



European Network of
Transmission System Operators
for Electricity

POWER SCHEDULE PROFILE SPECIFICATION

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Revision History

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1 Introduction

The power schedule profile enables exchanging power schedule information and their time points.

2 Application profile specification

2.1 Version information

The content is generated from UML model file CIM17-2_CGMES31v01_PROF-20v02_NC24v18_MS10v03_DES10v01.eap.

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

- Title: Power schedule vocabulary
- Keyword: PS
- Description: This vocabulary is describing the object registry profile.
- Version IRI: <https://ap-voc.cim4.eu/PowerSchedule/2.4>
- Version info: 2.4.0
- Prior version: <https://ap-voc.cim4.eu/PowerSchedule/2.3>
- 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:///CIM17-2_CGMES31v01_PROF-20v02_NC24v18_MS10v03_DES10v01.eap
- Identifier: urn:uuid:470c9792-7798-4eb6-b7f2-6e18293c5f7b

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

195 The cardinality defined in the CIM model shall be followed, unless a more restrictive
196 cardinality is explicitly defined in this document. For instance, the cardinality on the
197 association between VoltageLevel and BaseVoltage indicates that a VoltageLevel shall
198 be associated with one and only one BaseVoltage, but a BaseVoltage can be associated
199 with zero to many VoltageLevels.

- 200 • R:452:ALL:NA:associations

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

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

204 The attribute “name” inherited by many classes from the abstract class IdentifiedObject
205 is not required to be unique. It must be a human readable identifier without additional
206 embedded information that would need to be parsed. The attribute is used for purposes
207 such as User Interface and data exchange debugging. The MRID defined in the data
208 exchange format is the only unique and persistent identifier used for this data exchange.
209 The attribute IdentifiedObject.name is, however, always required for CoreEquipment
210 profile and Short Circuit profile.

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

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

- 215 • R:452:ALL:NA:uniqueIdentifier

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

- 218 • R:452:ALL:NA:unitMultiplier

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

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

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

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

224 The string IdentifiedObject.description is maximum 256 characters.

- 225 • C:452:ALL:NA:float

226 An attribute that is defined as float (e.g. has a type Float or a type which is a Datatype
227 with .value attribute of type Float) shall support ISO/IEC 60559:2020 for floating-point
228 arithmetic using single precision floating point. A single precision float supports 7
229 significant digits where the significant digits are described as an integer, or a decimal
230 number with 6 decimal digits. Two float values are equal when the significant with 7
231 digits are identical, e.g. 1234567 is equal 1.234567E6 and so are 1.2345678 and
232 1.234567E0.

- 233 • R:NC:ALL:NA:serialization

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

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

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

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

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

257 It should be taken into account that this approach deviates from MVAL5 (IEC 61970-
 258 600-1:2021), which creates multiple inheritance at serialization. For instance, with this
 259 more explicit exchange the serialization of the association between abstract class
 260 Equipment and abstract class Circuit for a PowerTransformer will be serialized as
 261 follows:

262 ○ for association

```

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

266 ○ for attribute

```

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

270 The usage of rdf:ID or rdf:about depends on the stereotype of the class. rdf:about is
 271 used if the class has the stereotype "Description".

