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Title

IEC 61970-501 Ed.1: Energy management system application program interface (EMS-API) - Part 501: Common information model resource description framework (CIM RDF) Schema

Titre

ATTENTION
VOTE PARALLÈLE
CEI – CENELEC

L'attention des Comités nationaux de la CEI, membres du CENELEC, est attirée sur le fait que ce projet finale de Norme internationale est soumis au vote parallèle.
Un bulletin de vote séparé pour le vote CENELEC leur sera envoyé par le Secrétariat Central du CENELEC.

ATTENTION
IEC – CENELEC
PARALLEL VOTING

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this final draft International Standard (DIS) is submitted for parallel voting.
A separate form for CENELEC voting will be sent to them by the CENELEC Central Secretariat.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENERGY MANAGEMENT SYSTEM APPLICATION PROGRAM INTERFACE (EMS-API) –

Part 501: Common Information Model Resource Description Framework (CIM RDF) Schema

FOREWORD

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International Standard IEC 61970-501 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this standard is based on the following documents:

FDIS	Report on voting
57/XX/FDIS	57/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 61970 consists of the following parts, under the general title *Energy Management System Application Program Interface (EMS-API):*

Part 1: Guidelines and general requirements

Part 2: Glossary

Part 301: Common Information Model (CIM) base

Part 302: Common information model (CIM) financial, energy scheduling and reservations [1]

Part 401: Component interface specification (CIS) framework

Part 402: Component interface specification (CIS) – Common services[1]

Part 403: Component Interface Specification (CIS) – Generic data access[1]

Part 404: Component Interface Specification (CIS) – High speed data access[1]

Part 405: Component Interface Specification (CIS) – Generic eventing and subscription[1]

Part 407: Component Interface Specification (CIS) – Time series data access[1]

Part 453: Exchange of Graphics Schematics Definitions (Common Graphics Exchange) [1]

Part 501: Common Information Model Resource Description Framework (CIM RDF) Schema

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date[2] indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual edition of this standard may be issued at a later date.

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1 Under consideration.

2 The National Committees are requested to note that for this publication the maintenance result date is 2008.

INTRODUCTION

This standard is part of the IEC 61970 series that define an Application Program Interface (API) for an Energy Management System (EMS). This standard is based upon the work of the EPRI Control Center API (CCAPI) research project (RP-3654-1).

This part specifies the mapping between the conceptual model specified as Unified Modeling Language (UML) defined in IEC 61970-3XX series: Common Information Model and the machine readable Extensible Markup Language (XML) representation of that schema using the Resource Description Framework (RDF) Schema specification language.

ENERGY MANAGEMENT SYSTEM APPLICATION PROGRAM INTERFACE (EMS-API) –

Part 501: Common Information Model Resource Description Framework (CIM RDF) Schema

1 Scope

This International Standard specifies a Component Interface Specification (CIS) for energy management systems application program interfaces. This part of IEC 61970 specifies the format and rules for producing a machine readable form of the Common Information Model (CIM) as specified in the IEC 61970-301 standard. It describes a CIM vocabulary to support the data access facility and associated CIM semantics.

This part of IEC 61970 supports a mechanism for applications from independent suppliers to access CIM metadata in a common format and with standard services for the purpose of subsequent CIM data access. Secondary objectives are to provide CIM versioning capabilities and a mechanism that is easily extensible to support site-specific needs. The proposed solution:

- is both machine readable and human readable, although primarily intended for programmatic access;
- can be accessed using any tool that supports the Document Object Model (DOM) application program interface;
- is self-describing;
- takes advantage of current web standards.

This document is the Level 2 Component Interface Specification document that describes in narrative terms (with text and examples based on the CIM), the detailed definition of the CIM metadata interface to be standardized.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61970-1, *Energy management system application program interface (EMS-API) – Part 1: Guidelines and general requirements*[3]

IEC 61970-2, *Energy management system application program interface (EMS-API) – Part 2: Glossary*

IEC 61970-301, *Energy management system application program interface (EMS-API) – Part 301: Common Information Model (CIM) base*

IEC 60050 series: *International Electrotechnical Vocabulary*

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[3] To be published.

3 Terms and definitions

For the purposes of this part of IEC 61970, the terms and definitions given in IEC 61970-2, as well as the following, apply.

