**SIF Data Model Extension Proposal Template**

*This template should be used by individuals or Project Teams to submit (and later track the progress of) proposed extensions to the SIF Data Model. These extensions can either be new data objects or revisions to the schema defining elements and / or attributes in existing ones.*

***Energy Management Project Team Proposal: EnergyUsage Object***

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|  |  |  |  |
| --- | --- | --- | --- |
| Extension Proposal Version Control | | | |
| Version | Date: | Author/Organization: | Comments |
| 1.0 | 9/22/2011 | Dick Robinson,  Ron Kleinman | Converted from SIF Object Proposal Format |
| 2.0 | 10/3/2011 | Dick Robinson | Revised |
| 3.1  3.2 | 11/2/2011 | Dick Robinson  Mike Lavelle | Second Revision – revised to 3.1-3.2 |
| 3.3 | 11/3/2011 | Ron Kleinman | General Cleanup and addition of Detailed Design information |
| 3.4 | 11/21/2011 | Ron Kleinman | Updates from team 11/21 design review:   * No Requests or OOB data returned * All Events are Add Events (each update is a new Object) * Object has no provider or Ref ID |
| 3.5 | 11/28/2011 | Ron Kleinman  Bill Duncan | Updates from team 11/28 design review   * Restructuring of location identification and reading subelements |
| 3.6 | 12/06/2011 | Ron Kleinman, Bill Duncan, Mike Lavelle, Dick Robinson, Dave Moravec | Pre-webinar review changes rolled into the proposal |
| 3.7 | 1/11/2012 | Ron Kleinman | Post-webinar changes rolled into the proposal |
| 3.8 | 2/20/2012 | Ron Kleinman | Final changes for draft SIF v2.6 specification |

# **1 Identification**

|  |  |
| --- | --- |
| **Proposed Extension Name** | **Energy Usage Object** |
| Submitted by (Project Team or Individual) | Facilities and Energy Management Project Team |
| Date of initial submittal | 09/22/2011 |
| Date of current version submission | 02/20/2012 |
| What is the base SIF Data Model release? | V2.6 |
| What is the base SIF Infrastructure release? | V2.6 |
|  |  |
| What existing SIF object(s) if any will be affected? | None |
| What is the name of any new object(s)? | Energy Usage Object |
|  |  |
| DM Extension ID (to be assigned when submitted) | TBD |

**Status Tracker Phase 1: Documentation and Approval**

*The steps in this initial phase document the proposed extensions to the SIF Data Model to the point where they can be reviewed and approved by the Tech Board as deserving of further effort. Completion of the detailed design and evaluation of the dependencies and migration impacts are left until Phase II.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Template Section** | **Draft Completed**  **(Owner / Date)**  **Dick Robinson**  **11/1/2011** | **Reviewed (R) or Accepted (A)**  **(Owner / Date)** | **Comments**  **This revision is to be assessed and finalized by the Team** |
| Rationale and Business Case | Champion  Dick Robinson  **Date: Nov.1, 2011** | Tech Board (A)  **Date:** | Completed |
| Use Case(s) | Champion / Project Team  Dick Robinson  FEM Project Team  **Date: Nov.2, 2011** | Project Team (R)  **Date:** | Completed |
| Proposal approval | Project Team  **Date: TBD** | Tech Board (A)  **Date:** | Webinar scheduled |

# **2. Proposal**

*This section should be completed by the “Proposal Champion”. A champion is usually one of the authors of the business case (although it may be SIF staff). This individual is responsible for driving the proposal through the qualification and acceptance cycle.*

*The following two subsections must be completed before the process can begin.*

## 2.1 Rationale for Extension

*Explain the rationale for the proposed extension to the SIF Data Model:*

* *What are the problems / limitations to be addressed?*

Today, School Districts are becoming increasingly concerned about energy conservation and more specifically, by the increasing energy costs to operate schools. It is now proposed that SIF support the work of the Facility and Energy Management Project Team in its planning of data objects for energy usage.

