European Network of
Transmission System Operators
for Electricity

AVAILABLE REMEDIAL ACTION PROFILE SPECIFICATION

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SOC APPROVED
VERSION 1.0

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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	Release	Date	Paragraph	Comments
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1 Introduction

The available remedial action profile is a profile to exchange a list of available remedial actions.

A remedial action means any measure applied by a TSO or several TSOs, manually or automatically, in order to maintain operational security.[1]

An available remedial action is a remedial action which is available to solve identified constraints. It includes the needed technical and cost information.[2]

The available remedial actions are input data for security analysis.

The available remedial action profile enables the exchange of both curative and preventive remedial actions. Grid state alterations (the change in the power system state that should be applied) are defined for each remedial action. The definition of grid state alterations allows for constraining or further precising some of the properties available in the IGM. Grid state alterations can be configured for every parameter of the steady state hypothesis instance data from the IGM. The available remedial action profile provides information on the availability of the remedial actions. In cases where it is necessary to only update the status of the remedial action, only an instance of RemedialAction class can be exchanged without any other objects from the profile

2 Application profile specification

2.1 Version information

The content is generated from UML model file CGMES30v25_501-20v01_HeaderMetaData-10v08_CSA01v35.eap.

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

- Title: Available Remedial Action Vocabulary
- Keyword: ARA
- Description: This vocabulary is describing the available remedial action profile.
- Version IRI: http://entsoe.eu/ns/CIM/AvailableRemedialAction-EU/1.0
- Version info: 1.0.0
- 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://CGMES-30v25_501-20v01.eap
- Identifier: urn:uuid:bb6670e1-ad28-4504-bbc4-3aaa4929c979

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}"

[1] [SOURCE: CACM art.2.13]

[2] [SOURCE: 2019 Inter-RSC report]

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.

- R:CSA:ALL:Region:reference

  The reference to the Region is normally a reference to the capacity calculation region, which is identified by “Y” EIC code of the capacity calculation region.

- R:CSA:ALL:SystemOperator:reference

  The reference to the System Operator is normally identified by “X” EIC code of TSO.

- R:CSA:ARA:RemedialActionCostCharacteristic:usage

  If the RemedialActionCostCharacteristic is not defined, the RemedialAction is non-costly.

- C:CSA:ARA:RemedialAction:gridStateAlteration

  A RemedialAction shall have at least one GridStateAlteration.

- C:CSA:ARA:RemedialAction:connectingSystemOperator

  A RemedialAction shall have one connecting SystemOperator.

- C:CSA:ARA:RemedialAction:region

  A RemedialAction shall be considered in at least one Region.

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 is included in the metadata and document header specification document.

For this profile, header definitions are embedded directly in the profile. The header and the payload are in principle two different profiles, but they are currently implemented as one profile specification due to limitation in the current standards. With the approval of IEC 61970-501 Ed2 it will be possible to export it as two embedded profiles.

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 (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 available remedial action profile.

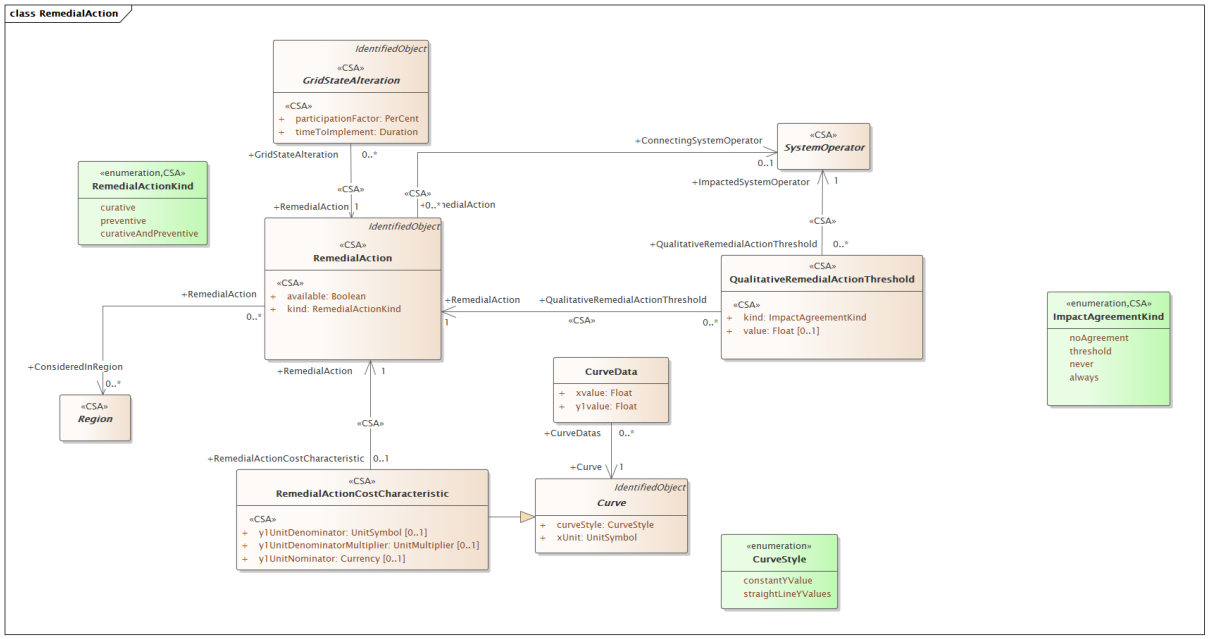


Figure 1 – Class diagram AvailableRemedialActionProfile::RemedialAction

Figure 1: The diagram contains main classes related to the remedial action.

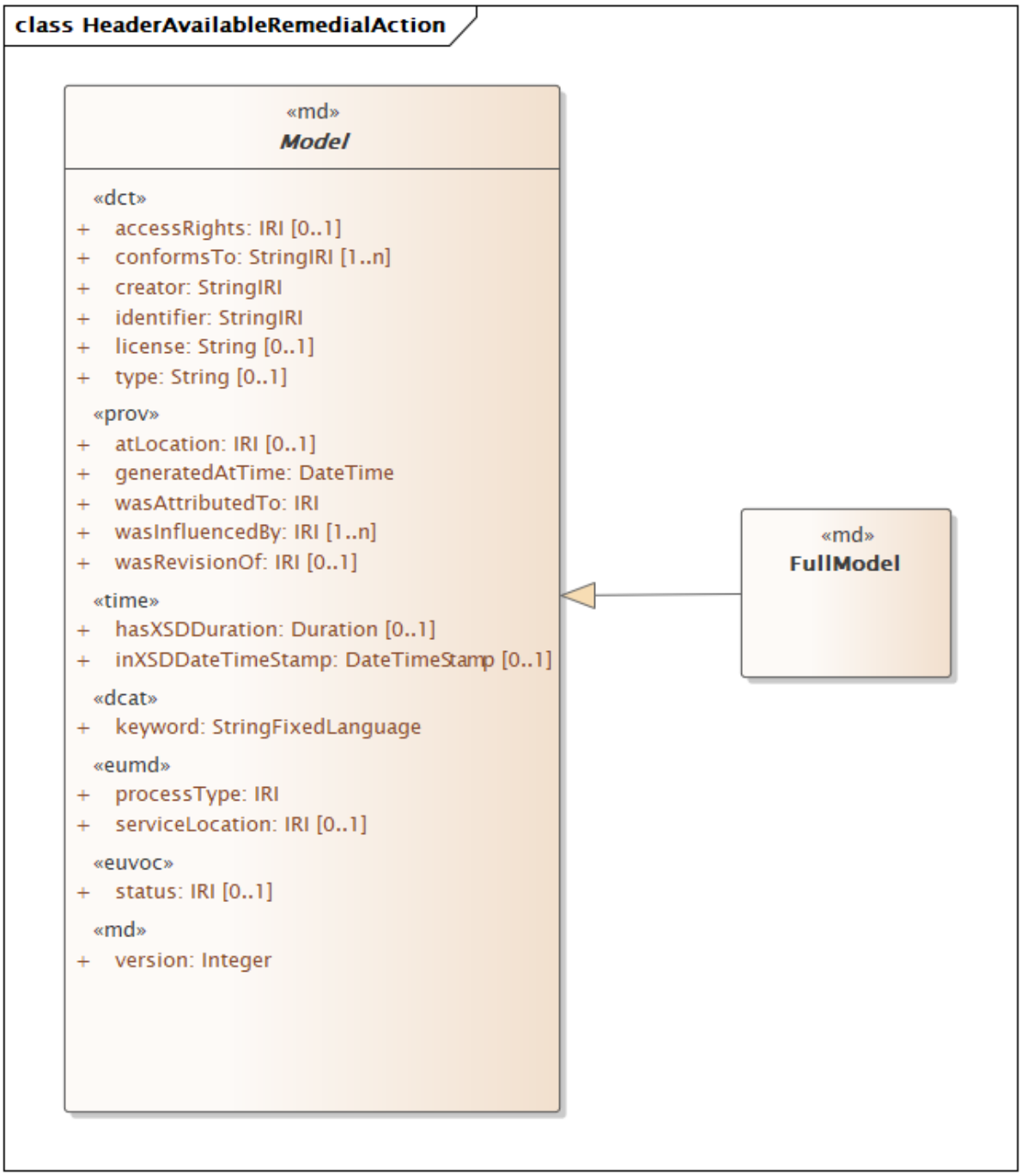
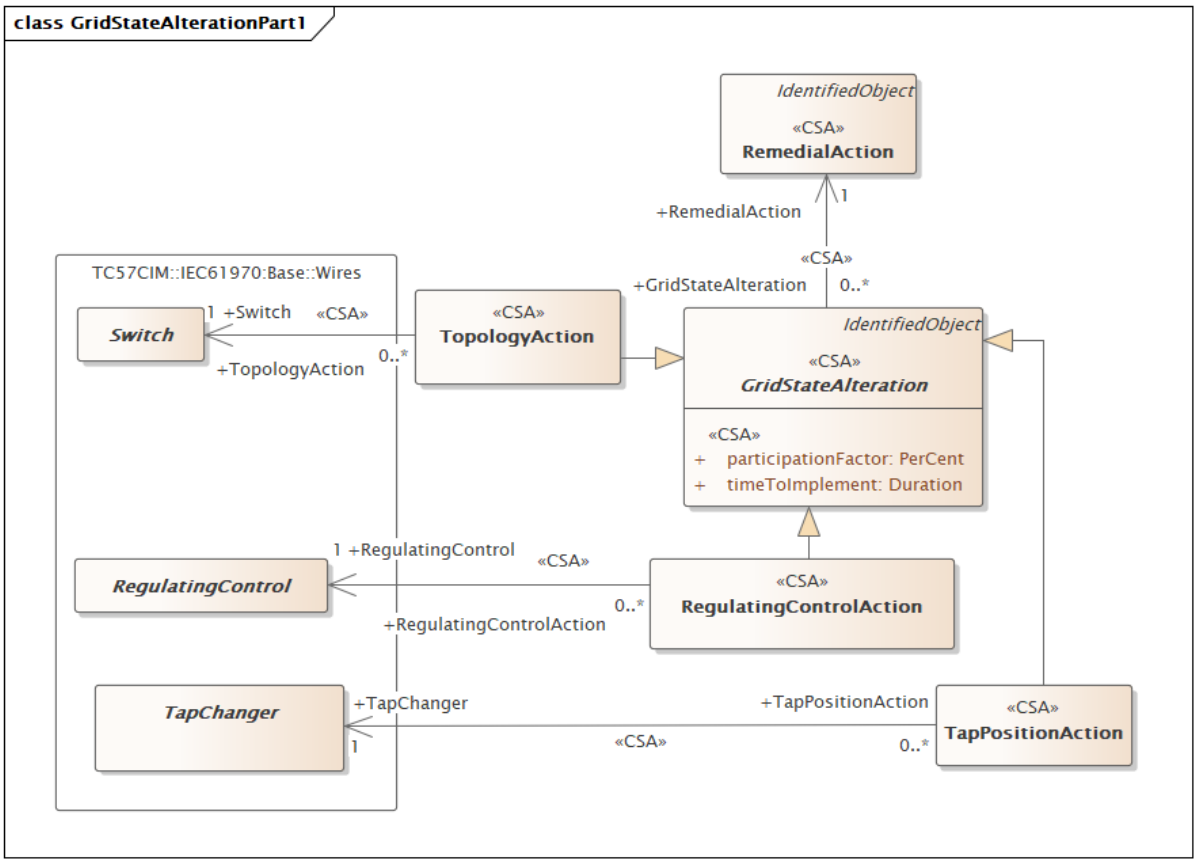


Figure 2 – Class diagram
AvailableRemedialActionProfile::HeaderAvailableRemedialAction

Figure 2: The diagram contains classes related to the header.



