NIST SG function description and use case template
DGH ver.2
(Building-centric view of Smart Grid)

1 Smart Grid function description

1.1 SG function name

Load management with dynamic tariffs, predictable and non-predictable demand reduction with demand shifting, shedding and limiting and/or on-site generation capability without local resource optimization.

1.2 Description

Load management is a daily effort with a goal to minimize utility costs. While the goals in the future may include reducing CO2 emission minimization or buying "green" power in which case generation resources need to communicate these attributes (or these attributes may be a part of the price?), in this use case, load management is defined as managing a consumer's supply and demand sources using dynamic prices as the main trigger. DR is any action taken by the consumer to reduce loads when market conditions raise price of electricity. In this use case, high prices will trigger DR. **Predictable on-site generation** is any generation unit with known parameters for *min, max, ave load, ramp up and ramp down time and with an availability schedule.* The availability schedule may be fixed or dynamically produced.
Non-predictable on-site generation is any generation (e.g. solar, wind, PHEV) where at least one of the parameters may be missing from an availability schedule.
. **Demand limiting** refers to shedding loads when pre-determined peak demand limits are about to be exceeded. This is historically done in daily load management activities to minimize peak demand charges. Loads are restored when the building demand is sufficiently reduced. Demand limiting is done to flatten the load shape when the electric load shape is nearing a pre-determined peak. **Demand shifting** moves electric loads from peak times to off-peak periods. The most common technologies to support diurnal demand shifting are thermal energy storage systems, which are often designed with ice or chilled water. **Demand shedding** is dynamic temporary reduction of peak load that can be dispatched with automated controls.
Local resource optimization means buying power from the resources on the same feeder before buying it from the grid. IEEE 1547 only addresses what a small generator must do to be allowed to connect to the grid. It says nothing about the economic relationships. In CA, the rules allow sales between neighbors with a common boundary, but not across roads, rivers, etc. A separate use case is needed to hash out this issue.

There are several underlying assumptions for this use case:

1. There is a uniform market infrastructure that allows for each consumer to buy and sell power, that is information exchange between an energy provider and a single consumer can be the same as the one between an ISO and an aggregator.
    a. DAVID: RTP price structure. But is that all to a "market infrastructure"? We need agreement on common elements besides the price itself at the semantics level. Plus agreement on syntax, transport protocols, security.
    b. DAVID: What are the other non-RTP DR services that need to be harmonized? What are the main utility and ISO based programs? Can less common apps build off the common information structures?
2. Buildings have sophisticated energy management and controls systems and/or energy information systems such as real-time optimization, predictive controls, etc.

3. There is a clearly defined divide between building-side technologies and strategies and energy provider technologies and strategies. The energy provider does not reach into the buildings but provides information to the consumer systems in a form that can be directly utilized.
    a. DAVID: agreed—we need to identify the info that is needed at the interface and what those interfaces look like. What does CNE need? Seems they need to define the info required by ISOs and help organize it. Some program information elements will be common across multiple ISOs and multiple programs. RTP or reliability programs are an example. What are the pieces that are not common? Outside the information elements, what are common elements and differences?
    b. Intelligrid use cases are based on known ways of doing things and ideas for the future. What the IECSA document we looked at does not have is the details of how different utilities and ISOs implement these applications. The information elements may be common more or less, but no standards yet. The packaging of common information elements likely varies. How does ISO NE deliver a message to curtail? Is it XML in web services? Is the customer expected to go to their FTP site and download a file? By email? What exact pieces of information are transferred in what steps? Is there confirmation of receipt? What security is used on the connection?
    c. If a customer class is used, is there any standard for those classes? Is there a standard for the taxonomy of programs? Can we have common information elements across ISOs and utility programs? Can we look at security requrienements and solutions?
    d. I want the TWiki to help us develop the taxonomy of applications classes (like DR), then major sub-classes in DR, then specific types of these (like how different utilities or ISOs implement them) with associated information elements and protocols.
    e. We need to capture all of the what is out there now in general at least. We need to know that there is "this kind of a program" that exchanges "this info" so we ca include that info in our approach to getting toward common info elements and structures that cover what is out there now and the foreseeable future.
    f. I expect that the Bus&Policy and T&D groups can help flesh out some of the program details—which utilities will step up to help with this? where is this kind of information already summarized? Plexus can likely contribute to this effort as part of the SKB development.

1.3 Smart Grid context and standards

1.3.1 Business Objective

The goal of this function is for the consumers to manage their load so that they can minimize utility costs. This requires optimization of resources such as on-site generation plus electric load management with changing price of electricity.

1.3.2 Smart Grid domain and stakeholders

There are two main parts to managing load: utility-side information delivery (prices) and building-side information process (demand and on-site supply management). On the building-side, energy information system providers, control system providers, building owners, facility management firms, building system manufacturers, etc. On the utility-side, the stake holders are ISOs, T&D as well as energy providers.

