European Network of
Transmission System Operators
for Electricity

GRID DISTURBANCE PROFILE SPECIFICATION

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ICTC APPROVED
VERSION 1.1.1

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NOTE CONCERNING WORDING USED IN THIS DOCUMENT

The force of the following words is modified by the requirement level of the document in which they are used.

- SHALL: This word, or the terms “REQUIRED” or “MUST”, means that the definition is an absolute requirement of the specification.
- SHALL NOT: This phrase, or the phrase “MUST NOT”, means that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective “RECOMMENDED”, means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase “NOT RECOMMENDED”, means that there may exist valid reasons in particular circumstances when the particular behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.
- MAY: This word, or the adjective “OPTIONAL”, means that an item is truly optional.

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Revision History

Version	Date	Paragraph	Comments
1.0.0	2022-11-03		Document for ICTC approval.
1.1.0-alpha	2024-03-20		For CIM WG review.
1.1.0-beta	2024-04-09		For StG Strategy review.
1.1.1-alpha	2024-09-07		For CIM WG review.

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1 Introduction

The grid disturbance profile is a profile to exchange a list of already occurred grid disturbances, faults, outages and interruptions. A grid disturbance is defined as “Automatic, unintended, or manual undeferrable switching of breakers as a result of faults in the power grid”.

The grid disturbances are input data that describe incidents in the power grid. This input data is used for statistical purposes and for Probabilistic Risk Assessment (PRA) pursuant to CSAM Article 44.

2 Application profile specification

2.1 Version information

The content is generated from UML model file CIM17-2_CGMES31v01_PROF-20v02_NC23v65_MS10v01_DES10v01.eap.

This edition is based on the IEC 61970 UML version ‘IEC61970CIM17v40’, dated ‘2020-08-24’.

- Title: Grid Disturbance vocabulary
- Keyword: GD
- Description: This vocabulary is describing the grid disturbance profile.
- Version IRI: https://ap-voc.cim4.eu/GridDisturbance/1.1
- Version info: 1.1.1
- Prior version:
- Conforms to: urn:iso:std:iec:61970-600-2:ed-1|urn:iso:std:iec:61970-301:ed-7:amd1|file://iec61970cim17v40_iec61968cim13v13a_iec62325cim03v17a.eap|urn:iso:std:iec:61970-401:draft:ed-1|urn:iso:std:iec:61970-501:draft:ed-2|file://CIM100_CGMES31v01_501-20v02_NC23v62_MM10v01.eap
- Identifier: urn:uuid:81c488d7-a09f-49ef-a3cd-3bb19a1d6f16

2.2 Constraints naming convention

The naming of the rules shall not be used for machine processing. The rule names are just a string. The naming convention of the constraints is as follows.

“{rule.Type}:{rule.Standard}:{rule.Profile}:{rule.Property}:{rule.Name}”

where

rule.Type: C – for constraint; R – for requirement

rule.Standard: the number of the standard e.g. 301 for 61970-301, 456 for 61970-456, 13 for 61968-13. 61970-600 specific constraints refer to 600 although they are related to one or combination of the 61970-450 series profiles. For CSA profiles, CSA is used.

rule.Profile: the abbreviation of the profile, e.g. TP for Topology profile. If set to “ALL” the constraint is applicable to all IEC 61970-600 profiles.

rule.Property: for UML classes, the name of the class, for attributes and associations, the name of the class and attribute or association end, e.g. EnergyConsumer, IdentifiedObject.name, etc. If set to “NA” the property is not applicable to a specific UML element.

rule.Name: the name of the rule. It is unique for the same property.

Example: C:600:ALL:IdentifiedObject.name:stringLength

2.3 Profile constraints

This clause defines requirements and constraints that shall be fulfilled by applications that conform to this document.

This document is the master for rules and constraints tagged "CSA". For the sake of self-containment, the list below also includes a copy of the relevant rules from IEC 61970-452, tagged "452".

- C:452:ALL:NA:datatypes

  According to 61970-501, datatypes are not exchanged in the instance data. The UnitMultiplier is 1 in cases none value is specified in the profile.

- R:452:ALL:NA:exchange

  Optional and required attributes and associations must be imported and exported if they are in the model file prior to import.

- R:452:ALL:NA:exchange1

  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 the export is resulting from an action by the user performed after the import, e.g. data processing or model update the export can contain optional attributes.

- R:452:ALL:NA:exchange2

  In most of the profiles the selection of optional and required attributes is made so as to ensure a minimum set of required attributes without which the exchange does not fulfil its basic purpose. Business processes governing different exchanges can require mandatory exchange of certain optional attributes or associations. Optional and required attributes and associations shall therefore be supported by applications which claim conformance with certain functionalities of the IEC 61970-452. This provides flexibility for the business processes to adapt to different business requirements and base the exchanges on IEC 61970-452 compliant applications.

- R:452:ALL:NA:exchange3

  An exporter may, at his or her discretion, produce a serialization containing additional class data described by the CIM Schema but not required by this document provided these data adhere to the conventions established in Clause 5.

- R:452:ALL:NA:exchange4

  From the standpoint of the model import used by a data recipient, the document describes a subset of the CIM that importing software shall be able to interpret in order to import exported models. Data providers are free to exceed the minimum requirements described herein as long as their resulting data files are compliant with the CIM Schema and the conventions established in Clause 5. 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 labelled 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 Schema.

