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Schnittstelle für Anwendungsprogramme für Netzführungssysteme (EMS-API) – Teil 452: CIM-Statische-Übertragungsnetzwerk-Modell-Profile (IEC 61970-452:2017); Englische Fassung EN 61970-452:2017

Energy management system application program interface (EMS-API) –
Part 452: CIM static transmission network model profiles
(IEC 61970-452:2017);
English version EN 61970-452:2017

Interface de programmation d'application pour système de gestion d'énergie (EMS-API) –
Partie 452: Profils du modèle de réseau de transport statique CIM
(IEC 61970-452:2017);
Version anglaise EN 61970-452:2017

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Gesamtumfang 186 Seiten

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Anwendungsbeginn

Anwendungsbeginn dieser Norm ist ... .

Nationales Vorwort

Für dieses Dokument ist das nationale Arbeitsgremium K 952 „Netzleittechnik“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE (www.dke.de) zuständig.

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Der Zusammenhang der zitierten Dokumente mit den entsprechenden deutschen Dokumenten ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als EN 60068 als Europäische Norm durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für die vorliegende Norm erfüllt.

Da sich die Benutzer des vorliegenden Normentwurfs der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN 61970-452 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt, und Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA des vorliegenden Normentwurfs hinzugefügt. Für die meisten der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Normentwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

Es ist vorgesehen, auch bei der entsprechenden zukünftigen Deutschen Norm auf die deutsche Sprachfassung zu verzichten und diese in der englischsprachigen Fassung zu veröffentlichen.

Eventuell berechtigte Kommentare können nicht mehr in die aktuelle Kommentarfrist der veröffentlichten IEC und EN Norm aufgenommen werden und werden im Überarbeitungsprozess der neuen Standards eingereicht.

Änderungen

Gegenüber DIN EN 61970-452:2016-12 wurden folgende Änderungen vorgenommen:

a) Das Profil „Equipment“ wurde in drei einzelne Profile unterteilt, „CoreEquipment“, „Operation“ und „ShortCircuit“.

b) Das HGÜ-Modell wurde durch das neue, in 61970 301, Ausgabe 6, definierte Modell ersetzt.

c) Das Attribut „IdentifiedObject.mRID“ wurde hinzugefügt.

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d) Die Klasse „BusNameMarker“ wurde hinzugefügt.

e) Das Attribut „HydroPowerPlant.hydroPlantType“ wurde hinzugefügt.

f) Das Attribut „HydroGeneratingUnit.energyConversionCapability“ wurde entfernt.

g) Es wurden die Erdung betreffende Klassen („PetersenCoil“, „GroundImpedance“, „GroundDisconnector“, „GroundSwitch“ und „Ground“) hinzugefügt.

h) Es wurden verschiedene Änderungen im Zusammenhang mit der Frage vorgenommen, ob bestimmte Attribute und Assoziationen erforderlich oder optional sind.

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Nationaler Anhang NA
(informativ)

Auszugsweise Übersetzung[N1)]

1 Anwendungsbereich

Dieses IEC-Dokument gehört zu der Reihe IEC 61970-450 bis 499, welche auf einer abstrakten Ebene den Inhalt und die Austauschmechanismen derjenigen Daten definiert, die zwischen Netzleitstellen und/oder Teilen einer Netzleitstelle, wie beispielsweise Anwendungen von Energieversorgungssystemen, übertragen werden.

Ziel dieses Dokuments ist die Definition einer Teilmenge von Klassen, Klassenattributen und Rollen aus dem CIM, welche für die Ausführung von Zustandsschätzungen und Lastflussanwendungen benötigt werden. Die Data Exchange Working Group (DEWG) Common Power System Modeling group (CPSM) des North American Electric Reliability Council (NERC) hat die ursprünglichen Datenanforderungen erstellt; diese sind in Anhang E dargestellt. Diese Anforderungen beruhen auf bisherigen Vorgehensweisen der Industrie beim Austausch von Daten aus Energieversorgungsmodellen, die in erster Linie in Planungsstudien verwendet werden. Die Liste der erforderlichen Daten wurde jedoch erweitert, um einen Austausch von Modellen zu erleichtern, der auch solche Parameter umfasst, die für Leistungsschalter-bezogene Anwendungen üblich sind. Wo nötig, erstellt dieses Dokument Grundsätze (dargestellt in Abschnitt 6), mit denen eine XML-Datei übereinstimmen muss, um als gültig für den Austausch von Modellen zu gelten.

Dieses Dokument richtet sich an zwei bestimmte Zielgruppen, Datenproduzenten und Datenempfänger, und kann daher aus zwei Blickwinkeln gelesen werden.

Aus Sicht der von dem Datenproduzenten verwendeten Software für den Modellexport beschreibt das Dokument eine Mindest-Teilmenge an CIM-Klassen, -Attributen und -Assoziationen, die in einer XML-formatierten Datei für den Austausch von Modellen vorhanden sein müssen. Diese Norm schreibt jedoch nicht vor, wie das Netzwerk zu modellieren ist. Sie gibt lediglich vor, welche Klassen, Attribute und Assoziationen für die Beschreibung des bestehenden Quellenmodells zu verwenden sind.

Sowohl optionale als auch erforderliche Klassen, Attribute und Assoziationen müssen importiert werden, wenn sie sich vor dem Import in der Modelldatei befinden. Wenn ein optionales Attribut in der importierten Datei nicht existiert, muss es nicht exportiert werden, wenn genau derselbe Datensatz exportiert wird, d. h., das Tool muss dieses Attribut nicht automatisch bereitstellen. Wenn ein obligatorisches Attribut oder eine obligatorische Assoziation fehlt, gelten die ausgetauschten Daten als ungültig. Möglicherweise werden die Einschränkungen des Profils bei bestimmten Geschäftsprozessen gelockert, ein solcher Austausch würde dann jedoch nicht als normgerecht angesehen werden. Von Geschäftsprozessen, nach denen sich unterschiedliche Austausche richten, kann auch vorgeschrieben werden, dass der Austausch bestimmter optionaler Attribute oder Assoziationen obligatorisch ist.

Darüber hinaus darf die Person, die den Export durchführt, auch eine XML-Datei erzeugen, die zusätzliche Klassendaten enthält, welche im CIM-RDF-Schema beschrieben, aber von dem vorliegenden Dokument nicht gefordert werden, vorausgesetzt, dass diese Daten den in Abschnitt 6 aufgestellten Grundsätzen entsprechen.

Aus Sicht des von einem Datenempfänger verwendeten Modellimports beschreibt das Dokument eine Teilmenge des CIM, welche die Import-Software interpretieren können muss, um die exportierten Modelle zu importieren. Wie bereits erwähnt, steht es Datenlieferanten frei, die hier beschriebenen Mindestanforderungen zu überschreiten, solange die resultierenden Dateien dem CIM-RDF-Schema und den in Abschnitt 6 aufgestellten Grundsätzen entsprechen. Das Dokument beschreibt aus diesem Grund zusätzliche Klassen und Klassendaten, die zwar nicht erforderlich sind, von der Person, die den Export durchführt, aber wahrscheinlich in die Dateien aufgenommen werden. Die zusätzlichen Klassen und Daten werden als erforderlich

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[N1)] Nationale Fußnote: Die Nummerierung der IEC 61970-452:2017-07 wurde beibehalten.