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412 **Figure 3 – Class diagram AvailableRemedialActionProfile::GridStateAlterationPart1**

413 Figure 3: This diagram contains extended classes for the purpose of the remedial action data
414 exchange.

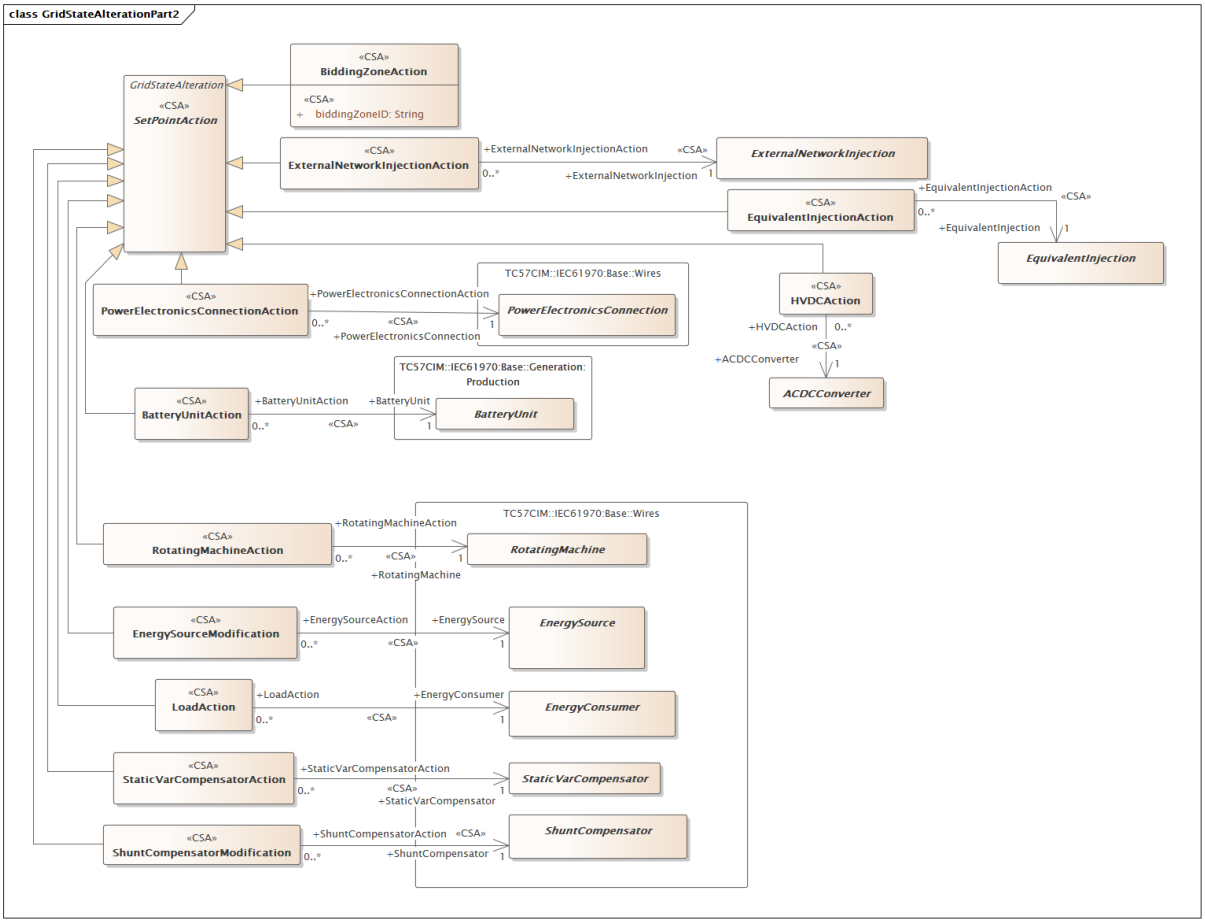

Figure 4 – Class diagram AvailableRemedialActionProfile::GridStateAlterationPart2

Figure 4: This diagram contains extended classes for the purpose of the remedial action data exchange.

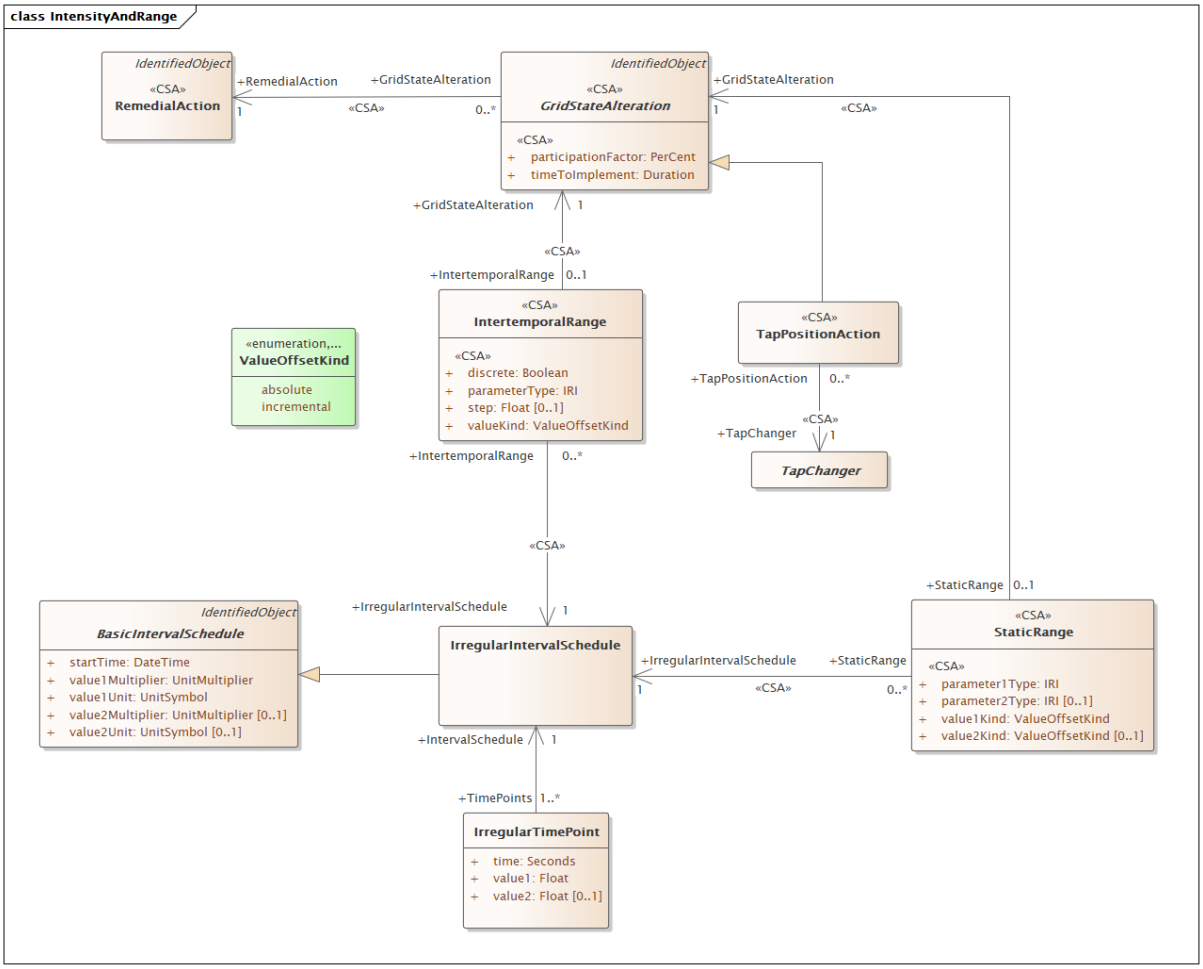

Figure 5 – Class diagram AvailableRemedialActionProfile::IntensityAndRange

Figure 5: This diagram contains extended classes related to the modelling of static, dynamic ranges and intensity.

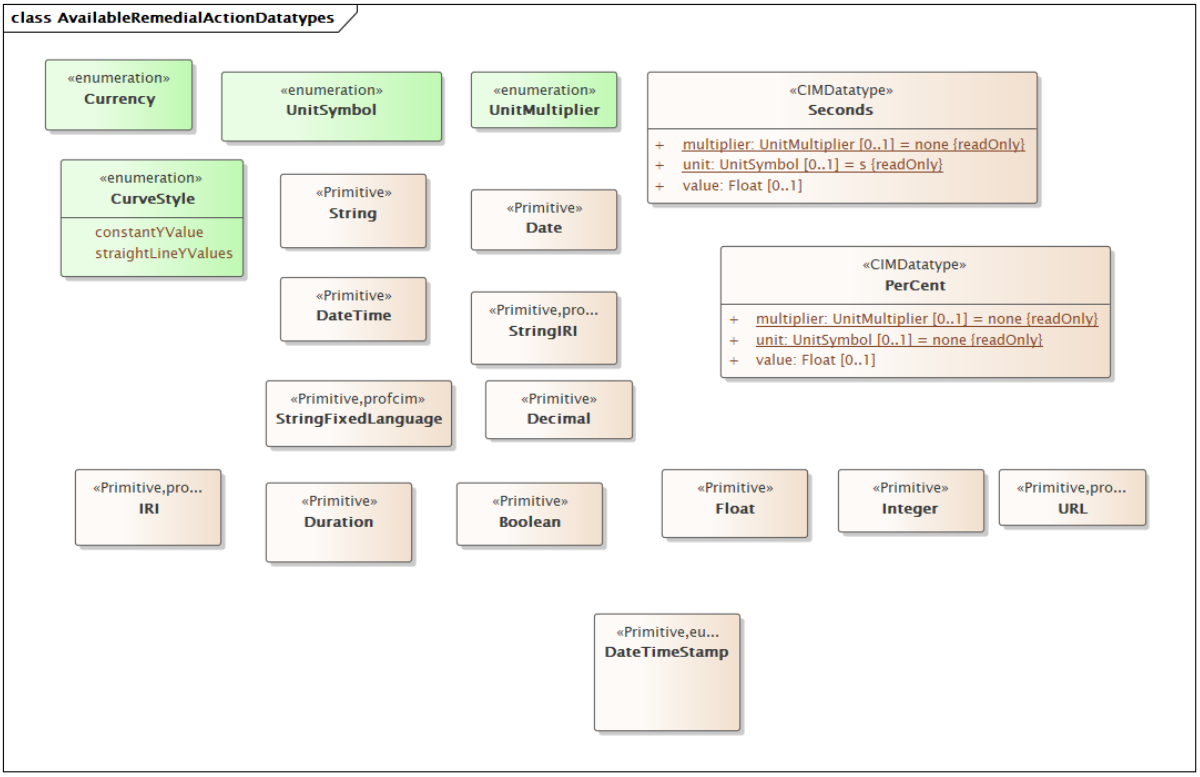

Figure 6 – Class diagram AvailableRemedialActionProfile::AvailableRemedialActionDatatypes

Figure 6: The diagram shows datatypes that are used by classes in the profile. Stereotypes are used to describe the datatypes. The following stereotypes are defined:
<<enumeration>> A list of permissible constant values.
<<Primitive>> The most basic data types used to compose all other data types.
<<CIMDatatype>> A datatype that contains a value attribute, an optional unit of measure and a unit multiplier. The unit and multiplier may be specified as a static variable initialized to the allowed value.
<<Compound>> A composite of Primitive, enumeration, CIMDatatype or other Compound classes, as long as the Compound classes do not recurse.
For all datatypes both positive and negative values are allowed unless stated otherwise for a particular datatype.

