Utility Metering Best Practices

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Acronyms

A	ampere (also amp)
ACEEE	American Council for an Energy-Efficient Economy
acf	actual cubic feet
AEC	Architectural Energy Corporation
AMI	advanced metering infrastructure
AMR	automated meter reading
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning
BACnet	building automation and control networks
BAS	building automation system
BMP	Best Manufacturing Practices Center of Excellence
Btu	British thermal unit
CEC	California Energy Commission
CEQ	Council for Environmental Quality
CIPEC	Canadian Industry Program for Energy Conservation
cfm	cubic feet per minute
CMMS	computerized maintenance management system
CRAC	computer room air conditioning
CPUC	California Public Utility Commission
CT	current transformer
dc	direct current
DC Pro	Data Center Energy Profiler
DHW	domestic hot water
DOE	U.S. Department of Energy
ECAM	Energy Charting and Metrics
ECIA	Electronics Components Industry Association
ECM	energy conservation measure
EIS	energy information system
EISA	Energy Independence and Security Act of 2007
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act of 2005
EPRI	Electric Power Research Institute
ESCO	energy service company
ESPC	energy savings performance contract
EUI	energy-use intensity (also energy-use index)
F	foot
FCC	Federal Communications Commission
FEMP	Federal Energy Management Program
FRPS	Federal Real Property Statistics

ft^2	square feet
gpm	gallons per minute
gsf	gross square feet
h	hour
HART	highway addressable remote transducer
HDD	heating degree days
HVAC	heating, ventilation, and air conditioning
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineering
IES	Illuminating Engineering Society
IESO	Independent Electricity System Operator
IREC	Interstate Renewable Energy Council
IRP	integrated resource planning
ISO	International Organization for Standards
IT	information technology
kBtu	thousand British thermal units
kVA	thousand volt-amperes
kW	kilowatt (1,000 Watts)
kWh	kilowatt-hour (1,000 Watt-hours)
kWh/h	kilowatt-hour per hour (equates to average kW)
L-L	line-to-line
L-N	line-to-neutral
LAN	local area network
LBNL	Lawrence Berkeley National Laboratory
LonWorks	local operating network
M&V	measurement and verification (also monitoring and verification)
Mcf	thousand cubic feet
MW	megawatt (million Watts)
MWh	megawatt-hour (million Watt-hours)
NBI	New Buildings Institute
NEEA	Northwest Energy Efficiency Alliance
NEMA	National Electric Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NSTC	National Science and Technology Council
O&M	operations and maintenance
PF	power factor
PIER	Public Interest Energy Resource Program (California)
PKI	public key infrastructure
PNNL	Pacific Northwest National Laboratory
Portfolio Manager	ENERGY STAR Portfolio Manager
PECI	Portland Energy Commission, Inc.

pph	pounds per hour
psia	pounds per square inch – absolute
psig	pounds per square inch – gage
PT	potential transducer
PUE	power usage effectiveness
PURPA	Public Utility Regulatory Policies Act of 1978
PV	photovoltaic
RF	radio frequency
RMS	root mean square
SCADA	supervisory control and data acquisition
scf	standard cubic feet
scfh	standard cubic feet per hour
scfm	standard cubic feet per minute
SSWC	Standard Surge Withstand Capability
TCP/IP	transmission control protocol/internet protocol
THD	total harmonic distortion
TOU	time-of-use (pricing)
UESC	utility energy service contract
UPS	uninterruptible power supply
USC	U.S. Code of Federal Regulations
USGBC	U.S. Green Building Council
V	voltage (also volt)
VA	volt-ampere
VAR	volt-ampere reactive
VEE	validating, estimation, and editing
W	Watt
w.c.	water column
W-h	Watt-hour
WAN	wide-area network
yr	year
XML	extensible markup language

Contents

Chapter 1 Introduction and Overview

The purpose of this course is to provide information on effective energy and water metering strategies, relevant metering technologies and communications, how to collect and use metered data, and how to develop a metering plan. This course is designed to serve as a resource for facility, energy, and water management and technical staff. It does not try to represent the universe of metering-related material. Rather, it attempts to:

- Provide background information on why metering is important.
- Provide guidance on the structure of an effective metering program.
- Provide information on metering and communications technologies.
- Highlight common uses of metered data.