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(Kardinalität 1..1) oder als optional (Kardinalität 0..1) gekennzeichnet, um sie von ihren erforderlichen Pendants abzugrenzen. Es wird darauf hingewiesen, dass beim Datenimport möglicherweise Daten empfangen werden, die Instanzen aller im CIM-RDF-Schema beschriebenen Klassen enthalten.

3 Begriffe

Es werden keine Begriffe in diesem Dokument angegeben.

ISO und IEC führen Terminologiedatenbanken für die Normung unter folgenden Adressen:

– IEC Electropedia: verfügbar unter http://www.electropedia.org
– ISO Online Browsing Platform: verfügbar unter http://www.iso.org/obp

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— *Entwurf* —

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Interface de programmation d'application pour système de gestion d'énergie (EMS-API) - Partie 452: Profils du modèle de réseau de transport statique CIM (IEC 61970-452:2017)

Schnittstelle für Anwendungsprogramme für Netzführungssysteme (EMS-API) - Teil 452: CIM-Statische-Übertragungsnetzwerk-Modell-Profile (IEC 61970-452:2017)

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European foreword

The text of document 57/1868/FDIS, future edition 3 of IEC 61970-452, prepared by IEC/TC 57 "Power systems management and associated information exchange" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61970-452:2017.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2018-05-30
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2020-08-30

This document supersedes EN 61970-452:2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61970-452:2017 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61970-1	NOTE	Harmonized as EN 61970-1.
IEC/TS 61970-2	NOTE	Harmonized as CLC/TS 61970-2.
IEC 61970-552	NOTE	Harmonized as EN 61970-552.

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INTRODUCTION

This part of IEC 61970 is part of the IEC 61970 series that define an application program interface (API) for an energy management system (EMS).

The IEC 61970-3x series specifies a Common Information Model (CIM). The CIM is an abstract model that represents all of the major objects in an electric utility enterprise typically needed to model the operational aspects of a utility. It provides the semantics for the IEC 61970 APIs specified in the IEC 61970-4x series of Component Interface Standards (CIS). The IEC 61970-3x series includes IEC 61970-301, *Common Information Model (CIM) base* and draft standard IEC 61970-302[1], *Common Information Model (CIM) for Dynamics*.

This document is one of the IEC 61970-4x series of Compoment Interface Standards that specify the functional requirements for interfaces that a component (or application) shall implement to exchange information with other components (or applications) and/or to access publicly available data in a standard way. The component interfaces describe the specific message contents and services that can be used by applications for this purpose. The implementation of these messages in a particular technology is described in the IEC 61970-5x series.

This document specifies the specific profiles (or subsets) of the CIM for exchange of static power system data between utilities, security coordinators and other entities participating in a interconnected power system, such that all parties have access to the modeling of their neighbor's systems that is necessary to execute state estimation or power flow applications. Currently three profiles, the CoreEquipment Profile, the Operation Profile and the Short Circuit Profile, have been defined. A companion standard, IEC 61970-552, defines the CIM XML Model Exchange Format based on the Resource Description Framework (RDF) Schema specification language. IEC 61970-552 is the common industry approach and is recommended to be used to transfer power system model data for the IEC 61970-452 profile.

1 Under preparation. Stage at the time of publication: IEC/AFDIS 61970-302:2017.

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

Part 452: CIM static transmission network model profiles

1 Scope

This IEC document is one of the IEC 61970-450 to 499 series that, taken as a whole, defines at an abstract level the content and exchange mechanisms used for data transmitted between control centers and/or control center components, such as power systems applications.

The purpose of this document is to define the subset of classes, class attributes, and roles from the CIM necessary to execute state estimation and power flow applications. The North American Electric Reliability Council (NERC) Data Exchange Working Group (DEWG) Common Power System Modeling group (CPSM) produced the original data requirements, which are shown in 0. These requirements are based on prior industry practices for exchanging power system model data for use primarily in planning studies. However, the list of required data has been extended to facilitate a model exchange that includes parameters common to breaker-oriented applications. Where necessary this document establishes conventions, shown in Clause 6, with which an XML data file must comply in order to be considered valid for exchange of models.

This document is intended for two distinct audiences, data producers and data recipients, and may be read from two perspectives.

From the standpoint of model export software used by a data producer, the document describes a minimum subset of CIM classes, attributes, and associations which must be present in an XML formatted data file for model exchange. This standard does not dictate how the network is modelled, however. It only dictates what classes, attributes, and associations are to be used to describe the source model as it exists.

Optional and required classes, attributes and associations must be imported if they are in the model file prior to import. If an optional attribute does not exist in the imported file, it does not have to be exported in case exactly the same data set is exported, i.e. the tool is not obliged to automatically provide this attribute. If any mandatory attribute or association is missing, the exchanged data is considered invalid. Specific business processes may relax restrictions of the profile, but such exchanges would not be considered to be compliant with the standard. Business processes governing different exchanges can also require mandatory exchange of certain optional attributes or associations.

Furthermore, an exporter may, at his or her discretion, produce an XML data file containing additional class data described by the CIM RDF Schema but not required by this document provided these data adhere to the conventions established in Clause 6.

From the standpoint of the model import used by a data recipient, the document describes a subset of the CIM that importing software must be able to interpret in order to import exported models. As mentioned above, data providers are free to exceed the minimum

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requirements described herein as long as their resulting data files are compliant with the CIM RDF Schema and the conventions established in Clause 6. The document, therefore, describes additional classes and class data that, although not required, exporters will, in all likelihood, choose to include in their data files. The additional classes and data are labeled as required (cardinality 1..1) or as optional (cardinality 0..1) to distinguish them from their required counterparts. Please note, however, that data importers could potentially receive data containing instances of any and all classes described by the CIM RDF Schema.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE For general glossary definitions, see IEC 60059, *International Electrotechnical Vocabulary*.

IEC 61968-13, *Application integration at electric utilities – System interfaces for distribution management – Part 13: CIM RDF Model exchange format for distribution*

IEC 61970-301:2016, *Energy management system application program interface (EMS-API) – Part 301: Common information model (CIM) base*

IEC 61970-456, *Energy management system application program interface (EMS-API) – Part 456: Solved power system state profiles*

IEC 61970-501, *Energy management system application program interface (EMS-API) – Part 501: Common Information Model Resource Description Framework (CIM RDF) schema*

IEC 61970-552, *Energy management system application program interface (EMS-API) – Part 552: CIMXML Model exchange format*

Extensible Markup Language (XML) 1.0 (Second Edition), http://www.w3.org/TR/REC-xml

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

4 Overview of data requirements

4.1 Overview

An extensive discussion of the model exchange use cases can be found in 0. In all cases, the purposes of this document are:

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- To improve the accuracy of power system models used in critical systems, particularly the representation of parts of the network outside the primary domain of the system in question.
- To achieve consistency among the models used by the various systems that play a role in operating or planning the interconnection.
- To reduce the overall cost of maintaining critical models used in operating or planning an interconnection.

The classes, attributes, and associations identified in this document and specified in IEC 61970-456 represent the minimum subset of the full CIM model necessary to exchange sufficient power system data to support state estimation and power flow for HV(high voltage) and MV (medium voltage) networks. IEC 61968-13 describes the profiles used to exchange distribution MV/LV (low voltage) network models.

