European Network of
Transmission System Operators
for Electricity

STEADY STATE INSTRUCTION PROFILE SPECIFICATION

2023-05-10

APPROVED DOCUMENT
VERSION 2.2

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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.

Revision History

Version	Release	Date	Paragraph	Comments
0	1	2021-10-12		For CIM EG review
1	0	2022-02-16		SOC approved.
2	1	2022-09-21		SOC approved.
2	2	2023-03-24		For review.
2	2	2023-05-10		ICTC approved.

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The steady state instruction profile enables an exchange of additional information related to MTU.

2 Application profile specification

2.1 Version information

The content is generated from UML model file CIM100_CGMES31v01_501-20v02_NC22v95_MM10v01.eap.

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

- Title: Steady state instruction Vocabulary
- Keyword: SSI
- Description: This vocabulary is describing the steady state instruction profile.
- Version IRI: http://entsoe.eu/ns/CIM/SteadyStateInstruction-EU/2.2
- Version info: 2.2.0
- Prior version: http://entsoe.eu/ns/CIM/SteadyStateInstruction-EU/2.1
- 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:6d01969f-38fd-460d-b260-b839a8123319

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.

2.4 Metadata

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

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

2.4.1 Constraints

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

- R: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 steady state instruction profile.

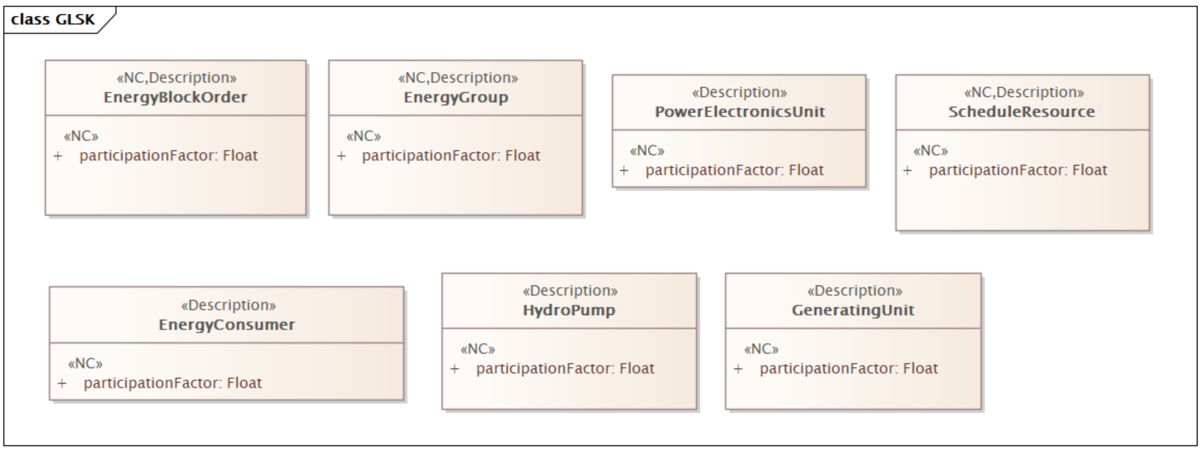

Figure 1 – Class diagram SteadyStateInstructionProfile::GLSK

Figure 1: The diagram shows generation and load shift keys related classes.