3.2 (CSA) QualitativeRemedialActionThreshold root class

It provides the qualitative threshold for a remedial action. It is only applicable to quantifiable grid state alterations such as tap alteration, redispatch, target value alteration, but not status related alterations.
All grid alterations linked to the remedial action have to be of the same type.
Table 1 shows all attributes of QualitativeRemedialActionThreshold.

Table 1 – Attributes of AvailableRemedialActionProfile::QualitativeRemedialActionThreshold

name	mult	type	description
value	0..1	Float	(CSA) The value is the threshold about which the System Operator is potentially impacted.
kind	1..1	ImpactAgreementKind	(CSA) The impact agreement kind.

Table 2 shows all association ends of QualitativeRemedialActionThreshold with other classes.

Table 2 – Association ends of AvailableRemedialActionProfile::QualitativeRemedialActionThreshold with other classes

mult from	name	mult to	type	description
0..*	RemedialAction	1..1	RemedialAction	(CSA) The remedial action that has a qualitative threshold.
0..*	ImpactedSystemOperator	1..1	SystemOperator	(CSA) The impacted System Operator that assigns a qualitative threshold.

3.3 (abstract) EnergyConsumer root class

Generic user of energy - a point of consumption on the power system model. EnergyConsumer.pfixed, .qfixed, .pfixedPct and .qfixedPct have meaning only if there is no LoadResponseCharacteristic associated with EnergyConsumer or if LoadResponseCharacteristic.exponentModel is set to False.

3.4 (md) FullModel

Inheritance path = Model
It represents the full model header and its contents is described by the Model class.
Table 3 shows all attributes of FullModel.

Table 3 – Attributes of AvailableRemedialActionProfile::FullModel

name	mult	type	description
version	1..1	Integer	(md) inherited from: Model
status	0..1	IRI	(euvoc) inherited from: Model
keyword	1..1	StringFixedLanguage	(dcat) inherited from: Model
accessRights	0..1	IRI	(dct) inherited from: Model
conformsTo	1..n	StringIRI	(dct) inherited from: Model
identifier	1..1	StringIRI	(dct) inherited from: Model
license	0..1	String	(dct) inherited from: Model
type	0..1	String	(dct) inherited from: Model
generatedAtTime	1..1	DateTime	(prov) inherited from: Model
atLocation	0..1	IRI	(prov) inherited from: Model
wasInfluencedBy	1..n	IRI	(prov) inherited from: Model
wasAttributedTo	1..1	IRI	(prov) inherited from: Model
wasRevisionOf	0..1	IRI	(prov) inherited from: Model
inXSDDateTimeStamp	0..1	DateTimeStamp	(time) inherited from: Model
hasXSDDuration	0..1	Duration	(time) inherited from: Model
processType	1..1	IRI	(eumd) inherited from: Model
creator	1..1	StringIRI	(dct) inherited from: Model
serviceLocation	0..1	IRI	(eumd) inherited from: Model

3.5 (abstract) IdentifiedObject root class

This is a root class to provide common identification for all classes needing identification and naming attributes.
Table 4 shows all attributes of IdentifiedObject.

Table 4 – Attributes of AvailableRemedialActionProfile::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. 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.

3.6 (abstract,md) Model root class

A Model is a collection of data describing instances, objects or entities, real or computed. In the context of CIM the semantics of the data is defined by profiles. Hence a model can contain equipment data, power flow initial values, power flow results etc.
The Model class describes the header content that is the same for the FullModel and the DifferenceModel. A Model is identified by an rdf:about attribute. The rdf:about attribute uniquely describes the model data and not the CIMXML document. A new rdf:about identification is generated for created documents only when the model data has changed. A repeated creation of documents from unchanged model data shall have the same rdf:about identification as previous document generated from the same model data.
Table 5 shows all attributes of Model.

Table 5 – Attributes of AvailableRemedialActionProfile::Model

name	mult	type	description
version	1..1	Integer	(md) The version of the model. If the instance file is imported and exported with no change, the version number is kept the same. The version changes only if the content of the file changes. It is the same logic as for the header id. The version is the human readable id. [CIM context: It relates to the version of the document and not the version of the model which is serialized.].
status	0..1	IRI	(euvoc) Indicates the status of a skos:Concept or a skosxl:Label, or any resource related to controlled vocabulary management. [CIM context: The condition or position of an object with regard to its standing. (Validated, Primary, Backup etc.)].
keyword	1..1	StringFixedLanguage	(dcat) A keyword or tag describing a resource. [CIM context: The intended content type of the model, usually the profile keyword. Used to identify what profiles and content is expected in the document, e.g., Equipment, Boundary, SSH, AE, etc. The same keyword is used for different versions of same profile. It can be also used to

name	mult	type	description
			identify different content based on the same profile. For instance, as the equipment profile can be used for both boundary data and equipment not related to boundary, the keyword is different to indicate that boundary data is exchanged. In order to avoid ambiguity the property is not exchanged in cases where the document contains multiple profiles referenced by dct:conformsTo.].
accessRights	0..1	IRI	(dct) Information about who access the resource or an indication of its security status.Access Rights may include information regarding access or restrictions based on privacy, security, or other policies. [CIM context: Reference to the confidentiality level that shall be applied when handling this model.].
conformsTo	1..n	StringIRI	(dct) An established standard to which the described resource conforms. [CIM context: An IRI describing the profile that governs this model. It uniquely identifies the profile and its version. Multiple instances of the property describe all standards or specifications to which the model and the document representing this model conform to. A document would normally conform to profile definitions, the constraints that relate to the profile and/or the set of business specific constrains. A reference to a machine- readable constraints or specification indicates that the document was tested against these constraints and it conforms to them.].
identifier	1..1	StringIRI	(dct) An unambiguous reference to the resource within a given context. Recommended practice is to identify the resource by means of a string conforming to an identification system. Examples include International Standard Book Number (ISBN), Digital Object Identifier (DOI), and Uniform Resource Name (URN). Persistent identifiers should be provided as HTTP URIs. [CIM context: A unique identifier of the model which is serialised in the document where the header is located. The identifier is persistent for a given version of the model and shall change when the model changes. If a model is serialized as complete (full) model or as difference model exchange the identifier shall be the same. The identifier shall not be used as an identifier of the document which can be different for a given version of a model.].
license	0..1	String	(dct) A legal document giving official permission to do something with the resource. Recommended practice is to identify the license document with a URI. If this is not possible or feasible, a literal value that identifies the license may be provided. [CIM context: Reference to the license under which the data is made available. If no license holder is defined,

name	mult	type	description
			then the original data provider holds the license.].
type	0..1	String	(dct) The nature or genre of the resource. Recommended practice is to use a controlled vocabulary such as the DCMI Type Vocabulary [DCMI-TYPE]. To describe the file format, physical medium, or dimensions of the resource, use the property Format.
generatedAtTime	1..1	DateTime	(prov) Generation is the completion of production of a new entity by an activity. This entity did not exist before generation and becomes available for usage after this generation. [CIM context: The date and time when the model was serialized in the document where the header is located. The format is an extended format according to the ISO 8601-2005. European exchanges shall refer to UTC.].
atLocation	0..1	IRI	(prov) A location can be an identifiable geographic place (ISO 19112), but it can also be a non-geographic place such as a directory, row, or column. As such, there are numerous ways in which location can be expressed, such as by a coordinate, address, landmark, and so forth. [CIM context: Reference to a region or a domain for which this model is provided.].
wasInfluencedBy	1..n	IRI	(prov) Influence is the capacity of an entity, activity, or agent to have an effect on the character, development, or behavior of another by means of usage, start, end, generation, invalidation, communication, derivation, attribution, association, or delegation. [CIM context: A reference to the model on which the model serialised in this document depends on. The references are maintained by the producer of the model. Minimum requirements for the dependency are specified and can be restricted within a business process as long as they do not contradict requirements by standards. For instance, IEC 61970-600-1 defines minimum requirements for the profiles defined in that standard.].
wasAttributedTo	1..1	IRI	(prov) Attribution is the ascribing of an entity to an agent. [CIM context: Reference to the agent (or service provider) from which the model originates.].
wasRevisionOf	0..1	IRI	(prov) A revision is a derivation for which the resulting entity is a revised version of some original. The implication here is that the resulting entity contains substantial content from the original. Revision is a particular case of derivation. [CIM context: When a model is updated the resulting model supersedes the models that were used as basis for the update. Hence this is a reference to the model which are superseded by this model. A model can supersede 1 or more models, e.g. a difference model or a full model supersede multiple models (difference or full). In this case,

name	mult	type	description
			multiple properties are included in the header. The referenced document(s) is (are) identified by the URN/MRID/UUID in the FullModel rdf:about attribute when full model(s) is (are) referenced and by the URN/MRID/UUID in the DifferenceModel rdf:about attribute when difference model(s) is (are) referenced.].
inXSDDateTimeStamp	0..1	DateTimeStamp	(time) Position of an instant, expressed using xsd:dateTimeStamp, in which the time-zone field is mandatory. [CIM context: The date and time that this model represents, i.e. for which the model is (or was) valid. If used in relation with hasXSDDuration it indicates the beginning of the validity period. It is indicating either an instant (in cases where the model is only valid for a point in time) or the start time of a period. If not provided the model is considered valid for any time stamp. The format is an extended format according to the ISO 8601-2005. European exchanges shall refer to UTC.].
hasXSDDuration	0..1	Duration	(time) Extent of a temporal entity, expressed using xsd:duration. [CIM context: The duration of the validity period of the model that it is serialized in the document where the header is located. It is only used in relation to the inXSDDateTimeStamp property which indicates the beginning of the validity period of the model. The end of the validity period is derived from both inXSDDateTimeStamp and hasXSDDuration.].
processType	1..1	IRI	(eumd) The exact business nature. Reference to Business Process configurations.
creator	1..1	StringIRI	(dct) An entity responsible for making the resource. Recommended practice is to identify the creator with a URI. If this is not possible or feasible, a literal value that identifies the creator may be provided. [CIM context: The name of the agent (Modeling Authority) from which the model originates].
serviceLocation	0..1	IRI	(eumd) Reference to a service location (region or a domain).

3.7 (abstract) ShuntCompensator root class

A shunt capacitor or reactor or switchable bank of shunt capacitors or reactors. A section of a shunt compensator is an individual capacitor or reactor. A negative value for bPerSection indicates that the compensator is a reactor. ShuntCompensator is a single terminal device. Ground is implied.

3.8 (abstract) BasicIntervalSchedule

Inheritance path = IdentifiedObject
Schedule of values at points in time.
Table 6 shows all attributes of BasicIntervalSchedule.

Table 6 – Attributes of AvailableRemedialActionProfile::BasicIntervalSchedule

name	mult	type	description
startTime	1..1	DateTime	The time for the first time point. The value can be a time of day, not a specific date.
value1Multiplier	1..1	UnitMultiplier	Multiplier for value1.
value1Unit	1..1	UnitSymbol	Value1 units of measure.
value2Multiplier	0..1	UnitMultiplier	Multiplier for value2.
value2Unit	0..1	UnitSymbol	Value2 units of measure.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.9 (abstract) Curve

Inheritance path = IdentifiedObject

A multi-purpose curve or functional relationship between an independent variable (X-axis) and dependent (Y-axis) variables.

