**ภาคผวก A10  
โปรไฟล์เพื่อการเชื่อมโยงข้อมูล DTMS\_OMS**

การพัฒนาเชื่อมโยงข้อมูลระหว่างซอฟต์แวร์จำเป็นต้องมีข้อกำหนดกลางเพื่อการเชื่อมโยงข้อมูล มาตรฐาน ไออีซี ซิม หรือ IEC CIM (Common Information Model) เป็นมาตรฐานสากลเพื่อการเชื่อมโยงข้อมูลเกี่ยวกับ การจำหน่ายกระแสไฟฟ้าและการบริหารไฟฟ้าขัดข้อง ที่สำคัญได้แก่ IEC-61970 และ IEC-61968 มาตรฐานสากลดังกล่าวจัดทำขึ้นเพื่อใช้เป็นข้อกำหนดกลางในการรับส่งข้อมูลระหว่างซอฟต์แวร์ที่แตกต่างกัน เพื่อลดเวลา ลดค่าใช้จ่าย และเพิ่มประสิทธิภาพในการพัฒนาเชื่อมโยงข้อมูลระหว่างกัน ปัจจุบันผลิตภัณฑ์ซอฟต์แวร์ที่พัฒนาขึ้นเพื่อสนับสนุนการปฏิบัติระบบไฟฟ้าและบริหารไฟฟ้าขัดข้อง มักมีความสามารถในการเชื่อมโยงข้อมูลตามมาตรฐานนี้

โปรไฟล์เพื่อการเชื่อมโยงข้อมูล (CIM Profile) คือ ข้อกำหนดขอบเขตและคุณลักษณะเฉพาะของข้อมูลภายใต้บริบทหนึ่ง ประกอบด้วย ชื่อข้อมูล ความหมายและรูปแบบข้อมูล เพื่อใช้ในการพัฒนาระบบเชื่อมโยงข้อมูลภายใต้วัตถุประสงค์หนึ่ง ตัวอย่างโปรไฟล์มาตรฐาน ได้แก่ IEC-61970-452, IEC-61970-453, IEC-61970-456 องค์กรสามารถกำหนดโปรไฟล์ที่เหมาะสมกับบริบทของตนได้ โดยการกำหนดรายการข้อมูลเฉพาะส่วนที่จำเป็นสำหรับการเชื่อมโยงข้อมูลภายใต้บริบทนั้น มักมีขนาดเล็กและง่ายต่อการพัฒนา โปรไฟล์การเชื่อมโยงข้อมูลนี้จัดทำขึ้นตามมาตรฐานสากล IEC-61970-501 จัดทำขึ้นโดยใช้ซอฟต์แวร์เครื่องมือเพื่อใช้สร้างโปรไฟล์ อาทิ เช่น CIMtool เป็นต้น

เอกสารนี้อธิบายโปรไฟล์เพื่อการเชื่อมโยง ระบบ DTMS ชื่อว่า DTMS\_OMS หรือเนมสเปส ชื่อเต็มว่า

CIM profile: [http://pea.co.th/cim/profile/DTMS\_OMS#](http://pea.co.th/cim/profile/DTMS_OMS)

ประกอบด้วย เอกสารดังนี้

1. เอกสารอธิบายโปรไฟล์ : DTMS\_OMS.rtf, DTMS\_OMS.html
2. แฟ้มเอกสารอิเล็กทรอนิกส์ ข้อกำหนดโปรไฟล์ : DTMS\_OMS.owl
3. แฟ้มเอกสารอิเล็กทรอนิกส์ IEC-61970-501 : DTMS\_OMS.legacy-rdfs
4. แฟ้มเอกสารอิเล็กทรอนิกส์ IEC-61968-100 : DTMS\_OMS.part100-ed2.xsd

ผู้รับจ้างต้องดำเนินการศึกษา ทบทวนและสอบทาน ข้อกำหนดโปรไฟลน์นี้ กับผู้ที่เกี่ยวข้องกับซอฟต์แวร์ที่จะเชื่อมโยงนั้น ปรับข้อกำหนดโปรไฟล์ให้สอดคล้องกับความต้องการของผู้เกี่ยวข้องและเสนอขอรับความเห็นชอบก่อนการดำเนินการ

**DTMS\_OMS\_Profile Profile**

Profile namespace: http://pea.co.th/cim/profile/DTMS\_OMS#

**Concrete Classes**

**ActivityRecord**

Records activity for an entity at a point in time; activity may be for an event that has already occurred or for a planned activity.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| createdDateTime | 1..1 | dateTime | Date and time this activity record has been created (different from the 'status.dateTime', which is the time of a status change of the associated object, if applicable). |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |
| reason | 1..1 | string | Reason for event resulting in this activity record, typically supplied when user initiated. |
| severity | 1..1 | string | Severity level of event resulting in this activity record. |
| type | 1..1 | string | Type of event resulting in this activity record. |

**Outage**

Document describing details of an active or planned outage in a part of the electrical network.

A non-planned outage may be created upon:

- a breaker trip,

- a fault indicator status change,

- a meter event indicating customer outage,

- a reception of one or more customer trouble calls, or

- an operator command, reflecting information obtained from the field crew.

Outage restoration may be performed using a switching plan which complements the outage information with detailed switching activities, including the relationship to the crew and work.

A planned outage may be created upon:

- a request for service, maintenance or construction work in the field, or

- an operator-defined outage for what-if/contingency network analysis.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| comment | 1..1 | string | Free text comment. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| subject | 1..1 | string | Document subject. |
| title | 1..1 | string | Document title. |
| type | 1..1 | string | Utility-specific classification of this document, according to its corporate standards, practices, and existing IT systems (e.g., for management of assets, maintenance, work, outage, customers, etc.). |

**PowerTransformer**

An electrical device consisting of two or more coupled windings, with or without a magnetic core, for introducing mutual coupling between electric circuits. Transformers can be used to control voltage and phase shift (active power flow).

A power transformer may be composed of separate transformer tanks that need not be identical.

A power transformer can be modelled with or without tanks and is intended for use in both balanced and unbalanced representations. A power transformer typically has two terminals, but may have one (grounding), three or more terminals.

The inherited association ConductingEquipment.BaseVoltage should not be used. The association from TransformerEnd to BaseVoltage should be used instead.