1.3.3 Standards landscape

Standard/ guideline/ standardization effort	*SDO/ organizations involved*	*Gaps/ harmonization efforts*
Utility Price delivery - OpenADR	Lawrence Berkeley National Laboratory	
Building-side demand and supply management -?	Various building controls protocols	
Local Supply and Demand Management	None so far…	

1.4 Function use case narrative

The simplest use case is current typical case in CA where large commercial customers manage their loads for TOU rates and Demand Charges. It is assumed that smaller customers may participate individually and directly in the future.

Typical scenario includes:

1. Energy Provider publishes prices a day ahead or day-of (one hour or 15 min. before).
2. Facility sets up price thresholds and for each threshold, decides what kind of load reduction or on-site generation they want to bring up and pre-program these strategies (or have tools to dynamically respond).
3. For predictable loads, all known parameters (min, max, average, ramp up, ramp down) are sent as "predicted response schedule"
4. For non-predictable loads, estimated parameters are sent as "estimated response schedule"
5. Energy Provider receives this information and uses it in its planning.

Note: This scenario can be used for DR and Daily Peak Load Management.

1.5 Actors

Name	*Role description*
Utility/ISO	Provide a brief description of the role that an Actor has in this particular use case. An Actor can be a human or a system. The same Actor can play different roles in different use cases but only one role in one use case. If the same Actor does play multiple roles in one use case, list these separately.
Building EIS/EMCS	
Local resource network	

1.6 Information exchanged

Describe any information exchanged in this function.

Information Object Name	*Information Object Description*

Information Object Name	*Information Object Description*

1.7 Services

Describe or list the services involved in this Function (in the context of this Function). A service can be provided by a computer system, a set of applications, or manual procedures. These services should be described at an appropriate level, with the understanding that sub-services should be described if they are important for operational issues, automation needs, and implementation reasons. Other sub-services could be left for later analysis.

Service Name	*Services Provided*

1.8 Contracts, regulations, other constraints

Identify any human-initiated contracts, regulations, policies, financial considerations, engineering constraints, pollution constraints, or other issues that affect the design and requirements of the function.

Contract/Regulation	*Impact of Contract/Regulation on Function*

Policy	*From Actor*	*May*	*Shall Not*	*Shall*	*Description (verb)*	*To Actor*
ProvideEnergy	ESP			X	Provide power on demand	Customer

Constraint	*Type*	*Description*	*Applies to*

2 Step by step analysis of function

2.1 Pre-conditions and assumptions

Describe conditions that must exist prior to the initiation of the Function, such as prior state of the actors and activities.

Identify any assumptions, such as what systems already exist, what contractual relations exist, and what configurations of systems are probably in place.

Identify any initial states of information exchanged in the steps in the next section. For example, if a purchase order is exchanged in an activity, its precondition to the activity might be 'filled in but unapproved'.

Actor/System/Information/Contract	*Preconditions or Assumptions*

2.2 Normal sequence

Describe the normal sequence of events, and focus on steps that identify new types of interactions, new information, or new issues to address. Should the sequence require detailed steps that are also used by other functions, consider creating a new "sub" function and then referring to that "sub-routine" in this function.

Step	*Event*	*Sender to receiver*	*Description of process/action*	*Information to be exchanged*	*Response to action*
1.	Triggering event	What actor or system is sending to what other actor or system	Describe the actions that take place in active and present tense. The step should be a descriptive noun-verb phrase that portrays an outline summary of the step.	Identify the information that will be exchanged. Indicate special conditions such as accuracy, security, and availability requirements.	Describe the response to the action in present tense form as for the "Actor action." "If…Then…Else" scenarios can be captured as multiple responses or as separate steps.
2.					
3.					
4.					

2.3 Alternative/exception sequences

Describe any alternative or exception sequences that may be required that deviate from the normal course of activities.

Step	*Event*	*Sender to receiver*	*Description of process/action*	*Information to be exchanged*	*Response to action*
1.					
2.					
3.					
4.					

2.4 Post-conditions

Describe conditions that must exist at the conclusion of the Function. Identify significant items similar to that in the preconditions section.

Describe any significant results from the Function

Actor/Activity	*Post-conditions Description and Results*

3 Additional issues

3.1 References and contacts

Documents and individuals or organizations used as background to the function described; other functions referenced by this function, or acting as "sub" functions; or other documentation that clarifies the requirements or activities described. All prior work (intellectual property of the company or individual) or proprietary (non-publicly available) work must be so noted.

ID	*Title or contact*	*Reference or contact information*

3.2 Key Interfaces

Note key interfaces between function stakeholders. For each interface, discuss GWAC interoperability framework cross-cutting issues (shared meaning of content, resource identification, time synch and sequence, security and privacy, logging and auditing, transaction and state management, system preservation, quality of service, discovery and configuration, system evolution and scalability).

Interface between	*Cross-cutting issues*

3.3 Outstanding Issues

As the use case is developed, identify issues that need clarification, resolution, or other notice taken of them. This can act as an action item list.

ID	*Description*	*Status*

3.4 Revision history

No.	*Date*	*Author*	*Description*

3.5 Diagram

For clarification, draw (using UML diagram conventions, as appropriate) the interactions described above and identify the steps where possible.