- R:452:ALL:NA:cardinality

  The cardinality defined in the CIM model shall be followed, unless a more restrictive 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.

- R:452:ALL:NA:associations

  Associations between classes referenced in this document and classes not referenced here are not required regardless of cardinality.

- R:452:ALL:IdentifiedObject.name:rule

  The attribute “name” inherited by many classes from the abstract class IdentifiedObject is not required to be unique. It must be a human readable identifier without additional embedded information that would need to be parsed. The attribute is used for purposes such as User Interface and data exchange debugging. The MRID 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 for CoreEquipment profile and Short Circuit profile.

- R:452:ALL:IdentifiedObject.description:rule

  The attribute “description” inherited by many classes from the abstract class IdentifiedObject must contain human readable text without additional embedded information that would need to be parsed.

- R:452:ALL:NA:uniqueIdentifier

  All IdentifiedObject-s shall have a persistent and globally unique identifier (Master Resource Identifier - mRID).

- R:452:ALL:NA:unitMultiplier

  For exchange of attributes defined using CIM Data Types (ActivePower, Susceptance, etc.) a unit multiplier of 1 is used if the UnitMultiplier specified in this document is “none”.

- C:452:ALL:IdentifiedObject.name:stringLength

  The string IdentifiedObject.name has a maximum of 128 characters.

- C:452:ALL:IdentifiedObject.description:stringLength

  The string IdentifiedObject.description is maximum 256 characters.

- C:452:ALL:NA:float

  An attribute that is defined as float (e.g. has a type Float or a type which is a Datatype with .value attribute of type Float) shall support ISO/IEC 60559:2020 for floating-point arithmetic using single precision floating point. A single precision float supports 7 significant digits where the significant digits are described as an integer, or a decimal

number with 6 decimal digits. Two float values are equal when the significant with 7 digits are identical, e.g. 1234567 is equal 1.234567E6 and so are 1.2345678 and 1.234567E0.

- C:13:GL:CoordinateSystem.crsUrn:epsg

CoordinateSystem.crsUrn: If not specified elsewhere, the CoordinateSystem.crsUrn uses WGS84 (latitude, longitude), i.e. urn:ogc:def:crs:EPSG::4326.

- C:13:GL:PositionPoint:coordinates

In order to support various coordinate systems, position attributes are defined as strings. It is up to the implementation to ensure to correctly parse coordinate positions as defined by the coordinate system type.

- R:NC:ALL:NA:serialization

The profiles are defined in the EnterpriseArchitect application and have multiple artifacts that describe them. The main artifacts are:

1) the EAP file (EnterpriseArchitect project file),
2) the profiles' specification document and
3) the application profiles (RDFS and SHACL).

Due to the complexity of the profiles, there are various cross profile associations that, from profiling and profile maintenance point of view, it is not practical to include the complete inheritance structure in all profiles. If this is done the documentation provided for all profiles would also include duplicated information on the description of classes defined in other profiles. The following cases are often observed in profiles:

- Case 1: An association end refers to an abstract class
- Case 2: An abstract class (stereotyped with "Description") has an association (direction to another class)
- Case 3: An abstract class (not stereotyped with "Description") has an association (direction to another class)
- Case 4: An abstract class has attributes and subclasses are not in the profile

In all cases, the datasets shall only include the subtypes of the abstract classes with the related properties (i.e. association or attributes) defined in the profile. The information is taken from either canonical model or the profiles where complete (expected) inheritance structure for the related abstract class is described. SHACL based constraints include constraints only for the concrete classes that are subtypes of the abstract class in the profile, and this can be used to inform which are the concrete classes expected in a dataset that conforms to this profile.

It should be taken into account that this approach deviates from MVAL5 (IEC 61970-600-1:2021), which creates multiple inheritance at serialization. For instance, with this more explicit exchange the serialization of the association between abstract class Equipment and abstract class Circuit for a PowerTransformer will be serialized as follows:

- for association

```
<cim:PowerTransformer rdf:about="_c328f787-bc17-47ad-a59f-6ba7133340d0">
  <nc:Equipment.Circut rdf:resource="#_9ced16ac-d076-4ef9-a241-a998a579e77b"/>
</cim:PowerTransformer>
```

- for attribute

```
<cim:ACLineSegment rdf:about="_04f681aa-6999-4fb3-9775-acaa5eb7ceff">
  <cim:Equipment.inService>true</cim:Equipment.inService>
</cim:ACLineSegment>
```

The usage of rdf:ID or rdf:about depends on the stereotype of the class. rdf:about is used if the class has the stereotype “Description”.

An example of not allowed serialization, as the Equipment is an abstract class

```
<cim:Equipment rdf:about="_c328f787-bc17-47ad-a59f-6ba7133340d0">
  <nc:Equipment.Circut rdf:resource="#_9ced16ac-d076-4ef9-a241-a998a579e77b"/>
</cim:Equipment>
```

2.4 Metadata

ENTSO-E agreed to extend the header and metadata definitions by IEC 61970-552 Ed2. This new header definitions rely on W3C recommendations which are used worldwide and are positively recognised by the European Commission. The new definitions of the header mainly use Provenance ontology (PROV-O), Time Ontology and Data Catalog Vocabulary (DCAT). The global new header applicable for this profile is included in the metadata and document header specification document.