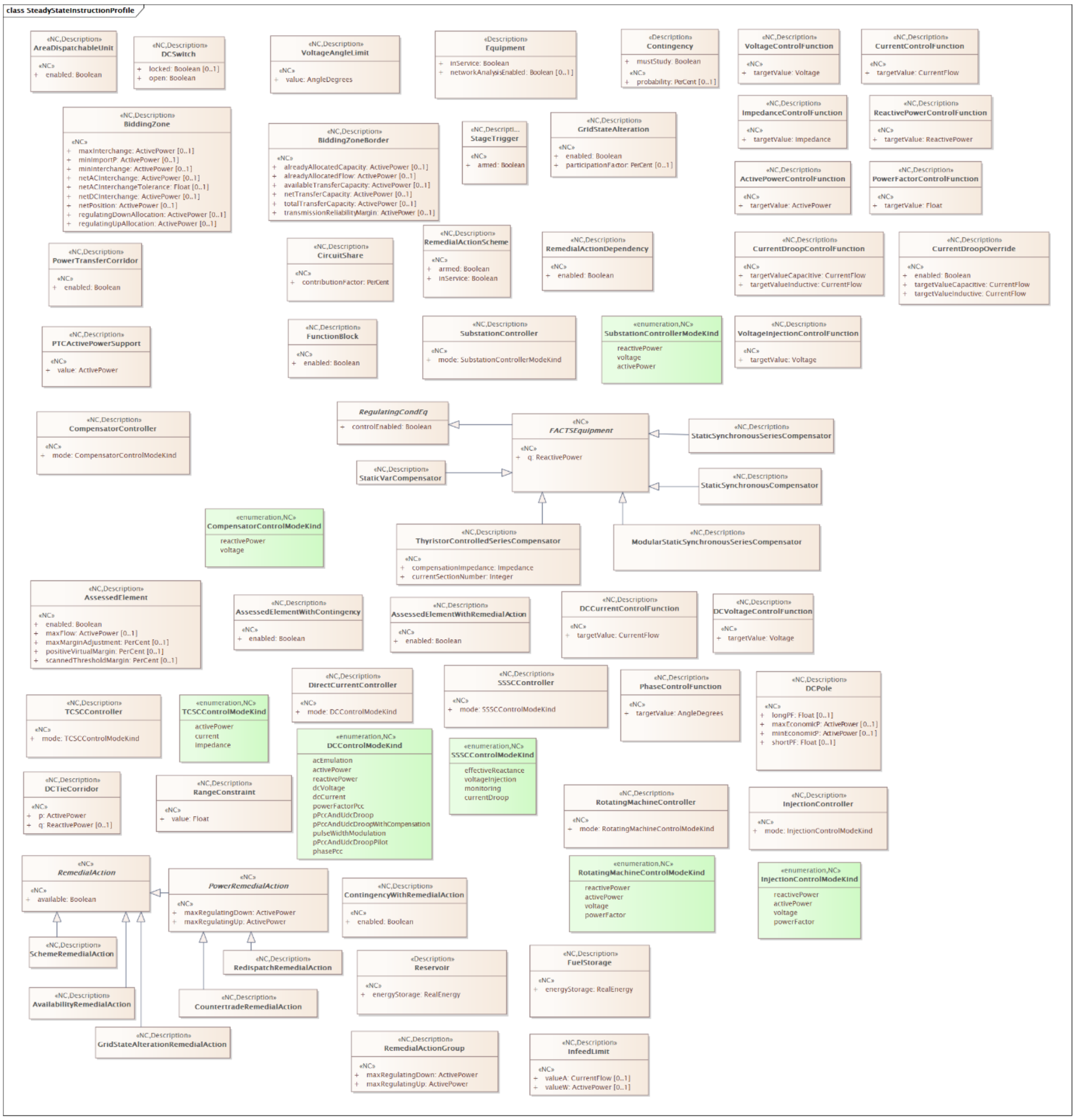

Figure 2 – Class diagram SteadyStateInstructionProfile::SteadyStateInstructionProfile

Figure 2: The diagram shows steady state instruction related classes.

3.2 (NC,Description) ActivePowerControlFunction root class

Active power control function is a function block that calculates operating point of the controlled equipment to achieve the target active power.
Table 1 shows all attributes of ActivePowerControlFunction.

Table 1 – Attributes of SteadyStateInstructionProfile::ActivePowerControlFunction

name	mult	type	description
targetValue	1..1	ActivePower	(NC) Target value for the active power that the control function is calculating to achieve by adjusting the operational setting to the controlled equipment.

3.3 (NC,Description) 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.

Table 2 shows all attributes of AreaDispatchableUnit.

Table 2 – Attributes of SteadyStateInstructionProfile::AreaDispatchableUnit

name	mult	type	description
enabled	1..1	Boolean	(NC) Identifies if the unit is enabled to accept a dispatch instruction. If true, the unit is enabled to accept a dispatch instruction. If false, the unit has the capability, but it is not enabled to receive a dispatch instruction.

3.4 (NC,Description) AssessedElement root class

Assessed element is a network element for which the electrical state is evaluated in the regional or cross-regional process and which value is expected to fulfil regional rules function of the operational security limits.

The measurements and limits are as defined in the steady state hypothesis.

Table 3 shows all attributes of AssessedElement.

Table 3 – Attributes of SteadyStateInstructionProfile::AssessedElement

name	mult	type	description
maxFlow	0..1	ActivePower	(NC) Maximum flow on a conducting equipment or a collection of conducting equipment forming a power transfer corridor. For assessed element that becomes critical due to contingency, this value represents the maximum flow with remedial action taken into consideration.
maxMarginAdjustment	0..1	PerCent	(NC) Maximum adjustment, relative to maximum flow allowed for exceeding the maximum flow of this assessed element. The allowed value range is [0,100].
enabled	1..1	Boolean	(NC) If true, the assessed element is enabled, otherwise it is disabled.
positiveVirtualMargin	0..1	PerCent	(NC) A positive margin that defines the overload allowed in a solution for the assessed element for the current situation. The margin represents influences that can be solved by the System Operators using available remedial action which is not cross-border relevant remedial action. All relevant operational limits (e.g. PATL, TATL, etc) are modified by this margin value. The attribute represents the increase. The allowed value range is [0,100].
scannedThresholdMargin	0..1	PerCent	(NC) Threshold percentage that a scanned element can be overloaded, on a given element, on top of any overload prior to optimisation (default= 5%). e.g. Initial loading of the element is 110%, with a 5% scanned threshold margin, the new maximum is 115% of the limit (e.g. PATL, TATL, etc). The allowed value range is [0,100].

3.5 (NC,Description) AssessedElementWithContingency root class

Combination of an assessed element and a contingency.
Table 4 shows all attributes of AssessedElementWithContingency.

Table 4 – Attributes of SteadyStateInstructionProfile::AssessedElementWithContingency

name	mult	type	description
enabled	1..1	Boolean	(NC) If true, the assessed element with contingency is enabled, otherwise it is disabled.

3.6 (NC,Description) AssessedElementWithRemedialAction root class

Combination of an assessed element and a remedial action
Table 5 shows all attributes of AssessedElementWithRemedialAction.

Table 5 – Attributes of SteadyStateInstructionProfile::AssessedElementWithRemedialAction

name	mult	type	description
enabled	1..1	Boolean	(NC) If true, the assessed element with remedial action is enabled, otherwise it is disabled.

3.7 (NC,Description) AvailabilityRemedialAction

Inheritance path = RemedialAction
Availability remedial action is a remedial action that cancels or reschedules an availability schedule.
Table 6 shows all attributes of AvailabilityRemedialAction.

Table 6 – Attributes of SteadyStateInstructionProfile::AvailabilityRemedialAction

name	mult	type	description
available	1..1	Boolean	(NC) inherited from: RemedialAction

3.8 (NC,Description) 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.
Table 7 shows all attributes of BiddingZone.