4.2 General requirements

The following requirements are general in nature or involve multiple classes. Additional requirements are defined in Subclauses 5.2.1 and 5.2.2 for the individual classes.

- The cardinality defined in the CIM model shall be followed, unless a different cardinality is explicitly defined in this document. For instance, the cardinality on the association between VoltageLevel and BaseVoltage indicates that a VoltageLevel shall be associated with one and only one BaseVoltage, but a BaseVoltage can be associated with zero to many VoltageLevels.
- Associations between classes referenced in this document and classes not referenced here are not required regardless of cardinality.
- The attribute “name” inherited by many classes from the abstract class IdentifiedObject is not required to be unique. The RDF ID defined in the data exchange format is the only unique and persistent identifier used for this data exchange. The attribute IdentifiedObject.name is, however, always required. The additional attribute of IdentifiedObject, aliasName, is not required.
- The IdentifiedObject.mRID attribute should be used as the RDF ID. The RDF ID can not begin with a number. An underscore should be added as the first character if necessary. The RDF ID shall be globally unique. A prefix may be added, if necessary, to ensure global uniqueness, but the RDF ID including the prefix shall be within the maximum character limit specified below.
- The maximum character length of names and identifiers are listed below.
  - rdf:ID – 60 characters maximum
  - IdentifiedObject.name – 32 characters maximum
  - IdentifiedObject.aliasname – 40 characters maximum
- To maintain a consistent naming hierarchy, each Substation shall be contained by a SubGeographicalRegion and each SubGeographicalRegion shall be contained by one and only one GeographicalRegion.
- Equipment defined without connectivity, because the associated Terminal(s) are not connected to ConnectivityNodes is allowed, for instance a ShuntCompensator whose Terminal is not associated to a ConnectivityNode.
- UTF-8 is the standard for file encoding. UTF-16 is not supported.
- Instance data to be exchanged shall make use of the most detailed class possible. The classes GeneratingUnit, Switch, and EnergyConsumer should only be used if the information to determine the more detailed class (ThermalGeneratingUnit, HydroGeneratingUnit, Breaker, Disconnector, etc.) is not available.
- All Equipment must be within a VoltageLevel except PowerTransformer, GeneratingUnit, HydroPump, Conductor, Switch and DCConductingEquipment. A PowerTransformer, GeneratingUnit or HydroPump should be contained in a substation; a Switch may be in a VoltageLevel or a Bay; and Conductor should be contained in a Line. For networks with HVDC

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the ACDCConverter will be in a DCConverterUnit and the associated PowerTransformer, Switches and SeriesCompensators will also be contained in a DCConverterUnit.

4.3 Transformer modeling

A two winding PowerTransformer has two PowerTransformerEnds. This gives the option to specify the impedance values for the equivalent pi-model completely at one end or split them between the two ends. The impedances shall be specified at the primary voltage side as shown in Figure 1.

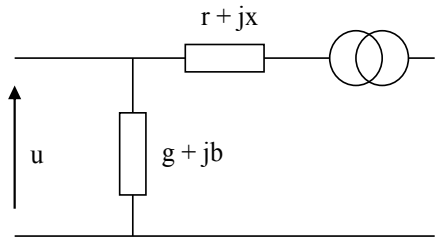

Figure 1 – Two winding transformer impedance

A three winding PowerTransformer has three PowerTransformerEnds. The equivalent pi-model corresponds to three ends connected in wye configuration as shown below. The impedance values for a three winding transformer are specified on each of the three TransformerWindings. Each of the ends has series impedances rn+jxn and shunt gn+jbn where n is: p for primary, s for secondary and t for tertiary as shown in Figure 2.

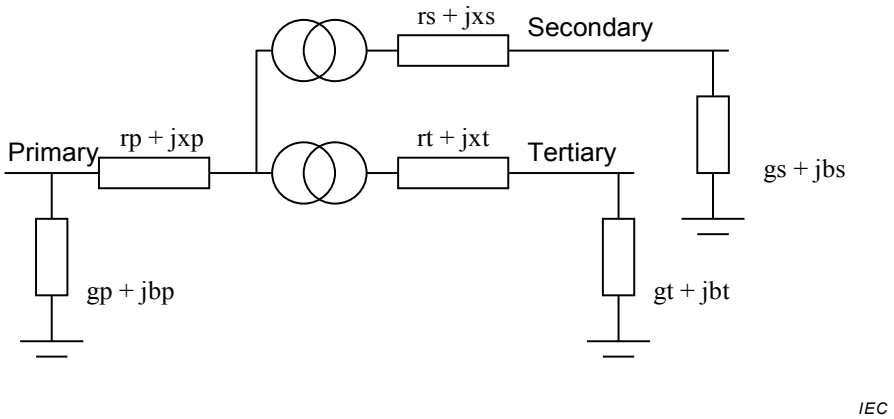

Figure 2 – Three winding transformer impedance

Additional requirements related to transformer modeling are listed below.

- Each PowerTransformer and its associated PowerTransformerEnds and tap changers (RatioTapChanger, PhaseTapChangerLinear, PhaseTapChangerSymetrical, and PhaseTapChangerAsymetrical) shall be contained within one substation. For the case of a transformer that connects two substations, however, the terminal of one of the PowerTransformerEnds can be connected to a ConnectivityNode defined in another substation. In this case, the PowerTransformer, the PowerTransformerEnds, the tap changers are still all defined in one substation.

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- A PowerTransformer shall be contained by a Substation. A PowerTransformerEnd shall be contained by a PowerTransformer. A RatioTapChanger, PhaseTapChangerLinear, PhaseTapChangerSymetrical, and PhaseTapChangerAsymetrical shall be contained by a PowerTransformerEnd.
- Each PowerTransformer shall have at least two and no more than three PowerTransformerEnds. Each PowerTransformerEnd can have at most one tap changer (RatioTapChanger, PhaseTapChangerLinear, PhaseTapChangerSymetrical, or PhaseTapChangerAsymetrical). If a PowerTransformerEnd does not have an associated tap changer, the end should be considered to have a fixed tap.

Multiple types of regulating transformers are supported by the CIM model. Depending on the regulation capabilities, the effects of tap movement will be defined using the RatioTapChanger class, PhaseTapChangerLinear class, PhaseTapChangerSymetrical class, or PhaseTapChangerAsymetrical class. Each of these classes are subtypes of the TapChanger class. The use of the various subtypes is explained in IEC 61970-301.

4.4 Modeling authorities

From the use cases for model exchange detailed in 0, it is clear that most situations involve multiple entities that shall cooperate. In these situations, it is very important to establish which entity has the authority for modeling each region or set of data objects. For this purpose we use the concepts of ModelingAuthority and ModelingAuthoritySet. ModelingAuthority and ModelingAuthoritySet are not defined as classes in the normative portion of the CIM. When multiple modeling entities are involved, each modeled object is assigned to a ModelingAuthoritySet. A ModelingAuthority can be responsible for one or more ModelingAuthoritySets. A more detailed description of the use ModelingAuthorities and ModelingAuthoritySets can be found in 0. When using the concept of ModelingAuthoritySets, a single file shall contain only data objects associated with a single ModelingAuthoritySet.

4.5 Use of measurement classes

4.5.1 General

Use of the CIM Measurement classes (Analog, Accumulator, and Discrete) is frequently misunderstood and has changed over time. Previously in addition to the use representing points in the system where telemetry is available, the classes had been used to associate Limits with a piece of Equipment and to define regulated points. Measurements are now only used to define where telemetry is available and to facilitate exchange of ICCP data.