Up to the present time school administrators are not able to assess energy usage in real time for specific schools, zones within the school, dates, and time frames (whether several days, hours and minutes). In order to manage energy efficiently within the school and subsequently monitor energy usage data needed to compare energy usage data for (a) school usage and comparison reports and (b) energy usage reports for all schools within a district and/or using the data for reporting energy usage for districts, which may be needed for submission to an area educational agency or at the request of a SEA, the Project Team, hereby, proposes an EnergyUsage object to enable a school administration to request usage data to lead to a report of the usage which can help facilitate the reduction of wasted energy and potentially reduction of energy cost.

Currently, energy usage data/info is not available in a standard way in schools. Additional info is lacking in consumption and related data (i.e., outside temperature energy usage measured in real time [5 to 15 minute intervals] and usage variables in zones within a school facility).

However, today, SIF standardizes student data so that it may be provided by multiple SIF certified systems in identical format, sent “upstream” to the District, the AEA and State for apples-to-apples comparisons between schools and later analyzed to make informed educational policy decisions.

The EnergyUsage object described in this proposal is designed to do precisely the same thing for energy usage data obtained from school facilities. By standardizing on how this data is reported “upstream” independently of the system which provides it, it is anticipated that this object will enable cross-school and before-after retrofit energy cost comparisons, and reveal energy usage best practices that will help educational authorities construct an informed green school energy policy resulting in significant monetary savings.

It is believed by the Project Team that the SIF data model can be deployed for energy usage analysis and reporting to help reduce waste, reduce cost of energy consumption and in so doing provide a healthy and comfortable learning environment for our students.

* *What is the additional information required?*

*None*

* *<If applicable> Why* should this proposal be a Fast Track request?

There is no reason to consider fast-tracking this proposal at the current time.

## 2.2 Business Case

*Provide a specific example of an example where the additional information defined in this proposal will be used in one or more educational processes*

*It should focus exclusively on the business problem to be solved and avoid proposing solutions.*

Today there are a wide variety of energy-related software products on the market, many with self-contained energy usage collection, analytic and reporting capabilities.

Many utility companies also provide (for a surprisingly significant cost) energy usage and peak loading cost information, in the form of “comma-separated” spreadsheet data. It becomes very difficult to understand the reasons behind building energy costs at the District or State level, let alone to control them.

In the typical school building, there are three main types of systems which may be used to help control energy costs:

* Building Automation Systems (BAS) regulate heating, air conditioning, ventilation usage and collect usage data derived from room scheduling data and management of sensors (ex: heating thermostats) to dynamically regulate temperatures and turn equipment on and off for HVAC equipment management.
* Utility company services including electricity, gas and oil vendors which supply energy to support HVAC/electrical operations in the school building. Typically, utility company meters supply usage data which is captured by the vendor to invoice the school on a monthly basis to record usage and cost for usage for KWh, BTUs, etc.
* Energy Monitoring, Data Analytic and Reporting Systems which use the data supplied by the other two systems to let the Facilities team get a handle in near real-time on energy usage and conduct meaningful energy usage audits as well as generate comparison reports to show periods of usage in contrast to other time frames/dates. These systems may also collect their own energy usage data through the use of “shadow metering”.

However, the problem facing school administrators is that typically the above three sources for energy management are not linked.

With the increasing availability of energy management/monitoring systems for the school district use, there is now the opportunity to provide district administrators who already have a SIF Zone installed with an additional option. Defining and standardizing an Energy Usage object that can be used by one or more of the above systems, will allow District (and State) officials to compare energy usage between buildings in the same manner as standardizing on student data allowed student performance to be compared.

The analogy is best summed up in the phrase “No School Building left behind”, where an integrated SIF implementation solution can be constructed to enable the school to capture energy use data to assist the district in evaluating a school’s performance in energy conservation.

**S**ubsequently, the district officials can compare a specific school’s analysis with other schools in the district and throughout the nation using programs like EPA’s Energy Star Rating system.