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

```

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

- 276 • C:NC:PS:PowerSchedule:dc-associations

277 PowerSchedule can have associations to either DCTieCorridor or DCPole but not both.

278

279 **2.4 Metadata**

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

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

290 **2.4.1 Constraints**

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

- 293 • R:NC:ALL:wasAttributedTo:usage

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

296

297 **2.4.2 Reference metadata**

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

306 **3 Detailed Profile Specification**307 **3.1 General**

308 This package contains the power schedule profile.

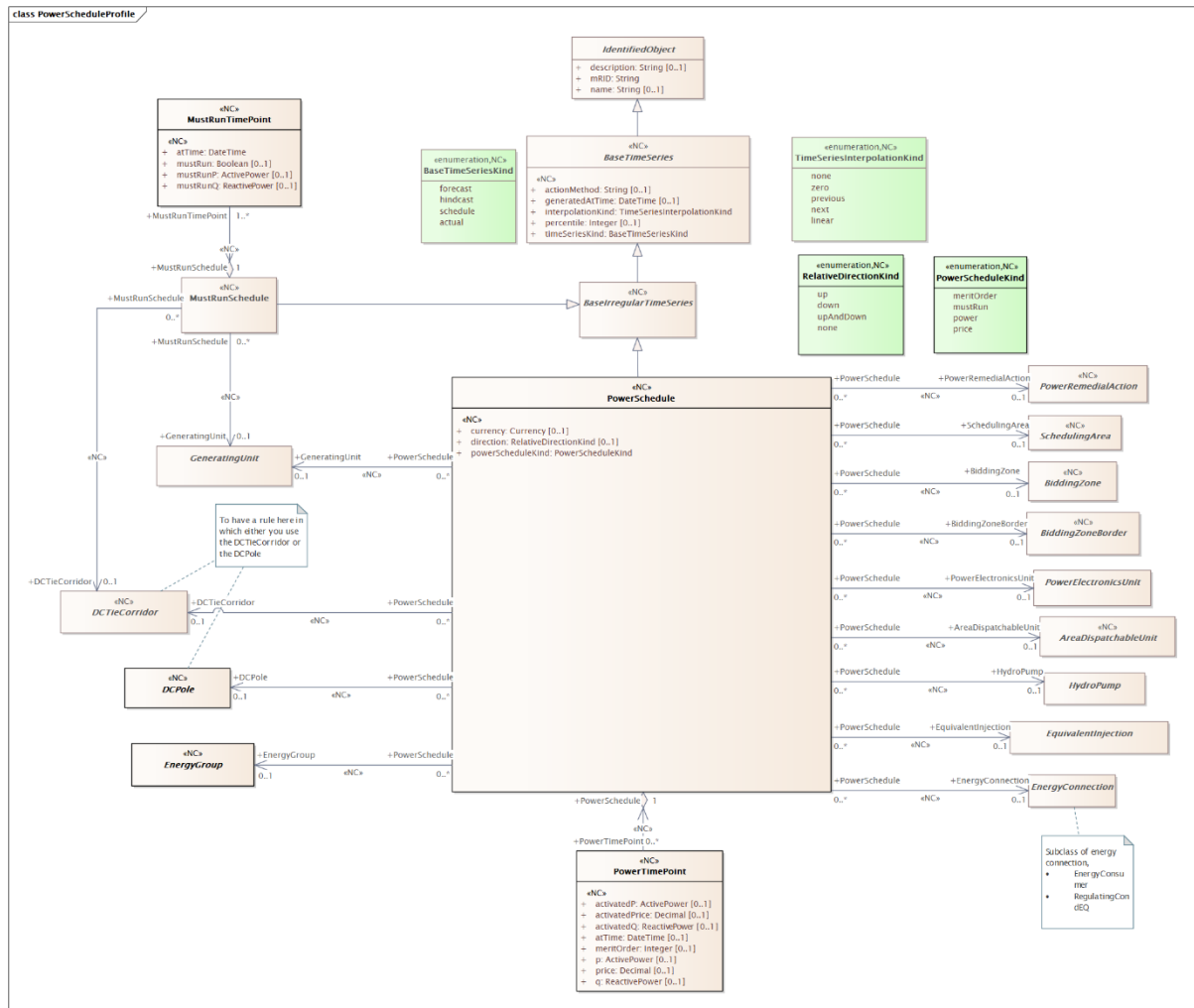


Figure 1 – Class diagram PowerScheduleProfile::PowerScheduleProfile

Figure 1: The diagram contains main classes related to the power schedule profile.

3.2 (abstract) IdentifiedObject root class

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

Table 1 shows all attributes of IdentifiedObject.

Table 1 – Attributes of PowerScheduleProfile::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

name	mult	type	description
			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.

3.3 (abstract,NC) BaseTimeSeries

Inheritance path = [IdentifiedObject](#)

Time series of values at points in time.

Table 2 shows all attributes of BaseTimeSeries.

Table 2 – Attributes of PowerScheduleProfile::BaseTimeSeries

name	mult	type	description
interpolationKind	1..1	TimeSeriesInterpolationKind	(NC) Kind of interpolation done between time point.
timeSeriesKind	1..1	BaseTimeSeriesKind	(NC) Kind of base time series.
generatedAtTime	0..1	DateTime	(NC) The time this time series (entity) come to existents and available for use.
percentile	0..1	Integer	(NC) The percentile is a number where a certain percentage of scores/ranking/values of a sample fall below that number. This is a way for expressing uncertainty in the number provided.
actionMethod	0..1	String	(NC) Action method used to create the value. This is used for identification in the case where there is multiple time series for the same validity period and kind.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.4 (abstract,NC) BaseIrregularTimeSeries

Inheritance path = [BaseTimeSeries](#) : [IdentifiedObject](#)

Time series that has irregular points in time.

Table 3 shows all attributes of BaseIrregularTimeSeries.

Table 3 – Attributes of PowerScheduleProfile::BaseIrregularTimeSeries

name	mult	type	description
interpolationKind	1..1	TimeSeriesInterpolationKind	(NC) inherited from: BaseTimeSeries
timeSeriesKind	1..1	BaseTimeSeriesKind	(NC) inherited from: BaseTimeSeries
generatedAtTime	0..1	DateTime	(NC) inherited from: BaseTimeSeries
percentile	0..1	Integer	(NC) inherited from: BaseTimeSeries
actionMethod	0..1	String	(NC) inherited from: BaseTimeSeries
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

3.5 (NC) BaseTimeSeriesKind enumeration

Kind of time series.

Table 4 shows all literals of BaseTimeSeriesKind.

Table 4 – Literals of PowerScheduleProfile::BaseTimeSeriesKind

literal	value	description
forecast		Time series is forecast data. The values represent the result of scientific predictions based on historical time stamped data.
hindcast		Time series is hindcast data. The value represent probable past (historic) condition given by calculation done using actual values. For instance, determine the among of wind based on the energy produced by wind. However, hindcast is typical the result of a simulated forecasts for historical periods.
schedule		Time series is schedule data. The values represent the result of a committed and plan forecast data that has been through a quality control and could incur penalty when not followed.