Table 7 – Attributes of SteadyStateInstructionProfile::BiddingZone

name	mult	type	description
netACInterchange	0..1	ActivePower	(NC) The netted aggregation of all AC external schedules of an area. Positive sign means flow into the area (Import).
netACInterchangeTolerance	0..1	Float	(NC) The area AC Net Position tolerance.
netDCInterchange	0..1	ActivePower	(NC) The netted aggregation of all DC external schedules of an area. Positive sign means flow into the area.
regulatingUpAllocation	0..1	ActivePower	(NC) The balancing capacity allocated for regulating up, by increasing the production, decreasing the direct current export, increasing direct current import or reducing the

name	mult	type	description
			consumption of energy in the bidding zone. This must be a positive number.
maxInterchange	0..1	ActivePower	(NC) Maximum total active power (AC and DC) that the net position for the bidding zone can have to maintain operational security. Positive sign means flow into the bidding zone.
minImportP	0..1	ActivePower	(NC) Minimum imported active power requirement.
minInterchange	0..1	ActivePower	(NC) Minimum total active power (AC and DC) that the net position for the bidding zone can have to maintain operational security. Negative sign means flow out of the bidding zone.
netPosition	0..1	ActivePower	(NC) Net position is the netted sum of electricity exports and imports for each market time unit for a bidding zone.
regulatingDownAllocation	0..1	ActivePower	(NC) The balancing capacity allocated for regulating down, by decreasing the production, increasing the direct current export, decreasing direct current import or increasing the consumption of energy in the bidding zone. This must be a positive number.

3.9 (NC,Description) BiddingZoneBorder root class

Defines the aggregated connection capacity between two Bidding Zones.
Table 8 shows all attributes of BiddingZoneBorder.

Table 8 – Attributes of SteadyStateInstructionProfile::BiddingZoneBorder

name	mult	type	description
totalTransferCapacity	0..1	ActivePower	(NC) Total Transfer Capacity (TTC) is the maximum exchange program between two areas compatible with operational security standards applicable at each system if future network conditions, generation and load patterns were perfectly known in advance.
transmissionReliabilityMargin	0..1	ActivePower	(NC) Transmission Reliability Margin (TRM) is the minimum reserve that system operators must have available at their connections so that they can help other countries to which their system is directly or indirectly connected, if necessary.
netTransferCapacity	0..1	ActivePower	(NC) Net Transfer Capacity (NTC) is defined as NTC = TTC – TRM and corresponds to the maximum exchange between two areas compatible with operational security limits applicable in both areas and taking into account the technical uncertainties on future network conditions.
alreadyAllocatedCapacity	0..1	ActivePower	(NC) Already Allocated Capacity (AAC) means the total amount of allocated transmission rights i.e. transmission capacity reserved by virtue of historical long-term contracts and the previously held transmission capacity reservation auctions.
availableTransferCapacity	0..1	ActivePower	(NC) Available Transfer Capacity (ATC) means the transmission capacity that remains available, after allocation procedure, to be used under the physical conditions of the transmission system. ATC value is defined as: ATC = NTC - AAC.

name	mult	type	description
alreadyAllocatedFlow	0..1	ActivePower	(NC) The maximum allowed flow on the collection of interconnection between two bidding zones.

3.10 (NC,Description) CircuitShare root class

Defines the share of the circuit which is part of an associated power transfer corridor.
Table 9 shows all attributes of CircuitShare.

Table 9 – Attributes of SteadyStateInstructionProfile::CircuitShare

name	mult	type	description
contributionFactor	1..1	PerCent	(NC) Contribution factor for the circuit which is part of a power transfer corridor. The allowed value range is [0,100].

3.11 (NC,Description) CompensatorController root class

Compensator controller is controlling the equipment to optimize the use of the compensators.
Table 10 shows all attributes of CompensatorController.

Table 10 – Attributes of SteadyStateInstructionProfile::CompensatorController

name	mult	type	description
mode	1..1	CompensatorControlModeKind	(NC) Mode of the compensator controller.

3.12 (Description) Contingency root class

An event threatening system reliability, consisting of one or more contingency elements.
Table 11 shows all attributes of Contingency.

Table 11 – Attributes of SteadyStateInstructionProfile::Contingency

name	mult	type	description
mustStudy	1..1	Boolean	Set true if must study this contingency.
probability	0..1	PerCent	(NC) The forecasted probability of the occurrence of the contingency based on the given operational condition, status of the equipment and the forecasted environment condition. The allowed value range is [0,100].

3.13 (NC,Description) CountertradeRemedialAction

Inheritance path = PowerRemedialAction : RemedialAction
Countertrade is a remedial action to relieve physical congestions where the location of activated resources within the bidding zone is not known.
Table 12 shows all attributes of CountertradeRemedialAction.

Table 12 – Attributes of SteadyStateInstructionProfile::CountertradeRemedialAction

name	mult	type	description
maxRegulatingDown	1..1	ActivePower	(NC) inherited from: PowerRemedialAction
maxRegulatingUp	1..1	ActivePower	(NC) inherited from: PowerRemedialAction
available	1..1	Boolean	(NC) inherited from: RemedialAction

3.14 (NC,Description) ContingencyWithRemedialAction root class

Combination of a contingency and a remedial action. ContingencyWithRemedialAction shall not be instantiated for preventive RemedialAction (RemedialAction.kind equals RemedialActionKind.preventive).
Table 13 shows all attributes of ContingencyWithRemedialAction.

Table 13 – Attributes of SteadyStateInstructionProfile::ContingencyWithRemedialAction

name	mult	type	description
enabled	1..1	Boolean	(NC) If true, the contingency with remedial action is enabled, otherwise it is disabled.

3.15 (NC,Description) CurrentDroopControlFunction root class

Current droop control function is a function block that calculates the operating point of the controlled equipment to achieve the target current.
Table 14 shows all attributes of CurrentDroopControlFunction.

Table 14 – Attributes of SteadyStateInstructionProfile::CurrentDroopControlFunction

name	mult	type	description
targetValueInductive	1..1	CurrentFlow	(NC) Setpoint when control is active in inductive region.
targetValueCapacitive	1..1	CurrentFlow	(NC) Setpoint when control is active in capacitive region.

3.16 (NC,Description) CurrentControlFunction root class

Current control function is a function block that calculates the operating point of the controlled equipment to achieve the target current.
Table 15 shows all attributes of CurrentControlFunction.

Table 15 – Attributes of SteadyStateInstructionProfile::CurrentControlFunction

name	mult	type	description
targetValue	1..1	CurrentFlow	(NC) Target value for the current that the control function is calculating to achieve by adjusting the operational setting to the controlled equipment.