Thus, the district upon securing interoperability between the software applications can allow district users to have the capability of integrating seamlessly the information (***data***) between the applications to provide a fully integrated solution for the measurement and analysis of district and school performance in managing energy efficiency and cost effectiveness throughout the district. The fact that the energy usage, demand cost and external environmental data (such as temperature) can be correlated in a series of standardized time based measurements will vastly increase the effectiveness of Energy Analysis and Reporting programs at the State and District levels in terms of flagging equipment problems (ex: the thermostat at Building X appears to “flutter” whenever the outside temperature hits 65 degrees, turning the building heater on and off and wasting energy) and providing hard data feedback on energy audits and retrofit project effectiveness.

Furthermore, today’s schools also need to participate in Demand Response and similar programs where each building is capable of reducing the demand (kW) for electricity, which cost often equals or exceeds the cost of energy (kWh). ***The two-way communicating ability of the SIF Energy Usage Object also permits schools to participate in a variety of utility and grid-managed energy demand programs.***

# **Use Case**

*The proposal champion or the assigned project team must provide one or more high-level use cases illustrating the interactions between “actors” (typically applications) that become possible if this proposal is adopted and successfully implemented. Use one copy of the form below for each.*

**Use Case Title: No School Building Left Behind**

|  |  |
| --- | --- |
| **Summary Description** | A school is utilizing the school’s BAS and energy monitoring system to collect data related to HVAC operations and use of electricity/gas in the operation of the school. All data reported in an Energy Usage Event will be archived in a centralized data base to be evaluated and (at the request of district administrators) formatted in a report for the district. |
| **Actors and types:**  **One or more of:**   * **Requestor** * **Provider** * **Publisher** * **Subscriber** | **Publishers:** Building Automation System (heating, ventilation and air conditioning, HVAC information), Energy Monitoring System obtaining data from communication-equipped smart meters or shadow meters (utility usage-electricity and gas), and Utilities or smart meters providing Demand Energy Usage Costs.  **Subscriber**: Centralized Energy Management Analysis and Reporting System |
| **Preconditions** | The SIF Zone is operational and the energy monitoring systems are in place. One of those systems is the Energy Usage object provider, although it does not respond to Request messages.  All energy use analysis/measurements are being reported as SIF Events. |
| **Main Sequence of Events / Action Steps** | 1. One or more Energy Analysis and Reporting Programs subscribe to Energy Usage Object Events and begin receiving the data provided by the Energy Data Collection Systems 2. This data is collated and deposited into a centralized Energy Management Data Store (outside the scope of the SIF Specification). |
| **Alternative Sequence of Events / Action Steps** | 1. For buildings that do not have a BAS installation, the SIF EnergyUsage events can be generated by an application using inexpensive wireless devices to measure both building and zone energy usage and equipment performance. 2. Manual data entry of (or automatic conversion from) comma separated utility company spreadsheets may be used as the front end to an application publishing these events. . |
| **Post Conditions** | The school district facility manager or other district administrator (i.e., business manager, IT director, Superintendent) can request energy usage assessments from the Energy Usage Analysis and Reporting program. This will be done through the program GUI and is orthogonal to this effort, which is focused solely on standardizing the format of the underlying data, which could have been provided by a wide variety of very different applications. |
| **SIF Mandatory Objects** | EnergyUsage |
| **SIF Optional Objects** |  |
| **Open Issues** | See “Detailed Design” section |

**Status Tracker Phase 2: Execution of Proposed Changes**

*At this point the initial Data Model extension proposal has been accepted by the Tech Board and is either in the object pipeline, or being fast-tracked. The following sections have to be completed and (where indicated) reviewed and approved before this proposal can be reflected in the SIF specification.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Template Section** | **Draft Completed**  **(Owner / Date)** | **Reviewed (R) or Accepted (A)**  **(Owner / Date)** | **Comments** |
| Dependencies | Project Team / Staff  **Date: 11/1/2011** | **N/A** | None |
| Object Definition Table | Project Team  **Date: TBD** | Tech Board (R)  **Date:** |  |
| Migration Plan | Staff / Project Team  **Date: 11/1/2011** | **N/A** | New object.  None needed |
| Sample XML | Staff / Project Team  **Date: TBD** | Optional |  |