actual		Time series is actual data. The values represent measured or calculated values that represent the actual behaviour.

3.6 (NC) TimeSeriesInterpolationKind enumeration

Kinds of interpolation of values between two time point.

Table 5 shows all literals of TimeSeriesInterpolationKind.

Table 5 – Literals of PowerScheduleProfile::TimeSeriesInterpolationKind

literal	value	description
none		No interpolation is applied.
zero		The value between two time points is set to zero.
previous		The value between two time points is set to previous value.
next		The value between two time points is set to next value.
linear		Linear interpolation is applied for values between two time points.

3.7 (NC) PowerSchedule

Inheritance path = [BaseIrregularTimeSeries](#) : [BaseTimeSeries](#) : [IdentifiedObject](#)

Time series represent irregular power, active and reactive, values at given points in time.

Table 6 shows all attributes of PowerSchedule.

Table 6 – Attributes of PowerScheduleProfile::PowerSchedule

name	mult	type	description
currency	0..1	Currency	(NC) Currency the energy price is given in.
direction	0..1	RelativeDirectionKind	(NC) Kind of direction.
powerScheduleKind	1..1	PowerScheduleKind	(NC) Kind of power schedule.
interpolationKind	1..1	TimeSeriesInterpolationKind	(NC) inherited from: BaseTimeSeries
timeSeriesKind	1..1	BaseTimeSeriesKind	(NC) inherited from: BaseTimeSeries
generatedAtTime	0..1	DateTime	(NC) inherited from: BaseTimeSeries

name	mult	type	description
percentile	0..1	Integer	(NC) inherited from: BaseTimeSeries
actionMethod	0..1	String	(NC) inherited from: BaseTimeSeries
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

Table 7 shows all association ends of PowerSchedule with other classes.

Table 7 – Association ends of PowerScheduleProfile::PowerSchedule with other classes

mult from	name	mult to	type	description
0..*	PowerElectronicsUnit	0..1	PowerElectronicsUnit	(NC) Power electronics unit which belongs to the power schedule.
0..*	EnergyConnection	0..1	EnergyConnection	(NC) The energy connection that has a power schedule.
0..*	SchedulingArea	0..1	SchedulingArea	Scheduling area which has power schedules.
0..*	AreaDispatchableUnit	0..1	AreaDispatchableUnit	(NC) Area dispatchable unit which belongs to the power schedule.
0..*	DCTieCorridor	0..1	DCTieCorridor	(NC) DC tie corridor which belongs to the power schedule.
0..*	GeneratingUnit	0..1	GeneratingUnit	(NC) Generating unit which belongs to the power schedule.
0..*	HydroPump	0..1	HydroPump	(NC) Hydro pump which belongs to the power schedule.
0..*	PowerRemedialAction	0..1	PowerRemedialAction	(NC) Power remedial action which belongs to the Remedial Action Schedule.
0..*	EnergyGroup	0..1	EnergyGroup	(NC) Energy group which belongs to a power schedule.
0..*	BiddingZoneBorder	0..1	BiddingZoneBorder	(NC) Bidding zone border which belongs to the power schedule.
0..*	EquivalentInjection	0..1	EquivalentInjection	(NC) Equivalent injection which belongs to the power schedule.
0..*	DCPole	0..1	DCPole	(NC) DC pole which belongs to the power schedule.
0..*	BiddingZone	0..1	BiddingZone	(NC) Bidding zone which has power schedules.

3.8 (NC) PowerTimePoint root class

Power, active and reactive, value at a given point in time.

Table 8 shows all attributes of PowerTimePoint.

Table 8 – Attributes of PowerScheduleProfile::PowerTimePoint

name	mult	type	description
atTime	0..1	DateTime	(NC) The time the data is valid for.
p	0..1	ActivePower	(NC) Active power injection. Load sign convention is used, i.e. positive sign means flow out from a node.

name	mult	type	description
q	0..1	ReactivePower	(NC) Reactive power injection. Load sign convention is used, i.e. positive sign means flow out from a node.
