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Facility smart grid information model

Modèle d'informations des réseaux électriques intelligents des installations

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CONTENTS

FOREWORD iii
INTRODUCTION viii
1. Purpose 1
2. Scope 1
3. Definitions 2
3.1. Terms Adopted from External Sources 2
3.2. Terms Defined for this Standard 3
3.3. Abbreviations and Acronyms Used in this Standard 5
4. FSGIM Structure and Usage 7
4.1. Overview 7
4.2. How the FSGIM Component Model can be Applied to Real-World Examples 9
5. Device and Model Components 14
5.1. Facility Model Overview Diagram 14
5.2. Device 18
5.3. Meter Component 29
5.4. Load Component 36
5.5. Generator Component 59
5.6. Energy Manager Component 94
5.7. Model Elements from External Sources 241
6. Common Primitive Types, Classes, and Enumerations 509
6.1. Time 509
6.2. Enumerations 510
6.3. Primitive Data Types 515
6.4. Measurements 516
6.5. Other Common Classes 548
6.6. Elements Defined in the Common Primitive Types, Classes, and Enumerations Model 551
7. Conformance Requirements 595
7.1. Introduction 595
7.2. Conformance Requirements 596
7.3. Conformance Blocks 599
8. References 815
9. Annex A – UML Model (Normative) 816

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INTRODUCTION

The effort to substantially modernize and transform the national electric grid and create what has become known as a "smart grid" is an enormous undertaking that reflects both the size and importance of the electric grid. Viewed in its entirety, it is an international effort involving hundreds of organizations and companies, and it will impact billions of people. The standards infrastructure that will be needed to support this transformation may include over one hundred standards by the time that it is fully in place. This standard is one part of that infrastructure.

Almost all electricity is consumed in a building of some kind – homes, retail establishments, offices, schools, factories, hospitals – the list goes on. This standard attempts to capture the breadth and diversity of these consumers by using the term "facility." A facility is any kind of building or collection of buildings, and all of the electrical loads or local generation sources contained within them or controlled by the facility owner.

Historically, electricity consumption has been viewed as a collection of dumb loads at the end of a distribution system. There has been almost no interaction between the "loads" and those responsible for electricity generations and distribution. The vision of the smart grid changes this picture radically. In a smart grid world, facilities become full partners in supporting and managing the electric grid. Facilities become generators using local renewable or other generation capacity. Facilities moderate electrical demand in response to fluctuations in the price or availably of electricity. Facilities communicate and negotiate with energy providers, sharing information about the facility's projected electrical demand or ability to respond to the energy provider's needs for maintaining grid stability and reliability.

In some respects all facilities have common characteristics and needs with respect to interactions with a smart grid, regardless of whether the facility is a commercial, institutional, or industrial building, or a private home. The Facility Smart Grid Information Model (FSGIM) standard attempts to capture this commonality and standardize the content of the information that a facility manager needs to have, or, in some cases, needs to exchange with the energy provider, in order to manage the facility. Energy providers benefit from the FSGIM standard because it enables interaction with all different types of facilities in a common way. Facility owners benefit because products can be designed for use in multiple facility types and products designed primarily for one type of facility, a home for example, can more easily be used in another, say a commercial building.

An information model is an abstraction, not an implementation. This abstract representation is a way to account for the reality that the technology used to manage a facility may be quite different depending on the type of facility. It is intended that the FSGIM will be used to develop or enhance other standards that define technology and communication protocol specific implementations of the model for particular markets.

The FSGIM was developed in the context of a much larger framework of smart grid standards. It builds on some of those standards in a way that is intended to maintain consistency and harmony with established and developing standards that impact the information needed to managing the facility, while at the same time capturing all of the key information needed in one place.

If the smart grid is to become a reality there must be smart facilities of all types that interact with it. The considerable time and talent that went into developing the FSGIM was invested in order to lay a solid foundation upon which to fulfill this vision.

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1. PURPOSE

The purpose of this standard is to define an abstract, object-oriented information model to enable appliances and control systems in homes, buildings, and industrial facilities to manage electrical loads and generation sources in response to communication with a “smart” electrical grid and to communicate information about those electrical loads to utility and other electrical service providers.

2. SCOPE

This model provides the basis for common information exchange between control systems and end use devices found in single - and multi-family homes, commercial and institutional buildings, and industrial facilities that is independent of the communication protocol in use. It provides a common basis for electrical energy consumers to describe, manage, and communicate about electrical energy consumption and forecasts.