**Native Members**

| **name** | **mult** | **type** | **description** |
| --- | --- | --- | --- |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| aliasName | 1..1 | string | The aliasName is free text human readable name of the object alternative to IdentifiedObject.name. It may be non unique and may not correlate to a naming hierarchy.The attribute aliasName is retained because of backwards compatibility between CIM relases. It is however recommended to replace aliasName with the Name class as aliasName is planned for retirement at a future time. |
| beforeShCircuitHighestOperatingCurrent | 1..1 | [CurrentFlow](#CurrentFlow) | The highest operating current (Ib in IEC 60909-0) before short circuit (depends on network configuration and relevant reliability philosophy). It is used for calculation of the impedance correction factor KT defined in IEC 60909-0. |
| beforeShCircuitHighestOperatingVoltage | 1..1 | [Voltage](#Voltage) | The highest operating voltage (Ub in IEC 60909-0) before short circuit. It is used for calculation of the impedance correction factor KT defined in IEC 60909-0. This is worst case voltage on the low side winding (3.7.1 of IEC 60909:2001). Used to define operating conditions. |
| beforeShortCircuitAnglePf | 1..1 | [AngleDegrees](#AngleDegrees) | The angle of power factor before short circuit (phib in IEC 60909-0). It is used for calculation of the impedance correction factor KT defined in IEC 60909-0. This is the worst case power factor. Used to define operating conditions. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| highSideMinOperatingU | 1..1 | [Voltage](#Voltage) | The minimum operating voltage (uQmin in IEC 60909-0) at the high voltage side (Q side) of the unit transformer of the power station unit. A value well established from long-term operating experience of the system. It is used for calculation of the impedance correction factor KG defined in IEC 60909-0. |
| isPartOfGeneratorUnit | 1..1 | boolean | Indicates whether the machine is part of a power station unit. Used for short circuit data exchange according to IEC 60909. It has an impact on how the correction factors are calculated for transformers, since the transformer is not necessarily part of a synchronous machine and generating unit. It is not always possible to derive this information from the model. This is why the attribute is necessary. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |
| operationalValuesConsidered | 1..1 | boolean | It is used to define if the data (other attributes related to short circuit data exchange) defines long term operational conditions or not. Used for short circuit data exchange according to IEC 60909. |
| vectorGroup | 1..1 | string | Vector group of the transformer for protective relaying, e.g., Dyn1. For unbalanced transformers, this may not be simply determined from the constituent winding connections and phase angle displacements.The vectorGroup string consists of the following components in the order listed: high voltage winding connection, mid voltage winding connection (for three winding transformers), phase displacement clock number from 0 to 11, low voltage winding connectionphase displacement clock number from 0 to 11. The winding connections are D (delta), Y (wye), YN (wye with neutral), Z (zigzag), ZN (zigzag with neutral), A (auto transformer). Upper case means the high voltage, lower case mid or low. The high voltage winding always has clock position 0 and is not included in the vector group string. Some examples: YNy0 (two winding wye to wye with no phase displacement), YNd11 (two winding wye to delta with 330 degrees phase displacement), YNyn0d5 (three winding transformer wye with neutral high voltage, wye with neutral mid voltage and no phase displacement, delta low voltage with 150 degrees displacement).Phase displacement is defined as the angular difference between the phasors representing the voltages between the neutral point (real or imaginary) and the corresponding terminals of two windings, a positive sequence voltage system being applied to the high-voltage terminals, following each other in alphabetical sequence if they are lettered, or in numerical sequence if they are numbered: the phasors are assumed to rotate in a counter-clockwise sense. |
| AssetDatasheet | 1..1 | [AssetInfo](#AssetInfo) | Datasheet information for this power system resource. |
| Assets | 1..\* | [Asset](#Asset) | All assets represented by this power system resource. For example, multiple conductor assets are electrically modelled as a single AC line segment. |
| Location | 1..1 | [Location](#Location) | Location of this power system resource. |
| Names | 1..\* | [Name](#Name) | All names of this identified object. |
| Outages | 1..\* | [Outage](#Outage) | All outages in which this equipment is involved. |

**TransformerTankInfo**

Set of transformer tank data, from an equipment library.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| aliasName | 1..1 | string | The aliasName is free text human readable name of the object alternative to IdentifiedObject.name. It may be non unique and may not correlate to a naming hierarchy.The attribute aliasName is retained because of backwards compatibility between CIM relases. It is however recommended to replace aliasName with the Name class as aliasName is planned for retirement at a future time. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |
| PowerSystemResources | 1..\* | [PowerSystemResource](#PowerSystemResource) | All power system resources with this datasheet information. |
| ProductAssetModel | 1..1 | [ProductAssetModel](#ProductAssetModel) | Product asset model which conforms to this catalog asset type. |

**Inherited Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | see [AssetInfo](#AssetInfo) |
| aliasName | 1..1 | string | see [AssetInfo](#AssetInfo) |
| description | 1..1 | string | see [AssetInfo](#AssetInfo) |
| name | 1..1 | string | see [AssetInfo](#AssetInfo) |

**Abstract Classes**

**Analytic**

An algorithm or calculation for making an assessment about an asset or asset grouping for lifecycle decision making.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| bestValue | 1..1 | float | Value that indicates best possible numeric value. |
| createdDateTime | 1..1 | dateTime | Date and time that this document was created. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| kind | 1..1 | [AnalyticKind](#AnalyticKind) | Kind of analytic this analytic is. |
| lastModifiedDateTime | 1..1 | dateTime | Date and time this document was last modified. Documents may potentially be modified many times during their lifetime. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |
| scaleKind | 1..1 | [ScaleKind](#ScaleKind) | The scoring scale kind. |
| worstValue | 1..1 | float | Value that indicates worst possible numeric value. |

**AnalyticScore**

An indicative scoring by an analytic that can be used to characterize the health of or the risk associated with one or more assets. The analytic score reflects the results of an execution of an analytic against an asset or group of assets.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| calculationDateTime | 1..1 | dateTime | Timestamp of when the score was calculated. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| effectiveDateTime | 1..1 | dateTime | Date-time for when the score applies. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |
| value | 1..1 | float | Asset health score value. |

**Asset**

Tangible resource of the utility, including power system equipment, various end devices, cabinets, buildings, etc. For electrical network equipment, the role of the asset is defined through PowerSystemResource and its subclasses, defined mainly in the Wires model (refer to IEC61970-301 and model package IEC61970::Wires). Asset description places emphasis on the physical characteristics of the equipment fulfilling that role.

