European Network of
Transmission System Operators
for Electricity

REMEDIAL ACTION SCHEDULE PROFILE SPECIFICATION

2022-02-16

SOC APPROVED
VERSION 2.0

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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
1	0	2021-03-22		Document for SOC approval
2	0	2022-02-16		For CIM EG review. Association to OverlappingZone was added to the profile. Approved by SOC

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1 Introduction

The remedial action schedule profile is a profile to exchange a list of proposed, agreed, rejected, etc. remedial action schedules.

Each grid state alteration defined as part of an available remedial action (by the available remedial action profile) gets a schedule for the parameter that should be modified when the remedial action schedule is agreed and ordered. The remedial action schedule profile allows for several data exchanges:

- List of remedial action schedules as output from a security analysis
- An exchange of the status of the remedial action
- An exchange of the agreements per TSO.

2 Application profile specification

2.1 Version information

The content is generated from UML model file CGMES30v25_501-20v01_HeaderMetaData-10v08_NC20v70.eap.

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

- Title: Remedial Action Schedule Vocabulary
- Keyword: RAS
- Description: This vocabulary is describing the remedial action schedule profile.
- Version IRI: http://entsoe.eu/ns/CIM/RemedialActionSchedule-EU/2.0
- Version info: 2.0.0
- 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:6e90c546-3c6c-471b-8040-e05037081c59

2.2 Constraints naming convention

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

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

where

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

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

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

- C:NC:RAS:RemedialActionSchedule.ImpactedSystemOperator:consistency

  The impacted System Operators references by RemedialActionSchedule.ImpactedSystemOperator shall include at least the connecting System Operator referenced by the RemedialAction.ConnectingSystemOperator.

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.

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

2.4.1 Constraints

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

- R:NC: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 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 remedial action schedule profile.