price	0..1	Decimal	(NC) Price for the scheduled active power per unit of active power. e.g. per MW.
activatedP	0..1	ActivePower	(NC) Active power activated as part of redispatch. Negative number means that the value is scheduling down. Positive number means that the value is scheduling up.
activatedPrice	0..1	Decimal	(NC) Price for the activated active power per unit e.g. per MW.
activatedQ	0..1	ReactivePower	(NC) Reactive power activated as part of redispatch. Negative number means that the value is scheduling down. Positive number means that the value is scheduling up.
meritOrder	0..1	Integer	(NC) Ranking the energy blocks. Ranking can be based on historical values or other sources. It is required if power schedule is kind merit order.

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

Table 9 – Association ends of PowerScheduleProfile::PowerTimePoint with other classes

mult from	name	mult to	type	description
0..*	PowerSchedule	1..1	PowerSchedule	(NC) Time series the time point values belongs to.

3.9 (NC) MustRunSchedule

Inheritance path = [BaseIrregularTimeSeries](#) : [BaseTimeSeries](#) : [IdentifiedObject](#)

Time series represent irregular must-run instruction values at given points in time. This could be instruction to a reliability must-run (RMR) generation facility that is necessary to run to meet certain operating conditions in order to maintain the security of power systems in a competitive environment.

Table 10 shows all attributes of MustRunSchedule.

Table 10 – Attributes of PowerScheduleProfile::MustRunSchedule

name	mult	type	description
interpolationKind	1..1	TimeSeriesInterpolationKind	(NC) inherited from: BaseTimeSeries
timeSeriesKind	1..1	BaseTimeSeriesKind	(NC) inherited from: BaseTimeSeries
generatedAtTime	0..1	DateTime	(NC) inherited from: BaseTimeSeries
percentile	0..1	Integer	(NC) inherited from: BaseTimeSeries
actionMethod	0..1	String	(NC) inherited from: BaseTimeSeries
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

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

Table 11 – Association ends of PowerScheduleProfile::MustRunSchedule with other classes

mult from	name	mult to	type	description
0..*	DCTieCorridor	0..1	DCTieCorridor	(NC) Hydro pump which belongs to the power schedule.
0..*	GeneratingUnit	0..1	GeneratingUnit	(NC) Generating unit which belongs to the must run schedule.

3.10 (NC) MustRunTimePoint root class

Must-run instruction value at a given point in time.

Table 12 shows all attributes of MustRunTimePoint.

Table 12 – Attributes of PowerScheduleProfile::MustRunTimePoint

name	mult	type	description
atTime	1..1	DateTime	(NC) The time the data is valid for.
mustRunP	0..1	ActivePower	(NC) Minimum active power injection that is needed to meet must-run requirement. This value can be higher or equal to minimum operational limit. Load sign convention is used, i.e. positive sign means flow out from a node.
mustRunQ	0..1	ReactivePower	(NC) Minimum reactive power injection that is needed to meet must-run requirement. This value can be higher or equal to minimum operational limit. Load sign convention is used, i.e. positive sign means flow out from a node.
mustRun	0..1	Boolean	(NC) True, if the must-run instruction is active this time point. Otherwise false.

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

Table 13 – Association ends of PowerScheduleProfile::MustRunTimePoint with other classes

mult from	name	mult to	type	description
1..*	MustRunSchedule	1..1	MustRunSchedule	(NC) Time series the time point values belongs to.

3.11 (abstract) EnergyConnection root class

A connection of energy generation or consumption on the power system model.

3.12 (abstract) HydroPump root class

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

3.13 (abstract,NC) AreaDispatchableUnit root class