A Measurement shall be associated with a PowerSystemResource to convey containment information for the Measurement. Transmission line measurements should be associated with an ACLineSegment, not with a Line. Transformer measurements should be associated with a PowerTransformer, not with a Transformer Winding. Voltage measurements should be associated with a piece of equipment, not with a VoltageLevel. A TapPosition measurement shall be associated with a tap changer (RatioTapChanger, PhaseTapChangerLinear, PhaseTapChangerSymetrical or PhaseTapChangerAsymetrical). A SwitchPosition measurement shall be associated with a Switch or a subtype of Switch.

The Measurement may also be associated with one of the Terminals associated with a piece of equipment. For measurements representing actual telemetered points, it is especially important that the association to a Terminal defines the specific topological point in the network that is measured. A Measurement can be associated with at most one Terminal. Each flow measurement (active power, reactive power, or current) shall be associated with a terminal. This association is particularly important for State Estimation.

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The measurement shall be associated with the correct terminal of the piece of conducting equipment that is being measured (SynchronousMachine, EnergyConsumer, ACLineSegment, PowerTransformer, etc.). Associating the measurement with a terminal of the wrong equipment or the terminal on the wrong end of the correct piece of equipment will cause problems for State Estimation. Only two types of measurement, TapPosition and SwitchPosition, do not require an association to a Terminal.

Three subtypes of Measurement are included in this profile, Analog, Accumulator, and Discrete. To describe what is being measured, the attribute Measurement.measurementType is used, but only particular measurementTypes are valid for each of the subtypes of Measurement. The valid associations are defined in Table 1.

Table 1 – Valid measurementTypes

Measurement Subclass	measurementType
Analog	ThreePhasePower
	ThreePhaseActivePower
	ThreePhaseReactivePower
	LineCurrent
	PhaseVoltage
	LineToLineVoltage
	Angle
	TapPosition
Accumulator	ApparentEnergy
	ReactiveEnergy
	ActiveEnergy
	SwitchPosition
Discrete	

4.5.2 ICCP data exchange

In the context of this data exchange profile, ICCP Data Exchange is only for the purpose of defining input measurements for use by State Estimator. It is not meant to be used to configure bidirectional ICCP exchange.

ICCP (known officially as IEC 60870-6 TASE.2) data is exchanged using the Measurement classes (Analog, Discrete, and Accumulator), the MeasurementValue classes (AnalogValue, DiscreteValue, and AccumulatorValue), and the MeasurementValueSource class. The MeasurementValueSource class is used to define the control center supplying the ICCP data. The MeasurementValueSource shall be associated with an instance of Name where the attribute Name.name holds the name of the supplying control center. The instance of NameType associated with the control center Name shall have the NameType.name attribute set to “ICCP Provider ID”.

The MeasurementValue classes are used to specify the ICCP ID. The MeasurementValue shall be associated with an instance of Name where the attribute Name.name holds the ICCP ID. The instance of NameType associated with the ICCP ID Name shall have the NameType.name attribute set to “ICCP ID”. The MeasurementValue.name attribute holds the SCADA point name. Each MeasurementValue will be associated with one Measurement.

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Each MeasurementValue being supplied via ICCP shall also have an association to a MeasurementValueSource.

To clearly specify the point in the system being measured, the Measurement should be associated with a Terminal. For a switch status measurement, however, the association to the appropriate PowerSystemResource representing the switch would be sufficient.

4.6 Voltage or active power regulation

To use CIM to define how a piece of equipment regulates a point in the system, an association is defined between the regulating conducting equipment (SynchronousMachine, LinearShuntCompensator, NonLinearShuntCompensator, StaticVarCompensator, RatioTapChanger, PhaseTapChangerLinear, PhaseTapChangerSymetrical, PhaseTapChangerAsymetrical, PhaseTapChangerTabular or ExternalNetworkInjection) and an instance of RegulatingControl or TapChangerControl. The RegulatingControl or TapChangerControl shall be associated with a Terminal. The control for a piece of regulating equipment can refer to a Terminal associated with another PowerSystemResource. For instance, for voltage regulation purposes the control for a SynchronousMachine could refer to a Terminal associated with a BusbarSection. The Terminal defines the point of regulation. The association between RegulatingControl or TapChangerControl and Terminal is required to define regulation of voltage or active power. For a piece of equipment that is not regulating, the association to RegulatingControl or TapChangerControl is not required.

4.7 Use of curves

4.7.1 General

The use of the Curve and CurveData attributes will differ for the different types of curves derived from Curve. To define a Y value that does not change, the curveStyle attribute should be set to “constantYValue”. In this case, only one instance of CurveData should be included defining the single point for the curve. Because the Y value is constant, the CurveData.xvalue value will be ignored, if it is supplied at all. A curve should never have multiple instances of CurveData where the xvalue value is repeated.

4.7.2 Generating unit reactive power limits

Generating unit reactive power limits shall be included in data exchange, but may be specified differently depending on the characteristics of the generating unit being represented. In most cases, a SynchronousMachine should be associated with a default ReactiveCapabilityCurve using the SynchronousMachine.InitialReactiveCapabilityCurve association.

If the reactive power limits of the generating unit do not vary with the real power output, the reactive power limit attributes on the SynchronousMachine class, minQ and maxQ, can be used. If the reactive power output of the generating unit is fixed, the reactive power limits should both be set to the fixed reactive output value.

4.8 Definition of schedules

The use of the RegularIntervalSchedule and RegularTimePoint attributes will differ for the different types of schedules derived from RegularIntervalSchedule. To specify a relative time for a schedule, the date portion of the dateTime format can be eliminated, which leaves the ISO 8601 time of day format “hh:mm:ss”. In this format, hh is the number of complete

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hours that have passed since midnight, mm is the number of complete minutes since the start of the hour, and ss is the number of complete seconds since the start of the minute.

The earliest allowed time used in a schedule (BasicIntervalSchedule.startTime) is “00:00:00”. The latest allowed time used in a schedule (RegularIntervalSchedule.endTime) is “24:00:00”. The point in time specified by the endTime is not included in the period of the schedule.

A schedule defining a day shall be defined with multiple RegularTimePoints associated with the same RegularIntervalSchedule. It shall not be defined with multiple schedules.

For schedules that are associated with Season and DayType, the associations to Season and DayType are not required. If a schedule does not have an associated Season, the schedule will be considered valid for all Seasons. Similarly, if a schedule does not have an association to a DayType, the schedule will be considered to apply to all days of the week.

When SeasonDayTypeSchedules are defined for a given entity, such as ConformLoadSchedules for a given ConformLoadGroup, only one schedule can be defined for a given combination of Season and DayType.

5 CIM Static Transmission Network Model Profiles

5.1 CIM Static Transmission Network Model Profiles General

This clause lists the profiles that will be used for data exchange and the classes, attributes, and associations that are a part of each profile. Included are all the classes that a data consumer would be expected to recognize in the data being consumed. Additional classes are referenced in this chapter, when the classes to be exchanged inherit attributes or associations. For instance, many classes inherit attributes from the class IdentifiedObject. However, no instances of the class IdentifiedObject would exist in the data exchanged, so IdentifiedObject has not been included in the set of CIM classes for exchange.