3.17 (NC,Description) CurrentDroopOverride root class

Current droop override uses the following logic:
- When the current exceeds a threshold the device executes the following transitions: 1) When injecting an inductive voltage or in monitoring mode the device tends to inject a voltage proportional to the difference between the line current and the aforementioned threshold. 2) When injecting a capacitive voltage the device transitions to monitoring mode.
- If the aforementioned proportional voltage is lower than the initial one, the voltage injection remains unchanged.

Current droop override is not applied when the device operates in currentDroop mode.
Table 16 shows all attributes of CurrentDroopOverride.

Table 16 – Attributes of SteadyStateInstructionProfile::CurrentDroopOverride

name	mult	type	description
targetValueInductive	1..1	CurrentFlow	(NC) Setpoint when control is active in inductive region.

name	mult	type	description
enabled	1..1	Boolean	(NC) True, if the current droop override is enabled (active). Otherwise false.
targetValueCapacitive	1..1	CurrentFlow	(NC) Setpoint when control is active in capacitive region.

3.18 (NC,Description) DCCurrentControlFunction root class

DC current control function is a function block that calculates the operating point of the controlled equipment to achieve the target current.
Table 17 shows all attributes of DCCurrentControlFunction.

Table 17 – Attributes of SteadyStateInstructionProfile::DCCurrentControlFunction

name	mult	type	description
targetValue	1..1	CurrentFlow	(NC) Target value for the current that the control function is calculating to achieve by adjusting the operational setting to the controlled equipment.

3.19 (NC,Description) DCPole root class

The direct current (DC) pole is the circuit which includes converter units from both sides and the relevant direct current line. This forms the smallest unit of transmission control.
Table 18 shows all attributes of DCPole.

Table 18 – Attributes of SteadyStateInstructionProfile::DCPole

name	mult	type	description
longPF	0..1	Float	(NC) Energy consumer long term economic participation factor.
maxEconomicP	0..1	ActivePower	(NC) Maximum high economic active power limit, that should not exceed the maximum operating active power limit.
minEconomicP	0..1	ActivePower	(NC) Low economic active power limit that shall be greater than or equal to the minimum operating active power limit.
shortPF	0..1	Float	(NC) Energy consumer short term economic participation factor.

3.20 (NC,Description) DCSwitch root class

A switch within the DC system.
Table 19 shows all attributes of DCSwitch.

Table 19 – Attributes of SteadyStateInstructionProfile::DCSwitch

name	mult	type	description
open	1..1	Boolean	The attribute tells if the switch is considered open when used as input to topology processing.
locked	0..1	Boolean	If true, the switch is locked. The resulting switch state is a combination of locked and DCSwitch.open attributes as follows: - locked=true and DCSwitch.open=true. The resulting state is open and locked; - locked=false and DCSwitch.open=true. The resulting state is open;

name	mult	type	description
			- locked=false and DCSwitch.open=false. The resulting state is closed.

3.21 (NC,Description) DCTieCorridor root class

A collection of one or more direct current poles that connect two different control areas.
Table 20 shows all attributes of DCTieCorridor.

Table 20 – Attributes of SteadyStateInstructionProfile::DCTieCorridor

name	mult	type	description
p	1..1	ActivePower	(NC) Active power at the point of common coupling. Load sign convention is used, i.e. positive sign means flow out from a node. Starting value for a steady state solution in the case a simplified power flow model is used.
q	0..1	ReactivePower	(NC) Reactive power at the point of common coupling. Load sign convention is used, i.e. positive sign means flow out from a node. Starting value for a steady state solution in the case a simplified power flow model is used.

3.22 (NC,Description) DCVoltageControlFunction root class

DC voltage control function is a function block that calculate the operating point of the controlled equipment to achieve the target voltage.
Table 21 shows all attributes of DCVoltageControlFunction.

Table 21 – Attributes of SteadyStateInstructionProfile::DCVoltageControlFunction

name	mult	type	description
targetValue	1..1	Voltage	(NC) Target value for the voltage that the control function is calculating to achieve by adjusting the operational setting to the controlled equipment.

3.23 (NC,Description) DirectCurrentController root class

Power flow controller for direct current that can be used in high-voltage direct current grids and for low-voltage direct current microgrids. It uses a high-frequency isolated dc-dc converter cascaded with a controllable full-bridge inverter that creates a small bipolar voltage in series with the line. The controller can control the power and compensate for accumulated voltage drop in a distribution line.
Table 22 shows all attributes of DirectCurrentController.

Table 22 – Attributes of SteadyStateInstructionProfile::DirectCurrentController

name	mult	type	description
mode	1..1	DCControlModeKind	(NC) Mode of the dc controller.

3.24 (NC,Description) FuelStorage root class

Fuel storage. e.g. pile of coal that can be shared between multiple thermal generating units.
Table 23 shows all attributes of FuelStorage.

Table 23 – Attributes of SteadyStateInstructionProfile::FuelStorage

name	mult	type	description
energyStorage	1..1	RealEnergy	(NC) Amount of energy available in the storage.

3.25 (NC,Description) EnergyBlockOrder root class

The energy block order is a block (an amount) of active power that forms the sequence of active power orders that are going to be distributed to an energy block component.
Table 24 shows all attributes of EnergyBlockOrder.

Table 24 – Attributes of SteadyStateInstructionProfile::EnergyBlockOrder

name	mult	type	description
participationFactor	1..1	Float	(NC) Participation factor.

3.26 (Description) 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.
Table 25 shows all attributes of EnergyConsumer.

Table 25 – Attributes of SteadyStateInstructionProfile::EnergyConsumer

name	mult	type	description
participationFactor	1..1	Float	(NC) Participation factor describing the entity part of the active power provided by a collection of entities (e.g. an active power forecast to a collection of entities is divided to each of the member entity according to the participation factor). Must be a positive value. In the case of a sharing strategy, the distribution is following entities value (V) equals aggregated value (T) divided by sum of participation factors (PF), i.e. V=T/sum(PF). In the case of priority strategy, the item with the lowest number gets allocated energy first.