# **4. Impact Assessment**

*This section is the first to consider the actual implementation which will address the use cases previously identified. It requires assessing the impacts to both the existing objects and infrastructure, and to previously deployed applications. It would normally be produced by the Project Team (new or existing) assigned to this data model extension by the Tech Board at the time this proposal was approved.*

Not applicable

## 4.1 External Object Dependencies and Relation Map

*Identify any dependencies on existing XML entities in other SIF objects*

There are no dependencies on SIF infrastructure, or existing objects or elements

## 4.2 Infrastructure / International Dependencies and Relation Map

*Identify any dependencies on infrastructure technologies and / or deliverables from the International Technical Board (ITB) which are planned for a future release.*

Under the current design (see below) multiple publishers of the Energy Usage object publish their time-based energy readings as a series of Add Events. For this object type, each “object” is a series of readings.

It will likely be the Energy Usage Analysis program (i.e. the Subscriber) which is the Object Provider for the Energy Usage object type, because only this program would have all the energy usage readings for the Zone, and thus be able to respond to Requests.

# **5 Detailed Design**

*Place the detailed element by element, attribute by attribute breakdown of the Data Model Extension here. This work is normally done by members of the assigned Project Team.*

It is anticipated that the Energy Management domain will be new to many of the reviewers of this document. As a result, the following subsections were added to provide some necessary context for the decisions implicit in selecting the elements documented in the Object Layout Table presented at the conclusion of this section.

## 5.1 Background

The business case details how the Energy Usage Object can be used to provide multiple information sources with the opportunity to publish time-based events containing Energy Usage data for a school building or facility. This data could include (as noted):

* Thermostat settings and outside temperature measurements from the Building Automation System
* Dynamic energy demand costs from smart meters or data from typed-in utility bill monthly spreadsheets
* Energy Usage information from shadow meters (which intercept BAS readings) from an Energy Management System

There are a wide variety of vendors for each of these sources, and in different school sites one of them may provide a “front end” to convert the data supplied by the others to SIF format. Alternatively, multiple systems in the Zone may directly report their energy data in SIF format. In the latter case, the following aspects of the gathered data in a SIF Energy Usage Event could be quite different, even within a single location:

* The sampling interval between readings (5 minutes, 15 minutes, once /hour).
* The number of separate samples contained in the Event (one or hundreds)
* The number of readings contained in each sample
* How current the data was (Utility Company data might not be available until the end of the month, and come in a single Event of many readings while meter data might come every 5 minutes with a single sample from the devices being monitored)
* The actual quantities being measured and the units they are reported in
* The type of location (are these readings for a facility such as an auditorium, cafeteria, floor or building)?

* The ID “tag” of the location, and its physical relationship to the ID tags of other locations which other published Events might apply (sample group “hierarchies”).

## 5.1.1 Primary Design Goal

The primary goal of this design is to allow maximum flexibility in the ways in which a SIF Zone may be utilized to gather energy management data published by multiple sources, while leaving it to the Energy Analysis program (the subscriber) to take the varied data events issued in conformance with this SIF standard, and correlate them into a unified format which it can use. In general this will involve storing the information in the equivalent of an Energy Management longitudinal data system (LDS).

From that point the Energy Usage data can be analyzed, trends and problems identified and reported on, and real and significant cost savings achieved. An analogy would be with the earlier efforts to standardize the way EKG data was reported by the manufacturers of those machines, so that other vendors could focus their efforts on developing algorithms to isolate and diagnose problems not evident to someone unskilled in understanding the implications of the data.