**Native Members**

| **name** | **mult** | **type** | **description** |
| --- | --- | --- | --- |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| aliasName | 1..1 | string | The aliasName is free text human readable name of the object alternative to IdentifiedObject.name. It may be non unique and may not correlate to a naming hierarchy.The attribute aliasName is retained because of backwards compatibility between CIM relases. It is however recommended to replace aliasName with the Name class as aliasName is planned for retirement at a future time. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| initialCondition | 1..1 | string | Condition of asset at last baseline. Examples include new, rebuilt, overhaul required, other. Refer to inspection data for information on the most current condition of the asset. |
| initialLossOfLife | 1..1 | [PerCent](#PerCent) | Percentage of initial life expectancy that has been lost as of the last life expectancy baseline. Represents(initial life expectancy - current life expectancy) / initial life expectancy. |
| inUseState | 1..1 | [InUseStateKind](#InUseStateKind) | Indication of whether asset is currently deployed (in use), ready to be put into use or not available for use. |
| kind | 1..1 | [AssetKind](#AssetKind) | Kind of asset. Used in description of asset components in asset instance templates. |
| lifecycleState | 1..1 | [AssetLifecycleStateKind](#AssetLifecycleStateKind) | Current lifecycle state of asset. |
| lotNumber | 1..1 | string | Lot number for this asset. Even for the same model and version number, many assets are manufactured in lots. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |
| purchasePrice | 1..1 | [Money](#Money) | Purchase price of asset. |
| retiredReason | 1..1 | [RetiredReasonKind](#RetiredReasonKind) | Reason asset retired. |
| serialNumber | 1..1 | string | Serial number of this asset. |
| type | 1..1 | string | Utility-specific classification of Asset and its subtypes, according to their corporate standards, practices, and existing IT systems (e.g., for management of assets, maintenance, work, outage, customers, etc.). |
| ActivityRecords | 1..\* | [ActivityRecord](#ActivityRecord) | All activity records created for this asset. |
| Analytic | 1..\* | [Analytic](#Analytic) | Analytic performed on this asset. |
| AnalyticScore | 1..\* | [AnalyticScore](#AnalyticScore) | Analytic result related to this asset. |
| AssetContainer | 1..1 | [AssetContainer](#AssetContainer) | Container of this asset. |
| AssetDeployment | 1..1 | [AssetDeployment](#AssetDeployment) | This asset's deployment. |
| AssetInfo | 1..1 | [AssetInfo](#AssetInfo) | Data applicable to this asset. |
| Measurements | 1..\* | [Measurement](#Measurement) | Measurement related to this asset. |
| Procedures | 1..\* | [Procedure](#Procedure) | All procedures applicable to this asset. |

**AssetContainer**

Asset that is aggregation of other assets such as conductors, transformers, switchgear, land, fences, buildings, equipment, vehicles, etc.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |

**Inherited Members**

| **name** | **mult** | **type** | **description** |
| --- | --- | --- | --- |
| mRID | 1..1 | string | see [Asset](#Asset) |
| aliasName | 1..1 | string | see [Asset](#Asset) |
| description | 1..1 | string | see [Asset](#Asset) |
| initialCondition | 1..1 | string | see [Asset](#Asset) |
| initialLossOfLife | 1..1 | [PerCent](#PerCent) | see [Asset](#Asset) |
| inUseState | 1..1 | [InUseStateKind](#InUseStateKind) | see [Asset](#Asset) |
| kind | 1..1 | [AssetKind](#AssetKind) | see [Asset](#Asset) |
| lifecycleState | 1..1 | [AssetLifecycleStateKind](#AssetLifecycleStateKind) | see [Asset](#Asset) |
| lotNumber | 1..1 | string | see [Asset](#Asset) |
| name | 1..1 | string | see [Asset](#Asset) |
| purchasePrice | 1..1 | [Money](#Money) | see [Asset](#Asset) |
| retiredReason | 1..1 | [RetiredReasonKind](#RetiredReasonKind) | see [Asset](#Asset) |
| serialNumber | 1..1 | string | see [Asset](#Asset) |
| type | 1..1 | string | see [Asset](#Asset) |
| ActivityRecords | 1..unbounded | [ActivityRecord](#ActivityRecord) | see [Asset](#Asset) |
| Analytic | 1..unbounded | [Analytic](#Analytic) | see [Asset](#Asset) |
| AnalyticScore | 1..unbounded | [AnalyticScore](#AnalyticScore) | see [Asset](#Asset) |
| AssetContainer | 1..1 | [AssetContainer](#AssetContainer) | see [Asset](#Asset) |
| AssetDeployment | 1..1 | [AssetDeployment](#AssetDeployment) | see [Asset](#Asset) |
| AssetInfo | 1..1 | [AssetInfo](#AssetInfo) | see [Asset](#Asset) |
| Measurements | 1..unbounded | [Measurement](#Measurement) | see [Asset](#Asset) |
| Procedures | 1..unbounded | [Procedure](#Procedure) | see [Asset](#Asset) |

**AssetDeployment**

Deployment of asset deployment in a power system resource role.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| deploymentState | 1..1 | [DeploymentStateKind](#DeploymentStateKind) | Current deployment state of asset. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| facilityKind | 1..1 | [FacilityKind](#FacilityKind) | Kind of facility (like substation or pole or building or plant or service center) at which asset deployed. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |
| transformerApplication | 1..1 | [TransformerApplicationKind](#TransformerApplicationKind) | Type of network role transformer is playing in this deployment (applies to transformer assets only). |

**AssetInfo**

Set of attributes of an asset, representing typical datasheet information of a physical device that can be instantiated and shared in different data exchange contexts:

- as attributes of an asset instance (installed or in stock)

- as attributes of an asset model (product by a manufacturer)

- as attributes of a type asset (generic type of an asset as used in designs/extension planning).