The header vocabulary contains all attributes defined in IEC 61970-552. This is done only for the purpose of having one vocabulary for header and to ensure transition for data exchanges that are using IEC 61970-552:2016 header. This profile does not use IEC 61970-552:2016 header attributes and relies only on the extended attributes.

2.4.1 Constraints

The identification of the constraints related to the metadata follows the same convention for naming of the constraints as for profile constraints.

- R:CSA:ALL:wasAttributedTo:usage

  The prov:wasAttributedTo should normally be the “X” EIC code of the actor or their URI (prov:Agent).

2.4.2 Reference metadata

The header defined for this profile requires availability of a set of reference metadata. For instance, the attribute prov:wasGeneratedBy requires a reference to an activity which produced the model or the related process. The activities are defined as reference metadata and their identifiers are referenced from the header to enable the receiving entity to retrieve the “static” (reference) information that it is not modified frequently. This approach imposes a requirement that both the sending entity and the receiving entity have access to a unique version of the reference metadata. Therefore, each business process shall define which reference metadata is used and where it is located.

3 Detailed Profile Specification

3.1 General

This package contains the grid disturbance profile.

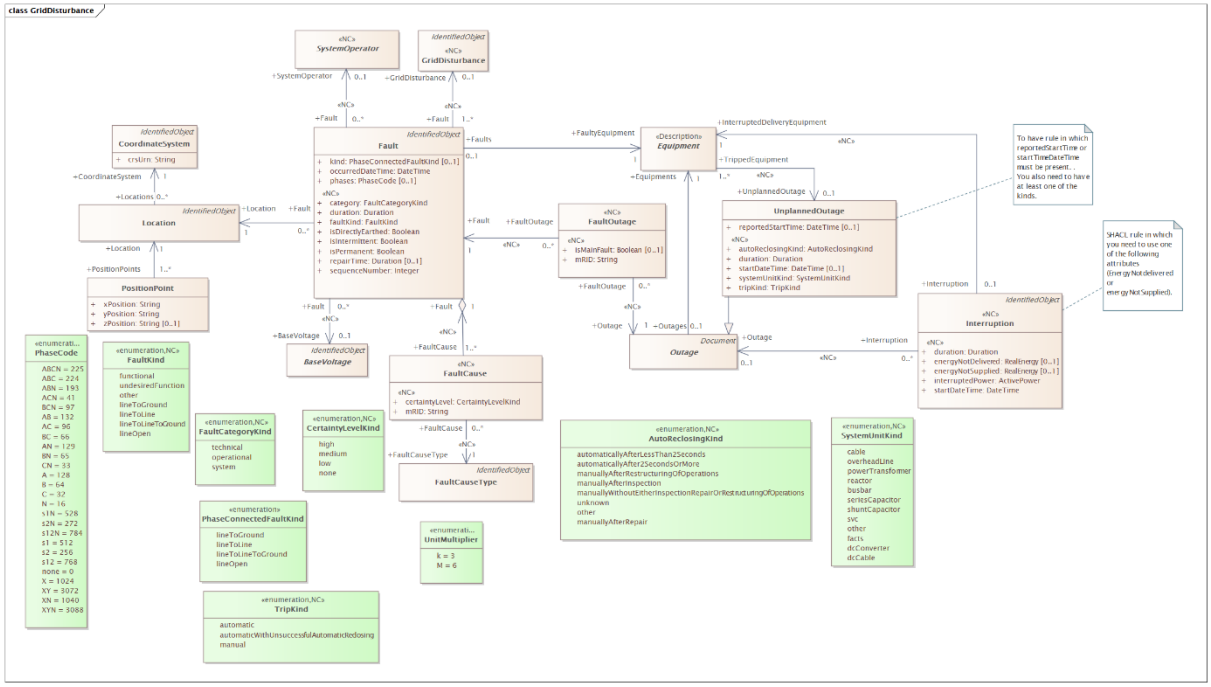

Figure 1 – Class diagram GridDisturbanceProfile::GridDisturbance

Figure 1: The diagram shows grid disturbance related classes.

3.2 (abstract) BaseVoltage

Inheritance path = IdentifiedObject
Defines a system base voltage which is referenced.
Table 1 shows all attributes of BaseVoltage.

Table 1 – Attributes of GridDisturbanceProfile::BaseVoltage

name	mult	type	description
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.3 CoordinateSystem

Inheritance path = IdentifiedObject
Coordinate reference system.
Table 2 shows all attributes of CoordinateSystem.

Table 2 – Attributes of GridDisturbanceProfile::CoordinateSystem

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

name	mult	type	description
			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::4236. A profile should limit this code to a set of allowed URNs agreed to by all sending and receiving parties.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.4 (abstract) Document

Inheritance path = IdentifiedObject

Parent class for different groupings of information collected and managed as a part of a business process. It will frequently contain references to other objects, such as assets, people and power system resources.

Table 3 shows all attributes of Document.

Table 3 – Attributes of GridDisturbanceProfile::Document

name	mult	type	description
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.5 (abstract,Description) Equipment root class

The parts of a power system that are physical devices, electronic or mechanical.

Table 4 shows all association ends of Equipment with other classes.

Table 4 – Association ends of GridDisturbanceProfile::Equipment with other classes

mult from	name	mult to	type	description
1..*	UnplannedOutage	0..1	UnplannedOutage	(NC) The outage this tripped breaker is involved with.

3.6 Fault

Inheritance path = IdentifiedObject

Abnormal condition causing current flow through conducting equipment, such as caused by equipment failure or short circuits from objects not typically modelled (for example, a tree falling on a line).