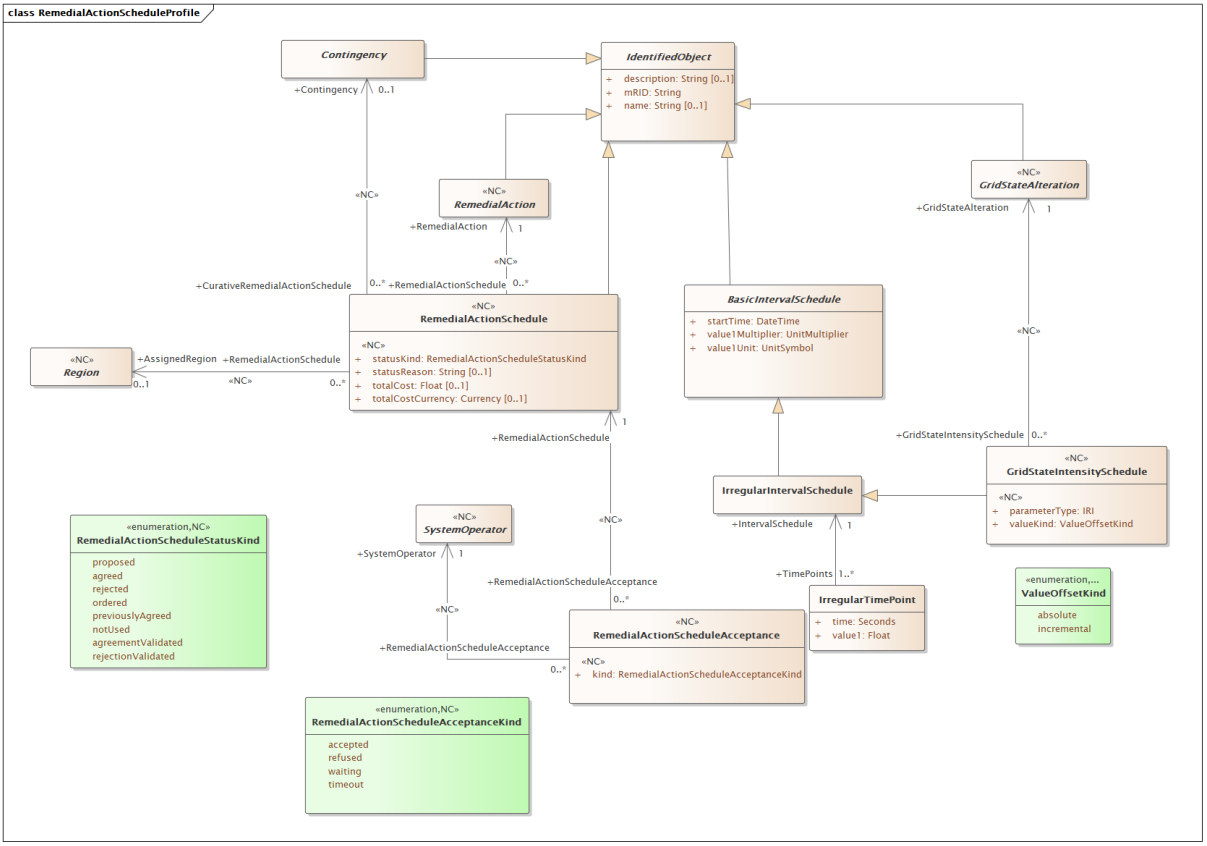

Figure 1 – Other diagram
RemedialActionScheduleProfile::RemedialActionScheduleProfile

Figure 1: The diagram contains the main classes used in the profile.

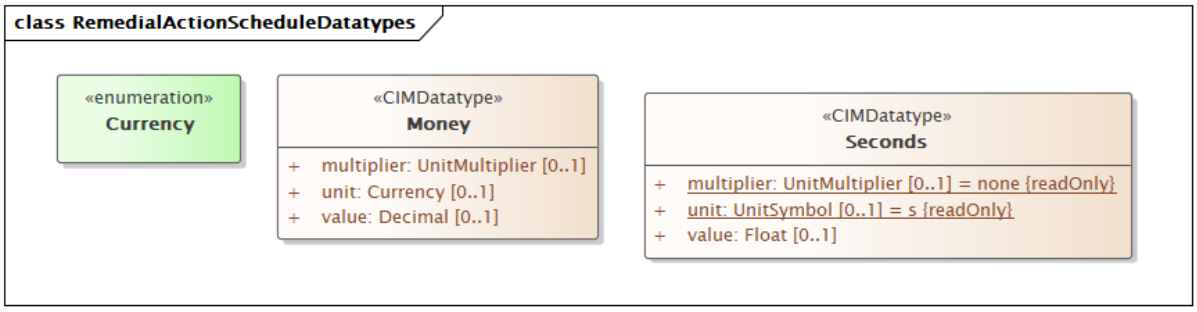

Figure 2 – Class diagram
RemedialActionScheduleProfile::RemedialActionScheduleDatatypes

Figure 2: 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 (NC) RemedialActionScheduleAcceptanceKind enumeration

The kind of acceptance for a remedial action schedule.
Table 1 shows all literals of RemedialActionScheduleAcceptanceKind.

Table 1 – Literals of RemedialActionScheduleProfile::RemedialActionScheduleAcceptanceKind

literal	value	description
accepted		The acceptance of remedial action schedule is concluded and accepted.
refused		The acceptance of the remedial action schedule is concluded and refused.
waiting		The acceptance of the remedial action schedule is waiting (in progress).
timeout		The acceptance of the remedial action schedule was not completed due to timeout.

3.3 (abstract) BasicIntervalSchedule

Inheritance path = IdentifiedObject
Schedule of values at points in time.
Table 2 shows all attributes of BasicIntervalSchedule.

Table 2 – Attributes of RemedialActionScheduleProfile::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.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.4 (abstract) Contingency

Inheritance path = IdentifiedObject
An event threatening system reliability, consisting of one or more contingency elements.
Table 3 shows all attributes of Contingency.

Table 3 – Attributes of RemedialActionScheduleProfile::Contingency

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

3.5 (abstract,NC) GridStateAlteration

Inheritance path = IdentifiedObject

Grid state alteration is a change of values of one element in the grid model compared to the base case.