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| aliasName | 1..1 | string | The aliasName is free text human readable name of the object alternative to IdentifiedObject.name. It may be non unique and may not correlate to a naming hierarchy.The attribute aliasName is retained because of backwards compatibility between CIM relases. It is however recommended to replace aliasName with the Name class as aliasName is planned for retirement at a future time. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |

**CatalogAssetType**

a Assets that may be used for planning, work or design purposes.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| estimatedUnitCost | 1..1 | [Money](#Money) | Estimated unit cost (or cost per unit length) of this type of asset. It does not include labor to install, construct or configure it. |
| kind | 1..1 | [AssetKind](#AssetKind) | Kind of asset (from enumerated list). |
| stockItem | 1..1 | boolean | True if item is a stock item (default). |
| type | 1..1 | string | Description of type of asset. |

**CoordinateSystem**

Coordinate reference system.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| crsUrn | 1..1 | string | A Uniform Resource Name (URN) for the coordinate reference system (crs) used to define 'Location.PositionPoints'.An example would be the European Petroleum Survey Group (EPSG) code for a coordinate reference system, defined in URN under the Open Geospatial Consortium (OGC) namespace as: urn:ogc:def:crs:EPSG::XXXX, where XXXX is an EPSG code (a full list of codes can be found at the EPSG Registry web site http://www.epsg-registry.org/). To define the coordinate system as being WGS84 (latitude, longitude) using an EPSG OGC, this attribute would be urn:ogc:def:crs:EPSG::4.3.2.6A profile should limit this code to a set of allowed URNs agreed to by all sending and receiving parties. |

**Location**

The place, scene, or point of something where someone or something has been, is, and/or will be at a given moment in time. It can be defined with one or more position points (coordinates) in a given coordinate system.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| direction | 1..1 | string | (if applicable) Direction that allows field crews to quickly find a given asset. For a given location, such as a street address, this is the relative direction in which to find the asset. For example, a streetlight may be located at the 'NW' (northwest) corner of the customer's site, or a usage point may be located on the second floor of an apartment building. |
| geoInfoReference | 1..1 | string | (if applicable) Reference to geographical information source, often external to the utility. |
| type | 1..1 | string | Classification by utility's corporate standards and practices, relative to the location itself (e.g., geographical, functional accounting, etc., not a given property that happens to exist at that location). |
| CoordinateSystem | 1..1 | [CoordinateSystem](#CoordinateSystem) | Coordinate system used to describe position points of this location. |
| PositionPoints | 1..\* | [PositionPoint](#PositionPoint) | Sequence of position points describing this location, expressed in coordinate system 'Location.CoordinateSystem'. |

**Measurement**

A Measurement represents any measured, calculated or non-measured non-calculated quantity. Any piece of equipment may contain Measurements, e.g. a substation may have temperature measurements and door open indications, a transformer may have oil temperature and tank pressure measurements, a bay may contain a number of power flow measurements and a Breaker may contain a switch status measurement.

The PSR - Measurement association is intended to capture this use of Measurement and is included in the naming hierarchy based on EquipmentContainer. The naming hierarchy typically has Measurements as leaves, e.g. Substation-VoltageLevel-Bay-Switch-Measurement.

Some Measurements represent quantities related to a particular sensor location in the network, e.g. a voltage transformer (VT) or potential transformer (PT) at a busbar or a current transformer (CT) at the bar between a breaker and an isolator. The sensing position is not captured in the PSR - Measurement association. Instead it is captured by the Measurement - Terminal association that is used to define the sensing location in the network topology. The location is defined by the connection of the Terminal to ConductingEquipment.

If both a Terminal and PSR are associated, and the PSR is of type ConductingEquipment, the associated Terminal should belong to that ConductingEquipment instance.

When the sensor location is needed both Measurement-PSR and Measurement-Terminal are used. The Measurement-Terminal association is never used alone.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| measurementType | 1..1 | string | Specifies the type of measurement. For example, this specifies if the measurement represents an indoor temperature, outdoor temperature, bus voltage, line flow, etc.When the measurementType is set to "Specialization", the type of Measurement is defined in more detail by the specialized class which inherits from Measurement. |
| phases | 1..1 | [PhaseCode](#PhaseCode) | Indicates to which phases the measurement applies and avoids the need to use 'measurementType' to also encode phase information (which would explode the types). The phase information in Measurement, along with 'measurementType' and 'phases' uniquely defines a Measurement for a device, based on normal network phase. Their meaning will not change when the computed energizing phasing is changed due to jumpers or other reasons.If the attribute is missing three phases (ABC) shall be assumed. |
| unitMultiplier | 1..1 | [UnitMultiplier](#UnitMultiplier) | The unit multiplier of the measured quantity. |
| unitSymbol | 1..1 | [UnitSymbol](#UnitSymbol) | The unit of measure of the measured quantity. |
| MeasurementAction | 1..1 | [MeasurementAction](#MeasurementAction) | The measurement action that is performed on the measurement |
| Procedures | 1..\* | [Procedure](#Procedure) | Measurements are specified in types of documents, such as procedures. |

**MeasurementAction**

Measurement taken as a switching step.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| executedDateTime | 1..1 | dateTime | Actual date and time of this switching step. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |
| plannedDateTime | 1..1 | dateTime | Planned date and time of this switching step. |

**MeasurementValue**

The current state for a measurement. A state value is an instance of a measurement from a specific source. Measurements can be associated with many state values, each representing a different source for the measurement.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| sensorAccuracy | 1..1 | [PerCent](#PerCent) | The limit, expressed as a percentage of the sensor maximum, that errors will not exceed when the sensor is used under reference conditions. |
| timeStamp | 1..1 | dateTime | The time when the value was last updated. |
| value | 0..1 | float | The value to supervise. |
| RemoteSource | 1..1 | [RemoteSource](#RemoteSource) | Link to the physical telemetered point associated with this measurement. |

**MeasurementValueQuality**

Measurement quality flags. Bits 0-10 are defined for substation automation in IEC 61850-7-3. Bits 11-15 are reserved for future expansion by that document. Bits 16-31 are reserved for EMS applications.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| MeasurementValue | 1..1 | [MeasurementValue](#MeasurementValue) | A MeasurementValue has a MeasurementValueQuality associated with it. |

**Name**

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

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| name | 1..1 | string | Any free text that name the object. |
| IdentifiedObject | 1..1 | [IdentifiedObject](#IdentifiedObject) | Identified object that this name designates. |
| NameType | 1..1 | [NameType](#NameType) | Type of this name. |

**NameType**

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** | **mult** | **type** | **description** |
| description | 1..1 | string | Description of the name type. |
| name | 1..1 | string | Name of the name type. |
| NameTypeAuthority | 1..1 | [NameTypeAuthority](#NameTypeAuthority) | Authority responsible for managing names of this type. |

**NameTypeAuthority**

Authority responsible for creation and management of names of a given type; typically an organization or an enterprise system.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| description | 1..1 | string | Description of the name type authority. |
| name | 1..1 | string | Name of the name type authority. |

**PositionPoint**

Set of spatial coordinates that determine a point, defined in the coordinate system specified in 'Location.CoordinateSystem'. Use a single position point instance to describe a point-oriented location. Use a sequence of position points to describe a line-oriented object (physical location of non-point oriented objects like cables or lines), or area of an object (like a substation or a geographical zone - in this case, have first and last position point with the same values).