The CoreEquipment profile primarily specifies the physical characteristics of the network model equipment such as impedance and connectivity. The Operation profile specifies data pertaining to how the system is operated such as limits and voltage regulation. The ShortCircuit profile specifies additional electrical characteristics necessary to execute Short Circuit studies. The profiles and associated URIs are listed in Table 2.

Table 2 – Profiles defined in this document

Name	Version	URI	Revision date
CoreEquipment	3	http://iec.ch/TC57/61970-452/CoreEquipment/3	2015-09-30
Operation	3	http://iec.ch/TC57/61970-452/Operation/3	2015-09-30
ShortCircuit	3	http://iec.ch/TC57/61970-452/ShortCircuit/3	2015-09-30

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5.2 Core Equipment Profile

5.2.1 Concrete Classes

5.2.1.1 ACDCConverterDCTerminal

DC

A DC electrical connection point at the AC/DC converter. The AC/DC converter is electrically connected also to the AC side. The AC connection is inherited from the AC conducting equipment in the same way as any other AC equipment. The AC/DC converter DC terminal is separate from generic DC terminal to restrict the connection with the AC side to AC/DC converter and so that no other DC conducting equipment can be connected to the AC side.

Native Members

polarity	0..1	DCPolarityKind	Represents the normal network polarity condition.
DCConductingEquipment	1..1	ACDCConverter	A DC converter terminal belong to an DC converter.

Inherited Members

DCNode	1..1	DCNode	see DCBaseTerminal

sequenceNumber	1..1	integer	see ACDCTerminal
BusNameMarker	0..1	BusNameMarker	see ACDCTerminal

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.2 ACLineSegment

Wires

A wire or combination of wires, with consistent electrical characteristics, building a single electrical system, used to carry alternating current between points in the power system.

For symmetrical, transposed 3ph lines, it is sufficient to use attributes of the line segment, which describe impedances and admittances for the entire length of the segment. Additionally impedances can be computed by using length and associated per length impedances.

The BaseVoltage at the two ends of ACLineSegments in a Line shall have the same BaseVoltage.nominalVoltage. However, boundary lines may have slightly different BaseVoltage.nominalVoltages and variation is allowed. Larger voltage difference in general requires use of an equivalent branch.

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- Each ACLineSegment is required to have an association to a BaseVoltage. The association to Line is not required.
- Using the EquipmentContainer association, an ACLineSegment can only be contained by a Line, but the association to Line is not required.

Native Members

bch	1..1	Susceptance	Positive sequence shunt (charging) susceptance, uniformly distributed, of the entire line section. This value represents the full charging over the full length of the line.
gch	0..1	Conductance	Positive sequence shunt (charging) conductance, uniformly distributed, of the entire line section.
r	1..1	Resistance	Positive sequence series resistance of the entire line section.
x	1..1	Reactance	Positive sequence series reactance of the entire line section.

Inherited Members

length	0..1	Length	see Conductor

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.3 AsynchronousMachine

Wires

A rotating machine whose shaft rotates asynchronously with the electrical field. Also known as an induction machine with no external connection to the rotor windings, e.g squirrel-cage induction machine.

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Native Members

nominalFrequency	0..1	Frequency	Nameplate data indicates if the machine is 50 or 60 Hz.
nominalSpeed	0..1	RotationSpeed	Nameplate data. Depends on the slip and number of pole pairs.

Inherited Members

ratedPowerFactor	0..1	float	see RotatingMachine
ratedS	0..1	ApparentPower	see RotatingMachine
ratedU	0..1	Voltage	see RotatingMachine
GeneratingUnit	0..1	GeneratingUnit	see RotatingMachine

RegulatingControl	0..1	RegulatingControl	see RegulatingCondEq

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.4 BaseVoltage

Core

Defines a system base voltage which is referenced.

Native Members

nominalVoltage	1..1	Voltage	The power system resource's base voltage.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

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5.2.1.5 Bay

Core

A collection of power system resources (within a given substation) including conducting equipment, protection relays, measurements, and telemetry. A bay typically represents a physical grouping related to modularization of equipment.

The Bay class is used as a container for Switches. Switches can either be contained by Bays or by VoltageLevels. If Switches are contained by VoltageLevels rather than by Bays in the sending system, then Bays are not required.

Native Members

VoltageLevel	1..1	VoltageLevel	The voltage level containing this bay.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.6 Breaker

Wires

A mechanical switching device capable of making, carrying, and breaking currents under normal circuit conditions and also making, carrying for a specified time, and breaking currents under specified abnormal circuit conditions e.g. those of short circuit.

Inherited Members

normalOpen	1..1	boolean	see Switch
ratedCurrent	0..1	CurrentFlow	see Switch
retained	1..1	boolean	see Switch

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

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5.2.1.7 BusbarSection

Wires

A conductor, or group of conductors, with negligible impedance, that serve to connect other conducting equipment within a single substation.

Voltage measurements are typically obtained from VoltageTransformers that are connected to busbar sections. A bus bar section may have many physical terminals but for analysis is modelled with exactly one logical terminal.

Inherited Members

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.8 BusNameMarker

Topology

Used to apply user standard names to topology buses. Typically used for "bus/branch" case generation. Associated with one or more terminals that are normally connected with the bus name. The associated terminals are normally connected by non-retained switches. For a ring bus station configuration, all busbar terminals in the ring are typically associated. For a breaker and a half scheme, both busbars would normally be associated. For a ring bus, all busbars would normally be associated. For a "straight" busbar configuration, normally only the main terminal at the busbar would be associated.

Native Members

priority	0..1	integer	Priority of bus name marker for use as topology bus name. Use 0 for don t care. Use 1 for highest priority. Use 2 as priority is less than 1 and so on.
ReportingGroup	0..1	ReportingGroup	The reporting group to which this bus name marker belongs.

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Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.9 ConformLoad

LoadModel

ConformLoad represent loads that follow a daily load change pattern where the pattern can be used to scale the load with a system load.

- The definition of the real and reactive power injections for an EnergyConsumer can be done using different sets of attributes. In the simplest case, the injections can be defined directly using only the attributes pfixed and qfixed.
- The injections for a ConformLoad can be defined as a percentage of the ConformLoadGroup with the attributes pfixedPct and qfixedPct. In this case, the associated ConformLoadGroup would have to have an associated ConformLoadSchedule.
- See EnergyConsumer for specific notes about inherited attributes.

Native Members

LoadGroup	1..1	ConformLoadGroup	Group of this ConformLoad.

Inherited Members

pfixed	0..1	ActivePower	see EnergyConsumer
pfixedPct	0..1	PerCent	see EnergyConsumer
qfixed	0..1	ReactivePower	see EnergyConsumer
qfixedPct	0..1	PerCent	see EnergyConsumer
LoadResponse	0..1	LoadResponseCharacteristic	see EnergyConsumer

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

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5.2.1.10 ConnectivityNode

Core

Connectivity nodes are points where terminals of AC conducting equipment are connected together with zero impedance.

By convention, ConnectivityNodes may only be placed within VoltageLevels or Lines.

Native Members

ConnectivityNodeContainer	1..1	ConnectivityNodeContainer	Container of this connectivity node.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.11 CsConverter

DC

DC side of the current source converter (CSC).