Table 7 shows all attributes of Curve.

Table 7 – Attributes of AvailableRemedialActionProfile::Curve

name	mult	type	description
curveStyle	1..1	CurveStyle	The style or shape of the curve.
xUnit	1..1	UnitSymbol	The X-axis units of measure.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.10 CurveData root class

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

Table 8 shows all attributes of CurveData.

Table 8 – Attributes of AvailableRemedialActionProfile::CurveData

name	mult	type	description
xvalue	1..1	Float	The data value of the X-axis variable, depending on the X-axis units.
y1value	1..1	Float	The data value of the first Y-axis variable, depending on the Y-axis units.

Table 9 shows all association ends of CurveData with other classes.

Table 9 – Association ends of AvailableRemedialActionProfile::CurveData with other classes

mult from	name	mult to	type	description
0..*	Curve	1..1	Curve	The curve of this curve data point.

3.11 IrregularIntervalSchedule

Inheritance path = BasicIntervalSchedule : IdentifiedObject

The schedule has time points where the time between them varies.

Table 10 shows all attributes of IrregularIntervalSchedule.

Table 10 – Attributes of AvailableRemedialActionProfile::IrregularIntervalSchedule

name	mult	type	description
startTime	1..1	DateTime	inherited from: BasicIntervalSchedule
value1Multiplier	1..1	UnitMultiplier	inherited from: BasicIntervalSchedule
value1Unit	1..1	UnitSymbol	inherited from: BasicIntervalSchedule
value2Multiplier	0..1	UnitMultiplier	inherited from: BasicIntervalSchedule
value2Unit	0..1	UnitSymbol	inherited from: BasicIntervalSchedule
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.12 IrregularTimePoint root class

TimePoints for a schedule where the time between the points varies.

Table 11 shows all attributes of IrregularTimePoint.

Table 11 – Attributes of AvailableRemedialActionProfile::IrregularTimePoint

name	mult	type	description
time	1..1	Seconds	The time is relative to the schedule starting time.
value1	1..1	Float	The first value at the time. The meaning of the value is defined by the derived type of the associated schedule.
value2	0..1	Float	The second value at the time. The meaning of the value is defined by the derived type of the associated schedule.

Table 12 shows all association ends of IrregularTimePoint with other classes.

Table 12 – Association ends of AvailableRemedialActionProfile::IrregularTimePoint with other classes

mult from	name	mult to	type	description
1..*	IntervalSchedule	1..1	IrregularIntervalSchedule	An IrregularTimePoint belongs to an IrregularIntervalSchedule.

3.13 (abstract,CSA) Region root class

A region where the system operator belongs to.

3.14 (abstract,CSA) SystemOperator root class

System operator.

Table 13 shows all association ends of SystemOperator with other classes.

Table 13 – Association ends of AvailableRemedialActionProfile::SystemOperator with other classes

mult from	name	mult to	type	description
1..1	QualitativeRemedialActionThreshold	0..*	QualitativeRemedialActionThreshold	(CSA) The qualitative threshold for a given System Operator.

3.15 (abstract) ACDCConverter root class

A unit with valves for three phases, together with unit control equipment, essential protective and switching devices, DC storage capacitors, phase reactors and auxiliaries, if any, used for conversion.

3.16 (abstract) BatteryUnit root class

An electrochemical energy storage device.

3.17 (abstract) EnergySource root class

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

3.18 Equipment root class

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

3.19 (abstract) EquivalentInjection root class

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

3.20 (abstract) ExternalNetworkInjection root class

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

3.21 (abstract) PowerElectronicsConnection root class

A connection to the AC network for energy production or consumption that uses power electronics rather than rotating machines.

3.22 (abstract) RegulatingControl root class

Specifies a set of equipment that works together to control a power system quantity such as voltage or flow.
Remote bus voltage control is possible by specifying the controlled terminal located at some place remote from the controlling equipment.
The specified terminal shall be associated with the connectivity node of the controlled point. The most specific subtype of RegulatingControl shall be used in case such equipment participate in the control, e.g. TapChangerControl for tap changers.
For flow control, load sign convention is used, i.e. positive sign means flow out from a TopologicalNode (bus) into the conducting equipment.
The attribute minAllowedTargetValue and maxAllowedTargetValue are required in the following cases:
- For a power generating module operated in power factor control mode to specify maximum and minimum power factor values;
- Whenever it is necessary to have an off center target voltage for the tap changer regulator. For instance, due to long cables to off shore wind farms and the need to have a simpler setup at the off shore transformer platform, the voltage is controlled from the land at the connection point for the off shore wind farm. Since there usually is a voltage rise along the cable, there is typical and overvoltage of up 3-4 kV compared to the on shore station. Thus in normal operation the tap changer on the on shore station is operated with a target set point, which is in the lower parts of the dead band.
The attributes minAllowedTargetValue and maxAllowedTargetValue are not related to the attribute targetDeadband and thus they are not treated as an alternative of the targetDeadband. They are needed due to limitations in the local substation controller. The attribute

targetDeadband is used to prevent the power flow from move the tap position in circles (hunting) that is to be used regardless of the attributes minAllowedTargetValue and maxAllowedTargetValue.

3.23 (abstract) RotatingMachine root class

A rotating machine which may be used as a generator or motor.

3.24 (abstract) StaticVarCompensator root class

A facility for providing variable and controllable shunt reactive power. The SVC typically consists of a stepdown transformer, filter, thyristor-controlled reactor, and thyristor-switched capacitor arms.
The SVC may operate in fixed MVar output mode or in voltage control mode. When in voltage control mode, the output of the SVC will be proportional to the deviation of voltage at the controlled bus from the voltage setpoint. The SVC characteristic slope defines the proportion. If the voltage at the controlled bus is equal to the voltage setpoint, the SVC MVar output is zero.

3.25 (abstract) Switch root class

A generic device designed to close, or open, or both, one or more electric circuits. All switches are two terminal devices including grounding switches. The ACDCTerminal.connected at the two sides of the switch shall not be considered for assessing switch connectivity, i.e. only Switch.open, .normalOpen and .locked are relevant.

3.26 (abstract) TapChanger root class

Mechanism for changing transformer winding tap positions.

3.27 (CSA) IntertemporalRange root class

It represents the intertemporal range, which means that this is the maximum change of an attribute value between two time stamps or per time unit (e.g. hour). Both up and down directions are defined. Value1 from the schedule is up direction and value2 is down direction. For instance, the value expressed by the GridStateIntensity class cannot be bigger than value1 in up direction and cannot be bigger than value2 in down direction.
Table 14 shows all attributes of IntertemporalRange.

Table 14 – Attributes of AvailableRemedialActionProfile::IntertemporalRange

name	mult	type	description
parameterType	1..1	IRI	(CSA) Parameter type for value 1 and value 2 of the schedule.
valueKind	1..1	ValueOffsetKind	(CSA) The kind of value1 and value2 for the schedule.
discrete	1..1	Boolean	(CSA) Indicates the mode of change between the operational value and values for up and down direction. If true, this is discrete change which requires attribute IntertemporalRange.step. If false, the change is continuous. In this case the attribute IntertemporalRange.step is not exchanged.
step	0..1	Float	(CSA) It defines the step of change. Used only when the IntertemporalRange.discrete is true.

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

Table 15 – Association ends of AvailableRemedialActionProfile::IntertemporalRange with other classes

mult from	name	mult to	type	description
0..1	GridStateAlteration	1..1	GridStateAlteration	(CSA) The grid state alteration which has an intertemporal range.
0..*	IrregularIntervalSchedule	1..1	IrregularIntervalSchedule	(CSA) The irregular interval schedule associated with an intertemporal range.

3.28 (CSA) RotatingMachineAction

Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject

Rotating machine action.

Table 16 shows all attributes of RotatingMachineAction.

Table 16 – Attributes of AvailableRemedialActionProfile::RotatingMachineAction

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
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 RotatingMachineAction with other classes.

Table 17 – Association ends of AvailableRemedialActionProfile::RotatingMachineAction with other classes

mult from	name	mult to	type	description
0..*	RotatingMachine	1..1	RotatingMachine	(CSA) The rotating machine that has an action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.29 (CSA) StaticRange root class

Defines the static range.

Table 18 shows all attributes of StaticRange.

Table 18 – Attributes of AvailableRemedialActionProfile::StaticRange

name	mult	type	description
parameter1Type	1..1	IRI	(CSA) Parameter type for IrregularTimePoint.value1.
value2Kind	0..1	ValueOffsetKind	(CSA) The kind of the IrregularTimePoint.value2.
parameter2Type	0..1	IRI	(CSA) Parameter type for IrregularTimePoint.value2.
value1Kind	1..1	ValueOffsetKind	(CSA) The kind of the IrregularTimePoint.value1.

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

Table 19 – Association ends of AvailableRemedialActionProfile::StaticRange with other classes

mult from	name	mult to	type	description
0..1	GridStateAlteration	1..1	GridStateAlteration	(CSA) The grid state alteration which has static range.
0..*	IrregularIntervalSchedule	1..1	IrregularIntervalSchedule	(CSA) The irregular interval schedule that associated with a static range.

3.30 (CSA) BatteryUnitAction

Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject

Battery unit setpoint action.

Table 20 shows all attributes of BatteryUnitAction.

Table 20 – Attributes of AvailableRemedialActionProfile::BatteryUnitAction

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

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

Table 21 – Association ends of AvailableRemedialActionProfile::BatteryUnitAction with other classes

mult from	name	mult to	type	description
0..*	BatteryUnit	1..1	BatteryUnit	(CSA) The BatteryUnit that is associated with an action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.31 (CSA) BiddingZoneAction

Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject

Bidding zone setpoint action. Mostly used for describing countertrading kind of grid state alteration.

Table 22 shows all attributes of BiddingZoneAction.

Table 22 – Attributes of AvailableRemedialActionProfile::BiddingZoneAction

name	mult	type	description
biddingZoneID	1..1	String	(CSA) The identifier of the bidding zone to which this action is applied.
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

644 Table 23 shows all association ends of BiddingZoneAction with other classes.

645 **Table 23 – Association ends of AvailableRemedialActionProfile::BiddingZoneAction**
646 **with other classes**

mult from	name	mult to	type	description
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

647

648 3.32 (CSA) RegulatingControlAction

649 Inheritance path = GridStateAlteration : IdentifiedObject
650 Control action means the set point change of a regulating control power system resource in the
651 grid model compared to the base case.
652 Table 24 shows all attributes of RegulatingControlAction.

653 **Table 24 – Attributes of AvailableRemedialActionProfile::RegulatingControlAction**

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

654
655 Table 25 shows all association ends of RegulatingControlAction with other classes.

656 **Table 25 – Association ends of**
657 **AvailableRemedialActionProfile::RegulatingControlAction with other classes**

mult from	name	mult to	type	description
0..*	RegulatingControl	1..1	RegulatingControl	(CSA) The regulating control which has an action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

658

659 3.33 (CSA) EquivalentInjectionAction

660 Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject
661 Equivalent injection action.
662 Table 26 shows all attributes of EquivalentInjectionAction.

663 **Table 26 – Attributes of AvailableRemedialActionProfile::EquivalentInjectionAction**

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

664
665 Table 27 shows all association ends of EquivalentInjectionAction with other classes.

Table 27 – Association ends of AvailableRemedialActionProfile::EquivalentInjectionAction with other classes

mult from	name	mult to	type	description
0..*	EquivalentInjection	1..1	EquivalentInjection	(CSA) The EquivalentInjection that is associated with an action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.34 (CSA) ExternalNetworkInjectionAction

Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject

External network injection action.

Table 28 shows all attributes of ExternalNetworkInjectionAction.

Table 28 – Attributes of AvailableRemedialActionProfile::ExternalNetworkInjectionAction

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 29 shows all association ends of ExternalNetworkInjectionAction with other classes.