1.1 Target Audience

Facility, energy, and water resource managers, practitioners, and technical staff represent the prime audience of this document. The benefits of a comprehensive metering program extend from the site-level, up through to the national headquarters' level. A comprehensive metering program requires the participation of staff from key areas within the overall facilities organization including operations, maintenance, engineering, procurement, training, and administration. While a given site may not have all of these areas as separate entities, these functions are provided for within the organization. These staff members are also part of the target audience of this course.

A successful metering program requires cooperation, dedication, and participation at all levels and cannot succeed without everyone involved understanding the basic principles and supporting the efforts to acquire technically sound data regarding resource use within buildings or associated with delivery of an energy resource.

1.2 Organization and Maintenance of the Document

This document represents Release 3.0 of *Metering Best Practice Guide: A Guide to Achieving Utility Resource Efficiency*. The initial release of this document occurred in October 2007. Some of the detailed information provided in previous versions of the guide has been replaced with summary tables.

The first chapter of this course is an introduction and overview. Chapter 2 provides the rationale for metering. Chapter 3 discusses metering planning, providing key issues and highlighting their importance and covers metering economics. Chapter 4 provides an overview of different metering technologies by major utility type: electricity, natural gas, steam, water, and heated and chilled water circulation systems. Chapter 5 describes various data analysis techniques used by energy information systems and uses for metered data. Chapter 6 is a list of the references used to create the guide. A glossary of terms is presented in Appendix A. Appendix B provides a copy of Section 103 of the *Energy Policy Act of 2005* and Section 434(b) of the *Energy Independence and Security Act of 2007.* Appendix C includes select applicable codes and standards as related to metering equipment and installations.

Chapter 2 Why Meter?

Energy and water managers have long known the value of metered data. With recent advances in energy and water metering and information systems resulting in increased functionality at lower costs, obtaining these data in a cost-effective manner is now a standard practice. Whether energy and water resource managers are trying to comply with legislated and mandated metering requirements, or looking to apply accepted building management best practices, such as utility bill verification or benchmarking, today's metering technologies can provide the information needed to meet energy and water goals, save money, and improve building operations.

> The importance of metering can be summed up in the Energy Manager's maxim:
>
> You can't manage what do don't measure. If you don't measure it, you can't improve it.

Metering of energy and water utilities has seen an increase in interest, application, and technology advancement in both the private and the public sectors. One significant driver of this heightened interest is the ongoing modernization of the nation's electric infrastructure with the move toward the smart grid and smart meters. Another significant driver, specific to the Federal sector, includes the legislative mandates for metering of Federal buildings. See Appendix A, Glossary of Common Terms, for additional advanced metering terms and definitions.

2.1 Business Case for Metering

The application of meters to individual buildings and energy-intensive equipment provides facility managers and operators with real-time information on how much energy has been or is being used. This type of information can be used to assist in optimizing building and equipment operations, in utility procurements, and in building energy budget planning and tracking.

It is important to keep in mind that meters are not an energy efficiency/energy conservation technology per se; instead, meters and their supporting systems are resources that provide building owners and operators with data that can be used to:

- Reduce energy and water use
- Reduce energy and water costs
- Improve overall building operations
- Improve equipment operations.

How the metered data are used is critical to a successful metering program.

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Depending on the type of data collected, these data can enable the following practices and functions:

- Verification of utility bills
- Comparison of utility rates
- Proper allocation of costs or billing of reimbursable tenants
- Demand response or load shedding when purchasing electricity under time-based rates
- Measurement and verification of energy project performance

Purchase this course to see the remainder of the technical materials.