### 5.1.2 Architectural Overview

An overview of the proposed architecture is shown below:



In this example, the Energy Usage Change Events are being published by a single Energy Usage Data Collector which has private interfaces (“P”) to the various systems which actually collect the data.

One added complexity mentioned during the design discussions is that not all the available energy data might be available in these change events (ex: Fan on/off which might not have changed) and a backdoor mechanism would need to exist to allow the Energy Analysis program to ask the Data Collector for all the information it knows about. *It was determined that this is a use case that involves non-SIF message exchanges and it will not be discussed further since it does not impact the current design.*

Please note that only the data going between the Energy Usage Data Collector (at many schools) and the Fast Bridge Energy Data Analysis Program (at the District) will be conformant with the SIF specification.

To map this sort of multi-provider / single subscriber architecture into the SIF Zone, a rather unique set of design constraints were imposed.

## 5.2 Multiple Energy Usage Object Publishers

It is expected and encouraged that even within one Zone, there could be multiple publishers of the Energy Usage object, where each publisher provides a set of repeating time based energy measurements of the measurements / meter readings it is acquiring, as they apply to the “Energy Zone” it services.

## 5.3 No clear Energy Usage Object Provider

After due consideration, it was determined that the local systems collecting the data are in many cases so simple, that they could not be required to have a “memory” of previous measurements. This means that there was nothing a client could ask these applications for which they were not already providing in the Events (i.e. we could not standardize any request of the form “*Give me all your energy data for last week*”). If responding to such requests were of critical importance, they could be made directly to the Energy Analyzer program (which has collected the data) without going through the Zone, and this case was also considered to be out of scope for this release.

A second problem arose. Each publisher of Energy Management data is the “owner of record” for the readings it reports. There would typically only be one of these publishers in a Zone (as shown in the diagram), but there could well be more, in which case one of the (P) private connections would be replaced by a SIF Agent connection to the ZIS. Such multiple agents split the role of the Object Provider of the Energy Usage Object, and it isn’t clear which one the ZIS should route object Request messages to, especially since none of these applications would have access to all the Energy Usage data that has been collected and reported in the Zone.

As a result, the Energy Usage object has multiple Publishers of its Events but no Provider to service its Requests. There is no Request message defined for these objects, and in fact it will be illegal to issue one. As noted above, and under “Issues” below, this might create a problem for some implementations of the SIF infrastructure.

## 5.4 Just how many Energy Usage Objects are there?

The number of Energy Usage objects is determined by deciding how an Energy Usage object is identified and distinguished from other Energy usage objects. Two design choices presented themselves. In neither case was a RefId required.

1. Use location (or school) as the ID of an Energy Usage object. All Events being reported at the school are then Change Events for this single object.

1. Use location (or school) and Start Time and SourceId as the ID of an Energy Usage Object. Every Event being reported on is then an Add Event for a new Energy Usage object.

The second option is the one that was selected. The Energy Usage object schema will almost certainly have lists. Change Events require the publication of all values in a list even if they don’t change (otherwise they are assumed to have been deleted). Requiring one publisher to know the values of previously posted Events by other publishers was considered a showstopper to the current design. Using Add Events sidesteps the entire issue.

## 5.5. Self-contained Events

Given the realities of the current energy management domain, the less conformity imposed on the sources of energy management data the more widely the standard is likely to be adopted. At an earlier point in the design we had determined that an additional “Energy Usage Configuration” object would be utilized to define the following sorts of parameters that all Energy Usage events within the Zone would have to conform to:

* Sampling Frequency
* Units

It was quickly realized that the individual energy usage monitoring programs would need to determine their own sampling intervals. Units were more pragmatic ... would it be advantageous to dynamically specify the types of units (ex: is temperature in Fahrenheit or Centigrade (or Kelvin)) that all energy monitoring programs in the Zone would use.

The problem was that this would require every publisher of Energy Usage Event messages to subscribe to Events on a different object, which would tell it how to format the Events it was publishing. This was deemed an onerous requirement for potentially very small systems front ended by Agents, with little payback.