Table 29 – Association ends of AvailableRemedialActionProfile::ExternalNetworkInjectionAction with other classes

mult from	name	mult to	type	description
0..*	ExternalNetworkInjection	1..1	ExternalNetworkInjection	(CSA) The ExternalNetworkInjection that is associated with an action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.35 (CSA) EnergySourceModification

Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject

Energy source action.

Table 30 shows all attributes of EnergySourceModification.

Table 30 – Attributes of AvailableRemedialActionProfile::EnergySourceModification

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 31 shows all association ends of EnergySourceModification with other classes.

687 **Table 31 – Association ends of**
688 **AvailableRemedialActionProfile::EnergySourceModification with other classes**

mult from	name	mult to	type	description
0..*	EnergySource	1..1	EnergySource	(CSA) The EnergySource which is associated with an EnergySourceAction.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

689

690 ### 3.36 (abstract,CSA) GridStateAlteration

691 Inheritance path = IdentifiedObject
692 Grid state alteration is a change of values of one element in the grid model compared to the
693 base case.
694 Table 32 shows all attributes of GridStateAlteration.

695 **Table 32 – Attributes of AvailableRemedialActionProfile::GridStateAlteration**

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) Time to implement a grid state alteration.
participationFactor	1..1	PerCent	(CSA) It defines the participation of this grid state alteration. If 0 this grid alteration does not participate. The sum of all participation factors for all grid state alterations associated with same remedial action shall be equal to 100%. In cases where only one remedial action is associated with one grid state alteration, the participation factor shall be equal to 100%.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

696

697 Table 33 shows all association ends of GridStateAlteration with other classes.

698 **Table 33 – Association ends of AvailableRemedialActionProfile::GridStateAlteration**
699 **with other classes**

mult from	name	mult to	type	description
0..*	RemedialAction	1..1	RemedialAction	(CSA) The remedial action associated with a given grid state alteration.

700

701 ### 3.37 (CSA) HVDCAction

702 Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject
703 HVDC action.
704 Table 34 shows all attributes of HVDCAction.

705 **Table 34 – Attributes of AvailableRemedialActionProfile::HVDCAction**

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

706
707 Table 35 shows all association ends of HVDCAction with other classes.

708 **Table 35 – Association ends of AvailableRemedialActionProfile::HVDCAction with other**
709 **classes**

mult from	name	mult to	type	description
0..*	ACDCConverter	1..1	ACDCConverter	(CSA) The ACDCConverter that is associated with an action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

710

711 ### 3.38 (CSA) LoadAction

712 Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject
713 Load action.
714 Table 36 shows all attributes of LoadAction.

715 **Table 36 – Attributes of AvailableRemedialActionProfile::LoadAction**

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

716
717 Table 37 shows all association ends of LoadAction with other classes.

718 **Table 37 – Association ends of AvailableRemedialActionProfile::LoadAction with other**
719 **classes**

mult from	name	mult to	type	description
0..*	EnergyConsumer	1..1	EnergyConsumer	(CSA) The EnergyConsumer that is associated with a load action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

720

721 ### 3.39 (CSA) OutageAction

722 Inheritance path = GridStateAlteration : IdentifiedObject
723 Outage action.
724 Table 38 shows all attributes of OutageAction.

725 **Table 38 – Attributes of AvailableRemedialActionProfile::OutageAction**

name	mult	type	description
outageID	0..1	String	(CSA) The identifier of the outage.
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

726

Table 39 shows all association ends of OutageAction with other classes.

Table 39 – Association ends of AvailableRemedialActionProfile::OutageAction with other classes

mult from	name	mult to	type	description
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.40 (CSA) PowerElectronicsConnectionAction

Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject
Power electronics setpoint action.
Table 40 shows all attributes of PowerElectronicsConnectionAction.

Table 40 – Attributes of AvailableRemedialActionProfile::PowerElectronicsConnectionAction

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 41 shows all association ends of PowerElectronicsConnectionAction with other classes.

Table 41 – Association ends of AvailableRemedialActionProfile::PowerElectronicsConnectionAction with other classes

mult from	name	mult to	type	description
0..*	PowerElectronicsConnection	1..1	PowerElectronicsConnection	(CSA) The PowerElectronicsConnection that is applied to an action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.41 (CSA) RemedialActionCostCharacteristic

Inheritance path = Curve : IdentifiedObject
The cost characteristic for a remedial action.
Table 42 shows all attributes of RemedialActionCostCharacteristic.

Table 42 – Attributes of AvailableRemedialActionProfile::RemedialActionCostCharacteristic

name	mult	type	description
y1UnitNominator	0..1	Currency	(CSA) The nominator of the Y1-axis units of measure.
y1UnitDenominator	0..1	UnitSymbol	(CSA) The denominator of the Y1-axis units of measure.
y1UnitDenominatorMultiplier	0..1	UnitMultiplier	(CSA) The multiplier of the denominator of the Y1-axis units of measure.
curveStyle	1..1	CurveStyle	inherited from: Curve
xUnit	1..1	UnitSymbol	inherited from: Curve
description	0..1	String	inherited from: IdentifiedObject

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

Table 43 shows all association ends of RemedialActionCostCharacteristic with other classes.

Table 43 – Association ends of AvailableRemedialActionProfile::RemedialActionCostCharacteristic with other classes

mult from	name	mult to	type	description
0..1	RemedialAction	1..1	RemedialAction	(CSA) The remedial action that has cost characteristic.

3.42 (abstract,CSA) SetPointAction

Inheritance path = GridStateAlteration : IdentifiedObject
Setpoint action.
Table 44 shows all attributes of SetPointAction.

Table 44 – Attributes of AvailableRemedialActionProfile::SetPointAction

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 45 shows all association ends of SetPointAction with other classes.

Table 45 – Association ends of AvailableRemedialActionProfile::SetPointAction with other classes

mult from	name	mult to	type	description
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.43 (CSA) ShuntCompensatorModification

Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject
Shunt compensator action.
Table 46 shows all attributes of ShuntCompensatorModification.

Table 46 – Attributes of AvailableRemedialActionProfile::ShuntCompensatorModification

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 47 shows all association ends of ShuntCompensatorModification with other classes.

Table 47 – Association ends of AvailableRemedialActionProfile::ShuntCompensatorModification with other classes

mult from	name	mult to	type	description
0..*	ShuntCompensator	1..1	ShuntCompensator	(CSA) The ShuntCompensator that is associated with an action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.44 (CSA) StaticVarCompensatorAction

Inheritance path = SetPointAction : GridStateAlteration : IdentifiedObject
Static Var compensator action.
Table 48 shows all attributes of StaticVarCompensatorAction.

Table 48 – Attributes of AvailableRemedialActionProfile::StaticVarCompensatorAction

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 49 shows all association ends of StaticVarCompensatorAction with other classes.

Table 49 – Association ends of AvailableRemedialActionProfile::StaticVarCompensatorAction with other classes

mult from	name	mult to	type	description
0..*	StaticVarCompensator	1..1	StaticVarCompensator	(CSA) The StaticVarCompensator which is associated with an action.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.45 (CSA) TapPositionAction

Inheritance path = GridStateAlteration : IdentifiedObject
Tap position action represents a change of a tap changer position in the grid model compared to the base case.
Table 50 shows all attributes of TapPositionAction.

Table 50 – Attributes of AvailableRemedialActionProfile::TapPositionAction

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 51 shows all association ends of TapPositionAction with other classes.

Table 51 – Association ends of AvailableRemedialActionProfile::TapPositionAction with other classes

mult from	name	mult to	type	description
0..*	TapChanger	1..1	TapChanger	(CSA) The tap changer that has a tap position action associated.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.46 (CSA) TopologyAction

Inheritance path = GridStateAlteration : IdentifiedObject

Topology action means the connection or disconnection of a switch in the grid model compared to the base case.

Table 52 shows all attributes of TopologyAction.

Table 52 – Attributes of AvailableRemedialActionProfile::TopologyAction

name	mult	type	description
timeToImplement	1..1	Duration	(CSA) inherited from: GridStateAlteration
participationFactor	1..1	PerCent	(CSA) inherited from: GridStateAlteration
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 53 shows all association ends of TopologyAction with other classes.

Table 53 – Association ends of AvailableRemedialActionProfile::TopologyAction with other classes

mult from	name	mult to	type	description
0..*	Switch	1..1	Switch	(CSA) The switch that has a topology action associated.
0..*	RemedialAction	1..1	RemedialAction	(CSA) inherited from: GridStateAlteration

3.47 (CSA) RemedialAction

Inheritance path = IdentifiedObject

A remedial action is described by one of many grid state alterations applied to a grid model state or particular scenario in order to resolve one or more Identified constraints. Only costly remedial actions require a cost characteristic.

Table 54 shows all attributes of RemedialAction.

Table 54 – Attributes of AvailableRemedialActionProfile::RemedialAction

name	mult	type	description
kind	1..1	RemedialActionKind	(CSA) The kind of the remedial action.
available	1..1	Boolean	(CSA) It identifies if the remedial action is available. (True-Available/False-Unavailable).
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 55 shows all association ends of RemedialAction with other classes.

Table 55 – Association ends of AvailableRemedialActionProfile::RemedialAction with other classes

mult from	name	mult to	type	description
1..1	QualitativeRemedialActionThreshold	0..*	QualitativeRemedialActionThreshold	(CSA) This is the qualitative threshold for a given remedial action.
0..*	ConsideredInRegion	0..*	Region	The region in which the remedial action is considered.
0..*	ConnectingSystemOperator	0..1	SystemOperator	(CSA) System operator which are connected by remedial actions.

3.48 Seconds datatype

Time, in seconds.
Table 56 shows all attributes of Seconds.

Table 56 – Attributes of AvailableRemedialActionProfile::Seconds

name	mult	type	description
value	0..1	Float	Time, in seconds
unit	0..1	UnitSymbol	(const=s)
multiplier	0..1	UnitMultiplier	(const=none)

3.49 PerCent datatype

Percentage on a defined base. For example, specify as 100 to indicate at the defined base.
Table 57 shows all attributes of PerCent.

Table 57 – Attributes of AvailableRemedialActionProfile::PerCent

name	mult	type	description
value	0..1	Float	Normally 0 to 100 on a defined base.
unit	0..1	UnitSymbol	(const=none)
multiplier	0..1	UnitMultiplier	(const=none)

3.50 Currency enumeration

Monetary currencies. ISO 4217 standard including 3-character currency code.
Table 58 shows all literals of Currency.