3.27 (NC,Description) EnergyGroup root class

An energy group is an aggregation of energy components which have the same energy characteristic, e.g. fuel type and technology. It can be used to allocate energy.
Table 26 shows all attributes of EnergyGroup.

Table 26 – Attributes of SteadyStateInstructionProfile::EnergyGroup

name	mult	type	description
participationFactor	1..1	Float	(NC) Participation factor.

3.28 (Description) Equipment root class

The parts of a power system that are physical devices, electronic or mechanical.
Table 27 shows all attributes of Equipment.

Table 27 – Attributes of SteadyStateInstructionProfile::Equipment

name	mult	type	description
inService	1..1	Boolean	Specifies the availability of the equipment. True means the equipment is available for topology processing, which determines if the equipment is energized or not. False means that the equipment is treated by network applications as if it is not in the model.
networkAnalysisEnabled	0..1	Boolean	The equipment is enabled to participate in network analysis. If unspecified, the value is assumed to be true.

3.29 (abstract,NC) FACTSEquipment

Inheritance path = RegulatingCondEq
Flexible Alternating Current Transmission System regulating equipment.
Table 28 shows all attributes of FACTSEquipment.

Table 28 – Attributes of SteadyStateInstructionProfile::FACTSEquipment

name	mult	type	description
q	1..1	ReactivePower	(NC) Reactive power injection. Load sign convention is used, i.e. positive sign means flow out from a node. Starting value for a steady state solution.
controlEnabled	1..1	Boolean	inherited from: RegulatingCondEq

3.30 (NC,Description) FunctionBlock root class

Function block is a function described as a set of elementary blocks. The blocks describe the function between input variables and output variables.
Table 29 shows all attributes of FunctionBlock.

Table 29 – Attributes of SteadyStateInstructionProfile::FunctionBlock

name	mult	type	description
enabled	1..1	Boolean	(NC) True, if the function block is enabled (active). Otherwise false.

3.31 (Description) 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.
Table 30 shows all attributes of GeneratingUnit.

Table 30 – Attributes of SteadyStateInstructionProfile::GeneratingUnit

name	mult	type	description
participationFactor	1..1	Float	(NC) Participation factor describing the entity part of the active power provided by a collection of entities (e.g. an active power forecast to a collection of entities is divided to each of the member entity according to the participation factor). Must be a positive value.

name	mult	type	description
			In the case of a sharing strategy, the distribution is following entities value (V) equals aggregated value (T) divided by sum of participation factors (PF), i.e. V=T/sum(PF). In the case of priority strategy, the item with the lowest number gets allocated energy first.

3.32 (NC,Description) GridStateAlteration root class

Grid state alteration is a change of values describing state (operating point) of one element in the grid model compared to the base case.
Table 31 shows all attributes of GridStateAlteration.

Table 31 – Attributes of SteadyStateInstructionProfile::GridStateAlteration

name	mult	type	description
enabled	1..1	Boolean	(NC) The status of the GridStateAlteration set by an operation or by a signal resulting from a control action.
participationFactor	0..1	PerCent	(NC) Participation factor describing the entity part of the active power provided by a collection of entities (e.g. an active power forecast to a collection of entities is divided to each of the member entity according to the participation factor). Must be a positive value. In the case of a sharing strategy, the distribution is following entities value (V) equals aggregated value (T) divided by sum of participation factors (PF), i.e. V=T/sum(PF). In the case of priority strategy, the item with the lowest number gets allocated energy first. e.g. 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%.

3.33 (NC,Description) GridStateAlterationRemedialAction

Inheritance path = RemedialAction
Grid state alteration remedial action describes one or many grid state alterations applied to a grid model state or a particular scenario in order to resolve one or more identified constraints.
Table 32 shows all attributes of GridStateAlterationRemedialAction.

Table 32 – Attributes of SteadyStateInstructionProfile::GridStateAlterationRemedialAction

name	mult	type	description
available	1..1	Boolean	(NC) inherited from: RemedialAction

3.34 (Description) HydroPump root class

A synchronous motor-driven pump, typically associated with a pumped storage plant.
Table 33 shows all attributes of HydroPump.

Table 33 – Attributes of SteadyStateInstructionProfile::HydroPump

name	mult	type	description
participationFactor	1..1	Float	(NC) Participation factor describing the entity part of the active power provided by a collection of entities (e.g. an active power forecast to a

name	mult	type	description
			collection of entities is divided to each of the member entity according to the participation factor). Must be a positive value. In the case of a sharing strategy, the distribution is following entities value (V) equals aggregated value (T) divided by sum of participation factors (PF), i.e. V=T/sum(PF). In the case of priority strategy, the item with the lowest number gets allocated energy first.

3.35 (NC,Description) ImpedanceControlFunction root class

Impedance control function is a function block that calculates the operating point of the controlled equipment to achieve the target impedance.
Table 34 shows all attributes of ImpedanceControlFunction.

Table 34 – Attributes of SteadyStateInstructionProfile::ImpedanceControlFunction

name	mult	type	description
targetValue	1..1	Impedance	(NC) Target value for the impedance that the control function is calculating to achieve by adjusting the operational setting to the controlled equipment.

3.36 (NC,Description) InfeedLimit root class

Infeed limit set constraints fed in to the network by two or more terminals.
Table 35 shows all attributes of InfeedLimit.

Table 35 – Attributes of SteadyStateInstructionProfile::InfeedLimit

name	mult	type	description
valueW	0..1	ActivePower	(NC) Value of active power limit. The attribute shall be a positive value or zero.
valueA	0..1	CurrentFlow	(NC) Value of current limit. The attribute shall be a positive value or zero.

3.37 (NC,Description) InjectionController root class

Injection controller is controlling the equipment which represents an injection or an external network.
Table 36 shows all attributes of InjectionController.