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| sequenceNumber | 1..1 | integer | Zero-relative sequence number of this point within a series of points. |
| xPosition | 1..1 | string | X axis position. |
| yPosition | 1..1 | string | Y axis position. |

**PowerSystemResource**

A power system resource (PSR) can be an item of equipment such as a switch, an equipment container containing many individual items of equipment such as a substation, or an organisational entity such as sub-control area. Power system resources can have measurements associated.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| aliasName | 1..1 | string | The aliasName is free text human readable name of the object alternative to IdentifiedObject.name. It may be non unique and may not correlate to a naming hierarchy.The attribute aliasName is retained because of backwards compatibility between CIM relases. It is however recommended to replace aliasName with the Name class as aliasName is planned for retirement at a future time. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |

**PowerTransformerEnd**

A PowerTransformerEnd is associated with each Terminal of a PowerTransformer.

The impedance values r, r0, x, and x0 of a PowerTransformerEnd represents a star equivalent as follows.

1) for a two Terminal PowerTransformer the high voltage (TransformerEnd.endNumber=1) PowerTransformerEnd has non zero values on r, r0, x, and x0 while the low voltage (TransformerEnd.endNumber=2) PowerTransformerEnd has zero values for r, r0, x, and x0. Parameters are always provided, even if the PowerTransformerEnds have the same rated voltage. In this case, the parameters are provided at the PowerTransformerEnd which has TransformerEnd.endNumber equal to 1.

2) for a three Terminal PowerTransformer the three PowerTransformerEnds represent a star equivalent with each leg in the star represented by r, r0, x, and x0 values.

3) For a three Terminal transformer each PowerTransformerEnd shall have g, g0, b and b0 values corresponding to the no load losses distributed on the three PowerTransformerEnds. The total no load loss shunt impedances may also be placed at one of the PowerTransformerEnds, preferably the end numbered 1, having the shunt values on end 1. This is the preferred way.

4) for a PowerTransformer with more than three Terminals the PowerTransformerEnd impedance values cannot be used. Instead use the TransformerMeshImpedance or split the transformer into multiple PowerTransformers.

Each PowerTransformerEnd must be contained by a PowerTransformer. Because a PowerTransformerEnd (or any other object) can not be contained by more than one parent, a PowerTransformerEnd can not have an association to an EquipmentContainer (Substation, VoltageLevel, etc).

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| connectionKind | 1..1 | [WindingConnection](#WindingConnection) | Kind of connection. |
| description | 1..1 | string | The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |

**PowerTransformerInfo**

Set of power transformer data, from an equipment library.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended.For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements. |
| name | 1..1 | string | The name is any free human readable and possibly non unique text naming the object. |
| CatalogAssetType | 1..1 | [CatalogAssetType](#CatalogAssetType) | Asset information (nameplate) for this catalog asset type. |
| ProductAssetModel | 1..1 | [ProductAssetModel](#ProductAssetModel) | Product asset model which conforms to this catalog asset type. |
| TransformerTankInfos | 1..\* | [TransformerTankInfo](#TransformerTankInfo) | Data for all the tanks described by this power transformer data. |

**Inherited Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| mRID | 1..1 | string | see [AssetInfo](#AssetInfo) |
| aliasName | 1..1 | string | see [AssetInfo](#AssetInfo) |
| description | 1..1 | string | see [AssetInfo](#AssetInfo) |
| name | 1..1 | string | see [AssetInfo](#AssetInfo) |

**Procedure**

Documented procedure for various types of work or work tasks on assets.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| instruction | 1..1 | string | Textual description of this procedure. |
| kind | 1..1 | [ProcedureKind](#ProcedureKind) | Kind of procedure. |
| sequenceNumber | 1..1 | string | Sequence number in a sequence of procedures being performed. |
| ProcedureDataSets | 1..\* | [ProcedureDataSet](#ProcedureDataSet) | All data sets captured by this procedure. |

**ProcedureDataSet**

A data set recorded each time a procedure is executed. Observed results are captured in associated measurement values and/or values for properties relevant to the type of procedure performed.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| completedDateTime | 1..1 | dateTime | Date and time procedure was completed. |
| MeasurementValue | 1..\* | [MeasurementValue](#MeasurementValue) | Measurement value related to this procedure data set. |

**ProductAssetModel**

Asset model by a specific manufacturer.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| catalogueNumber | 1..1 | string | Catalogue number for asset model. |
| corporateStandardKind | 1..1 | [CorporateStandardKind](#CorporateStandardKind) | Kind of corporate standard for this asset model. |
| drawingNumber | 1..1 | string | Drawing number for asset model. |
| modelNumber | 1..1 | string | Manufacturer's model number. |
| modelVersion | 1..1 | string | Version number for product model, which indicates vintage of the product. |

**RemoteSource**

Remote sources are state variables that are telemetered or calculated within the remote unit.

**Native Members**

|  |  |  |  |
| --- | --- | --- | --- |
| **name** | **mult** | **type** | **description** |
| deadband | 1..1 | float | The smallest change in value to be reported. |
| scanInterval | 1..1 | [Seconds](#Seconds) | The time interval between scans. |
| sensorMaximum | 1..1 | float | The maximum value the telemetry item can return. |
| sensorMinimum | 1..1 | float | The minimum value the telemetry item can return. |

**Enumerations**

**AnalyticKind**

Possible kinds of analytics.

|  |  |
| --- | --- |
| **name** | **description** |
| agingAnalytic | Analytic evaluates aging. |
| faultAnalytic | Analytic evaluates fault. |
| healthAnalytic | Analytic evaluates asset health. |
| other | Analytic evaluates other factor. |
| replacementAnalytic | Analytic evaluates need for replacement. |
| riskAnalytic | Analytic evaluates risk. |

**AssetKind**

Kinds of assets or asset components.