Table 5 shows all attributes of Fault.

Table 5 – Attributes of GridDisturbanceProfile::Fault

name	mult	type	description
kind	0..1	PhaseConnectedFaultKind	The kind of phase fault.

name	mult	type	description
phases	0..1	PhaseCode	The phases participating in the fault. The fault connections into these phases are further specified by the type of fault.
occurredDateTime	1..1	DateTime	The date and time at which the fault occurred.
duration	1..1	Duration	(NC) The duration of the fault.
repairTime	0..1	Duration	(NC) Time from when repair commences, including necessary troubleshooting, until the unit's function(s) has (have) been resumed and the unit is ready for operation. Note 1: repair time is registered only for permanent faults and does not include administrative delays (voluntary waiting time). However, any preparations necessary to carry out repairs, for example the collection or ordering of spare parts, waiting for spare parts or transport, are included in the repair time. Note 2: the repair time is zero if a fault is left unrepaired deliberately. Note 3: this definition differs from the IEC 192-07-19 definition by also including the preparation time necessary to carry out the repairs mentioned in note 1.
sequenceNumber	1..1	Integer	(NC) A chronological serial number indicating the order of the faults related to the grid disturbance. Primary faults have fault ID "1", and secondary/latent faults have fault ID "2" or more.
category	1..1	FaultCategoryKind	(NC) The fault category.
faultKind	1..1	FaultKind	(NC) One fault can consist of several fault types. If a fault consists of several fault types, the most significant fault type is used. In case of developing faults, that is in faults changing from one type to another, the final type is given.
isDirectlyEarthed	1..1	Boolean	(NC) Whether the power system is directly earthed (true) or compensated (false). Usually optional for faults on units with reactive compensation with voltages lower than 100 kV.
isIntermittent	1..1	Boolean	(NC) The kind of occurrence of the fault. It is either intermittent (true) or non-intermittent (false). An intermittent fault is a recurring fault in the same unit and in the same place and for the same reason which repeats itself before it becomes necessary to carry out any repairs or eliminate the cause [8]. A non-intermittent fault occurs only once. Note 1: a fault which repeats itself after an inspection, which did not result in the fault being pinpointed or repaired, is not considered an intermittent fault. A fault like this is considered as the beginning of a grid disturbance every time the fault occurs. Note 2: one example of an intermittent fault is galloping lines. Note 3: when deciding whether a fault is intermittent or not, one should consider more of the cause, location and consequence of the fault and not on the time between the faults. An intermittent fault is counted as one fault.

name	mult	type	description
			However, all individual caused outages are connected to this fault. Note 4: there is no standard for the required timespan between intermittent faults. Some system operators use 2 hours.
isPermanent	1..1	Boolean	(NC) Whether the fault is a permanent (true) or a temporary (false) fault. A permanent fault is a fault that will remain unless it is removed by some intervention. Note 1 to entry: The “intervention” may be modification or maintenance. Note 2: a permanent fault requires repair or adjustment before the unit is ready for operation. For example, the resetting of computers is considered as repair work and a switch in the wrong position is considered as a permanent fault. Signal acknowledgement is not considered as repair work. Note 3: the duration of the disconnection is irrelevant when determining if a fault is permanent or not. A temporary fault is a fault where the unit or component is undamaged and is restored to service by switching operations without repair but possibly with on-site inspection. Note 1: a temporary fault does not require measures other than the reconnection of circuit breakers, replacement of fuses or signal acknowledgement. Note 2: the duration of the disconnection is irrelevant when determining if a fault is temporary or not. If, for example, a fault results in long-term disconnection and (on-site) inspection cannot pinpoint its source, the fault is considered to be temporary as no repairs are carried out.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 6 shows all association ends of Fault with other classes.

Table 6 – Association ends of GridDisturbanceProfile::Fault with other classes

mult from	name	mult to	type	description
1..*	GridDisturbance	0..1	GridDisturbance	(NC) A grid disturbance to contain all faults.
0..*	SystemOperator	0..1	SystemOperator	(NC) The system operator in whose control area this fault occurred.
0..*	BaseVoltage	0..1	BaseVoltage	(NC) The base voltage of this fault.
0..1	FaultyEquipment	1..1	Equipment	Equipment carrying this fault.
0..*	Location	1..1	Location	Location of this fault.

3.7 (NC) FaultCause root class

Fault cause.
Table 7 shows all attributes of FaultCause.

373 **Table 7 – Attributes of GridDisturbanceProfile::FaultCause**

name	mult	type	description
certaintyLevel	1..1	CertaintyLevelKind	(NC) The degree of certainty of which the cause of a fault is determined by a user. Note 1: the used certainty levels are low, medium and high. High certainty level is used when the cause of a fault is 100 % certain or when the cause is the most probable cause and potentially determined by an expert. Medium certainty level is used when the cause of the fault is very probable but there is not enough evidence to fully support the claim. Low certainty level is used when there is some idea of what the cause could be with the help of, for example, the fault details or expert knowledge. Note 2: the fault cause 'unknown' is used if no other fault cause can be chosen by any degree of certainty.
mRID	1..1	String	(NC) 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.

