovered for use by that process.

Other than the domestic water data, the data for this tier is picked up by physical submeters. Specifically,

- Electrical energy data is picked up by a metering system that is furnished, installed and programmed as part of the electrical distribution system gear by the electrical contractor. This metering is integrated with the Siemens system via a network

level interface provided by Siemens.

- Thermal energy is picked up by physical submeters provided furnished by Siemens for installation at appropriate points in the fuel oil and gas piping systems by the mechanical contractor.
- Domestic water consumption is fed to this tier via the Siemens Navigator package, which has access to the utility smart meter data.
- Wash rack process domestic water and rain water consumption are picked up by physical submeters furnished by Siemens for installation at appropriate points in the fuel oil and gas piping systems by the mechanical contractor.
- A virtual meter in the Siemens Navigator package is used to separate the wash rack water consumption from the total building domestic water consumption.

The Siemens control system/network and the Siemens Navigator software package feed this data to a web accessible energy dashboard.

Tier 4 - Metering to Support Measurement and Verification

The LEED credits associated with the project require metering to support a Measurement and Verification credit (M&V). This credit requires that energy consumption be documented in the following categories.

1. Interior lighting
2. Exterior lighting
3. Space heating
4. Space cooling
5. Pumps
6. Heat rejection
7. Interior fans
8. Domestic hot water heating
9. Receptacles
10. Refrigeration
11. Cooking
12. Process
13. Elevators

The data required for this level is provided by the Siemens network via a number of avenues.

1. Proof of operation for the various equipment items on the project is provided by a Current Transformer (CT) monitoring power into the equipment which triggers a virtual point on or off based on the in coming current crossing a threshold setting that is associated with the equipment being in operation.

The proof of operation points are used to accumulate run time hours in addition to demonstrating that the equipment is in operation.

The analog data from the CT's is used in conjunction with power factor and voltage data provided the submetering system provided with the electrical distribution gear to calculate energy consumption for the various equipment loads via the following equations.

Equation 1 - kW Calculation

The kW and run time are used to create a virtual energy meter using Equation 2.

Equation 2 - kWh Calculation

2. CTs are also provided by the Siemens system to submeter from some of the electrical distribution panels to break out exterior lighting, refrigeration, cooking, and process loads. Energy

consumption for these loads is calculated using Equation 1 and Equation 2.

3. The Siemens system uses data from the meters provided for the other tiers in combination with the meters discussed under items 1 and 2 above to create virtual meters that accumulate the data required for the LEED M&V credit.

The M&V data is presented via a graphic dashboard available in the Siemens network. The data is also archived on a backed up virtual hard drive located in the Seattle IT data center. Siemens feeds data to this storage location which is furnished, supported, and backed up by SEAIT.

Tier 5 - Metering to Support Ongoing Commissioning and Diagnostics

Tier 5 metering is a future provision intended to support a future ongoing commissioning fault detection and diagnostics dashboard.

For the current project, this requires that all of the calculated values in the Siemens network be made available as virtual points so that they can be accessed via the Siemens web browser based OWS and the Siemens Navigator package.

It also requires that all modules in the Siemens Navigator package that support diagnostics and operations including the following modules and features:

1. Efficiency module
2. Supply module
3. Environmental reporting module
4. Building raw data capture module
5. Building energy systems data capture module
6. IT systems integration module
7. Market data capture module
8. Load profile reporting module
9. Operational analysis module
10. Performance indicators module
11. Consumption reporting module
12. Emissions reporting module
13. Cost analysis module
14. Energy budgeting module
15. Building environment monitoring and reporting module
16. Plant optimization module
17. Site ranking module

Note that some of the modules listed are required for the functions associated with some of the other metering tiers and that some of the modules are required to support future sites and are not necessarily required by the SPU DWW project site. The plant optimization module is an example of this.

$$kW_{Motor} = \left(\frac{V_{APhaseN} \times A_{ProofCT} \times PF_{APhase}}{1,000} \right)$$

Where:

- kW_{Motor} = Instantaneous motor kilowatts
- $V_{APhaseN}$ = Phase to neutral voltage from the phase voltage inputs to the control system: a balanced load is assumed
- $A_{ProofCTAPhase}$ = Phase amperage from the control system proof of operation CT associated with the load: a balanced load is assumed
- PF_{APhase} = A power factor established for the load via testing by the control contractor and commissioning provider during start-up

Equation 1

$$kWh = kW \times Hours_{kWLevel}$$

Where:

- kWh = The energy into equipment operating at the given kW level in kilowatt hours
- kW = The instantaneous power consumption of the equipment in kilowatts
- $Hours_{kWLevel}$ = The number of hours at a given kilowatt level

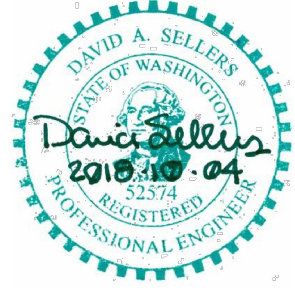
Equation 2

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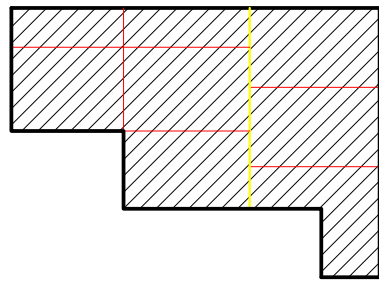
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SEATTLE

SPU DWW SOUTH
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KEY PLAN



APPROVED BY
Department of Finance and Administrative Services
CITY OF SEATTLE

DOVE ALBERG DATE
By: Capital Development & Construction Management

APPROVED FOR ADVERTISING
LIZ ALZEER
City Purchasing and Contracting Services
SEATTLE, WA 20

BY
City Purchasing and Contracting Services Director

PROJECT-NO FAS 2016-054

DRAWN DAS

CHECKED BY CBM

DATE 10/04/18

REVISIONS DATE

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VPI-NO 790-641

SHEET TITLE
Metering System
Sequence of Operation

SHEET NUMBER

MI.8.07