Table 4 shows all attributes of GridStateAlteration.

Table 4 – Attributes of RemedialActionScheduleProfile::GridStateAlteration

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

3.6 (NC) GridStateIntensitySchedule

Inheritance path = IrregularIntervalSchedule : BasicIntervalSchedule : IdentifiedObject

Defines the intensity applied for a given grid state alteration. It is primarily used in exchanges related to the remedial action schedule.

Table 5 shows all attributes of GridStateIntensitySchedule.

Table 5 – Attributes of RemedialActionScheduleProfile::GridStateIntensitySchedule

name	mult	type	description
parameterType	1..1	IRI	(NC) Parameter type for IrregularTimePoint.value1.
valueKind	1..1	ValueOffsetKind	(NC) The kind of the IrregularTimePoint.value1.
startTime	1..1	DateTime	inherited from: BasicIntervalSchedule
value1Multiplier	1..1	UnitMultiplier	inherited from: BasicIntervalSchedule
value1Unit	1..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

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

Table 6 – Association ends of RemedialActionScheduleProfile::GridStateIntensitySchedule with other classes

mult from	name	mult to	type	description
0..*	GridStateAlteration	1..1	GridStateAlteration	(NC) The grid state alteration which has intensity.

3.7 (abstract) IdentifiedObject root class

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

Table 7 shows all attributes of IdentifiedObject.

Table 7 – Attributes of RemedialActionScheduleProfile::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

name	mult	type	description
			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.

3.8 IrregularIntervalSchedule

Inheritance path = BasicIntervalSchedule : IdentifiedObject

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

Table 8 shows all attributes of IrregularIntervalSchedule.

Table 8 – Attributes of RemedialActionScheduleProfile::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
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.9 IrregularTimePoint root class

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

Table 9 shows all attributes of IrregularTimePoint.

Table 9 – Attributes of RemedialActionScheduleProfile::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.

Table 10 shows all association ends of IrregularTimePoint with other classes.

Table 10 – Association ends of RemedialActionScheduleProfile::IrregularTimePoint with other classes

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

3.10 (abstract,NC) Region root class

A region where the system operator belongs to.

3.11 (abstract,NC) 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 11 shows all attributes of RemedialAction.

Table 11 – Attributes of RemedialActionScheduleProfile::RemedialAction

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

3.12 (NC) RemedialActionSchedule

Inheritance path = IdentifiedObject
This is a schedule for a determined remedial action.
Table 12 shows all attributes of RemedialActionSchedule.

Table 12 – Attributes of RemedialActionScheduleProfile::RemedialActionSchedule

name	mult	type	description
statusKind	1..1	RemedialActionScheduleStatusKind	(NC) Indicates the status kind for the remedial action schedule.
statusReason	0..1	String	(NC) Description of reasoning for the status. For instance, in case of rejected remedial action, the reason for this rejection is described here.
totalCost	0..1	Float	(NC) Total cost of the remedial action.
totalCostCurrency	0..1	Currency	(NC) The currency of the total cost.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

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

Table 13 – Association ends of RemedialActionScheduleProfile::RemedialActionSchedule with other classes

mult from	name	mult to	type	description
0..*	Contingency	0..1	Contingency	(NC) The contingency for a curative remedial action schedule.
0..*	RemedialAction	1..1	RemedialAction	(NC) The remedial action that has a remedial action schedule associatiated.
0..*	AssignedRegion	0..1	Region	(NC) The assigned region for this remedial action schedule.

3.13 (NC) RemedialActionScheduleAcceptance root class

It identifies if the remedial action schedule is accepted for a given system operator.
Table 14 shows all attributes of RemedialActionScheduleAcceptance.

Table 14 – Attributes of RemedialActionScheduleProfile::RemedialActionScheduleAcceptance

name	mult	type	description
kind	1..1	RemedialActionScheduleAcceptanceKind	(NC) The kind of the remedial action acceptance.