374

375 Table 8 shows all association ends of FaultCause with other classes.

376 **Table 8 – Association ends of GridDisturbanceProfile::FaultCause with other classes**

mult from	name	mult to	type	description
1..*	Fault	1..1	Fault	(NC) The fault defined for this fault and cause combination.
0..*	FaultCauseType	1..1	FaultCauseType	(NC) The fault and cause combination to be simulated for this cause.

377

378 ## 3.8 FaultCauseType

379 Inheritance path = IdentifiedObject
380 Type of cause of the fault.
381 Table 9 shows all attributes of FaultCauseType.

382 **Table 9 – Attributes of GridDisturbanceProfile::FaultCauseType**

name	mult	type	description
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

383

384 ## 3.9 (NC) FaultOutage root class

385 Association class for relating one fault and one outage.
386 Table 10 shows all attributes of FaultOutage.

Table 10 – Attributes of GridDisturbanceProfile::FaultOutage

name	mult	type	description
isMainFault	0..1	Boolean	(NC) If true the fault outage is the main fault.
mRID	1..1	String	(NC) 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.

Table 11 shows all association ends of FaultOutage with other classes.

Table 11 – Association ends of GridDisturbanceProfile::FaultOutage with other classes

mult from	name	mult to	type	description
0..*	Fault	1..1	Fault	(NC) The fault defined for this combination of a fault and an outage.
0..*	Outage	1..1	Outage	(NC) The outage defined for this combination of a fault and an outage.

3.10 (NC) GridDisturbance

Inheritance path = IdentifiedObject

Automatic, unintended, or manual undeferrable switching of breakers as a result of faults in the power grid.

Table 12 shows all attributes of GridDisturbance.

Table 12 – Attributes of GridDisturbanceProfile::GridDisturbance

name	mult	type	description
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.11 (abstract) IdentifiedObject root class

This is a root class to provide common identification for all classes needing identification and naming attributes.

Table 13 shows all attributes of IdentifiedObject.

Table 13 – Attributes of GridDisturbanceProfile::IdentifiedObject

name	mult	type	description
description	0..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.
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.

name	mult	type	description
			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	0..1	String	The name is any free human readable and possibly non unique text naming the object.

3.12 (NC) Interruption

Inheritance path = IdentifiedObject

Disappearance of the supply voltage at a delivery point.

Table 14 shows all attributes of Interruption.

Table 14 – Attributes of GridDisturbanceProfile::Interruption

name	mult	type	description
startDateTime	1..1	DateTime	(NC) The date and time at which the interruption occurred.
duration	1..1	Duration	(NC) The duration of the interruption.
energyNotDelivered	0..1	RealEnergy	(NC) The estimated energy which would have been delivered through the delivery point if no interruption and no transmission restrictions had occurred.
energyNotSupplied	0..1	RealEnergy	(NC) The estimated energy which would have been supplied to end-users if no interruption and no transmission restrictions had occurred.
interruptedPower	1..1	ActivePower	(NC) The estimated power that was delivered through the delivery point when the interruption occurred.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 15 shows all association ends of Interruption with other classes.

Table 15 – Association ends of GridDisturbanceProfile::Interruption with other classes

mult from	name	mult to	type	description
0..1	InterruptedDeliveryEquipment	1..1	Equipment	(NC) The delivery point (equipment) that is affected by the interruption. It is an equipment, power transformer or busbar in the grid where electricity is exchanged.
0..*	Outage	0..1	Outage	(NC) One outage may have multiple interruptions.

3.13 Location

Inheritance path = IdentifiedObject

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.

Table 16 shows all attributes of Location.

Table 16 – Attributes of GridDisturbanceProfile::Location

name	mult	type	description
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 17 shows all association ends of Location with other classes.

Table 17 – Association ends of GridDisturbanceProfile::Location with other classes

mult from	name	mult to	type	description
0..*	CoordinateSystem	1..1	CoordinateSystem	Coordinate system used to describe position points of this location.

3.14 (abstract) Outage

Inheritance path = Document : IdentifiedObject

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.

Table 18 shows all attributes of Outage.

Table 18 – Attributes of GridDisturbanceProfile::Outage

name	mult	type	description
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 19 shows all association ends of Outage with other classes.

Table 19 – Association ends of GridDisturbanceProfile::Outage with other classes

mult from	name	mult to	type	description
0..1	Equipments	1..1	Equipment	All equipments associated with this outage.

3.15 PositionPoint root class

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).

Table 20 shows all attributes of PositionPoint.

Table 20 – Attributes of GridDisturbanceProfile::PositionPoint

name	mult	type	description
xPosition	1..1	String	X axis position.
yPosition	1..1	String	Y axis position.
zPosition	0..1	String	(if applicable) Z axis position.

Table 21 shows all association ends of PositionPoint with other classes.

Table 21 – Association ends of GridDisturbanceProfile::PositionPoint with other classes

mult from	name	mult to	type	description
1..*	Location	1..1	Location	Location described by this position point.

3.16 (abstract,NC) SystemOperator root class

System operator.

3.17 UnplannedOutage

Inheritance path = Outage : Document : IdentifiedObject

Document describing the consequence of an unplanned outage in a part of the electrical network. For the purposes of this model, an unplanned outage refers to a state where energy is not delivered; such as, customers out of service, a street light is not served, etc.

A unplanned outage may be created upon:

- impacts the SAIDI calculation
- 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.

Table 22 shows all attributes of UnplannedOutage.