|  |  |
| --- | --- |
| **name** | **description** |
| breakerAirBlastBreaker | Air blast circuit breaker. |
| breakerBulkOilBreaker | Bulk oil circuit breaker. |
| breakerInsulatingStackAssembly | Breaker insulating stack assembly (for live tank breaker). |
| breakerMinimumOilBreaker | Minimum oil circuit breaker. |
| breakerSF6DeadTankBreaker | SF6 dead tank breaker. |
| breakerSF6LiveTankBreaker | SF6 live tank breaker. |
| breakerTankAssembly | Breaker tank assembly. |
| other | Other type of Asset. The type attribute may provide more details in this case. |
| transformer | Transformer. |
| transformerTank | Transformer tank. |

**AssetLifecycleStateKind**

Lifecycle states an asset can be in.While the possible lifecycle states are standardized, the allowed transitions are not - they are intended to be defined by the business process requirements of local implementations.

|  |  |
| --- | --- |
| **name** | **description** |
| disposedOf | Asset disposed of. |
| manufactured | Asset manufactured. |
| purchased | Asset purchased. |
| received | Asset received. |
| retired | Asset retired. |

**CorporateStandardKind**

Kind of corporate standard.

|  |  |
| --- | --- |
| **name** | **description** |
| experimental | Asset model is used experimentally. |
| other | Other kind of corporate standard for the asset model. |
| standard | Asset model is used as corporate standard. |
| underEvaluation | Asset model usage is under evaluation. |

**DeploymentStateKind**

Possible states of asset deployment.

|  |  |
| --- | --- |
| **name** | **description** |
| inService | Asset in service in deployment location. |
| installed | Asset installed in deployment location. |
| notYetInstalled | Asset not yet installed in deployment location. |
| outOfService | Asset out of service, but in deployment location. |
| removed | Asset removed from deployment location. |

**FacilityKind**

Types of facilities at which an asset can be deployed.

|  |  |
| --- | --- |
| **name** | **description** |
| distributionPoleTop | Distribution pole top. |
| substationDistribution | Distribution substation. |
| substationFossilPlant | Fossil plant substation. |
| substationHydroPlant | Hydro plant substation. |
| substationNuclearPlant | Nuclear plant substation. |
| substationSubTransmission | Subtransmission substation. |
| substationTransmission | Transmission substation. |

**InUseStateKind**

Possible 'in use' states that an asset can be in.

|  |  |
| --- | --- |
| **name** | **description** |
| inUse | Asset is deployed (in use) or is being put into use. |
| notReadyForUse | Asset is not ready to be put into use. |
| readyForUse | Asset is ready to be put into use. |

**ProcedureKind**

Kind of procedure.

|  |  |
| --- | --- |
| **name** | **description** |
| diagnosis | Diagnosis procedure. |
| inspection | Inspection procedure. |
| maintenance | Maintenance procedure. |
| other | Other procedure. |
| test | Test procedure. |

**RetiredReasonKind**

Reason asset retired.

|  |  |
| --- | --- |
| **name** | **description** |
| environmental | Retired due to environmental reasons. |
| excessiveMaintenance | Retired due to excessive maintainance issues. |
| facilitiesUpgrade | Retired due to facility upgrade. |
| failed | Retired because of failure. |
| obsolescence | Retired due to obsolescence. |
| other | Retired due to other reasons. |
| sold | Retired and sold. |

**ScaleKind**

Kinds of scaling.

|  |  |
| --- | --- |
| **name** | **description** |
| exponential | Exponential scale. |
| linear | Linear scale. |

**TransformerApplicationKind**

Classifications of network roles in which transformers can be deployed. The classifications are intended to reflect both criticality of transformer in network operations and typical usage experienced by transformer.Note: This enumeration provides essential information to asset health analytics. The existing list is a starting point and is anticipated to be fleshed out further as requirements are better understood (PAB 2016/01/09).

|  |  |
| --- | --- |
| **name** | **description** |
| distribution | Transformer between one distribution voltage level and another distribution voltage level. |
| generatorStepUp | Transformer is generator step-up transformer. |
| transmissionBusToBus | Transformer between bus at one transmission voltage level and a bus at another transmission voltage level. |
| transmissionBusToDistribution | Transformer between bus at transmission voltage level and bus at distribution voltage level. |

**UnitMultiplier**

The unit multipliers defined for the CIM. When applied to unit symbols, the unit symbol is treated as a derived unit. Regardless of the contents of the unit symbol text, the unit symbol shall be treated as if it were a single-character unit symbol. Unit symbols should not contain multipliers, and it should be left to the multiplier to define the multiple for an entire data type.For example, if a unit symbol is "m2Pers" and the multiplier is "k", then the value is k(m\*\*2/s), and the multiplier applies to the entire final value, not to any individual part of the value. This can be conceptualized by substituting a derived unit symbol for the unit type. If one imagines that the symbol "" represents the derived unit "m2Pers", then applying the multiplier "k" can be conceptualized simply as "k".For example, the SI unit for mass is "kg" and not "g". If the unit symbol is defined as "kg", then the multiplier is applied to "kg" as a whole and does not replace the "k" in front of the "g". In this case, the multiplier of "m" would be used with the unit symbol of "kg" to represent one gram. As a text string, this violates the instructions in IEC 80000-1. However, because the unit symbol in CIM is treated as a derived unit instead of as an SI unit, it makes more sense to conceptualize the "kg" as if it were replaced by one of the proposed replacements for the SI mass symbol. If one imagines that the "kg" were replaced by a symbol "", then it is easier to conceptualize the multiplier "m" as creating the proper unit "m", and not the forbidden unit "mkg".

| **name** | **description** |
| --- | --- |
| E | Exa 10\*\*18. |
| G | Giga 10\*\*9. |
| M | Mega 10\*\*6. |
| P | Peta 10\*\*15. |
| T | Tera 10\*\*12. |
| Y | Yotta 10\*\*24. |
| Z | Zetta 10\*\*21. |
| a | Atto 10\*\*-18. |
| c | Centi 10\*\*-2. |
| d | Deci 10\*\*-1. |
| da | Deca 10\*\*1. |
| f | Femto 10\*\*-15. |
| h | Hecto 10\*\*2. |
| k | Kilo 10\*\*3. |
| m | Milli 10\*\*-3. |
| micro | Micro 10\*\*-6. |
| n | Nano 10\*\*-9. |
| none | No multiplier or equivalently multiply by 1. |
| p | Pico 10\*\*-12. |
| y | Yocto 10\*\*-24. |
| z | Zepto 10\*\*-21. |