Table 58 – Literals of AvailableRemedialActionProfile::Currency

literal	value	description
AED	784	United Arab Emirates dirham.
AFN	971	Afghan afghani.
ALL	008	Albanian lek.
AMD	051	Armenian dram.
ANG	532	Netherlands Antillean guilder.
AOA	973	Angolan kwanza.
ARS	032	Argentine peso.
AUD	036	Australian dollar.

literal	value	description
AWG	533	Aruban florin.
AZN	944	Azerbaijani manat.
BAM	977	Bosnia and Herzegovina convertible mark.
BBD	052	Barbados dollar.
BDT	050	Bangladeshi taka.
BGN	975	Bulgarian lev.
BHD	048	Bahraini dinar.
BIF	108	Burundian franc.
BMD	060	Bermudian dollar (customarily known as Bermuda dollar).
BND	096	Brunei dollar.
BOB	068	Boliviano.
BOV	984	Bolivian Mvdol (funds code).
BRL	986	Brazilian real.
BSD	044	Bahamian dollar.
BTN	064	Bhutanese ngultrum.
BWP	072	Botswana pula.
BYR	974	Belarusian ruble.
BZD	084	Belize dollar.
CAD	124	Canadian dollar.
CDF	976	Congolese franc.
CHF	756	Swiss franc.
CLF	990	Unidad de Fomento (funds code), Chile.
CLP	152	Chilean peso.
CNY	156	Chinese yuan.
COP	170	Colombian peso.
COU	970	Unidad de Valor Real.
CRC	188	Costa Rican colon.
CUC	931	Cuban convertible peso.
CUP	192	Cuban peso.
CVE	132	Cape Verde escudo.
CZK	203	Czech koruna.
DJF	262	Djiboutian franc.
DKK	208	Danish krone.
DOP	214	Dominican peso.
DZD	012	Algerian dinar.
EEK	233	Estonian kroon.
EGP	818	Egyptian pound.
ERN	232	Eritrean nakfa.
ETB	230	Ethiopian birr.
EUR	978	Euro.

literal	value	description
FJD	242	Fiji dollar.
FKP	238	Falkland Islands pound.
GBP	826	Pound sterling.
GEL	981	Georgian lari.
GHS	936	Ghanaian cedi.
GIP	929	Gibraltar pound.
GMD	270	Gambian dalasi.
GNF	324	Guinean franc.
GTQ	320	Guatemalan quetzal.
GYD	328	Guyanese dollar.
HKD	344	Hong Kong dollar.
HNL	340	Honduran lempira.
HRK	191	Croatian kuna.
HTG	332	Haitian gourde.
HUF	348	Hungarian forint.
IDR	360	Indonesian rupiah.
ILS	376	Israeli new sheqel.
INR	356	Indian rupee.
IQD	368	Iraqi dinar.
IRR	364	Iranian rial.
ISK	352	Icelandic króna.
JMD	388	Jamaican dollar.
JOD	400	Jordanian dinar.
JPY	392	Japanese yen.
KES	404	Kenyan shilling.
KGS	417	Kyrgyzstani som.
KHR	116	Cambodian riel.
KMF	174	Comoro franc.
KPW	408	North Korean won.
KRW	410	South Korean won.
KWD	414	Kuwaiti dinar.
KYD	136	Cayman Islands dollar.
KZT	398	Kazakhstani tenge.
LAK	418	Lao kip.
LBP	422	Lebanese pound.
LKR	144	Sri Lanka rupee.
LRD	430	Liberian dollar.
LSL	426	Lesotho loti.
LTL	440	Lithuanian litas.
LVL	428	Latvian lats.
LYD	434	Libyan dinar.

literal	value	description
MAD	504	Moroccan dirham.
MDL	498	Moldovan leu.
MGA	969	Malagasy ariary.
MKD	807	Macedonian denar.
MMK	104	Myanma kyat.
MNT	496	Mongolian tugrik.
MOP	446	Macanese pataca.
MRO	478	Mauritanian ouguiya.
MUR	480	Mauritian rupee.
MVR	462	Maldivian rufiyaa.
MWK	454	Malawian kwacha.
MXN	484	Mexican peso.
MYR	458	Malaysian ringgit.
MZN	943	Mozambican metical.
NAD	516	Namibian dollar.
NGN	566	Nigerian naira.
NIO	558	Cordoba oro.
NOK	578	Norwegian krone.
NPR	524	Nepalese rupee.
NZD	554	New Zealand dollar.
OMR	512	Omani rial.
PAB	590	Panamanian balboa.
PEN	604	Peruvian nuevo sol.
PGK	598	Papua New Guinean kina.
PHP	608	Philippine peso.
PKR	586	Pakistani rupee.
PLN	985	Polish zloty.
PYG	600	Paraguayan guaraní.
QAR	634	Qatari rial.
RON	946	Romanian new leu.
RSD	941	Serbian dinar.
RUB	643	Russian rouble.
RWF	646	Rwandan franc.
SAR	682	Saudi riyal.
SBD	090	Solomon Islands dollar.
SCR	690	Seychelles rupee.
SDG	938	Sudanese pound.
SEK	752	Swedish krona/kronor.
SGD	702	Singapore dollar.
SHP	654	Saint Helena pound.
SLL	694	Sierra Leonean leone.

literal	value	description
SOS	706	Somali shilling.
SRD	968	Surinamese dollar.
STD	678	São Tomé and Príncipe dobra.
SYP	760	Syrian pound.
SZL	748	Lilangeni.
THB	764	Thai baht.
TJS	972	Tajikistani somoni.
TMT	934	Turkmenistani manat.
TND	788	Tunisian dinar.
TOP	776	Tongan pa'anga.
TRY	949	Turkish lira.
TTD	780	Trinidad and Tobago dollar.
TWD	901	New Taiwan dollar.
TZS	834	Tanzanian shilling.
UAH	980	Ukrainian hryvnia.
UGX	800	Ugandan shilling.
USD	840	United States dollar.
UYU	858	Uruguayan peso.
UZS	860	Uzbekistan som.
VEF	937	Venezuelan bolívar fuerte.
VND	704	Vietnamese Dong.
VUV	548	Vanuatu vatu.
WST	882	Samoan tala.
XAF	950	CFA franc BEAC.
XCD	951	East Caribbean dollar.
XOF	952	CFA Franc BCEAO.
XPF	953	CFP franc.
YER	886	Yemeni rial.
ZAR	710	South African rand.
ZMK	894	Zambian kwacha.
ZWL	932	Zimbabwe dollar.

3.51 CurveStyle enumeration

Style or shape of curve.
Table 59 shows all literals of CurveStyle.

Table 59 – Literals of AvailableRemedialActionProfile::CurveStyle

literal	value	description
constantYValue		The Y-axis values are assumed constant until the next curve point and prior to the first curve point.

literal	value	description
straightLineYValues		The Y-axis values are assumed to be a straight line between values. Also known as linear interpolation.

3.52 (CSA) ImpactAgreementKind enumeration

The impact agreement for the remedial action threshold.
Table 60 shows all literals of ImpactAgreementKind.

Table 60 – Literals of AvailableRemedialActionProfile::ImpactAgreementKind

literal	value	description
noAgreement		An agreement is no reached on the qualitative impact of a remedial action.
threshold		An agreement that the remedial action is impacting when the remedial action intensity is above a given threshold. Therefore, QualitativeRemedialActionThreshold.value is required.
never		An agreement is reached that a remedial action is never impacting.
always		An agreement is reached that the remedial action is always impacting whichever the intensity.

3.53 (CSA) RemedialActionKind enumeration

The different kinds for a remedial action.
Table 61 shows all literals of RemedialActionKind.

Table 61 – Literals of AvailableRemedialActionProfile::RemedialActionKind

literal	value	description
curative		It indicates if the remedial action is curative.
preventive		It indicates if the remedial action is preventive.
curativeAndPreventive		It indicates if the remedial action is curative and preventive.

3.54 UnitSymbol enumeration

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.
Table 62 shows all literals of UnitSymbol.

Table 62 – Literals of AvailableRemedialActionProfile::UnitSymbol

literal	value	description
none	0	Dimension less quantity, e.g. count, per unit, etc.
m	2	Length in metres.
kg	3	Mass in kilograms. Note: multiplier “k” is included in this unit symbol for compatibility with IEC 61850-7-3.
s	4	Time in seconds.
A	5	Current in amperes.
K	6	Temperature in kelvins.
mol	7	Amount of substance in moles.
cd	8	Luminous intensity in candelas.
deg	9	Plane angle in degrees.
rad	10	Plane angle in radians (m/m).
sr	11	Solid angle in steradians (m2/m2).
Gy	21	Absorbed dose in grays (J/kg).
Bq	22	Radioactivity in becquerels (1/s).
degC	23	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.
Sv	24	Dose equivalent in sieverts (J/kg).
F	25	Electric capacitance in farads (C/V).
C	26	Electric charge in coulombs (A·s).
S	27	Conductance in siemens.
H	28	Electric inductance in henrys (Wb/A).
V	29	Electric potential in volts (W/A).
ohm	30	Electric resistance in ohms (V/A).
J	31	Energy in joules (N·m = C·V = W·s).
N	32	Force in newtons (kg·m/s²).
Hz	33	Frequency in hertz (1/s).
lx	34	Illuminance in lux (lm/m²).
lm	35	Luminous flux in lumens (cd·sr).
Wb	36	Magnetic flux in webers (V·s).
T	37	Magnetic flux density in teslas (Wb/m2).

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.
Pa	39	Pressure in pascals (N/m^2). Note: the absolute or relative measurement of pressure is implied with this entry. See below for more explicit forms.
m2	41	Area in square metres (m^2).
m3	42	Volume in cubic metres (m^3).
mPers	43	Velocity in metres per second (m/s).
mPers2	44	Acceleration in metres per second squared (m/s^2).
m3Pers	45	Volumetric flow rate in cubic metres per second (m^3/s).
mPerm3	46	Fuel efficiency in metres per cubic metres (m/m^3).
kgm	47	Moment of mass in kilogram metres (kg·m) (first moment of mass). Note: multiplier “k” is included in this unit symbol for compatibility with IEC 61850-7-3.
kgPerm3	48	Density in kilogram/cubic metres (kg/m^3). Note: multiplier “k” is included in this unit symbol for compatibility with IEC 61850-7-3.
m2Pers	49	Viscosity in square metres / second (m^2/s).
WPermK	50	Thermal conductivity in watt/metres kelvin.
JPerK	51	Heat capacity in joules/kelvin.
ppm	52	Concentration in parts per million.
rotPers	53	Rotations per second (1/s). See also Hz (1/s).
radPers	54	Angular velocity in radians per second (rad/s).
WPerm2	55	Heat flux density, irradiance, watts per square metre.
JPerm2	56	Insulation energy density, joules per square metre or watt second per square metre.
SPerm	57	Conductance per length (F/m).
KPers	58	Temperature change rate in kelvins per second.
PaPers	59	Pressure change rate in pascals per second.
JPerkgK	60	Specific heat capacity, specific entropy, joules per kilogram Kelvin.
VA	61	Apparent power in volt amperes. See also real power and reactive power.
VAr	63	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.

literal	value	description
cosPhi	65	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.
Vs	66	Volt seconds (Ws/A).
V2	67	Volt squared (W^2/A^2).
As	68	Ampere seconds (A·s).
A2	69	Amperes squared (A^2).
A2s	70	Ampere squared time in square amperes (A^2s).
VAh	71	Apparent energy in volt ampere hours.
Wh	72	Real energy in watt hours.
VArh	73	Reactive energy in volt ampere reactive hours.
VPerHz	74	Magnetic flux in volt per hertz.
HzPers	75	Rate of change of frequency in hertz per second.
character	76	Number of characters.
charPers	77	Data rate (baud) in characters per second.
kgm2	78	Moment of mass in kilogram square metres ($kg·m^2$) (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.
dB	79	Sound pressure level in decibels. Note: multiplier “d” is included in this unit symbol for compatibility with IEC 61850-7-3.
WPers	81	Ramp rate in watts per second.
lPers	82	Volumetric flow rate in litres per second.
dBm	83	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.
h	84	Time in hours, hour = 60 min = 3600 s.
min	85	Time in minutes, minute = 60 s.
Q	100	Quantity power, Q.
Qh	101	Quantity energy, Qh.
ohmm	102	Resistivity, ohm metres, (rho).
APerm	103	A/m, magnetic field strength, amperes per metre.
V2h	104	Volt-squared hour, volt-squared-hours.
A2h	105	Ampere-squared hour, ampere-squared hour.
Ah	106	Ampere-hours, ampere-hours.
count	111	Amount of substance, Counter value.
ft3	119	Volume, cubic feet.
m3Perh	125	Volumetric flow rate, cubic metres per hour.