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Native Members

maxAlpha	0..1	AngleDegrees	Maximum firing angle. CSC configuration data used in power flow.
maxGamma	0..1	AngleDegrees	Maximum extinction angle. CSC configuration data used in power flow.
maxIdc	0..1	CurrentFlow	The maximum direct current (Id) on the DC side at which the converter should operate. Converter configuration data use in power flow.
minAlpha	0..1	AngleDegrees	Minimum firing angle. CSC configuration data used in power flow.
minGamma	0..1	AngleDegrees	Minimum extinction angle. CSC configuration data used in power flow.
minIdc	0..1	CurrentFlow	The minimum direct current (Id) on the DC side at which the converter should operate. CSC configuration data used in power flow.
ratedIdc	0..1	CurrentFlow	Rated converter DC current, also called IdN. Converter configuration data used in power flow.

Inherited Members

baseS	0..1	ApparentPower	see ACDCConverter
idleLoss	0..1	ActivePower	see ACDCConverter
maxUdc	0..1	Voltage	see ACDCConverter
minUdc	0..1	Voltage	see ACDCConverter
numberOfValves	0..1	integer	see ACDCConverter
ratedUdc	0..1	Voltage	see ACDCConverter
resistiveLoss	0..1	Resistance	see ACDCConverter
switchingLoss	0..1	ActivePowerPerCurrentFlow	see ACDCConverter
valveU0	0..1	Voltage	see ACDCConverter
PccTerminal	0..1	Terminal	see ACDCConverter

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

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mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.12 CurveData

Core

Multi-purpose data points for defining a curve. The use of this generic class is discouraged if a more specific class can be used to specify the x and y axis values along with their specific data types.

Native Members

xvalue	1..1	float	The data value of the X-axis variable, depending on the X-axis units.
y1value	1..1	float	The data value of the first Y-axis variable, depending on the Y-axis units.
y2value	0..1	float	The data value of the second Y-axis variable (if present), depending on the Y-axis units.
Curve	1..1	Curve	The curve of this curve data point.

5.2.1.13 DCBreaker

DC

A breaker within a DC system.

Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.14 DCBusbar

DC

A busbar within a DC system.

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Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.15 DCChopper

DC

Low resistance equipment used in the internal DC circuit to balance voltages. It has typically positive and negative pole terminals and a ground.

Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.16 DCConverterUnit

DC

Indivisible operative unit comprising all equipment between the point of common coupling on the AC side and the point of common coupling â€“ DC side, essentially one or more converters, together with one or more converter transformers, converter control equipment, essential protective and switching devices and auxiliaries, if any, used for conversion.

Native Members

operationMode	1..1		DCConverterOperatingModeKind
Substation	0..1	Substation	The containing substation of the DC converter unit.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

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5.2.1.17 DCDisconnector

DC

A disconnector within a DC system.

Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.18 DCGround

DC

A ground within a DC system.

Native Members

inductance	0..1	Inductance	Inductance to ground.
r	0..1	Resistance	Resistance to ground.

Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.19 DCLine

DC

Overhead lines and/or cables connecting two or more HVDC substations.

Native Members

Region	0..1	SubGeographicalRegion	The SubGeographicalRegion containing the DC line.

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Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.20 DCLineSegment

DC

A wire or combination of wires not insulated from one another, with consistent electrical characteristics, used to carry direct current between points in the DC region of the power system.

Native Members

capacitance	0..1	Capacitance	Capacitance of the DC line segment. Significant for cables only.
inductance	0..1	Inductance	Inductance of the DC line segment. Neglectable compared with DCSeriesDevice used for smoothing.
length	0..1	Length	Segment length for calculating line section capabilities.
resistance	0..1	Resistance	Resistance of the DC line segment.
PerLengthParameter	0..1	PerLengthDCLineParameter	Set of per-length parameters for this line segment.

Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.21 DCNode

DC

DC nodes are points where terminals of DC conducting equipment are connected together with zero impedance.

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Native Members

DCEquipmentContainer	1..1	DCEquipmentContainer	The DC container for the DC nodes.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.22 DCSeriesDevice

DC

A series device within the DC system, typically a reactor used for filtering or smoothing. Needed for transient and short circuit studies.

Native Members

inductance	1..1	Inductance	Inductance of the device.
ratedUdc	1..1	Voltage	Rated DC device voltage. Converter configuration data used in power flow.
resistance	1..1	Resistance	Resistance of the DC device.

Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.23 DCShunt

DC

A shunt device within the DC system, typically used for filtering. Needed for transient and short circuit studies.

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Native Members

capacitance	1..1	Capacitance	Capacitance of the DC shunt.
ratedUdc	1..1	Voltage	Rated DC device voltage. Converter configuration data used in power flow.
resistance	1..1	Resistance	Resistance of the DC device.

Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.24 DCSwitch

DC

A switch within the DC system.

Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.25 DCTerminal

DC

An electrical connection point to generic DC conducting equipment.

Native Members

DCConductingEquipment	1..1	DCConductingEquipment	An DC terminal belong to a DC conducting equipment.

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Inherited Members

DCNode	1..1	DCNode	see DCBaseTerminal

sequenceNumber	1..1	integer	see ACDCTerminal
BusNameMarker	0..1	BusNameMarker	see ACDCTerminal

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.26 Disconnector

Wires

A manually operated or motor operated mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a source of power. It is required to open or close circuits when negligible current is broken or made.

Inherited Members

normalOpen	1..1	boolean	see Switch
ratedCurrent	0..1	CurrentFlow	see Switch
retained	1..1	boolean	see Switch

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.27 EnergyConsumer

Wires

Generic user of energy – a point of consumption on the power system model.

The definition of the real and reactive power injections for an EnergyConsumer can be done using different sets of attributes. In the simplest case, the injections can be defined directly using only the attributes pfixed and qfixed.

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To specify conforming and nonconforming loads, the classes ConformLoad, NonConformLoad, or their subtypes should be used.

The attributes defining the affect of voltage and frequency on the injection defined by an associated LoadResponseCharacteristic should be supplied, if they are available, but are not required.

Native Members

pfixed	0..1	ActivePower	Active power of the load that is a fixed quantity. Load sign convention is used, i.e. positive sign means flow out from a node.
pfixedPct	0..1	PerCent	Fixed active power as per cent of load group fixed active power. Load sign convention is used, i.e. positive sign means flow out from a node.
qfixed	0..1	ReactivePower	Reactive power of the load that is a fixed quantity. Load sign convention is used, i.e. positive sign means flow out from a node.
qfixedPct	0..1	PerCent	Fixed reactive power as per cent of load group fixed reactive power. Load sign convention is used, i.e. positive sign means flow out from a node.
LoadResponse	0..1	LoadResponseCharacteristic	The load response characteristic of this load. If missing, this load is assumed to be constant power.

Inherited Members

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

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5.2.1.28 EnergySource

Wires

A generic equivalent for an energy supplier on a transmission or distribution voltage level.

Inherited Members

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.29 EquivalentBranch

Equivalents

The class represents equivalent branches.