Allocates a given producing or consuming unit, including direct current corridor and collection of units, to a given control area (through the scheduling area) for supporting the control of the given area through dispatch instruction.

3.14 (abstract) GeneratingUnit root class

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

GeneratingUnit for each member of the set and an additional GeneratingUnit corresponding to the set.

3.15 (abstract) PowerElectronicsUnit root class

A generating unit or battery or aggregation that connects to the AC network using power electronics rather than rotating machines.

3.16 (abstract,NC) DCTieCorridor root class

A collection of one or more direct current poles that connect two different control areas.

3.17 (abstract,NC) BiddingZone root class

A bidding zone is a market-based method for handling power transmission congestion. It consists of scheduling areas that include the relevant production (supply) and consumption (demand) to form an electrical area with the same market price without capacity allocation.

3.18 (abstract,NC) SchedulingArea root class

An area where production and/or consumption of energy can be forecasted, scheduled and measured. The area is operated by only one system operator, typically a Transmission System Operator (TSO). The area can consist of a sub area, which has the same definition as the main area, but it can be operated by another system operator (typically Distributed System Operator (DSO) or a Closed Distributed System Operator (CDSO)). This includes microgrid concept. A substation is the smallest grouping that can be included in the area. The area size should be considered in terms of the possibility of accumulated reading (settlement metering) and the capability of operating as an island.

3.19 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.

3.20 Integer primitive

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

3.21 String primitive

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

3.22 Boolean primitive

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

3.23 ActivePower datatype

Product of RMS value of the voltage and the RMS value of the in-phase component of the current.

Table 14 shows all attributes of ActivePower.

Table 14 – Attributes of PowerScheduleProfile::ActivePower

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

3.24 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 "P" represents the derived unit "m2Pers", then applying the multiplier "k" can be conceptualized simply as "kP".

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 "P", then it is easier to conceptualize the multiplier "m" as creating the proper unit "mP", and not the forbidden unit "mkg".

Table 15 shows all literals of UnitMultiplier.

Table 15 – Literals of PowerScheduleProfile::UnitMultiplier

literal	value	description
M	6	Mega 10^{**6} .

3.25 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 16 shows all literals of UnitSymbol.

Table 16 – Literals of PowerScheduleProfile::UnitSymbol

literal	value	description
W	38	Real power in watts (J/s). Electrical power may have real and reactive components. The real portion of electrical power (I^2R or $V\cos(\phi)$), is expressed in Watts. See also apparent power and reactive power.
VAr	63	Reactive power in volt amperes reactive. The "reactive" or "imaginary" component of electrical

literal	value	description
		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.

476

477 **3.26 Float primitive**

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

479 **3.27 ReactivePower datatype**480 Product of RMS value of the voltage and the RMS value of the quadrature component of the
481 current.

482 Table 17 shows all attributes of ReactivePower.

483 **Table 17 – Attributes of PowerScheduleProfile::ReactivePower**