Table 22 – Attributes of GridDisturbanceProfile::UnplannedOutage

name	mult	type	description
startDateTime	0..1	DateTime	(NC) The date and time at which the unplanned outage occurred.
duration	1..1	Duration	(NC) The duration of the unplanned outage.
tripKind	1..1	TripKind	(NC) Whether the type of the trip due to the outage was automatic, automatic with successful automatic reclosing or manual. In case of a fault in the reclosing automatics resulting in lack of reclosing, automatic should be chosen as an alternative.
autoReclosingKind	1..1	AutoReclosingKind	(NC) The type of autoreclosing that occurred with the trip. If high-speed automatic reclosing is successful at one end of a line, but the line needs to be reclosed manually at the other end, choose manual reclosing.

name	mult	type	description
			In this document, high-speed automatic reclosing refers to automatic reclosing after less than 2 seconds.
systemUnitKind	1..1	SystemUnitKind	(NC) The type of system unit of the component affected by the outage. A system unit is defined as: A group of components which are delimited by one or more circuit breakers. Note 1: the system unit concept has been defined to simplify the calculation of availability. While a system unit is always delimited by circuit breakers, an individual component may not always be. A system unit may therefore contain more than one component. Note 2: the circuit breakers are not included in the system unit. Note 3: a tripped element is synonymous to a tripped system unit. Note 4: the type of a system unit is determined by its dominant component. The available system unit types are power transformer, overhead line, cable, reactor, busbar, series capacitor, shunt capacitor and SVC. Note 5: when a system unit is no longer transporting or supplying electrical energy, the system unit is affected by an outage. The system unit is unavailable after the outage has occurred.
reportedStartTime	0..1	DateTime	The earliest start time of the Outage - as reported by some system or individual
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 23 shows all association ends of UnplannedOutage with other classes.

Table 23 – Association ends of GridDisturbanceProfile::UnplannedOutage with other classes

mult from	name	mult to	type	description
0..1	Equipments	1..1	Equipment	inherited from: Outage

3.18 (NC) AutoReclosingKind enumeration

The type of autoreclosing that occurred with the trip.
If high-speed automatic reclosing is successful at one end of a line, but the line needs to be reclosed manually at the other end, choose manual reclosing.
In this document, high-speed automatic reclosing refers to automatic reclosing after less than 2 seconds.
Table 24 shows all literals of AutoReclosingKind.

Table 24 – Literals of GridDisturbanceProfile::AutoReclosingKind

literal	value	description
automaticallyAfterLessThan2Seconds		If the automatic reclosing was successful in 2 seconds or less. Also known as "successful high-speed reclosing".

literal	value	description
automaticallyAfter2SecondsOrMore		If the automatic reclosing was successful in 2 seconds or more. Also known as "successful high-speed reclosing".
manuallyAfterRestructuringOfOperations		If the reclosing was done manually after restructuring of operations.
manuallyAfterInspection		If the reclosing was done manually after inspection of the component.
manuallyWithoutEitherInspectionRepairOrRestructuringOfOperations		If the reclosing was done manually without any inspections, repairs or restructurings of operations.
unknown		If the type of auto-reclosing is unknown.
other		If the type of auto-reclosing is not unknown but does not fit the other categories, report it as other.
manuallyAfterRepair		If the reclosing was done manually after repair.

3.19 (NC) CertaintyLevelKind enumeration

High certainty level is used when the cause of a fault is 100 % certain or when the cause is the most probable cause and potentially determined by an expert.
Table 25 shows all literals of CertaintyLevelKind.

Table 25 – Literals of GridDisturbanceProfile::CertaintyLevelKind

literal	value	description
high		The certainty level is high.
medium		The certainty level is medium.
low		The certainty level is low.
none		The certainty level is none.

3.20 (NC) FaultCategoryKind enumeration

Available kinds of fault categories.
Table 26 shows all literals of FaultCategoryKind.

Table 26 – Literals of GridDisturbanceProfile::FaultCategoryKind

literal	value	description
technical		A fault due to a technical error.
operational		A fault due to a temporary human error. Note 1: incorrect operation is considered a fault in a component, or in other words, the incorrect operation is attributed to the unit which has been operated incorrectly.
system		A fault due to off-nominal parameters, exceeding of regulated norms and standards, or exceeding protection limits. Note 1: Typical examples of system fault causes are high/low frequency, power oscillations, overload, overvoltage, undervoltage or high harmonic content in voltage or current. Common causes for system faults are significant changes in load or generation and switching of lines or transformers with following change of load flow.

500

501 ### 3.21 (NC) FaultKind enumeration

502 One fault can consist of several fault types. If a fault consists of several fault types, the most
503 significant fault type is used.
504 In case of developing faults, that is in faults changing from one type to another, the final type
505 is given.
506 Table 27 shows all literals of FaultKind.

507 **Table 27 – Literals of GridDisturbanceProfile::FaultKind**

literal	value	description
functional		The components main function failed to occur.
undesiredFunction		If the component's main function occurred correctly but had an undesired result, that is, the fault. Is only stated if the component is a circuit breaker, disconnector or control system.
other		For example, geomagnetic currents, SSR, capacitor bank imbalances, bad contact, overheating.
lineToGround		The fault connects the indicated phases to ground. The line to line fault impedance is not used and assumed infinite. The full ground impedance is connected between each phase specified in the fault and ground, but not between the phases.
lineToLine		The fault connects the specified phases together without a connection to ground. The ground impedance of this fault is ignored. The line to line impedance is connected between each of the phases specified in the fault. For example three times for a three phase fault, one time for a two phase fault. A single phase fault should not be specified.
lineToLineToGround		The fault connects the indicated phases to ground and to each other. The line to line impedance is connected between each of the phases specified in the fault in a full mesh. For example three times for a three phase fault, one time for a two phase fault. A single phase fault should not be specified. The full ground impedance is connected between each phase specified in the fault and ground.
lineOpen		The fault is when the conductor path is broken between two terminals. Additional coexisting faults may be required if the broken conductor also causes connections to grounds or other lines or phases.