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Native Members

r	1..1	Resistance	Positive sequence series resistance of the reduced branch.
r21	0..1	Resistance	Resistance from terminal sequence 2 to terminal sequence 1 .Used for steady state power flow. This attribute is optional and represent unbalanced network such as off-nominal phase shifter. If only EquivalentBranch.r is given, then EquivalentBranch.r21 is assumed equal to EquivalentBranch.r.Usage rule: EquivalentBranch is a result of network reduction prior to the data exchange.
x	1..1	Reactance	Positive sequence series reactance of the reduced branch.
x21	0..1	Reactance	Reactance from terminal sequence 2 to terminal sequence 1 .Used for steady state power flow. This attribute is optional and represent unbalanced network such as off-nominal phase shifter. If only EquivalentBranch.x is given, then EquivalentBranch.x21 is assumed equal to EquivalentBranch.x.Usage rule: EquivalentBranch is a result of network reduction prior to the data exchange.

Inherited Members

EquivalentNetwork	0..1	EquivalentNetwork	see EquivalentEquipment

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

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5.2.1.30 EquivalentInjection

Equivalents

This class represents equivalent injections (generation or load). Voltage regulation is allowed only at the point of connection.

Native Members

maxP	0..1	ActivePower	Maximum active power of the injection.
maxQ	0..1	ReactivePower	Used for modeling of infeed for load flow exchange. Not used for short circuit modeling. If maxQ and minQ are not used ReactiveCapabilityCurve can be used.
minP	0..1	ActivePower	Minimum active power of the injection.
minQ	0..1	ReactivePower	Used for modeling of infeed for load flow exchange. Not used for short circuit modeling. If maxQ and minQ are not used ReactiveCapabilityCurve can be used.
regulationCapability	1..1	boolean	Specifies whether or not the EquivalentInjection has the capability to regulate the local voltage.
ReactiveCapabilityCurve	0..1	ReactiveCapabilityCurve	The reactive capability curve used by this equivalent injection.

Inherited Members

EquivalentNetwork	0..1	EquivalentNetwork	see EquivalentEquipment

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

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5.2.1.31 EquivalentNetwork

Equivalents

A class that represents an external meshed network that has been reduced to an electrically equivalent model. The ConnectivityNodes contained in the equivalent are intended to reflect internal nodes of the equivalent. The boundary Connectivity nodes where the equivalent connects outside itself are NOT contained by the equivalent.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.32 EquivalentShunt

Equivalents

The class represents equivalent shunts.

Native Members

b	1..1	Susceptance	Positive sequence shunt susceptance.
g	1..1	Conductance	Positive sequence shunt conductance.

Inherited Members

EquivalentNetwork	0..1	EquivalentNetwork	see EquivalentEquipment

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.33 ExternalNetworkInjection

Wires

This class represents external network and it is used for IEC 60909 calculations.

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Native Members

governorSCD	1..1	ActivePowerPerFrequency	Power Frequency Bias. This is the change in power injection divided by the change in frequency and negated. A positive value of the power frequency bias provides additional power injection upon a drop in frequency.
maxP	1..1	ActivePower	Maximum active power of the injection.
maxQ	1..1	ReactivePower	Not for short circuit modelling; It is used for modelling of infeed for load flow exchange. If maxQ and minQ are not used ReactiveCapabilityCurve can be used
minP	1..1	ActivePower	Minimum active power of the injection.
minQ	1..1	ReactivePower	Not for short circuit modelling; It is used for modelling of infeed for load flow exchange. If maxQ and minQ are not used ReactiveCapabilityCurve can be used

Inherited Members

RegulatingControl	0..1	RegulatingControl	see RegulatingCondEq

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.34 FossilFuel

Production

The fossil fuel consumed by the non-nuclear thermal generating unit. For example, coal, oil, gas, etc. This a the specific fuels that the generating unit can consume.

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Native Members

fossilFuelType	1..1	FuelType	The type of fossil fuel, such as coal, oil, or gas.
ThermalGeneratingUnit	1..1	ThermalGeneratingUnit	A thermal generating unit may have one or more fossil fuels.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.35 GeneratingUnit

Production

A single or set of synchronous machines for converting mechanical power into alternating-current power. For example, individual machines within a set may be defined for scheduling purposes while a single control signal is derived for the set. In this case there would be a GeneratingUnit for each member of the set and an additional GeneratingUnit corresponding to the set.

To define a GeneratingUnit requires defining the initial real power injection, net real power limits, and the status of the unit. The initial injection is defined using the attribute initialP.

The net real power limits can be defined in three ways; 1) with the attributes maxOperatingP and minOperatingP, or 2) with the attribute ratedNetMaxP or 3) with the attributes ratedGrossMinP and ratedGrossMaxP used in conjunction with an associated GrossToNetActivePowerCurve.

The control status of the unit is defined with the attribute genControlSource, but it is not required. The participation factor attributes longPF, normalPF, and shortPF are not required.

The GeneratingUnit class should only be used in cases where the more specific classes, HydroGeneratingUnit and ThermalGeneratingUnit, do not apply.

The attributes governorSCD, maximumAllowableSpinningReserve, nominalP, startupCost, and variableCost are not required.

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Native Members

genControlSource	0..1	GeneratorControlSource	The source of controls for a generating unit.
governorSCD	0..1	PerCent	Governor Speed Changer Droop. This is the change in generator power output divided by the change in frequency normalized by the nominal power of the generator and the nominal frequency and expressed in percent and negated. A positive value of speed change droop provides additional generator output upon a drop in frequency.
initialP	1..1	ActivePower	Default initial active power which is used to store a powerflow result for the initial active power for this unit in this network configuration.
longPF	0..1	float	Generating unit long term economic participation factor.
maximumAllowableSpinningReserve	0..1	ActivePower	Maximum allowable spinning reserve. Spinning reserve will never be considered greater than this value regardless of the current operating point.
maxOperatingP	1..1	ActivePower	This is the maximum operating active power limit the dispatcher can enter for this unit.
minOperatingP	1..1	ActivePower	This is the minimum operating active power limit the dispatcher can enter for this unit.
nominalP	0..1	ActivePower	The nominal power of the generating unit. Used to give precise meaning to percentage based attributes such as the governor speed change droop (governorSCD attribute).The attribute shall be a positive value equal or less than RotatingMachine.ratedS.
normalPF	0..1	float	Generating unit economic participation factor.
ratedGrossMaxP	0..1	ActivePower	The unit's gross rated maximum capacity (book value).
ratedGrossMinP	0..1	ActivePower	The gross rated minimum generation level which the unit can safely operate at while delivering power to the transmission grid.

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ratedNetMaxP	0..1	ActivePower	The net rated maximum capacity determined by subtracting the auxiliary power used to operate the internal plant machinery from the rated gross maximum capacity.
shortPF	0..1	float	Generating unit short term economic participation factor.
startupCost	0..1	Money	The initial startup cost incurred for each start of the GeneratingUnit.
totalEfficiency	0..1	PerCent	The efficiency of the unit in converting the fuel into electrical energy.
variableCost	0..1	Money	The variable cost component of production per unit of ActivePower.

Inherited Members

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.36 GeographicalRegion

Core

A geographical region of a power system network model.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.37 HydroGeneratingUnit

Production

A generating unit whose prime mover is a hydraulic turbine (e.g., Francis, Pelton, Kaplan).

The attributes governorSCD, maximumAllowableSpinningReserve, nominalP, startupCost, and variableCost are not required.

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Native Members

energyConversionCapability	0..1	HydroEnergyConversionKind	Energy conversion capability for generating.
HydroPowerPlant	0..1	HydroPowerPlant	The hydro generating unit belongs to a hydro power plant.