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

Table 15 – Association ends of RemedialActionScheduleProfile::RemedialActionScheduleAcceptance with other classes

mult from	name	mult to	type	description
0..*	RemedialActionSchedule	1..1	RemedialActionSchedule	(NC) A remedial action schedule for which a remedial action schedule acceptance is reported.
0..*	SystemOperator	1..1	SystemOperator	(NC) A system operator for which a remedial action schedule acceptances are reported.

3.14 (abstract,NC) SystemOperator root class

System operator.

3.15 Currency enumeration

Monetary currencies. ISO 4217 standard including 3-character currency code.
Table 16 shows all literals of Currency.

Table 16 – Literals of RemedialActionScheduleProfile::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.
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.

literal	value	description
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.
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.

literal	value	description
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.
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.

literal	value	description
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.
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.

literal	value	description
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.

3.16 (NC) RemedialActionScheduleStatusKind enumeration

Remedial action schedule status kinds.
Table 17 shows all literals of RemedialActionScheduleStatusKind.

Table 17 – Literals of RemedialActionScheduleProfile::RemedialActionScheduleStatusKind

literal	value	description
proposed		Proposed remedial action schedule.
agreed		Agreed remedial action schedule.
rejected		Rejected remedial action schedule.
ordered		Ordered remedial action schedule.
previouslyAgreed		Previously agreed remedial action schedule.
notUsed		Not used remedial action schedule.
agreementValidated		The agreement is validated for the remedial action schedule.
rejectionValidated		The rejection is validated for the remedial action schedule.

3.17 UnitMultiplier enumeration

The unit multipliers defined for the CIM. When applied to unit symbols, the unit symbol is treated as a derived unit. Regardless of the contents of the unit symbol text, the unit symbol shall be treated as if it were a single-character unit symbol. Unit symbols should not contain multipliers, and it should be left to the multiplier to define the multiple for an entire data type.

For example, if a unit symbol is "m2Pers" and the multiplier is "k", then the value is k(m**2/s), and the multiplier applies to the entire final value, not to any individual part of the value. This can be conceptualized by substituting a derived unit symbol for the unit type. If one imagines that the symbol "Þ" represents the derived unit "m2Pers", then applying the multiplier "k" can be conceptualized simply as "kÞ".
For example, the SI unit for mass is "kg" and not "g". If the unit symbol is defined as "kg", then the multiplier is applied to "kg" as a whole and does not replace the "k" in front of the "g". In this case, the multiplier of "m" would be used with the unit symbol of "kg" to represent one gram. As a text string, this violates the instructions in IEC 80000-1. However, because the unit symbol in CIM is treated as a derived unit instead of as an SI unit, it makes more sense to conceptualize the "kg" as if it were replaced by one of the proposed replacements for the SI mass symbol. If one imagines that the "kg" were replaced by a symbol "Þ", then it is easier to conceptualize the multiplier "m" as creating the proper unit "mÞ", and not the forbidden unit "mkg".
Table 18 shows all literals of UnitMultiplier.

Table 18 – Literals of RemedialActionScheduleProfile::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.
E	18	Exa 10**18.
Z	21	Zetta 10**21.
Y	24	Yotta 10**24.

3.18 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 19 shows all literals of UnitSymbol.

Table 19 – Literals of RemedialActionScheduleProfile::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).

literal	value	description
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).
W	38	Real power in watts (J/s). Electrical power may have real and reactive components. The real portion of electrical power (I²R or VIcos(phi)), is expressed in Watts. See also apparent power and reactive power.
Pa	39	Pressure in pascals (N/m²). 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 (m²).
m3	42	Volume in cubic metres (m³).
mPers	43	Velocity in metres per second (m/s).
mPers2	44	Acceleration in metres per second squared (m/s²).
m3Pers	45	Volumetric flow rate in cubic metres per second (m³/s).
mPerm3	46	Fuel efficiency in metres per cubic metres (m/m³).
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/m³). Note: multiplier “k” is included in this unit symbol for compatibility with IEC 61850-7-3.
m2Pers	49	Viscosity in square metres / second (m²/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).

literal	value	description
		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.
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.

literal	value	description
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.
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.

literal	value	description
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.
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.

literal	value	description
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.
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).