literal	value	description
gal	128	Volume in gallons, US gallon (1 gal = 231 in3 = 128 fl ounce).
Btu	132	Energy, British Thermal Units.
l	134	Volume in litres, litre = dm3 = m3/1000.
lPerh	137	Volumetric flow rate, litres per hour.
lPerl	143	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 'µ' to express a quantity such as 'µL/L'.
gPerg	144	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 'µ' to express a quantity such as 'µg/g'.
molPerm3	145	Concentration, The amount of substance concentration, (c), the amount of solvent in moles divided by the volume of solution in m³.
molPermol	146	Concentration, Molar fraction, the ratio of the molar amount of a solute divided by the molar amount of the solution.
molPerkg	147	Concentration, Molality, the amount of solute in moles and the amount of solvent in kilograms.
sPers	149	Time, Ratio of time. Note: Users may need to supply a prefix such as 'µ' to show rates such as 'µs/s'.
HzPerHz	150	Frequency, rate of frequency change. Note: Users may need to supply a prefix such as 'm' to show rates such as 'mHz/Hz'.
VPerV	151	Voltage, ratio of voltages. Note: Users may need to supply a prefix such as 'm' to show rates such as 'mV/V'.
APerA	152	Current, ratio of amperages. Note: Users may need to supply a prefix such as 'm' to show rates such as 'mA/A'.
VPerVA	153	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.
rev	154	Amount of rotation, revolutions.
kat	158	Catalytic activity, katal = mol / s.
JPerkg	165	Specific energy, Joules / kg.
m3Uncompensated	166	Volume, cubic metres, with the value uncompensated for weather effects.
m3Compensated	167	Volume, cubic metres, with the value compensated for weather effects.
WPerW	168	Signal Strength, ratio of power. Note: Users may need to supply a prefix such as 'm' to show rates such as 'mW/W'.
therm	169	Energy, therms.
onePerm	173	Wavenumber, reciprocal metres, (1/m).
m3Perkg	174	Specific volume, cubic metres per kilogram, v.

literal	value	description
Pas	175	Dynamic viscosity, pascal seconds.
Nm	176	Moment of force, newton metres.
NPerm	177	Surface tension, newton per metre.
radPers2	178	Angular acceleration, radians per second squared.
JPerm3	181	Energy density, joules per cubic metre.
VPerm	182	Electric field strength, volts per metre.
CPerm3	183	Electric charge density, coulombs per cubic metre.
CPerm2	184	Surface charge density, coulombs per square metre.
FPerm	185	Permittivity, farads per metre.
HPerm	186	Permeability, henrys per metre.
JPermol	187	Molar energy, joules per mole.
JPermolK	188	Molar entropy, molar heat capacity, joules per mole kelvin.
CPerkg	189	Exposure (x rays), coulombs per kilogram.
GyPers	190	Absorbed dose rate, grays per second.
WPersr	191	Radiant intensity, watts per steradian.
WPerm2sr	192	Radiance, watts per square metre steradian.
katPerm3	193	Catalytic activity concentration, katals per cubic metre.
d	195	Time in days, day = 24 h = 86400 s.
anglemin	196	Plane angle, minutes.
anglesec	197	Plane angle, seconds.
ha	198	Area, hectares.
tonne	199	Mass in tons, “tonne” or “metric ton” (1000 kg = 1 Mg).
bar	214	Pressure in bars, (1 bar = 100 kPa).
mmHg	215	Pressure, millimetres of mercury (1 mmHg is approximately 133.3 Pa).
M	217	Length, nautical miles (1 M = 1852 m).
kn	219	Speed, knots (1 kn = 1852/3600) m/s.
Mx	276	Magnetic flux, maxwells (1 Mx = 10-8 Wb).
G	277	Magnetic flux density, gausses (1 G = 10-4 T).
Oe	278	Magnetic field in oersteds, (1 Oe = (103/4p) A/m).
Vh	280	Volt-hour, Volt hours.
WPerA		Active power per current flow, watts per Ampere.
onePerHz		Reciprocal of frequency (1/Hz).
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.

literal	value	description
ohmPerm	86	Electric resistance per length in ohms per metre ((V/A)/m).
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.
JPers		Energy rate in joules per second (J/s).

873

874 ### 3.55 UnitMultiplier enumeration

875 The unit multipliers defined for the CIM. When applied to unit symbols, the unit symbol is
876 treated as a derived unit. Regardless of the contents of the unit symbol text, the unit symbol
877 shall be treated as if it were a single-character unit symbol. Unit symbols should not contain
878 multipliers, and it should be left to the multiplier to define the multiple for an entire data type.
879 For example, if a unit symbol is "m2Pers" and the multiplier is "k", then the value is k(m**2/s),
880 and the multiplier applies to the entire final value, not to any individual part of the value. This
881 can be conceptualized by substituting a derived unit symbol for the unit type. If one imagines
882 that the symbol "Þ" represents the derived unit "m2Pers", then applying the multiplier "k" can
883 be conceptualized simply as "kÞ".
884 For example, the SI unit for mass is "kg" and not "g". If the unit symbol is defined as "kg", then
885 the multiplier is applied to "kg" as a whole and does not replace the "k" in front of the "g". In
886 this case, the multiplier of "m" would be used with the unit symbol of "kg" to represent one gram.
887 As a text string, this violates the instructions in IEC 80000-1. However, because the unit symbol
888 in CIM is treated as a derived unit instead of as an SI unit, it makes more sense to conceptualize
889 the "kg" as if it were replaced by one of the proposed replacements for the SI mass symbol. If
890 one imagines that the "kg" were replaced by a symbol "Þ", then it is easier to conceptualize the
891 multiplier "m" as creating the proper unit "mÞ", and not the forbidden unit "mkg".
892 Table 63 shows all literals of UnitMultiplier.

893 **Table 63 – Literals of AvailableRemedialActionProfile::UnitMultiplier**

literal	value	description
y	-24	Yocto 10**-24.
z	-21	Zepto 10**-21.
a	-18	Atto 10**-18.
f	-15	Femto 10**-15.
p	-12	Pico 10**-12.
n	-9	Nano 10**-9.
micro	-6	Micro 10**-6.
m	-3	Milli 10**-3.
c	-2	Centi 10**-2.
d	-1	Deci 10**-1.
none	0	No multiplier or equivalently multiply by 1.
da	1	Deca 10**1.
h	2	Hecto 10**2.
k	3	Kilo 10**3.
M	6	Mega 10**6.
G	9	Giga 10**9.
T	12	Tera 10**12.
P	15	Peta 10**15.

literal	value	description
E	18	Exa 10**18.
Z	21	Zetta 10**21.
Y	24	Yotta 10**24.

3.56 (CSA) ValueOffsetKind enumeration

The kind of the value offset.
Table 64 shows all literals of ValueOffsetKind.

Table 64 – Literals of AvailableRemedialActionProfile::ValueOffsetKind

literal	value	description
absolute		Absolute value.
incremental		Incremental value.

3.57 String primitive

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

3.58 (profcim) StringIRI primitive

An IRI (Internationalized Resource Identifier) within an RDF graph is a Unicode string that conforms to the syntax defined in RFC 3987.
The primitive is serialized as literal without language support.
IRIs in the RDF abstract syntax must be absolute, and may contain a fragment identifier.
IRI equality: Two IRIs are equal if and only if they are equivalent under Simple String Comparison according to section 5.1 of [RFC3987]. Further normalization must not be performed when comparing IRIs for equality.
IRIs are a generalization of URIs [RFC3986] that permits a wider range of Unicode characters. Every absolute URI and URL is an IRI, but not every IRI is an URI. When IRIs are used in operations that are only defined for URIs, they must first be converted according to the mapping defined in section 3.1 of [RFC3987]. A notable example is retrieval over the HTTP protocol. The mapping involves UTF-8 encoding of non-ASCII characters, %-encoding of octets not allowed in URIs, and Punycode-encoding of domain names.

3.59 DateTime primitive

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

3.60 (eumd) DateTimeStamp primitive

Position of an instant, expressed using xsd:dateTimeStamp, in which the time-zone field is mandatory.

3.61 Date primitive

Date as "yyyy-mm-dd", which conforms with ISO 8601. UTC time zone is specified as "yyyy-mm-ddZ". A local timezone relative UTC is specified as "yyyy-mm-dd(+/-)hh:mm".

3.62 (profcim) StringFixedLanguage primitive

A string consisting of a sequence of characters. The character encoding is UTF-8. The string length is unspecified and unlimited.
The primitive is serialized as literal without language support.

3.63 Decimal primitive

Decimal is the base-10 notational system for representing real numbers.

3.64 (profcim) IRI primitive

An IRI (Internationalized Resource Identifier) within an RDF graph is a Unicode string that conforms to the syntax defined in RFC 3987.
The primitive is serialized as rdf:resource in RDFXML.
IRIs in the RDF abstract syntax must be absolute, and may contain a fragment identifier.
IRI equality: Two IRIs are equal if and only if they are equivalent under Simple String Comparison according to section 5.1 of [RFC3987]. Further normalization must not be performed when comparing IRIs for equality.
IRIs are a generalization of URIs [RFC3986] that permits a wider range of Unicode characters. Every absolute URI and URL is an IRI, but not every IRI is an URI. When IRIs are used in operations that are only defined for URIs, they must first be converted according to the mapping defined in section 3.1 of [RFC3987]. A notable example is retrieval over the HTTP protocol. The mapping involves UTF-8 encoding of non-ASCII characters, %-encoding of octets not allowed in URIs, and Punycode-encoding of domain names.

3.65 Duration primitive

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

3.66 Boolean primitive

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

3.67 Float primitive

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

3.68 Integer primitive

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

3.69 (profcim) URL primitive

A Uniform Resource Locator (URL), colloquially termed a web address, is a reference to a web resource that specifies its location on a computer network and a mechanism for retrieving it. A URL is a specific type of Uniform Resource Identifier (URI), although many people use the two terms interchangeably.URLs occur most commonly to reference web pages (http), but are also used for file transfer (ftp), email (mailto), database access (JDBC), and many other applications.

Annex A(informative): Sample data

A.1 General

This Annex is designed to illustrate the profile by using fragments of sample data. It is not meant to be a complete set of examples covering all possibilities of using the profile. Defining a complete set of test data is considered a separate activity to be performed for the purpose of setting up interoperability testing and conformity related to this profile.

A.2 Header

```
<!--Header -->
  <md:FullModel rdf:about="urn:uuid:d2630bd5-9578-4fab-9647-13991c692d07"><!-- ID of the Full Model in RDF-->
    <!-- ID of the Full Model in Data Model-->
    <dct:identifier>urn:uuid:d2630bd5-9578-4fab-9647-13991c692d07</dct:identifier> <!--This is an example for mRID of the header -->
    <!-- creation time of the Document  -->
    <prov:generatedAtTime>2021-01-28T17:01:03Z</prov:generatedAtTime>
    <!-- Version of the Document -->
    <md:version>1</md:version>
    <!-- Validity/scenario period / delivery day [Optional]-->
    <time:inXSDDateTimeStamp>2021-11-25T17:00:00Z</time:inXSDDateTimeStamp>
    <time:hasXSDDuration>P1Y</time:hasXSDDuration>
    <!-- Description -->
    <dct:description>This is an example of assessed element</dct:description>
    <!-- Profile, Schema or Specification -->
    <dct:conformsTo>http://entsoe.eu/ns/CIM/AvailableRemedialAction-EU/1.0</dct:conformsTo>
    <dct:conformsTo>  http://entsoe.eu/ns/CIM/AvailableRemedialAction-EU/constraints/1.0</dct:conformsTo>  <!-- This is an example how to refer to SHACL constraints -->
    <!-- Message Type -->
    <dcat:keyword>PaneModel</dcat:keyword>
    <!-- Model Dependency-->
    <prov:wasInfluencedBy rdf:resource="urn:uuid:f0063d01-1dac-46f0-91a4-2b7479991173" />
    <!—Model revision -->
    <prov:wasRevisionOf rdf:resource="urn:uuid:8341cd19-779b-4a84-bafb-06b8bb56f767" />
    <!-- Modeling Authority -->
    <prov:wasAttributedTo rdf:resource="urn:eic:10X1001A1001A094"/>
    <!-- Modeling Region -->
    <prov:atLocation rdf:resource="urn:eic:10YBE----------2"/>
```

```
    <!-- Status -->

... <euvoc:status rdf:resource="http://entsoe.eu/StatusType#Validated"/>
    <!-- License -->
... <dct:license>http://publications.europa.eu/resource/authority/licence/EUPL_1_2</dct:license>
    <!-- Process Type -->
    <eumd:processType rdf:resource="urn:entsoe.eu:ProcessTypeList#CSA"/>
    <!-- Type -->
....<dct:type>dataset</dct:type>
    <!-- Modelling Authority of the originator of the model -->
    <dct:creator>urn:eic:10X1001A1001A094</dct:creator>
    <!-- Confidentaliaty for Security Plan -->
    <dct:accessRights rdf:resource="http://entsoe.eu/MVS/2016/Confidentialyt/OPDE_Secret"/>
    <!—Service Location -->
.... <eumd:serviceLocation rdf:resource="urn:eic:10Y1001A1001A94A" />
  </md:FullModel>
```