Table 36 – Attributes of SteadyStateInstructionProfile::InjectionController

name	mult	type	description
mode	1..1	InjectionControlModeKind	(NC) Mode of the injection controller.

3.38 (NC,Description) ModularStaticSynchronousSeriesCompensator

Inheritance path = FACTSEquipment : RegulatingCondEq
Modular static synchronous series compensator (MSSSC) is a type of flexible AC transmission system regulating equipment which consists of solid-state voltage source inverter connected in series with a transmission line. This is similar to static synchronous series compensator (SSSC), but without injection transformer. This enables the MSSSC to be truly modular with the ability to simply install a number of equipment in series to provide a desired maximum level of

impedance. MSSSC can be dispersed into multiple location in a circuit working collectively under the same controller scheme.
Table 37 shows all attributes of ModularStaticSynchronousSeriesCompensator.

Table 37 – Attributes of SteadyStateInstructionProfile::ModularStaticSynchronousSeriesCompensator

name	mult	type	description
q	1..1	ReactivePower	(NC) inherited from: FACTSEquipment
controlEnabled	1..1	Boolean	inherited from: RegulatingCondEq

3.39 (NC,Description) PhaseControlFunction root class

Phase control function is a function block that calculate the operating point of the controlled equipment to achieve the target voltage.
Table 38 shows all attributes of PhaseControlFunction.

Table 38 – Attributes of SteadyStateInstructionProfile::PhaseControlFunction

name	mult	type	description
targetValue	1..1	AngleDegrees	(NC) Target value for the phase that the control function is calculating to achieve by adjusting the operational setting to the controlled equipment.

3.40 (Description) PowerElectronicsUnit root class

A generating unit or battery or aggregation that connects to the AC network using power electronics rather than rotating machines.
Table 39 shows all attributes of PowerElectronicsUnit.

Table 39 – Attributes of SteadyStateInstructionProfile::PowerElectronicsUnit

name	mult	type	description
participationFactor	1..1	Float	(NC) Participation factor describing the entity part of the active power provided by a collection of entities (e.g. an active power forecast to a collection of entities is divided to each of the member entity according to the participation factor). Must be a positive value. In the case of a sharing strategy, the distribution is following entities value (V) equals aggregated value (T) divided by sum of participation factors (PF), i.e. V=T/sum(PF). In the case of priority strategy, the item with the lowest number gets allocated energy first.

3.41 (NC,Description) PowerFactorControlFunction root class

Power factor control function is a function block that calculates the operating point of the controlled equipment to achieve the target power factor.
Table 40 shows all attributes of PowerFactorControlFunction.

Table 40 – Attributes of SteadyStateInstructionProfile::PowerFactorControlFunction

name	mult	type	description
targetValue	1..1	Float	(NC) Target value for the power factor that the control function is calculating to achieve by adjusting the operational setting to the controlled equipment.

3.42 (abstract,NC) PowerRemedialAction

Inheritance path = RemedialAction
Energy remedial action describes actions to rearrange power schedules.
Table 41 shows all attributes of PowerRemedialAction.

Table 41 – Attributes of SteadyStateInstructionProfile::PowerRemedialAction

name	mult	type	description
maxRegulatingDown	1..1	ActivePower	(NC) Maximum net amount of active power that the remedial action can regulate down.
maxRegulatingUp	1..1	ActivePower	(NC) Maximum net amount of active power that the remedial action can regulate up.
available	1..1	Boolean	(NC) inherited from: RemedialAction

3.43 (NC,Description) PowerTransferCorridor root class

A power transfer corridor is defined as a set of circuits (transmission lines or transformers) separating two portions of the power system, or a subset of circuits exposed to a substantial portion of the transmission exchange between two parts of the system.
Table 42 shows all attributes of PowerTransferCorridor.

Table 42 – Attributes of SteadyStateInstructionProfile::PowerTransferCorridor

name	mult	type	description
enabled	1..1	Boolean	(NC) It enables/disables the monitoring/assessment of a power transfer corridor. True means that the monitoring of the power transfer corridor is assessed. False means the power transfer corridor is not assessed.

3.44 (NC,Description) PTCActivePowerSupport root class

Defines the active power capability (support) of the scheme in relation to a PowerTransferCorridor.
Table 43 shows all attributes of PTCActivePowerSupport.

Table 43 – Attributes of SteadyStateInstructionProfile::PTCActivePowerSupport

name	mult	type	description
value	1..1	ActivePower	(NC) The support that a System Integrity Protection Scheme (SIPS) gives to a Power Transfer Corridor (PTC).

3.45 (NC,Description) RangeConstraint root class

Defines the rage constraint.
Table 44 shows all attributes of RangeConstraint.

Table 44 – Attributes of SteadyStateInstructionProfile::RangeConstraint

name	mult	type	description
value	1..1	Float	(NC) The value at the time. The meaning of the value is defined by the attribute referenced by the PropertyReference. The value can be integer, float or boolean. In case of boolean 1 equals true and 0 equals false.

name	mult	type	description
			If the valueKind is incremental or incrementalPercentage, then the value shall be positive (greater than zero). If the valueKind is incrementalPercentage, then the value shall be in the range [0, 100].

3.46 (NC,Description) ReactivePowerControlFunction root class

Reactive power control function is a function block that calculate the operating point of the controlled equipment to achieve the target reactive power.
Table 45 shows all attributes of ReactivePowerControlFunction.

Table 45 – Attributes of SteadyStateInstructionProfile::ReactivePowerControlFunction

name	mult	type	description
targetValue	1..1	ReactivePower	(NC) Target value for the reactive power that the control function is calculating to achieve by adjusting the operational setting to the controlled equipment.

3.47 (NC,Description) RedispatchRemedialAction

Inheritance path = PowerRemedialAction : RemedialAction
Redispatch remedial action is a remedial action that through rearranging power schedules is eliminating breaches of constraints.
Table 46 shows all attributes of RedispatchRemedialAction.