3.1
Common Information Model
CIM
abstract model that represents all the major objects in an electric utility enterprise typically contained in an EMS information model

NOTE By providing a standard way of representing power system resources as object classes and attributes, along with their relationships, the CIM facilitates the integration of EMS applications developed independently by different vendors, between entire EMS systems developed independently, or between an EMS system and other systems concerned with different aspects of power system operations, such as generation or distribution management.

3.2
Document Object Model
DOM
platform- and language-neutral interface defined by the World Wide Web Consortium (W3C) that allows programs and scripts to dynamically access and exchange the content, structure and style of documents

3.3
Resource Description Framework
RDF
language recommended by the W3C for expressing metadata that machines can process simply. It is expressed as a special kind of XML document

3.4
RDF Schema
schema specification language expressed using RDF to describe resources and their properties, including how resources are related to other resources, which is used to specify an application-specific schema

3.5
Unified Modelling Language
UML
modelling language and methodology for specifying, visualizing, constructing, and documenting the artefacts of a system-intensive process

3.6
Extensible Markup Language
XML
subset of Standard Generalized Markup Language (SGML), ISO 8879, for putting structured data in a text file. It is an endorsed recommendation from the W3C

NOTE It is license-free, platform-independent and well-supported by many readily available software tools.

4 Structure of an XML document

4.1 General

An XML document is a set of containers. The containers can contain other containers as well as content. The two required pieces of a well-formed XML document are the prolog and the root element. The prolog contains statements that indicate the version of the XML standard to which the document conforms and the encoding that is used. The prolog for the CIM RDF Schema file is simply:

```
<?xml version="1.0" encoding="UTF-8"?>
```

The root element contains the XML document's actual contents, which are contained within starting and ending tags. The CIM RDF Schema contains the root element:

```
<rdf:RDF>
  .
 :
</rdf:RDF>
```

The root element also contains references to namespaces, which define a context for elements that are used within the rest of the document. The element name is preceded by the namespace alias followed by a colon. For example, the RDF Schema namespace is declared:

```
xmlns:rdfs="http://www.w3.org/TR/1999/PR-rdf-schema-19990303#"
```

References to it within the document use the syntax:

```
<rdfs:subClassOf rdf:resource="rdfs:Resource"/>
```

Comments can appear anywhere within an XML document; they are delimited with `<!--` and `-->` characters.

4.2 Elements

An element is a container enclosed between start and stop tags. The start tag defines the name of the element and contains any attributes of the element. In the following example, Class is the name of the element and ID is its attribute.

```
<rdfs:Class rdf:ID="Bay">
```

The stop tag for this element is `</rdfs:Class>`.

4.3 Attributes

The ID attribute is used for the Class elements to be able to reference other element nodes within the CIM RDF Schema document. The element with `ID="Bay"` can be referenced by other elements using the # symbol in front of the attribute's value, as `"#Bay"`.

Note that the XML concept of *attribute* is not the same as the UML definition. XML attributes store information about the element that are not directly or immediately relevant to the reader, such as an ID which is used for linking internal elements. UML attributes are data in this context. They shall hold structure of their own, such as datatype, constraints, and description. Therefore, they are specified as elements in the CIM RDF Schema.

5 Metadata and RDF Schema

5.1 General

RDF Schema allows the definition of application-specific vocabularies. It is a very concise way to represent the CIM classes and their attributes and relationships. It is designed to be extensible, so that local extensions to the CIM can easily be referenced.

5.2 Resource

A resource is anything that can be referenced by a Uniform Resource Identifier (URI). For the purposes of the CIM RDF Schema, a resource corresponds to a class. By convention, resources are named with an initial uppercase letter.

5.3 Property

A property is a specific aspect, characteristic, attribute, or relation used to describe a resource. Each property has a specific meaning, defines its permitted values, the types of resources it can describe, and its relationship with other properties. Within the context of the CIM RDF Schema, a property can be either a class attribute or a rolename for an association of the class. By convention, properties are named with an initial lowercase letter.

5.4 Namespaces

Namespaces are a way to tie a specific use of a word in context to the dictionary (schema) where the intended definition is to be found. RDF requires the XML namespace facility to precisely associate each property with the schema that defines the property.

5.5 CIM RDF Schema extensions

5.5.1 General

The RDF Schema has been extended to support some of the UML concepts that are important or useful in the CIM.