508

509 ### 3.22 PhaseConnectedFaultKind enumeration

510 The type of fault connection among phases.
511 Table 28 shows all literals of PhaseConnectedFaultKind.

512 **Table 28 – Literals of GridDisturbanceProfile::PhaseConnectedFaultKind**

literal	value	description
lineToGround		The fault connects the indicated phases to ground. The line to line fault impedance is not used and assumed infinite. The full ground impedance is connected between each phase

literal	value	description
		specified in the fault and ground, but not between the phases.
lineToLine		The fault connects the specified phases together without a connection to ground. The ground impedance of this fault is ignored. The line to line impedance is connected between each of the phases specified in the fault. For example three times for a three phase fault, one time for a two phase fault. A single phase fault should not be specified.
lineToLineToGround		The fault connects the indicated phases to ground and to each other. The line to line impedance is connected between each of the phases specified in the fault in a full mesh. For example three times for a three phase fault, one time for a two phase fault. A single phase fault should not be specified. The full ground impedance is connected between each phase specified in the fault and ground.
lineOpen		The fault is when the conductor path is broken between two terminals. Additional coexisting faults may be required if the broken conductor also causes connections to grounds or other lines or phases.

3.23 PhaseCode enumeration

An unordered enumeration of phase identifiers. Allows designation of phases for both transmission and distribution equipment, circuits and loads. The enumeration, by itself, does not describe how the phases are connected together or connected to ground. Ground is not explicitly denoted as a phase.

Residential and small commercial loads are often served from single-phase, or split-phase, secondary circuits. For the example of s12N, phases 1 and 2 refer to hot wires that are 180 degrees out of phase, while N refers to the neutral wire. Through single-phase transformer connections, these secondary circuits may be served from one or two of the primary phases A, B, and C. For three-phase loads, use the A, B, C phase codes instead of s12N.

The integer values are from IEC 61968-9 to support revenue metering applications.

Table 29 shows all literals of PhaseCode.

Table 29 – Literals of GridDisturbanceProfile::PhaseCode

literal	value	description
ABCN	225	Phases A, B, C, and N.
ABC	224	Phases A, B, and C.
ABN	193	Phases A, B, and neutral.
ACN	41	Phases A, C and neutral.
BCN	97	Phases B, C, and neutral.
AB	132	Phases A and B.
AC	96	Phases A and C.
BC	66	Phases B and C.
AN	129	Phases A and neutral.
BN	65	Phases B and neutral.
CN	33	Phases C and neutral.
A	128	Phase A.

literal	value	description
B	64	Phase B.
C	32	Phase C.
N	16	Neutral phase.
s1N	528	Secondary phase 1 and neutral.
s2N	272	Secondary phase 2 and neutral.
s12N	784	Secondary phases 1, 2, and neutral.
s1	512	Secondary phase 1.
s2	256	Secondary phase 2.
s12	768	Secondary phase 1 and 2.
none	0	No phases specified.
X	1024	Unknown non-neutral phase.
XY	3072	Two unknown non-neutral phases.
XN	1040	Unknown non-neutral phase plus neutral.
XYN	3088	Two unknown non-neutral phases plus neutral.

3.24 (NC) SystemUnitKind enumeration

A system unit is defined as:
A group of components which are delimited by one or more circuit breakers.
Note 1: the system unit concept has been defined to simplify the calculation of availability. While a system unit is always delimited by circuit breakers, an individual component may not always be. A system unit may therefore contain more than one component.
Note 2: the circuit breakers are not included in the system unit.
Note 3: a tripped element is synonymous to a tripped system unit.
Note 4: the type of a system unit is determined by its dominant component. The available system unit types are power transformer, overhead line, cable, reactor, busbar, series capacitor, shunt capacitor and SVC.
Note 5: when a system unit is no longer transporting or supplying electrical energy, the system unit is affected by an outage. The system unit is unavailable after the outage has occurred.
Table 30 shows all literals of SystemUnitKind.

Table 30 – Literals of GridDisturbanceProfile::SystemUnitKind

literal	value	description
cable		If the main function of the system unit is cable.
overheadLine		If the main function of the system unit is overhead line.
powerTransformer		If the main function of the system unit is power transformer.
reactor		If the main function of the system unit is reactor.
busbar		If the main function of the system unit is busbar.
seriesCapacitor		If the main function of the system unit is series capacitor.
shuntCapacitor		If the main function of the system unit is shunt capacitor.
svc		If the main function of the system unit is static var compensator (SVC).
other		If it is of other kind.
facts		If the main function of the system unit is FACTS.

literal	value	description
dcConverter		If the main function of the system unit is DCConverter.
dcCable		If the main function of the system unit is DCCable.

3.25 (NC) TripKind enumeration

Whether the type of the trip due to the outage was automatic, automatic with successful automatic reclosing or manual.
In case of a fault in the reclosing automatics resulting in lack of reclosing, automatic should be chosen as an alternative.
Table 31 shows all literals of TripKind.