Table 46 – Attributes of SteadyStateInstructionProfile::RedispatchRemedialAction

name	mult	type	description
maxRegulatingDown	1..1	ActivePower	(NC) inherited from: PowerRemedialAction
maxRegulatingUp	1..1	ActivePower	(NC) inherited from: PowerRemedialAction
available	1..1	Boolean	(NC) inherited from: RemedialAction

3.48 (abstract) RegulatingCondEq root class

A type of conducting equipment that can regulate a quantity (i.e. voltage or flow) at a specific point in the network.
Table 47 shows all attributes of RegulatingCondEq.

Table 47 – Attributes of SteadyStateInstructionProfile::RegulatingCondEq

name	mult	type	description
controlEnabled	1..1	Boolean	Specifies the regulation status of the equipment. True is regulating, false is not regulating.

3.49 (abstract,NC) RemedialAction root class

Remedial action describes one or more actions that can be performed on a given power system model situation to eliminate one or more identified breaches of constraints. The remedial action can be costly, and have a cost characteristic, or non costly.
Table 48 shows all attributes of RemedialAction.

Table 48 – Attributes of SteadyStateInstructionProfile::RemedialAction

name	mult	type	description
available	1..1	Boolean	(NC) Identifies if the remedial action is available to be proposed. True means available, False means unavailable.

3.50 (NC,Description) RemedialActionDependency root class

Remedial action dependency is making two remedial actions depending on each other. Multiple dependency is done by multiple instances of this class. The dependency can arrive by having one of the following examples.
- The dependent remedial action is controlled by different system operator (Modeling Authority) (e.g. SIPS that goes across control area).
- The dependent remedial action is representing two or more remedial action that represent the same grid state alteration but with different modeling resolution (e.g. detail direct current model versus a simplified model).
- The remedial action can be combined with other remedial action without the need to create multiple remedial action with the same grid alteration for enabling dependency.

Table 49 shows all attributes of RemedialActionDependency.

Table 49 – Attributes of SteadyStateInstructionProfile::RemedialActionDependency

name	mult	type	description
enabled	1..1	Boolean	(NC) If true, the remedial action dependency is enabled, otherwise it is disabled.

3.51 (NC,Description) RemedialActionGroup root class

Grouping of remedial actions that can be operated together.
Table 50 shows all attributes of RemedialActionGroup.

Table 50 – Attributes of SteadyStateInstructionProfile::RemedialActionGroup

name	mult	type	description
maxRegulatingDown	1..1	ActivePower	(NC) Maximum net amount of active power that the group of remedial actions can regulate down.
maxRegulatingUp	1..1	ActivePower	(NC) Maximum net amount of active power that the group of remedial actions can regulate up.

3.52 (NC,Description) RemedialActionScheme root class

Remedial Action Scheme (RAS), Special Protection Schemes (SPS), System Protection Schemes (SPS) or System Integrity Protection Schemes (SIPS).
A Remedial Action Scheme consists of one or more stages that can trigger and execute a protection action.
Table 51 shows all attributes of RemedialActionScheme.

Table 51 – Attributes of SteadyStateInstructionProfile::RemedialActionScheme

name	mult	type	description
armed	1..1	Boolean	(NC) Defines the arming status of the remedial action scheme. It is set by operation or by signal.
inService	1..1	Boolean	(NC) Specifies the availability of the Remedial Action Scheme (RAS). If true, the RAS is available for contingency processing. If false, the

name	mult	type	description
			RAS is treated by contingency processing as if it is not in the model.

3.53 (Description) Reservoir root class

A water storage facility within a hydro system, including: ponds, lakes, lagoons, and rivers. The storage is usually behind some type of dam.
Table 52 shows all attributes of Reservoir.

Table 52 – Attributes of SteadyStateInstructionProfile::Reservoir

name	mult	type	description
energyStorage	1..1	RealEnergy	(NC) Amount of energy available in the storage.

3.54 (NC,Description) RotatingMachineController root class

Rotating machine controller is controlling the equipment which may be used as a generator or motor.
Table 53 shows all attributes of RotatingMachineController.

Table 53 – Attributes of SteadyStateInstructionProfile::RotatingMachineController

name	mult	type	description
mode	1..1	RotatingMachineControlModeKind	(NC) Mode of the rotating machine controller.

3.55 (NC,Description) ScheduleResource root class

A schedule resource is a market-based method for handling participation of small units, particularly located on the lower voltage level that is controlled by a Distributed System Operator (DSO). It is a collection of units that can operate in the market by providing bids, offers and a resulting committed operational schedule for the collection.
Table 54 shows all attributes of ScheduleResource.

Table 54 – Attributes of SteadyStateInstructionProfile::ScheduleResource

name	mult	type	description
participationFactor	1..1	Float	(NC) Participation factor describing the entity part of the active power provided by a collection of entities (e.g. an active power forecast to a collection of entities is divided to each of the member entity according to the participation factor). Must be a positive value. In the case of a sharing strategy, the distribution is following entities value (V) equals aggregated value (T) divided by sum of participation factors (PF), i.e. V=T/sum(PF). In the case of priority strategy, the item with the lowest number gets allocated energy first.

3.56 (NC,Description) SchemeRemedialAction

Inheritance path = RemedialAction
Scheme remedial action is remedial action that involves a scheme that can include conditional logic and stages of grid alteration. The primary remedial action is the arming of these schemes, that will then perform curative remedial action when the condition is met. System Integrity Protection Scheme (SIPS) and Special Protection Scheme (SPS) are example of this.
Table 55 shows all attributes of SchemeRemedialAction.

Table 55 – Attributes of SteadyStateInstructionProfile::SchemeRemedialAction

name	mult	type	description
available	1..1	Boolean	(NC) inherited from: RemedialAction

3.57 (NC,Description) SSSCController root class

The controller of a Static synchronous series compensator (SSSC).

Table 56 shows all attributes of SSSCController.