5.5.2 Multiplicity

A constraint property is a special kind of property that can be used to limit the values for the named properties. A multiplicity constraint documents the CIM values for allowed cardinality for a rolename in an association. The multiplicity resource is defined as:

```
<rdfs:ConstraintProperty rdf:ID="multiplicity">
 <rdfs:label xml:lang="en">multiplicity</rdfs:label>
 <rdfs:domain rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-
ns#Property"/>
 <rdfs:range rdf:resource="#Multiplicity"/>
 <rdfs:comment>Indicates how many instances of a given property are
allowed for a given resource. Allowed values are:
M:0..1 (zero-or-one), M:1..1 (exactly-one), M:0..n (zero-or-more),
M:1..n (one-or-more).</rdfs:comment>
</rdfs:ConstraintProperty>

<rdfs:Class rdf:ID="Multiplicity">
 <rdfs:label xml:lang="en">Multiplicity</rdfs:label>
 <rdfs:comment>Definition of the enumerated type which will contain
the list of valid values. </rdfs:comment>
</rdfs:Class>
```

The CIM RDF Schema extensions create resources of this type which are used to express the values for allowed CIM cardinalities. The resources are named M:0..1, M:1..1, M:0..n, and M:1..n to correspond to the UML values in the model.

5.5.3 Inverse Rolename

The inverseRolename property provides the name of the rolename at the opposite class for the association. This property is useful for navigating through the CIM relationships. It is defined as:

```
<rdfs:ConstraintProperty rdf:ID="inverseRoleName">
 <rdfs:label xml:lang="en">inverseRoleName</rdfs:label>
 <rdfs:domain rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-
ns#Property"/>
  <rdfs:comment>Role name at opposite end of this association.
  </rdfs:comment>
</rdfs:ConstraintProperty>
```

5.5.4 IsAggregate

Some of the associations in the CIM are specified as aggregations, or container type associations. For these associations, certain UML tools only report the rolename on the container side of the association. This property indicates if the rolename is an aggregation, and makes it possible to discover the rolenames on the “contained” side using the inverseRolename of the aggregate rolename.

```
<rdfs:ConstraintProperty rdf:ID="isAggregate">
 <rdfs:label xml:lang="en">isAggregate</rdfs:label>
 <rdfs:domain rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-
ns#Property"/>
 <rdfs:comment>Indicates if role is aggregate. If this is true, then
the inverseRoleName property may or may not be listed for the
otherside Class. </rdfs:comment>
</rdfs:ConstraintProperty>
```

5.5.5 Stereotype

The CIM uses UML stereotypes to indicate that certain classes are primitive types or enumerations. The stereotype property documents those stereotypes. It is defined as:

```
<rdfs:ConstraintProperty rdf:ID="stereotype">
 <rdfs:label xml:lang="en">stereotype</rdfs:label>
 <rdfs:domain rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-
ns#Property"/>
 <rdfs:comment>Used primarily to indicate primitive datatypes and
enumerations. </rdfs:comment>
</rdfs:ConstraintProperty>
```

5.5.6 Data type

Each UML class attribute has a data type definition. In the CIM model, data types are defined as classes. The data type definition of a class attribute refers to the corresponding data type class. The data type can be of type string, enumeration, float, integer or others. Depending upon that the syntax in the schema is different.

The data type reference is specified as part of the property specification of a class attribute.

```
rdf:Property rdf:about=http://iec.....#class-attribute-name
      cims:dataType rdf:resource=http://iec.....#data-type
```

In case of a “String, Float, Integer, or Others” data type there exists only a reference to the corresponding data type class.

```
rdfs:Class rdf:about=http://iec.....#data-type
```

The example below defines the data type “Admittance” referred by the “Compensator.yPerSection” attribute:

```
<rdf:Property rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#Compensator.yPerSection">
      <rdfs:label xml:lang="en">yPerSection</rdfs:label>
      <rdfs:comment>For a capacitor bank, the admittance of each
switchable section. Calculated using the MVAr per section and
corrected for network voltage.</rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <rdfs:domain rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#Compensator"/>
      <cims:dataType rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#Admittance"/>
</rdf:Property>

<rdfs:Class rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#Admittance">
      <rdfs:label xml:lang="en">Admittance</rdfs:label>
      <rdfs:comment>Ratio of current to voltage.</rdfs:comment>
```

```
      <cims:profile>Nerc</cims:profile>
      <cims:belongsToCategory
rdf:resource="http://iec.ch/TC57/2003/CIM-schema-cim10#Domain"/>
</rdfs:Class>
```

For UML class attributes that are defined as an enumeration data type, the mapping to the rdf schema is slightly different (refer to 6.3.5).