The decision was therefore made to drop the second object and let Event publishers decide their own units. In order for this to work, every Energy Usage Event must be self-contained, to the extent that it defines the units that it uses and the sampling interval between the readings, even though this information will be identical in every Event the publisher issues.

The Energy Analysis / Reporting program which is subscribing to these Events will therefore be required to make the necessary unit conversions before the information in the Energy Management Data Store can be utilized.

## 5.6 Location Coordination

This was the biggest challenge facing the designers of the Energy Usage object, and it is hoped reviewers will focus particular attention on the solution we came up with. For openers, we discarded the idea of requiring these systems to understand information in any of the Location Info elements currently defined for the SIF standard, because:

* These were not well suited for the purpose
* Many of the Energy Usage publishers simply publish what they have ... they have no capacity to be told to what location their sensors have been assigned by an external entity.

That decision simplified things, but it wasn’t enough. Consider the Use Case. Multiple independent publishers are supplying Energy Usage information obtained from various sensors. This information is being collected by one or more subscribers and stored in an Energy Management database. In order to be useful in supporting energy audits the data analysis program retrieving the information from the database must be able to determine:

* **When** the data was sampled
* **What** the values and associated units were
* **Where** the measurements applied

The first two pieces of information are contained in each Energy Usage Event. The third is more problematic. In order to utilize and report on the collected data, the following information must be known about the location to which the energy usage meter readings apply:

* How granular is the unique “Location ID” and how is that represented? Does it get down to the level of the individual sensor?
* What type of facility is being metered (Gymnasium, Cafeteria, Wing, Floor, classroom ...)? Are there a fixed set of types or is the specification open?
* Is there a location “hierarchy” where separate facilities are actually part of a larger location which another publisher might be reporting on (State / District / School / Building)?
* Are there lower level identifiers (energy management “zone”, sensor group, individual sensor) which might be valuable to include inside the “location”, even if just for audit purposes?

Remember that Energy Usage Events within the same school building might be published by multiple independent sources, no two of who communicate or share a common location reference. How can we ensure all the publishers agree on a common location nomenclature?

The simple answer is ... we can’t. So the problem got split into two separate pieces.

### 5.6.1 Global Identification (the School)

This defines the hierarchy in which the energy usage information is relevant (State, District, School, and Building). These are optional entities in the Energy Usage Event schema. Where they are not supplied the Energy Analysis subscriber would be expected to provide them based upon the Zone in which the Events were published.

Ideally most or all of this global information could be supplied by the SIF Zone ID. From the SIF v2.5 Web Service volume this is defined as:

urn:sif:zone:xxx.yyy.zzz where xxx.yyy.zzz is a structure that reading left to right starts with most specific identification such as school and works rightward to identify the higher levels

(*urn:sif:school:AcmeMiddleSchool1.CoyoteDistrict.Arizona*)

Such a School ID could be prepended with the building identification (ex: *Annex2*) but as it is not defined for the HTTP/S transport, it cannot be the only mechanism of supplying this value.

### 5.6.2 Local Identifiers

There are two further “narrowings” possible for the School location: Building and “Energy Zone”. The Energy Zone in turn consists of the following subelements:

* Type (Facility, Classroom, Floor, wing, office, gym, cafeteria, etc.)
* Name (Ex: “Cafeteria”, “Room 101”)
* Tag List (set of optional name / value pairs for additional Energy Zone information (Sensor ID, Sensor Group, Equipment settings, whatever)

If neither is specified, then the energy readings apply to the entire school.