The model defines a comprehensive set of data objects and actions that support a wide range of energy management applications and electrical service provider interactions including:

a) on-site generation,
b) demand response,
c) electrical storage,
d) peak demand management,
e) forward power usage estimation,
f) load shedding capability estimation,
g) end load monitoring (sub metering),
h) power quality of service monitoring,
i) utilization of historical energy consumption data, and
j) direct load control.

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3. DEFINITIONS

See Clause 8 for external standards that are referenced by this standard.

3.1. Terms Adopted from External Sources

The following terms used in this standard are drawn from other standards or published reference sources. The definitions are repeated here and a reference to the appropriate standard or document is provided. Words or phrases in italics refer to terms defined elsewhere in this clause.

asset
A logical entity with measurable and reportable consumption, e.g., an *asset* may be a physical device with its own meter, or the main meter at the *service delivery point* of a service location.
(NAESB 2010a).

baseline
A method of estimating the electricity that would have been consumed by a customer or *demand resource* in the absence of a *demand response event*. It may be calculated using interval metering and/or statistical sampling techniques.
(NAESB 2010a).

combined heat and power
Combined heat and power (CHP), also known as cogeneration, is the simultaneous production of electricity and heat from a single fuel source, such as: natural gas, biomass, biogas, coal, waste heat, or oil.
(http://www.epa.gov/chp/basic/index.html).

electrical coupling point
Point of electrical connection between the DER source of energy (generation or storage) and any electric power system (EPS). Each DER (generation or storage) unit has an ECP connecting it to its local power system; groups of DER units have an ECP where they interconnect to the power system at a specific site or plant; a group of DER units plus local loads have an ECP where they are interconnected to the utility power system.
(IEC 61850 Part 7-420).

energy management system
A system used to monitor and control the energy consuming devices in a building. Within this standard, "energy management system" always refers to a customer/facility energy management system and not a utility energy management system.
(EIS Alliance Use-Cases).

non-spinning reserve
1. That generating reserve not connected to the system but capable of serving demand within a specified time.
2. Interruptible load that can be removed from the system in a specified time.
(NERC Glossary).

peak load
The maximum amount of power delivered (*load*) for a given time period.
(NEMA glossary (http://www.nema.org/gov/energy/glossary/)).

power quality
Characteristics of the electricity at a given point on an electrical system, evaluated against a set of reference technical parameters.
NOTE: These parameters might, in some cases, relate to the compatibility between electricity supplied on a network and the loads connected to that network.
(IEC 61000-4-30 (2008)).

pricing node (Pnode)
A single network Node or subset of networked Nodes where a physical injection or withdrawal is modeled and for which a Locational Marginal Price is calculated and used for financial settlements.
(CAISO Tariff).

program administrator
An investor-owned, governmental or cooperative distribution company with the responsibility for developing and operating specific programs.
(NAESB REQ.0.2.179).

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spinning reserve
Unloaded generation that is synchronized and ready to serve additional demand.
(NERC Glossary).

3.2. Terms Defined for this Standard

aggregated pricing node
An *aggregated pricing node* is a location in the electric grid where the locational marginal price is calculated by a weighted average of one or more underlying *pricing nodes*.

capacity restraint
A limitation in the generating capacity or transmission capacity of an energy supplier that constrains the amount of electricity that is available to be bought or sold.

Commercial Buildings Energy Consumption Survey
A national sample survey that collects information on the stock of U.S. commercial buildings.

control system
A device or set of devices used to manage, command, direct, or regulate the behavior of other devices or systems.

critical loads
Individual *loads* deemed to be critical to the operation of the facility or process.

critical peak period
A time period during which a special high price for electricity is applied as a way to reduce demand.

curtailable load
Loads whose power consumption can be increased or decreased for the purpose of increasing or decreasing the total electrical demand on the grid.

demand
The rate at which energy is delivered to or used by a system or part of a system at a given instant in time or averaged over any designated interval of time.

demand forecast
Predictions regarding future electrical demand.

demand interval
The period of time over which an energy supplier calculates demand. Typical values range from five minutes to 60 minutes.

demand resource
A *load*, aggregation of loads, behind-the-meter generator, electrical storage system, or thermal storage system capable of providing measurable and verifiable *demand response*.

demand response
A temporary change in electricity usage by a *demand resource* in response to market or reliability conditions.

demand response event
A period of time defined by the *program administrator*, including notifications, deadlines, and transitions, during which *demand resources* provide *demand response*. All notifications, deadlines, and transitions may not be applicable to all *demand response* products or services.

demand target
Target in *demand* management; *peak demand* is a key factor in contract charges for electricity use.

direct load control
A d*emand response* activity by which the *program administrator* remotely shuts down or cycles a customer's electrical equipment (e.g., air conditioner, water heater). Direct load control programs are primarily offered to residential or small commercial retail customers.