Inherited Members

genControlSource	0..1	GeneratorControlSource	see GeneratingUnit
governorSCD	0..1	PerCent	see GeneratingUnit
initialP	1..1	ActivePower	see GeneratingUnit
longPF	0..1	Float	see GeneratingUnit
maximumAllowableSpinningReserve	0..1	ActivePower	see GeneratingUnit
maxOperatingP	1..1	ActivePower	see GeneratingUnit
minOperatingP	1..1	ActivePower	see GeneratingUnit
nominalP	0..1	ActivePower	see GeneratingUnit
normalPF	0..1	Float	see GeneratingUnit
ratedGrossMaxP	0..1	ActivePower	see GeneratingUnit
ratedGrossMinP	0..1	ActivePower	see GeneratingUnit
ratedNetMaxP	0..1	ActivePower	see GeneratingUnit
shortPF	0..1	float	see GeneratingUnit
startupCost	0..1	Money	see GeneratingUnit
totalEfficiency	0..1	PerCent	see GeneratingUnit
variableCost	0..1	Money	see GeneratingUnit

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.38 HydroPowerPlant

Production

A hydro power station which can generate or pump. When generating, the generator turbines receive water from an upper reservoir. When pumping, the pumps receive their water from a lower reservoir.

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Native Members

hydroPlantStorageType	1..1	HydroPlantStorageKind	The type of hydro power plant water storage.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.39 HydroPump

Production

A synchronous motor-driven pump, typically associated with a pumped storage plant.

Native Members

HydroPowerPlant	0..1	HydroPowerPlant	The hydro pump may be a member of a pumped storage plant or a pump for distributing water.
RotatingMachine	1..1	RotatingMachine	The synchronous machine drives the turbine which moves the water from a low elevation to a higher elevation. The direction of machine rotation for pumping may or may not be the same as for generating.

Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.40 IEC61970CIMVersion

This is the IEC 61970 CIM version number assigned to this UML model.

The two IEC61970CIMVersion attributes should be assigned the values defined as the initial values in the CIM UML. Currently the initial value for version is IEC61970CIM16v33. The current initial value for date is 2016-03-09.

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Native Members

date	1..1	date	Form is YYYY-MM-DD for example for January 5, 2009 it is 2009-01-05.
version	1..1	string	Form is IEC61970CIMXXvYY where XX is the major CIM package version and the YY is the minor version. For example IEC61970CIM13v18.

5.2.1.41 Junction

Wires

A point where one or more conducting equipments are connected with zero resistance.

Inherited Members

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.42 Line

Wires

Contains equipment beyond a substation belonging to a power transmission line.

Use of the Line class is not required. If used, it can only be used as a container for ACLineSegments and SeriesCompensators.

A Line is not required to be associated with a SubGeographicalRegion.

Native Members

Region	0..1	SubGeographicalRegion	The sub-geographical region of the line.

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Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.43 LinearShuntCompensator

Wires

A linear shunt compensator has banks or sections with equal admittance values.

Native Members

bPerSection	1..1	Susceptance	Positive sequence shunt (charging) susceptance per section
gPerSection	1..1	Conductance	Positive sequence shunt (charging) conductance per section

Inherited Members

aVRDelay	0..1	Seconds	see ShuntCompensator
grounded	0..1	boolean	see ShuntCompensator
maximumSections	1..1	integer	see ShuntCompensator
nomU	1..1	Voltage	see ShuntCompensator
normalSections	1..1	integer	see ShuntCompensator
voltageSensitivity	0..1	VoltagePerReactivePower	see ShuntCompensator

RegulatingControl	0..1	RegulatingControl	see RegulatingCondEq

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

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5.2.1.44 LoadBreakSwitch

Wires

A mechanical switching device capable of making, carrying, and breaking currents under normal operating conditions.

Inherited Members

normalOpen	1..1	boolean	see Switch
ratedCurrent	0..1	CurrentFlow	see Switch
retained	1..1	boolean	see Switch

BaseVoltage	0..1	BaseVoltage	see ConductingEquipment

aggregate	0..1	boolean	see Equipment
EquipmentContainer	0..1	EquipmentContainer	see Equipment

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.45 LoadResponseCharacteristic

LoadModel

Models the characteristic response of the load demand due to changes in system conditions such as voltage and frequency. This is not related to demand response.

If LoadResponseCharacteristic.exponentModel is True, the voltage exponents are specified and used as to calculate:

Active power component = Pnominal * (Voltage/cim:BaseVoltage.nominalVoltage) ** cim:LoadResponseCharacteristic.pVoltageExponent

Reactive power component = Qnominal * (Voltage/cim:BaseVoltage.nominalVoltage)** cim:LoadResponseCharacteristic.qVoltageExponent

Where * means "multiply" and ** is "raised to power of".

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Native Members

exponentModel	1..1	boolean	Indicates the exponential voltage dependency model is to be used. If false, the coefficient model is to be used.The exponential voltage dependency model consist of the attributes-pVoltageExponent-qVoltageExponent.The coefficient model consist of the attributes-pConstantImpedance-pConstantCurrent-pConstantPower-qConstantImpedance-qConstantCurrent-qConstantPower.The sum of pConstantImpedance, pConstantCurrent and pConstantPower shall equal 1.The sum of qConstantImpedance, qConstantCurrent and qConstantPower shall equal 1.
pConstantCurrent	0..1	float	Portion of active power load modeled as constant current.
pConstantImpedance	0..1	float	Portion of active power load modeled as constant impedance.
pConstantPower	0..1	float	Portion of active power load modeled as constant power.
pFrequencyExponent	0..1	float	Exponent of per unit frequency effecting active power.
pVoltageExponent	0..1	float	Exponent of per unit voltage effecting real power.
qConstantCurrent	0..1	float	Portion of reactive power load modeled as constant current.
qConstantImpedance	0..1	float	Portion of reactive power load modeled as constant impedance.
qConstantPower	0..1	float	Portion of reactive power load modeled as constant power.
qFrequencyExponent	0..1	float	Exponent of per unit frequency effecting reactive power.
qVoltageExponent	0..1	float	Exponent of per unit voltage effecting reactive power.

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Inherited Members

mRID	0..1	string	see IdentifiedObject
description	0..1	string	see IdentifiedObject
name	1..1	string	see IdentifiedObject

5.2.1.46 Name

Core

The Name class provides the means to define any number of human readable names for an object. A name is not to be used for defining inter-object relationships. For inter-object relationships instead use the object identification 'mRID'.

Native Members

name	1..1	string	Any free text that name the object.
IdentifiedObject	1..1	IdentifiedObject	Identified object that this name designates.
NameType	1..1	NameType	Type of this name.

5.2.1.47 NameType

Core

Type of name. Possible values for attribute 'name' are implementation dependent but standard profiles may specify types. An enterprise may have multiple IT systems each having its own local name for the same object, e.g. a planning system may have different names from an EMS. An object may also have different names within the same IT system, e.g. localName as defined in CIM version 14. The definition from CIM14 is:

The localName is a human readable name of the object. It is a free text name local to a node in a naming hierarchy similar to a file directory structure. A power system related naming hierarchy may be: Substation, VoltageLevel, Equipment etc. Children of the same parent in such a hierarchy have names that typically are unique among them.

Native Members

name	1..1	string	Name of the name type.

5.2.1.48 NonConformLoad

LoadModel

NonConformLoad represent loads that do not follow a daily load change pattern and changes are not correlated with the daily load change pattern.

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