A.3 Available remedial action

```
  <csa:RemedialAction rdf:ID="_64ec4c52-5e70-4e5d-acb7-57a6c06dcf07">
    <cim:IdentifiedObject.name>RA1</cim:IdentifiedObject.name>
    <cim:IdentifiedObject.mRID>64ec4c52-5e70-4e5d-acb7-57a6c06dcf07</cim:IdentifiedObject.mRID>
    <csa:RemedialAction.kind rdf:resource=" http://entsoe.eu/ns/csa#RemedialActionKind.curative" />
    <csa:RemedialAction.available>true</csa:RemedialAction.available>
    <csa:RemedialAction.ConnectingSystemOperator rdf:resource="#EliaTSO" />
    <csa:RemedialAction.ConsideredInRegion rdf:resource="#Region1" />
  </csa:RemedialAction>

  <csa:RemedialActionCostCharacteristic rdf:ID="_4228ac8c-fa54-4b26-b8d9-2f9d4c90360b">
    <csa:RemedialActionCostCharacteristic.RemedialAction rdf:resource="#_64ec4c52-5e70-4e5d-acb7-
57a6c06dcf07" />
    <cim:Curve.curveStyle rdf:resource="http://iec.ch/TC57/CIM100#CurveStyle.constantYValue" />
    <cim:Curve.xUnit rdf:resource="http://iec.ch/TC57/CIM100#UnitSymbol.h" />
    <csa:RemedialActionCostCharacteristic.y1UnitNominator
rdf:resource="http://iec.ch/TC57/CIM100#Currency.EUR" />
    <csa:RemedialActionCostCharacteristic.y1UnitDenominator
rdf:resource="http://iec.ch/TC57/CIM100#UnitSymbol.none" />
```

```
    <csa:RemedialActionCostCharacteristic.y1UnitDenominatorMultiplier
rdf:resource="http://iec.ch/TC57/CIM100#UnitMultiplier.M" />
    <cim:IdentifiedObject.mRID>4228ac8c-fa54-4b26-b8d9-2f9d4c90360b</cim:IdentifiedObject.mRID>
  </csa:RemedialActionCostCharacteristic>

  <cim:CurveData rdf:ID="_e5eef954-4b1b-4a27-aebb-4fb92aaf1089">
    <cim:CurveData.xvalue>1</cim:CurveData.xvalue>
    <cim:CurveData.y1value>150</cim:CurveData.y1value>
    <cim:CurveData.Curve rdf:resource="#_4228ac8c-fa54-4b26-b8d9-2f9d4c90360b" />
  </cim:CurveData>
  <cim:CurveData rdf:ID="_cce09281-1f42-4470-b8cc-85ef32720628">
    <cim:CurveData.xvalue>2</cim:CurveData.xvalue>
    <cim:CurveData.y1value>160</cim:CurveData.y1value>
    <cim:CurveData.Curve rdf:resource="#_4228ac8c-fa54-4b26-b8d9-2f9d4c90360b" />
  </cim:CurveData>

  <csa:TopologyAction rdf:ID="_32555ef9-e090-49fa-8bfe-837a48a7e888">
    <csa:TopologyAction.Switch rdf:resource="#_e1e32b03-54d6-47d8-8141-e1e182bfe4ec" />
    <csa:GridStateAlteration.timeToImplement>PT10M</csa:GridStateAlteration.timeToImplement>
    <csa:GridStateAlteration.participationFactor>50</csa:GridStateAlteration.participationFactor>
    <csa:GridStateAlteration.RemedialAction rdf:resource="#_64ec4c52-5e70-4e5d-acb7-57a6c06dcf07" />
    <cim:IdentifiedObject.mRID>32555ef9-e090-49fa-8bfe-837a48a7e888</cim:IdentifiedObject.mRID>
  </csa:TopologyAction>

  <csa:TapPositionAction rdf:ID="_998a118a-732f-4382-9312-644ab0dda04b">
    <csa:TapPositionAction.TapChanger rdf:resource="#_9a756b5a-71e4-4e45-96ff-74e0d434e389" />
    <csa:GridStateAlteration.timeToImplement>PT10M</csa:GridStateAlteration.timeToImplement>
    <csa:GridStateAlteration.participationFactor>50</csa:GridStateAlteration.participationFactor>
    <csa:GridStateAlteration.RemedialAction rdf:resource="#_64ec4c52-5e70-4e5d-acb7-57a6c06dcf07" />
    <cim:IdentifiedObject.mRID>998a118a-732f-4382-9312-644ab0dda04b</cim:IdentifiedObject.mRID>
  </csa:TapPositionAction>

  <csa:StaticRange rdf:ID="_05fa6b25-9adf-4d61-8ae8-47e6fb4101bf">
    <csa:StaticRange.parameter1Type rdf:resource="http://iec.ch/TC57/CIM100#TapChanger.highStep" />
    <csa:StaticRange.value1Kind rdf:resource="http://entsoe.eu/ns/csa#ValueOffsetKind.absolute" />
```

```
    <csa:StaticRange.parameter2Type rdf:resource="http://iec.ch/TC57/CIM100#TapChanger.lowStep" />
    <csa:StaticRange.value2Kind rdf:resource="http://entsoe.eu/ns/csa#ValueOffsetKind.absolute" />
    <csa:StaticRange.IrregularIntervalSchedule rdf:resource="#_f8a5a694-fb12-4794-b05f-5ed8480f0430" />
    <csa:StaticRange.GridStateAlteration rdf:resource="#_998a118a-732f-4382-9312-644ab0dda04b" />
  </csa:StaticRange>

  <cim:IrregularIntervalSchedule rdf:ID="_f8a5a694-fb12-4794-b05f-5ed8480f0430">
  <cim:IdentifiedObject.mRID>f8a5a694-fb12-4794-b05f-5ed8480f0430</cim:IdentifiedObject.mRID>
  <cim:BasicIntervalSchedule.value1Unit rdf:resource="http://iec.ch/TC57/CIM100#UnitSymbol.none" />
  <cim:BasicIntervalSchedule.value1Multiplier rdf:resource="http://iec.ch/TC57/CIM100#UnitMultiplier.none" />
  <cim:BasicIntervalSchedule.value2Unit rdf:resource="http://iec.ch/TC57/CIM100#UnitSymbol.none" />
  <cim:BasicIntervalSchedule.value2Multiplier rdf:resource="http://iec.ch/TC57/CIM100#UnitMultiplier.none" />
  <cim:BasicIntervalSchedule.startTime>2021-11-25T00:00:00Z</cim:BasicIntervalSchedule.startTime>
  </cim:IrregularIntervalSchedule>

  <cim:IrregularTimePoint rdf:ID="_0432b9b5-7f75-4160-95a7-2fd5fe1ef77c">
    <cim:IrregularTimePoint.time>0</cim:IrregularTimePoint.time>
    <cim:IrregularTimePoint.value1>9</cim:IrregularTimePoint.value1>
    <cim:IrregularTimePoint.value2>-9</cim:IrregularTimePoint.value2>
    <cim:IrregularTimePoint.IntervalSchedule rdf:resource="#_f8a5a694-fb12-4794-b05f-5ed8480f0430" />
  </cim:IrregularTimePoint>
  <cim:IrregularTimePoint rdf:ID="_e72b0344-63ff-4c86-a666-3998f15b5c41">
    <cim:IrregularTimePoint.time>10800</cim:IrregularTimePoint.time>
    <cim:IrregularTimePoint.value1>12</cim:IrregularTimePoint.value1>
    <cim:IrregularTimePoint.value2>-12</cim:IrregularTimePoint.value2>
    <cim:IrregularTimePoint.IntervalSchedule rdf:resource="#_f8a5a694-fb12-4794-b05f-5ed8480f0430" />
  </cim:IrregularTimePoint>
  <csa:IntertemporalRange rdf:ID="_86ec3436-931e-4041-9b8a-723fc91e1174">
    <csa:IntertemporalRange.parameterType rdf:resource="http://iec.ch/TC57/CIM100#TapChanger.step" />
    <csa:IntertemporalRange.valueKind rdf:resource="http://entsoe.eu/ns/csa#ValueOffsetKind.incremental" />
    <csa:IntertemporalRange.IrregularIntervalSchedule  rdf:resource="#_a1c29ee0-1ae4-48c3-99ba-a2971c9d6638"
/>
    <csa:IntertemporalRange.GridStateAlteration rdf:resource="#_998a118a-732f-4382-9312-644ab0dda04b" />
    <csa:IntertemporalRange.discrete>true</csa:IntertemporalRange.discrete>
    <csa:IntertemporalRange.step>1</csa:IntertemporalRange.step>
```

```
</csa:IntertemporalRange>
<cim:IrregularIntervalSchedule rdf:ID="_a1c29ee0-1ae4-48c3-99ba-a2971c9d6638">
<cim:IdentifiedObject.mRID>a1c29ee0-1ae4-48c3-99ba-a2971c9d6638</cim:IdentifiedObject.mRID>
<cim:BasicIntervalSchedule.value1Unit rdf:resource="http://iec.ch/TC57/CIM100#UnitSymbol.none" />
<cim:BasicIntervalSchedule.value1Multiplier rdf:resource="http://iec.ch/TC57/CIM100#UnitMultiplier.none" />
<cim:BasicIntervalSchedule.value2Unit rdf:resource="http://iec.ch/TC57/CIM100#UnitSymbol.none" />
<cim:BasicIntervalSchedule.value2Multiplier rdf:resource="http://iec.ch/TC57/CIM100#UnitMultiplier.none" />
<cim:BasicIntervalSchedule.startTime>2021-11-25T00:00:00Z</cim:BasicIntervalSchedule.startTime>
</cim:IrregularIntervalSchedule>


<cim:IrregularTimePoint rdf:ID="_53ece660-bad2-470d-ae88-0e0f62b7c14c">
  <cim:IrregularTimePoint.time>0</cim:IrregularTimePoint.time>
  <cim:IrregularTimePoint.value1>3</cim:IrregularTimePoint.value1>
  <cim:IrregularTimePoint.value2>2</cim:IrregularTimePoint.value2>
  <cim:IrregularTimePoint.IntervalSchedule rdf:resource="#_a1c29ee0-1ae4-48c3-99ba-a2971c9d6638" />
</cim:IrregularTimePoint>
<cim:IrregularTimePoint rdf:ID="_110bf0b2-6aa9-40d9-9b2c-572f7b8782d3">
  <cim:IrregularTimePoint.time>3600</cim:IrregularTimePoint.time>
  <cim:IrregularTimePoint.value1>2</cim:IrregularTimePoint.value1>
  <cim:IrregularTimePoint.value2>1</cim:IrregularTimePoint.value2>
  <cim:IrregularTimePoint.IntervalSchedule rdf:resource="#_a1c29ee0-1ae4-48c3-99ba-a2971c9d6638" />
</cim:IrregularTimePoint>

```