**UnitSymbol**

The derived units defined for usage in the CIM. In some cases, the derived unit is equal to an SI unit. Whenever possible, the standard derived symbol is used instead of the formula for the derived unit. For example, the unit symbol Farad is defined as "F" instead of "CPerV". In cases where a standard symbol does not exist for a derived unit, the formula for the unit is used as the unit symbol. For example, density does not have a standard symbol and so it is represented as "kgPerm3". With the exception of the "kg", which is an SI unit, the unit symbols do not contain multipliers and therefore represent the base derived unit to which a multiplier can be applied as a whole.Every unit symbol is treated as an unparseable text as if it were a single-letter symbol. The meaning of each unit symbol is defined by the accompanying descriptive text and not by the text contents of the unit symbol.To allow the widest possible range of serializations without requiring special character handling, several substitutions are made which deviate from the format described in IEC 80000-1. The division symbol "/" is replaced by the letters "Per". Exponents are written in plain text after the unit as "m3" instead of being formatted as "m" with a superscript of 3 or introducing a symbol as in "m^3". The degree symbol "" is replaced with the letters "deg". Any clarification of the meaning for a substitution is included in the description for the unit symbol.Non-SI units are included in list of unit symbols to allow sources of data to be correctly labelled with their non-SI units (for example, a GPS sensor that is reporting numbers that represent feet instead of meters). This allows software to use the unit symbol information correctly convert and scale the raw data of those sources into SI-based units.The integer values are used for harmonization with IEC 61850.