5.5.7 Profile

A subset of the classes, attributes, and associations in the UML model can be defined through a profile. Each profile has a name. The assignment to a profile is expressed through the cims:profile statement. It is optional, meaning not every class shall be assigned to a profile.

In the example below, the class “CurveSchedData” is assigned to the profile named "Nerc”.

```
<rdfs:Class rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#CurveSchedData">
      <rdfs:label xml:lang="en">CurveSchedData</rdfs:label>
      <rdfs:comment>Data point values for defining a curve or
schedule</rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <cims:belongsToCategory
rdf:resource="http://iec.ch/TC57/2003/CIM-schema-cim10#Core"/>
      <rdfs:subClassOf rdf:resource="http://iec.ch/TC57/2003/CIM-
schema-cim10#Naming"/>
</rdfs:Class>
```

The following example defines the attribute CurveSchedData.rampData of the class “CurveSchedData”:

```
<rdf:Property rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#CurveSchedData.rampData">
      <rdfs:label xml:lang="en">rampData</rdfs:label>
      <rdfs:comment>The data value of the rate-of-change of the Y-axis
variable with respect to the X-axis variable</rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <rdfs:domain rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#CurveSchedData"/>
      <cims:dataType rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#Float"/>
</rdf:Property>
```

Finally, there is an example of an association that is defined as part of the Nerc profile:

```
<rdf:Property rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#CurveSchedData.CurveSchedule">
      <rdfs:label xml:lang="en">CurveSchedule</rdfs:label>
      <rdfs:comment>The point data values that define a
curve</rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <rdfs:domain rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#CurveSchedData"/>
      <rdfs:range rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#CurveSchedule"/>
      <cims:multiplicity rdf:resource="http://iec.ch/TC57/1999/rdf-
schema-extensions-19990926#M:0..1"/>
      <cims:isAggregate>true</cims:isAggregate>
      <cims:inverseRoleName rdf:resource="http://iec.ch/TC57/2003/CIM-
schema-cim10#CurveSchedule.CurveScheduleDatas"/>
</rdf:Property>
```

5.5.8 Class category

The UML class model of the CIM uses categories to structure the classes. Categories are for example Core, or Domain. A category corresponds to a package in Rational Rose ®. In the rdf

schema the cims:ClassCategory defines a category. The name of the category is defined in the rdf:about statement.

In the example below defines the category “Core”:

```
<cims:ClassCategory rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#Core">
      <rdfs:label xml:lang="en">Core</rdfs:label>
      <rdfs:comment>Contains the core PowerSystemResource and
ConductingEquipment entities shared by all applications plus common
collections of those entities. Not all applications require all the
Core entities.</rdfs:comment>
</cims:ClassCategory>
```

Classes are assigned to a category through the cims:belongsToCategory (see 5.5.9)

5.5.9 Belongs To Category

Each class in the UML model is assigned to a category. The statement cims: BelongsToCategory refers to the category the class belongs to. The statement is part of a class definintion.

The example belows specifies the class “CurveSchedData” that belongs to the category “Core”.

```
<rdfs:Class rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#CurveSchedData">
      <rdfs:label xml:lang="en">CurveSchedData</rdfs:label>
      <rdfs:comment>Data point values for defining a curve or
schedule</rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <cims:belongsToCategory
rdf:resource="http://iec.ch/TC57/2003/CIM-schema-cim10#Core"/>
      <rdfs:subClassOf rdf:resource="http://iec.ch/TC57/2003/CIM-
schema-cim10#Naming"/>
</rdfs:Class>
```

6 CIM metadata

6.1 General

CIM metadata is extracted from the UML model using scripts to automatically generate the CIM RDF Schema XML file. The mapping is straightforward, with no intervening editing required. The mapping algorithm and scripts are described in Annex A.

6.2 Schema

6.2.1 CIM RDF Schema

The CIM RDF Schema file is generated as an XML RDF document type.