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

484

485 **3.28 Decimal primitive**

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

487 **3.29 (abstract,NC) PowerRemedialAction root class**

488 Energy remedial action describes actions to rearrange power schedules.

489 **3.30 (abstract,NC) BiddingZoneBorder root class**

490 A unidirectional interface between two adjacent Bidding Zones, representing the available
 491 transmission capacity from the Bidding Zone defined by the association FromBiddingZone
 492 (source) to the Bidding Zone defined by the association ToBiddingZone (sink). It defines the
 493 capacity constraints and market-based allocation mechanisms for cross-zonal electricity
 494 exchange in the specified direction, considering potential transmission congestion and market
 495 price differences.

496 **3.31 (abstract) EquivalentInjection root class**

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

499 **3.32 (abstract,NC) DCPole root class**

500 The direct current (DC) system pole (IEC 60633) is part of a DC system consisting of all the
 501 equipment in the DC substations and the interconnecting transmission lines, if any, which during
 502 normal operation exhibit a common direct voltage polarity with respect to earth.

503 **3.33 (NC) RelativeDirectionKind enumeration**

504 Kind of direction for the changes.

505 Table 18 shows all literals of RelativeDirectionKind.

506 **Table 18 – Literals of PowerScheduleProfile::RelativeDirectionKind**

literal	value	description
up		Up signifies that the changes are increasing from the current status.
down		Down signifies that the changes are decreasing from the current status.
upAndDown		Up and down signifies that both up and down values are equal.
none		There is no direction on the changes.

507

508 **3.34 (NC) PowerScheduleKind enumeration**

509 Kind of power schedule.

510 Table 19 shows all literals of PowerScheduleKind.

511 **Table 19 – Literals of PowerScheduleProfile::PowerScheduleKind**

literal	value	description
meritOrder		Power schedule is a merit order that includes ranking of the power block. Power block provides the maximum power allocation possible.
mustRun		Power schedule is a must run schedule that identifies the unit that must run for a given time point.
power		Power schedule that has no additional meaning than allocating power to unit for a given time point.
price		Power schedule includes prices for a given a power per time point.

512

513 **3.35 (abstract,NC) EnergyGroup root class**

514 An energy group is an aggregation of energy components which have the same energy
515 characteristic, e.g. fuel type and technology. It can be used to allocate energy.

516 **3.36 Currency enumeration**

517 Monetary currencies. ISO 4217 standard including 3-character currency code.

518 Table 20 shows all literals of Currency.

519 **Table 20 – Literals of PowerScheduleProfile::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.

literal	value	description
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.
FJD	242	Fiji dollar.
FKP	238	Falkland Islands pound.

literal	value	description
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.
MAD	504	Moroccan dirham.
MDL	498	Moldovan leu.

literal	value	description
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.
SOS	706	Somali shilling.
SRD	968	Surinamese dollar.

literal	value	description
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	Samoa 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.

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524 **Annex A (informative): Sample data**

525 **A.1 General**

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

530 **A.2 Sample instance data**

531 Test data files are available in the CIM EG SharePoint.

532

533