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dispatchable generator
Generators whose power supply may be increased or decreased for the purpose of decreasing or increasing the total electrical demand on the grid.

distributed energy resource
A small, modular, energy generation or storage device located within the electrical distribution system at or near the end user. Distributed energy resources may be connected to the local electrical power grid (e.g., for voltage support) or isolated from the grid in standalone applications, such as part of a micro grid.

emergency standby generation
The provision of capacity deployed by the balancing authority to meet NERC and regional reliability organization contingency requirements.

end device
A physical end-use device that consumes or supplies electricity.

energy consumption
A measure of the quantity of electricity used in a given time period, measured in kilowatt hours.

energy cost
That portion of the charge for electric service based upon the electric energy (kWh) consumed or billed.

energy emissions
The pollution emissions associated with generating a quantity of electrical energy.

energy information provider
A business that provide energy supply or *demand* information to customers or authorized third parties.

energy services company
A business providing *energy* savings, efficiency, and *generation* solutions.

energy services interface
An abstract representation of a bi-directional communication interface between devices within a facility and an external electric *service provider*. This interface enables exchange of information including pricing, energy consumption, demand response interactions, load forecasts, energy production forecasts, and weather information.

energy supplier
An entity that delivers electricity to end use customers. Examples include investor-owned utilities, municipal utilities, and private companies.

forward pricing forecast
The compilation of prices of actual transactions for forward (future) delivery periods that are executed today.

independent system operator
An independent system operator maintains balance of the grid system by controlling the dispatch of plants and ensuring that loads match system resources. As such, the operator must be neutral and independent.

intelligent end point
A system that internally measures, collects, and analyzes its *energy cost*/consumption.

load
A device, system or process that consumes electrical energy.

local codes
Local laws, regulations, and building codes that determine building operation and capabilities.

measurement and verification
Energy measurements that can be determined to a degree of accuracy and trust that is acceptable to all stakeholders.

net demand
Total demand minus total supply. Net demand is determined at the facility interconnection point, billing meter, or internal location, and may be positive or negative.

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peak demand
The highest measured *demand* encountered during a specified period of time (e.g., month, year, or finite set of time intervals).

plug load
A device that is powered by means of an electrical plug and matching socket or receptacle. This excludes devices that are accounted for as part of major building end uses such as HVAC, lighting systems, and water heating.

present demand
Demand occurring during the present *demand interval* or subinterval (e.g., Watts or VA).

present subinterval demand
Average rate of energy used over a small portion of a *demand interval*.

present subinterval net demand
Average net rate of energy used over a small portion of a *demand interval*.

present subinterval supply
Average rate of energy supplied over a small portion of a *demand interval*.

ramp rate
The rate at which a generator changes its output or a *demand resource* changes its demand.

service delivery point
The location where electric service is delivered to the facility.

service level agreement
A part of a service contract where the level of service is formally agreed upon.

smart power distribution unit
A device that measures and distributes electric power to an electrical circuit.

smart power strip
A power strip that measures electrical power being drawn by the connected equipment.

supply
The rate of energy generation or storage output that is used to serve facility load and possibly provided to the grid as a generation resource.

time of use pricing
A rate structure characterized by different prices for electricity use in a 24-hour time frame. Time of use pricing is generally used to encourage electricity use during periods of lower demand and discourage electricity use during periods of high demand.

use case
A story, told in structured and detailed steps, about how participants in an Application collaborate to reach a goal.

variable generation
Variable generation comprises any power generating device in which the source of the energy is not dispatchable and that the resource does not have control over its net power output. Variable generating devices include those powered by wind, solar, run of river hydro, tidal, wave, ocean thermal and other renewable resources.

3.3. Abbreviations and Acronyms Used in this Standard

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CBECS	*Commercial Buildings Energy Consumption Survey*
CHP	combined heat and power
DER	distributed energy resource
ECP	electrical coupling point
EIP	Energy Information Provider
EM	Energy Manager
EMS	energy management system
ESCO	energy services company

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ESI	Energy Services Interface
ESI EM	Energy Services Interface Energy Manager
ESP	Energy Service Provider
HMI	human machine interface
HVAC	Heating, ventilating, and air conditioning
IEP	Intelligent End Point
ISO	International Organization for Standardization
kW	kilowatt
M&V	Measurement and Verification
OASIS	(Organization for the Advancement of Structured Information Standards) is a not-for-profit consortium that drives the development, convergence and adoption of open standards for the global information society.
RTO	Regional Transmission Operator
SCADA	supervisory control and data acquisition
SLA	Service Level Agreement
SP	Service Provider
SPDU	Smart Power Distribution Unit
SPS	Smart Power Strip

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