6.2.2 Version

Each version of the CIM RDF Schema is assigned a version number that matches the version number of the UML model file, for example cimu08b.xml. The version number is indicated both by the name of the file and in the rdf:Description embedded in the file, for example:

```
<rdf:Description> CIM RDF schema exported from UML cimu08b.mdl on
1999-11-11. </rdf:Description>
```

6.3 Mapping from UML

6.3.1 General

UML classes are mapped to rdfs:Class resources. Attributes are mapped to rdf:Property resources. Rolenames are also mapped to rdf:Property resources, with a few additional properties as listed below.

6.3.2 Class

6.3.2.1 General

Each UML class is extracted as one rdfs:Class. It contains property resources for a display label, subClassOf, comment, and stereotype. For properties that have null values in the UML model, a property resource is generated with an empty string.

6.3.2.2 Label

The label property defaults to the name of the class in the CIM, with an indication that this is for the English language. The ID attribute for the class is the same as the xml:lang="en" value. This allows the CIM RDF Schema file to be localized into other languages, which may have other labels which would be preferred. The ID attribute is never changed or localized, only the display label. For example, here is the English element and label for Ground:

```
<rdfs:Class rdf:ID="Ground">
 <rdfs:label xml:lang="en">Ground</rdfs:label>
  .
 :
</rdfs:Class>
```

Localized into French, it would appear like this:

```
<rdfs:Class rdf:ID="Ground">
 <rdfs:label xml:lang="fr">Masse</rdfs:label>
  .
 :
</rdfs:Class>
```

6.3.2.3 SubClassOf

The subClassOf property indicates the superclass for each class. For top-level classes, such as PowerSystemResource, the subClassOf property is rdfs:Resource.

6.3.2.4 Comment

The comment property corresponds to the description of the class in the UML model. Comment text can be localized, since the contents are not referenced by any other part of the model.

6.3.2.5 Sterotype

The stereotype property is generated from the UML stereotype for the class. Currently, the only stereotypes in the CIM model are «Primitive» and «Enumeration.» If a class does not contain a stereotype, an empty string is generated for this property.

6.3.3 Property – Attribute

6.3.3.1 General

Each UML class attribute is extracted as one rdf:Property element. It contains property resources for a display label, domain, range, and comment. For properties that have null values in the UML model, a property resource is generated with an empty string.

6.3.3.2 Label

The display label for property attributes is similar to the display label for the class, but in this case it is different from the ID attribute. Only the UML attribute name is extracted into the label property, while the ID contains both the class name and the attribute name. This ensures that each UML attribute is specific to a particular class.

6.3.3.3 Domain

The domain property is an instance of a constraint property that is used to specify a class on which a property may be used. RDF Schema allows zero, one, or many classes to be listed as the domain property. The CIM RDF Schema always lists exactly one class, which represents the UML class for the attribute.

6.3.3.4 Range

The range property is an instance of ConstraintProperty that is used to constrain property values. The value of a range property is always a Class. It corresponds to the datatype, usually a Primitive class from the Domain package.

6.3.3.5 Comment

The comment property corresponds to the description of the class in the UML model.

6.3.4 Property – Rolename

6.3.4.1 General

Each UML rolename is extracted as one rdf:Property element. It contains property resources for a display label, domain, range, and comment, which are the same as the properties described for UML attributes. In addition, it contains property resources for inverseRolename, multiplicity, and isAggregate. For properties that have null values in the UML model, a property resource is generated with an empty string.

Rolenames shall be unique within a CIM class in order to generate unique property resources.

6.3.4.2 InverseRoleName

The inverseRoleName property contains the rolename for this association from the class at the opposite end.

6.3.4.3 Multiplicity

The multiplicity property indicates the allowed cardinality for this rolename in the association. There is no default.

6.3.4.4 IsAggregate

The isAggregate property indicates that this rolename is specified as a UML aggregation. Only rolenames that are on the container side of an aggregation association have isAggregate "True."

6.3.5 Enumerations

The CIM UML enumeration classes have a stereotype of «Enumeration». The named literal values are declared in the model as attribute names with no datatype. Each enumeration literal name represents one instance of the user-definable datatype of the enumeration. For each predefined instance of the datatype, an instance of the class is created in the CIM RDF Schema.