3.19 (NC) ValueOffsetKind enumeration

The kind of the value offset.
Table 20 shows all literals of ValueOffsetKind.

Table 20 – Literals of RemedialActionScheduleProfile::ValueOffsetKind

literal	value	description
absolute		Absolute value.
incremental		Incremental value.

3.20 Money datatype

Amount of money.
Table 21 shows all attributes of Money.

Table 21 – Attributes of RemedialActionScheduleProfile::Money

name	mult	type	description
multiplier	0..1	UnitMultiplier	
unit	0..1	Currency	
value	0..1	Decimal	

3.21 Seconds datatype

Time, in seconds.
Table 22 shows all attributes of Seconds.

Table 22 – Attributes of RemedialActionScheduleProfile::Seconds

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

3.22 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".

3.23 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.

3.24 Decimal primitive

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

3.25 Float primitive

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

3.26 (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.

3.27 String primitive

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

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 Sample instance data

```
<nc:RemedialActionSchedule rdf:ID="_3f37cfb0-dbf3-4616-9bf3-51e6fdd80058">
<cim:IdentifiedObject.name>RAS1</cim:IdentifiedObject.name>
<cim:IdentifiedObject.mRID>3f37cfb0-dbf3-4616-9bf3-51e6fdd80058</cim:IdentifiedObject.mRID>
<nc:RemedialActionSchedule.statusKind
rdf:resource="http://entsoe.eu/ns/csa#RemedialActionScheduleStatusKind.proposed" />
<nc:RemedialActionSchedule.totalCost>150</nc:RemedialActionSchedule.totalCost>
<nc:RemedialActionSchedule.totalCostCurrency rdf:resource="http://iec.ch/TC57/CIM100#Currency.EUR" />
<nc:RemedialActionSchedule.RemedialAction rdf:resource="#_64ec4c52-5e70-4e5d-acb7-57a6c06dcf07" />
<nc:RemedialActionSchedule.Contingency rdf:resource="#_54fc8802-d664-434b-8f9a-ab7b4102e5cc" />
<nc:RemedialActionSchedule.ImpactedSystemOperator rdf:resource="#urn:entsoe:10X1001A1001A094" />
<nc:RemedialActionSchedule.RelevantRegion rdf:resource="#urn:entsoe:10Y1001C--00059P " />
</nc:RemedialActionSchedule>

<nc:GridStateIntensity rdf:ID="_86ec3436-931e-4041-9b8a-723fc91e1174">
<nc:GridStateIntensity.parameterType rdf:resource="http://iec.ch/TC57/CIM100#TapChanger.step" />
<nc:GridStateIntensity.valueKind rdf:resource="http://entsoe.eu/ns/csa#ValueOffsetKind.incremental" />
<nc:GridStateIntensity.IrregularIntervalSchedule rdf:resource="#_c497ce13-7255-4de1-823d-fc8bb06469ce" />
<nc:GridStateIntensity.GridStateAlteration rdf:resource="#_998a118a-732f-4382-9312-644ab0dda04b" />
</nc:GridStateIntensity>
<cim:IrregularIntervalSchedule rdf:ID="_c497ce13-7255-4de1-823d-fc8bb06469ce">
<cim:IdentifiedObject.mRID>c497ce13-7255-4de1-823d-fc8bb06469ce</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.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>2</cim:IrregularTimePoint.value1>
```

```
528     <cim:IrregularTimePoint.IntervalSchedule rdf:resource="#_c497ce13-7255-4de1-823d-fc8bb06469ce" />
529   </cim:IrregularTimePoint>
530
531   <cim:IrregularTimePoint rdf:ID="_110bf0b2-6aa9-40d9-9b2c-572f7b8782d3">
532     <cim:IrregularTimePoint.time>3600</cim:IrregularTimePoint.time>
533     <cim:IrregularTimePoint.value1>-1</cim:IrregularTimePoint.value1>
534     <cim:IrregularTimePoint.IntervalSchedule rdf:resource="#_c497ce13-7255-4de1-823d-fc8bb06469ce" />
535   </cim:IrregularTimePoint>
536
537
```