| **name** | **description** |
| --- | --- |
| A | Current in amperes. |
| A2 | Amperes squared (A). |
| A2h | Ampere-squared hour, ampere-squared hour. |
| A2s | Ampere squared time in square amperes (As). |
| APerA | Current, ratio of amperages. Note: Users may need to supply a prefix such as m to show rates such as mA/A. |
| APerm | A/m, magnetic field strength, amperes per metre. |
| Ah | Ampere-hours, ampere-hours. |
| As | Ampere seconds (As). |
| Bq | Radioactivity in becquerels (1/s). |
| Btu | Energy, British Thermal Units. |
| C | Electric charge in coulombs (As). |
| CPerkg | Exposure (x rays), coulombs per kilogram. |
| CPerm2 | Surface charge density, coulombs per square metre. |
| CPerm3 | Electric charge density, coulombs per cubic metre. |
| F | Electric capacitance in farads (C/V). |
| FPerm | Permittivity, farads per metre. |
| G | Magnetic flux density, gausses (1 G = 10-4 T). |
| Gy | Absorbed dose in grays (J/kg). |
| GyPers | Absorbed dose rate, grays per second. |
| H | Electric inductance in henrys (Wb/A). |
| HPerm | Permeability, henrys per metre. |
| Hz | Frequency in hertz (1/s). |
| HzPerHz | Frequency, rate of frequency change. Note: Users may need to supply a prefix such as m to show rates such as mHz/Hz. |
| HzPers | Rate of change of frequency in hertz per second. |
| J | Energy in joules (Nm = CV = Ws). |
| JPerK | Heat capacity in joules/kelvin. |
| JPerkg | Specific energy, Joules / kg. |
| JPerkgK | Specific heat capacity, specific entropy, joules per kilogram Kelvin. |
| JPerm2 | Insulation energy density, joules per square metre or watt second per square metre. |
| JPerm3 | Energy density, joules per cubic metre. |
| JPermol | Molar energy, joules per mole. |
| JPermolK | Molar entropy, molar heat capacity, joules per mole kelvin. |
| JPers | Energy rate in joules per second (J/s). |
| K | Temperature in kelvins. |
| KPers | Temperature change rate in kelvins per second. |
| M | Length, nautical miles (1 M = 1852 m). |
| Mx | Magnetic flux, maxwells (1 Mx = 10-8 Wb). |
| N | Force in newtons (kgm/s). |
| NPerm | Surface tension, newton per metre. |
| Nm | Moment of force, newton metres. |
| Oe | Magnetic field in oersteds, (1 Oe = (103/4p) A/m). |
| Pa | Pressure in pascals (N/m). Note: the absolute or relative measurement of pressure is implied with this entry. See below for more explicit forms. |
| PaPers | Pressure change rate in pascals per second. |
| Pas | Dynamic viscosity, pascal seconds. |
| Q | Quantity power, Q. |
| Qh | Quantity energy, Qh. |
| S | Conductance in siemens. |
| SPerm | Conductance per length (F/m). |
| Sv | Dose equivalent in sieverts (J/kg). |
| T | Magnetic flux density in teslas (Wb/m2). |
| V | Electric potential in volts (W/A). |
| V2 | Volt squared (W/A). |
| V2h | Volt-squared hour, volt-squared-hours. |
| VA | Apparent power in volt amperes. See also real power and reactive power. |
| VAh | Apparent energy in volt ampere hours. |
| VAr | Reactive power in volt amperes reactive. The reactive or imaginary component of electrical power (VIsin(phi)). (See also real power and apparent power).Note: Different meter designs use different methods to arrive at their results. Some meters may compute reactive power as an arithmetic value, while others compute the value vectorially. The data consumer should determine the method in use and the suitability of the measurement for the intended purpose. |
| VArh | Reactive energy in volt ampere reactive hours. |
| VPerHz | Magnetic flux in volt per hertz. |
| VPerV | Voltage, ratio of voltages. Note: Users may need to supply a prefix such as m to show rates such as mV/V. |
| VPerVA | Power factor, PF, the ratio of the active power to the apparent power. Note: The sign convention used for power factor will differ between IEC meters and EEI (ANSI) meters. It is assumed that the data consumers understand the type of meter being used and agree on the sign convention in use at any given utility. |
| VPerVAr | Power factor, PF, the ratio of the active power to the apparent power. Note: The sign convention used for power factor will differ between IEC meters and EEI (ANSI) meters. It is assumed that the data consumers understand the type of meter being used and agree on the sign convention in use at any given utility. |
| VPerm | Electric field strength, volts per metre. |
| Vh | Volt-hour, Volt hours. |
| Vs | Volt seconds (Ws/A). |
| W | Real power in watts (J/s). Electrical power may have real and reactive components. The real portion of electrical power (I&#178;R or VIcos(phi)), is expressed in Watts. See also apparent power and reactive power. |
| WPerA | Active power per current flow, watts per Ampere. |
| WPerW | Signal Strength, ratio of power. Note: Users may need to supply a prefix such as m to show rates such as mW/W. |
| WPerm2 | Heat flux density, irradiance, watts per square metre. |
| WPerm2sr | Radiance, watts per square metre steradian. |
| WPermK | Thermal conductivity in watt/metres kelvin. |
| WPers | Ramp rate in watts per second. |
| WPersr | Radiant intensity, watts per steradian. |
| Wb | Magnetic flux in webers (Vs). |
| Wh | Real energy in watt hours. |
| anglemin | Plane angle, minutes. |
| anglesec | Plane angle, seconds. |
| bar | Pressure in bars, (1 bar = 100 kPa). |
| cd | Luminous intensity in candelas. |
| charPers | Data rate (baud) in characters per second. |
| character | Number of characters. |
| cosPhi | Power factor, dimensionless.Note 1: This definition of power factor only holds for balanced systems. See the alternative definition under code 153.Note 2: Beware of differing sign conventions in use between the IEC and EEI. It is assumed that the data consumer understands the type of meter in use and the sign convention in use by the utility. |
| count | Amount of substance, Counter value. |
| d | Time in days, day = 24 h = 86400 s. |
| dB | Sound pressure level in decibels. Note: multiplier d is included in this unit symbol for compatibility with IEC 61850-7-3. |
| dBm | Power level (logarithmic ratio of signal strength , Bel-mW), normalized to 1mW. Note: multiplier d is included in this unit symbol for compatibility with IEC 61850-7-3. |
| deg | Plane angle in degrees. |
| degC | Relative temperature in degrees Celsius.In the SI unit system the symbol is C. Electric charge is measured in coulomb that has the unit symbol C. To distinguish degree Celsius from coulomb the symbol used in the UML is degC. The reason for not using C is that the special character is difficult to manage in software. |
| ft3 | Volume, cubic feet. |
| gPerg | Concentration, The ratio of the mass of a solute divided by the mass of the solution. Note: Users may need use a prefix such a to express a quantity such as g/g. |
| gal | Volume in gallons, US gallon (1 gal = 231 in3 = 128 fl ounce). |
| h | Time in hours, hour = 60 min = 3600 s. |
| ha | Area, hectares. |
| kat | Catalytic activity, katal = mol / s. |
| katPerm3 | Catalytic activity concentration, katals per cubic metre. |
| kg | Mass in kilograms. Note: multiplier k is included in this unit symbol for compatibility with IEC 61850-7-3. |
| kgPerJ | Weight per energy in kilograms per joule (kg/J). Note: multiplier k is included in this unit symbol for compatibility with IEC 61850-7-3. |
| kgPerm3 | Density in kilogram/cubic metres (kg/m). Note: multiplier k is included in this unit symbol for compatibility with IEC 61850-7-3. |
| kgm | Moment of mass in kilogram metres (kgm) (first moment of mass). Note: multiplier k is included in this unit symbol for compatibility with IEC 61850-7-3. |
| kgm2 | Moment of mass in kilogram square metres (kgm) (Second moment of mass, commonly called the moment of inertia). Note: multiplier k is included in this unit symbol for compatibility with IEC 61850-7-3. |
| kn | Speed, knots (1 kn = 1852/3600) m/s. |
| l | Volume in litres, litre = dm3 = m3/1000. |
| lPerh | Volumetric flow rate, litres per hour. |
| lPerl | Concentration, The ratio of the volume of a solute divided by the volume of the solution. Note: Users may need use a prefix such a to express a quantity such as L/L. |
| lPers | Volumetric flow rate in litres per second. |
| lm | Luminous flux in lumens (cdsr). |
| lx | Illuminance in lux (lm/m). |
| m | Length in metres. |
| m2 | Area in square metres (m). |
| m2Pers | Viscosity in square metres / second (m/s). |
| m3 | Volume in cubic metres (m). |
| m3Compensated | Volume, cubic metres, with the value compensated for weather effects. |
| m3Perh | Volumetric flow rate, cubic metres per hour. |
| m3Perkg | Specific volume, cubic metres per kilogram, v. |
| m3Pers | Volumetric flow rate in cubic metres per second (m/s). |
| m3Uncompensated | Volume, cubic metres, with the value uncompensated for weather effects. |
| mPerm3 | Fuel efficiency in metres per cubic metres (m/m). |
| mPers | Velocity in metres per second (m/s). |
| mPers2 | Acceleration in metres per second squared (m/s). |
| min | Time in minutes, minute = 60 s. |
| mmHg | Pressure, millimetres of mercury (1 mmHg is approximately 133.3 Pa). |
| mol | Amount of substance in moles. |
| molPerkg | Concentration, Molality, the amount of solute in moles and the amount of solvent in kilograms. |
| molPerm3 | Concentration, The amount of substance concentration, (c), the amount of solvent in moles divided by the volume of solution in m. |
| molPermol | Concentration, Molar fraction, the ratio of the molar amount of a solute divided by the molar amount of the solution. |
| none | Dimension less quantity, e.g. count, per unit, etc. |
| ohm | Electric resistance in ohms (V/A). |
| ohmPerm | Electric resistance per length in ohms per metre ((V/A)/m). |
| ohmm | Resistivity, ohm metres, (rho). |
| onePerHz | Reciprocal of frequency (1/Hz). |
| onePerm | Wavenumber, reciprocal metres, (1/m). |
| ppm | Concentration in parts per million. |
| rad | Plane angle in radians (m/m). |
| radPers | Angular velocity in radians per second (rad/s). |
| radPers2 | Angular acceleration, radians per second squared. |
| rev | Amount of rotation, revolutions. |
| rotPers | Rotations per second (1/s). See also Hz (1/s). |
| s | Time in seconds. |
| sPers | Time, Ratio of time. Note: Users may need to supply a prefix such as &#181; to show rates such as &#181;s/s. |
| sr | Solid angle in steradians (m2/m2). |
| therm | Energy, therms. |
| tonne | Mass in tons, tonne or metric ton (1000 kg = 1 Mg). |

**Datatypes**

**AngleDegrees**

Measurement of angle in degrees.

XSD type: float

**CurrentFlow**

Electrical current with sign convention: positive flow is out of the conducting equipment into the connectivity node. Can be both AC and DC.

XSD type: float

**Money**

Amount of money.

XSD type: decimal

**PerCent**

Percentage on a defined base. For example, specify as 100 to indicate at the defined base.

XSD type: float

**Seconds**

Time, in seconds.

XSD type: float

**Voltage**

Electrical voltage, can be both AC and DC.

XSD type: float