For example, the allowed value for Measurement.eventLog is one of {true, false}. This is achieved through use of a range constraint. The CIM RDF Schema defines a class "Boolean," and uses rdfs:range to state that a Measurement.eventLog property only "makes sense" when it has a value which is an instance of the class Boolean. The schema then defines both instances of this class, as shown below:

```
<rdfs:Class rdf:ID="Boolean">
  <rdfs:subClassOf rdf:resource="rdfs:Resource"/>
  <rdfs:comment>"{ false, true }"</rdfs:comment>
  <cims:stereotype>"Enumeration"</cims:stereotype>
</rdfs:Class>

<Boolean rdf:ID="false"></Boolean>
<Boolean rdf:ID="true"></Boolean>
```

The example below defines the enumeration “GeneratorOperatingMode” with one enumerator “GeneratorOperatingMode.Off”.

```
<rdf:Property rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#GeneratingUnit.genOperatingMode">
      <rdfs:label xml:lang="en">genOperatingMode</rdfs:label>
      <rdfs:comment>Operating mode for secondary control, e.g.: Off,
Manual, Fixed, LFC, AGC, EDC, RPN, MRN, or REG</rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <rdfs:domain rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#GeneratingUnit"/>
      <rdfs:range rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#GeneratorOperatingMode"/>
</rdf:Property>

<rdfs:Class rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#GeneratorOperatingMode">
      <rdfs:label xml:lang="en">GeneratorOperatingMode</rdfs:label>
      <rdfs:comment>Operating mode for secondary generator control,
e.g.: Unavailable, Manual, Fixed, Load Frequency Control, AGC, EDC,
RPN, MRN, or REG</rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <cims:belongsToCategory
rdf:resource="http://iec.ch/TC57/2003/CIM-schema-cim10#Domain"/>
</rdfs:Class>

<rdf:Description rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#GeneratorOperatingMode.Off">
      <rdfs:label xml:lang="en">Off</rdfs:label>
      <rdfs:comment/>
      <rdf:type rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#GeneratorOperatingMode"/>
</rdf:Description>
```

6.4 Example CIM RDF Schema elements

For this example, only the CIM RDF Schema elements that correspond to the Company resource and its association with the PowerSystemResource resource are included. See Figure 1.

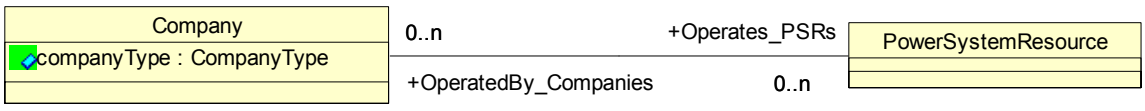

Figure 1 – Company-PowerSystemResource Association

```
<rdfs:Class rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#Company">
  <rdfs:label xml:lang="en">Company</rdfs:label>
      <rdfs:comment>A company is a legal entity that owns and operates
power system resources and is a party to interchange and transmission
contracts.</rdfs:comment>
      <cims:belongsToCategory
rdf:resource="http://iec.ch/TC57/2003/CIM-schema-cim10#Core"/>
      <rdfs:subClassOf rdf:resource="http://iec.ch/TC57/2003/CIM-
schema-cim10#Naming"/>
</rdfs:Class>

<rdf:Property rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#Company.companyType">
      <rdfs:label xml:lang="en">companyType</rdfs:label>
      <rdfs:comment>The type of company, e.g.: pool, municipal,
private</rdfs:comment>
      <rdfs:domain rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#Company"/>
      <rdfs:range rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#CompanyType"/>
</rdf:Property>

<rdfs:Class rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#PowerSystemResource">
      <rdfs:label xml:lang="en">PowerSystemResource</rdfs:label>
      <rdfs:comment>A power system resource can be an item of equipment
such  as a Switch, an EquipmentContainer containing many individual
items of equipment such as a &amp;#13;
Substation, or an organisational entity such as Company or
SubControlArea. This provides for the nesting of collections of
PowerSystemResources within other PowerSystemResources. For example, a
Switch could be a member of a Substation and a Substation could be a
member of a division of a Company.&amp;#13;
  </rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <cims:belongsToCategory
rdf:resource="http://iec.ch/TC57/2003/CIM-schema-cim10#Core"/>
      <rdfs:subClassOf rdf:resource="http://iec.ch/TC57/2003/CIM-
schema-cim10#Naming"/>
</rdfs:Class>

<rdf:Property rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#Company.Operates_PSRs">
      <rdfs:label xml:lang="en">Operates_PSRs</rdfs:label>
      <rdfs:comment>A power system resource may be part of one or more
companies</rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <rdfs:domain rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#Company"/>
      <rdfs:range rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#PowerSystemResource"/>
      <cims:multiplicity rdf:resource="http://iec.ch/TC57/1999/rdf-
schema-extensions-19990926#M:0..n"/>
      <cims:inverseRoleName rdf:resource="http://iec.ch/TC57/2003/CIM-
schema-cim10#PowerSystemResource.OperatedBy_Companies"/>
</rdf:Property>

<rdf:Property rdf:about="http://iec.ch/TC57/2003/CIM-schema-
cim10#PowerSystemResource.OperatedBy_Companies">
      <rdfs:label xml:lang="en">OperatedBy_Companies</rdfs:label>
```

```
      <rdfs:comment>A power system resource may be part of one or more
companies</rdfs:comment>
      <cims:profile>Nerc</cims:profile>
      <rdfs:domain rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#PowerSystemResource"/>
      <rdfs:range rdf:resource="http://iec.ch/TC57/2003/CIM-schema-
cim10#Company"/>
      <cims:multiplicity rdf:resource="http://iec.ch/TC57/1999/rdf-
schema-extensions-19990926#M:0..n"/>
      <cims:inverseRoleName rdf:resource="http://iec.ch/TC57/2003/CIM-
schema-cim10#Company.Operates_PSRs"/>
</rdf:Property>
```