Table 31 – Literals of GridDisturbanceProfile::TripKind

literal	value	description
automatic		The trip that resulted in the outage was automatic. In case of a fault in the reclosing automatics resulting in lack of reclosing, automatic should be chosen as an alternative.
automaticWithUnsuccessfulAutomaticReclosing		The trip that resulted in an outage was correctly initiated but the automatic reclosing was unsuccessful. In case of a fault in the reclosing automatics resulting in lack of reclosing, automatic should be chosen as an alternative.
manual		The trip that resulted in the outage was manually cleared.

3.26 UnitMultiplier enumeration

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 "Þ" represents the derived unit "m2Pers", then applying the multiplier "k" can be conceptualized simply as "kÞ".
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 "Þ", then it is easier to conceptualize the multiplier "m" as creating the proper unit "mÞ", and not the forbidden unit "mkg".
Table 32 shows all literals of UnitMultiplier.

Table 32 – Literals of GridDisturbanceProfile::UnitMultiplier

literal	value	description
k	3	Kilo 10**3.
M	6	Mega 10**6.

572

573 ### 3.27 UnitSymbol enumeration

574 The derived units defined for usage in the CIM. In some cases, the derived unit is equal to an
575 SI unit. Whenever possible, the standard derived symbol is used instead of the formula for the
576 derived unit. For example, the unit symbol Farad is defined as "F" instead of "CPerV". In cases
577 where a standard symbol does not exist for a derived unit, the formula for the unit is used as
578 the unit symbol. For example, density does not have a standard symbol and so it is represented
579 as "kgPerm3". With the exception of the "kg", which is an SI unit, the unit symbols do not contain
580 multipliers and therefore represent the base derived unit to which a multiplier can be applied as
581 a whole.
582 Every unit symbol is treated as an unparseable text as if it were a single-letter symbol. The
583 meaning of each unit symbol is defined by the accompanying descriptive text and not by the
584 text contents of the unit symbol.
585 To allow the widest possible range of serializations without requiring special character handling,
586 several substitutions are made which deviate from the format described in IEC 80000-1. The
587 division symbol "/" is replaced by the letters "Per". Exponents are written in plain text after the
588 unit as "m3" instead of being formatted as "m" with a superscript of 3 or introducing a symbol
589 as in "m^3". The degree symbol "°" is replaced with the letters "deg". Any clarification of the
590 meaning for a substitution is included in the description for the unit symbol.
591 Non-SI units are included in list of unit symbols to allow sources of data to be correctly labelled
592 with their non-SI units (for example, a GPS sensor that is reporting numbers that represent feet
593 instead of meters). This allows software to use the unit symbol information correctly convert
594 and scale the raw data of those sources into SI-based units.
595 The integer values are used for harmonization with IEC 61850.
596 Table 33 shows all literals of UnitSymbol.

597 **Table 33 – Literals of GridDisturbanceProfile::UnitSymbol**

literal	value	description
W	38	Real power in watts (J/s). Electrical power may have real and reactive components. The real portion of electrical power (I^2R or VIcos(phi)), is expressed in Watts. See also apparent power and reactive power.
Wh	72	Real energy in watt hours.

598

599 ### 3.28 ActivePower datatype

600 Product of RMS value of the voltage and the RMS value of the in-phase component of the
601 current.
602 Table 34 shows all attributes of ActivePower.

603 **Table 34 – Attributes of GridDisturbanceProfile::ActivePower**

name	mult	type	description
multiplier	0..1	UnitMultiplier	(const=M)
unit	0..1	UnitSymbol	(const=W)
value	0..1	Float	

604

605 ### 3.29 RealEnergy datatype

606 Real electrical energy.
607 Table 35 shows all attributes of RealEnergy.

608 **Table 35 – Attributes of GridDisturbanceProfile::RealEnergy**

name	mult	type	description
multiplier	0..1	UnitMultiplier	
unit	0..1	UnitSymbol	(const=Wh)
value	0..1	Float	

609

610 ### 3.30 Boolean primitive

611 A type with the value space "true" and "false".

612 ### 3.31 DateTime primitive

613 Date and time as "yyyy-mm-ddThh:mm:ss.sss", which conforms with ISO 8601. UTC time zone
614 is specified as "yyyy-mm-ddThh:mm:ss.sssZ". A local timezone relative UTC is specified as
615 "yyyy-mm-ddThh:mm:ss.sss-hh:mm". The second component (shown here as "ss.sss") could
616 have any number of digits in its fractional part to allow any kind of precision beyond seconds.

617 ### 3.32 Duration primitive

618 Duration as "PnYnMnDTnHnMnS" which conforms to ISO 8601, where nY expresses a number
619 of years, nM a number of months, nD a number of days. The letter T separates the date
620 expression from the time expression and, after it, nH identifies a number of hours, nM a number
621 of minutes and nS a number of seconds. The number of seconds could be expressed as a
622 decimal number, but all other numbers are integers.

623 ### 3.33 Integer primitive

624 An integer number. The range is unspecified and not limited.

625 ### 3.34 Float primitive

626 A floating point number. The range is unspecified and not limited.

627 ### 3.35 String primitive

628 A string consisting of a sequence of characters. The character encoding is UTF-8. The string
629 length is unspecified and unlimited.

630

631