## 5.7 Element Table

*One of the following primary (and mutually exclusive) characteristics:*

* ***M – Mandatory****. Item must appear in every Add Event and, where not excluded in a conditional Request, in every Response message for the object*
* ***Q – ReQuired****. Item must either appear in an Add Event or eventually be included in a Change Event, and once added is returned in all corresponding queries.*
* ***S – Supported****. Item may or may not appear in any message relating to the object. However if its value is supplied / available to the sender, the item is provided in Event and Response messages as if it were Mandatory.*
* ***O – Optional****. Item may or may not appear in any message relating to the object. It need not be supported by the sender*

Plus one or more of the following characteristics if applicable:

* ***C******– Conditional.*** *Item is treated as the accompanying primary characteristic if the specified conditions are satisfied*
* ***I –******Immutable.*** *Item value cannot be changed once supplied.*
* ***U –******Unique.*** *Item value is unique from all other objects containing that item (ex: RefId)*
* ***N –******Non-Queryable****. Item is often calculated (ex: an aggregate), and can’t be used as a search key in a conditional Request.*

Plus the following characteristic if applicable:

* ***R ­– Repeatable.*** *Item may appear more than one time.*

**Object Name: Energy Usage**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Element Name (or grouping in bold)** | **Char** | **Description** | Type | **Other Comments** |
| EnergyUsage |  | This object contains energy usage information for an energy location |  |  |
| LocationInfo | M | Complex element containing the location of where measurements apply to |  |  |
| LocationInfo  /SchoolId | M | urn:sif:school:xxx.yyy.zzz where xxx.yyy.zzz is a structure that reading left to right starts with the most specific identification (school location) and works rightward to identify the higher levels.  Ex: *urn:sif:school:AcmeMiddleSchool1.CoyoteDistrict.Arizona*) | Urn | School ID |
| LocationInfo/  Building | O | Name of the School Building | String | Ex: *Annex1* |
| LocationInfo/  EnergyZone | O | Complex element refining and narrowing the location of the contained readings within the School/Building |  |  |
| LocationInfo/  EnergyZone/  Type | M | Complex type of the facility or location supported by the Energy Zone. Contains either a an enumerated list element or (where no match in the list) a freeform string |  |  |
| LocationInfo/  EnergyZone/  Type/Facility | OC | Predefined set of possible educational facilities type | Enumerated List:  *Classroom*  *Office*  *Hall*  *Auditorium*  *Gymnasium*  *Locker Room*  *Swimming Pool*  *Cafeteria*  *Kitchen*  *Library*  *Study Hall*  *Laboratory*  *Shop*  *Storage*  *Home Economics*  *Wing*  *Floor*  *Building*  *Campus* | Published list of fixed location types in an attempt to avoid “Gym” and “Exercise Room” and “Gymnasium” all being used to name the same type of facility |
| LocationInfo/  EnergyZone/  Type/Description | OC |  | String | Used when location type is not covered by prefixed values in enumerated list |
| LocationInfo/  EnergyZone/  Name | M | Text description of Energy Zone Area to which readings will apply | String | Values could be “Room 101”, “Oven 3”, “Steinhart Auditorium” etc. |
| LocationInfo/  EnergyZone/  TagList | O | List of energy zone identifiers (each consisting of a Name and Value) | EnergyZoneTagListType | Could include “SensorGroup”, or individual SensorId”, or anything else.  Both Name and Value are strings interpreted external to SIF message exchanges |
|  |  |  |  |  |
| DataSource | M | The description of the source of the measurements |  |  |
| DataSource**/**  System | M | Identifier of the reporting system | String | Complete ID |
| DataSource/  StartTime | M | Start time of measurements that follow | xs:dateTime |  |
|  |  |  |  |  |
| DataSource/  ReadingData | M R | Complex element defining a set of parameters that apply to all the actual readings that follow |  | There may be multiple sets of “Reading Parameters” in an Energy Usage Event, each of which has multiple Reading Values” |
| DataSource/  ReadingData/  Measurement | M | One of enumerated list of measurement types: Gas, Electrical, Thermometer, Thermostat, Cost) |  | Full list needs to be fleshed out. If a new value is needed, |
| DataSource/  ReadingData/  SensorId | O | Identification of internal meter or data source | String | Could be utility number assigned to the meter and referenced on the utility bill |
| DataSource/ ReadingData/  Interval | M | Time in seconds between Measurements | Unsigned integer |  |
| DataSource/  ReadingData/  EnergyUnits | M | One of enumerated list of unit types for energy readings (temperature, electrical energy usage, gas usage and the price for both) | Enumerated List: | DegreeCentigrade  Kilowatt-Hour,  $/Kilowatt-hour,  ThousandCubicFeet,  $/ThousandCubicFeet |
| DataSource/  ReadingData/  ReadingName | O | Description of collection of readings | String |  |
|  |  |  |  |  |
| DataSource/  ReadingData/  Readings | M | Collection of reported data readings, in time order |  |  |
| DataSource/  ReadingData/  Readings/  Reading | O R | Values for the energy readings for each interval |  |  |
| DataSource/  ReadingData/  Readings/  Reading/  @IntervalIndex | O | Interval number when reading was taken | Unsigned integer | To get time of any measurement, take Start Time + (Interval Time \* Interval Index) |