Annex A
(informative)

CIM RDF Schema generation – Mechanism for schema generation

The CIM RDF Schema is generated from the UML model using the following algorithm:

1) Open the model file.

2) For all packages, except the Domain package
   For each class, print

```
<rdfs:Class rdf:ID="Class.Name">
      <rdfs:label xml:lang="en">Class.Name</rdfs:label>
      <rdfs:subClassOf rdf:resource="#MySuperClasses.Name"/>
      <rdfs:comment>"Class.Documentation"</rdfs:comment>
      <cims:stereotype>"Class.Stereotype"</cims:stereotype>
</rdfs:Class>
```

   For each attribute, print

```
<rdf:Property rdf:ID="Class.Name.Attribute.Name">
  <rdfs:label xml:lang="en">Attribute.Name</rdfs:label>
  <rdfs:domain rdf:resource="#Class.Name"/>
  <rdfs:range rdf:resource="#Attribute.Type"/>
  <rdfs:comment>"Attribute.Documentation"</rdfs:comment>
 </rdf:Property>
```

   For each rolename, print

```
<rdf:Property rdf:ID="Class.Name.Role.Name">
  <rdfs:label xml:lang="en">Role.Name</rdfs:label>
  <rdfs:domain rdf:resource="#Class.Name"/>
  <rdfs:range rdf:resource="#Role.ToClass.Name"/>
  <cims:inverseRoleName
       rdf:resource="#Role.ToClass.Name.Role.OtherRole.Name"/>
  <cims:multiplicity
        rdf:resource="http://www.omg.org/schema/utility/99-10-
        03#M:Role.CardinalityFrom"/>
  <cims:isAggregate rdf:Literal="Role.IsAggregate"/>
  <rdfs:comment>"Role.Documentation"</rdfs:comment>
 </rdf:Property>
```

3) For each of the classes in the Domain package, print

```
<rdfs:Class rdf:ID="Class.Name">
    <rdfs:subClassOf rdf:resource="#MySuperClasses.Name"/>
   <rdfs:comment>"Class.Documentation"</rdfs:comment>
    <cims:stereotype>"Class.Stereotype"</cims:stereotype>
</rdfs:Class>
```

   For each attribute of the Domain class, print

```
<rdf:Property rdf:ID="Class.Name.Attribute.Name">
      <rdfs:domain rdf:resource="#Class.Name"/>
   <rdfs:range rdf:resource="#Attribute.Type"/>
   <rdfs:comment>"Attribute.Documentation"</rdfs:comment>
</rdf:Property>
```

4) For each class in the Domain package with a stereotype of «Enumeration» and at least one attribute, print

```
<Class.Name rdf:ID="Attribute.Name">
</Class.Name>
```

The CIM RDF Schema file has been generated using a tool called Xpetal. Xpetal runs a Java program that extracts the metadata information from a UML model which has been converted from Rational Rose® .mdl format

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