# **6 Migration Plan (for proposed changes to existing objects only)**

*One of the mandatory components of every Data Model Change proposal is the Migration Plan. This section describes the impact of the proposed change to legacy SIF Zones and the techniques, best practices and deployment guidelines designed to minimize that impact. It is normally filled out in coordination with SIF Staff or an experienced SIF Data Modeler.*

This is a new object type. There aren’t any legacy objects, and therefore no migration plan is necessary.

# **7 Issues**

*List any issues surrounding this proposal which the reviewers or approvers may need to consider.*

* The Energy Usage Analyzer (subscriber) must be able to collate the Energy Zone identifiers used by the multiple applications publishing Energy Usage data in a SIF Zone. The information needed to map these identifiers into a location hierarchy spanning the entire building must for now be provided to the Energy Usage Analyzer “out of band” (perhaps through a configuration file or a user configuration form).
* The Energy Zone Type element type will be influenced by how the “extensible” Enumerated List problem is resolved:
  + Unsigned integer
  + A string with recommended values
  + A choice of an enumerated list or a String (depending on whether the value is in the list).

* The complete set of all allowable units used in an Energy Usage object must be identified and documented.

# **8 XML Example(s)**

*One or more examples of XML instances representing the items in the proposed extension should be placed here, as part of work done during the detailed design process.*

<EnergyUsage>

<LocationInfo>

<SchoolId> *urn:sif:school:AcmeMiddleSchool1.CoyoteDistrict.Arizona* </SchoolId>

<Building> HS14</Building>

<EnergyZone>

<Type>

<Facility>Floor</Facility>

</Type>

<Name>2nd </Name>

<TagList>

<Name>AirHandler </Name>

<Value>2-50</Value>

</TagList>

</EnergyZone>

</LocationInfo>

<DataSource>

<System>HoneywellBAS 1012</System>

<StartTime>2011-12-05T10:00:00+05:00</StartTime>

<ReadingData>

<Measurement>Electrical</ Measurement >

<SensorId>102211101</SensorId>

<Interval>15</Interval>

<EnergyUnits> Kilowatt-Hour </EnergyUnits>

<ReadingName>Electrical-102211101</ReadingName>

<Readings>

<Reading IntervalIndex=”0”>541</ Reading>

<Reading IntervalIndex=”1”>566</ Reading>

<Reading IntervalIndex=”2”>502</ Reading>

</Readings>

<ReadingData>

<ReadingData>

<Measurement>Electrical</ Measurement >

<SensorId>102233302</SensorId>

<Interval>15</Interval>

<EnergyUnits> Kilowatt-Hour </EnergyUnits>

<ReadingName>Electrical-102233302</ReadingName>

<Readings>

<Reading IntervalIndex=”0”>2241</ Reading>

<Reading IntervalIndex=”1”>2643</ Reading>

<Reading IntervalIndex=”2”>2491</ Reading>

</Readings>

</ReadingData>

</DataSource>

</EnergyUsage>