Table 56 – Attributes of SteadyStateInstructionProfile::SSSCController

name	mult	type	description
mode	1..1	SSSCControlModeKind	(NC) Mode of the Static Synchronous Series compensator controller.

3.58 (NC,Description) StageTrigger root class

Stage that is triggered either by TriggerCondition or by gate condition within a stage.

Table 57 shows all attributes of StageTrigger.

Table 57 – Attributes of SteadyStateInstructionProfile::StageTrigger

name	mult	type	description
armed	1..1	Boolean	(NC) The status of the class set by operation or by signal. Optional field that will override other status fields.

3.59 (NC,Description) StaticSynchronousCompensator

Inheritance path = FACTSEquipment : RegulatingCondEq

Static synchronous compensator (STATCOM), also known as a static synchronous condenser (STATCON), is a type of flexible AC transmission system regulating equipment used on alternating current electricity transmission networks. It is based on a power electronics voltage-source converter and can act as either a source or sink of reactive AC power to an electricity network. If connected to a source of power it can also provide active AC power.

Table 58 shows all attributes of StaticSynchronousCompensator.

Table 58 – Attributes of SteadyStateInstructionProfile::StaticSynchronousCompensator

name	mult	type	description
q	1..1	ReactivePower	(NC) inherited from: FACTSEquipment
controlEnabled	1..1	Boolean	inherited from: RegulatingCondEq

3.60 (NC,Description) StaticSynchronousSeriesCompensator

Inheritance path = FACTSEquipment : RegulatingCondEq

Static synchronous series compensator (SSSC) is a type of flexible AC transmission system which consists of a solid-state voltage source inverter coupled with a transformer that is connected in series with a transmission line. This device can inject an almost sinusoidal voltage in series with the line. This injected voltage could be considered as an inductive or capacitive reactance, which is connected in series with the transmission line. This feature can provide controllable voltage compensation. In addition, SSSC is able to reverse the power flow by injecting a sufficiently large series reactive compensating voltage. Moreover it can inject a voltage proportional to the difference between the line current and the pre-configured current threshold. It shall have two Terminal-s associated with it.

Table 59 shows all attributes of StaticSynchronousSeriesCompensator.

Table 59 – Attributes of SteadyStateInstructionProfile::StaticSynchronousSeriesCompensator

name	mult	type	description
q	1..1	ReactivePower	(NC) inherited from: FACTSEquipment
controlEnabled	1..1	Boolean	inherited from: RegulatingCondEq

3.61 (NC,Description) StaticVarCompensator

Inheritance path = FACTSEquipment : RegulatingCondEq

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.

Table 60 shows all attributes of StaticVarCompensator.

Table 60 – Attributes of SteadyStateInstructionProfile::StaticVarCompensator

name	mult	type	description
q	1..1	ReactivePower	(NC) inherited from: FACTSEquipment
controlEnabled	1..1	Boolean	inherited from: RegulatingCondEq

3.62 (NC,Description) SubstationController root class

Substation controller is controlling the equipment to optimize the use of the controlling equipment within a substation.

Table 61 shows all attributes of SubstationController.

Table 61 – Attributes of SteadyStateInstructionProfile::SubstationController

name	mult	type	description
mode	1..1	SubstationControllerModeKind	(NC) Mode of the substation controller.

3.63 (NC,Description) TCSCController root class

TCSC controller is controlling the equipment to optimize the performance of the TCSC.

Table 62 shows all attributes of TCSCController.

Table 62 – Attributes of SteadyStateInstructionProfile::TCSCController

name	mult	type	description
mode	1..1	TCSCControlModeKind	(NC) Mode of the TCSC controller.

3.64 (NC,Description) ThyristorControlledSeriesCompensator

Inheritance path = FACTSEquipment : RegulatingCondEq

Thyristor-controlled series capacitors (TCSC) is a type of flexible AC transmission system regulating equipment that is configured with controlled reactors in parallel with sections of a capacitor bank. This combination allows smooth control of the fundamental frequency capacitive reactance over a wide range. The thyristor valve contains a string of series connected high power thyristors. TCSC can control power flows in order to achieve eliminating of line overloads, reducing loop flows and minimising system losses.

Table 63 shows all attributes of ThyristorControlledSeriesCompensator.

Table 63 – Attributes of SteadyStateInstructionProfile::ThyristorControlledSeriesCompensator

name	mult	type	description
compensationImpedance	1..1	Impedance	(NC) The actual compensation impedance provided by the compensator. The attribute value shall be positive if compensation is in the capacitive range. The attribute value shall be negative if compensation is in the inductive rating.
currentSectionNumber	1..1	Integer	(NC) The current section on which the TCSC is operating.
q	1..1	ReactivePower	(NC) inherited from: FACTSEquipment
controlEnabled	1..1	Boolean	inherited from: RegulatingCondEq

3.65 (NC,Description) VoltageAngleLimit root class

Voltage angle limit between two terminals. The association end OperationalLimitSet.Terminal defines one end and the host of the limit. The association end VoltageAngleLimit.AngleReferenceTerminal defines the reference terminal.
Table 64 shows all attributes of VoltageAngleLimit.

Table 64 – Attributes of SteadyStateInstructionProfile::VoltageAngleLimit

name	mult	type	description
value	1..1	AngleDegrees	(NC) The difference in angle degrees between referenced by the association end OperationalLimitSet.Terminal and the Terminal referenced by the association end VoltageAngleLimit.AngleReferenceTerminal. The value shall be positive (greater than zero).

3.66 (NC,Description) VoltageControlFunction root class

Voltage control function is a function block that calculate the operating point of the controlled equipment to achieve the target voltage.
Table 65 shows all attributes of VoltageControlFunction.

Table 65 – Attributes of SteadyStateInstructionProfile::VoltageControlFunction

name	mult	type	description
targetValue	1..1	Voltage	(NC) Target value for the voltage that the control function is calculating to achieve by adjusting the operational setting to the controlled equipment.

3.67 (NC,Description) VoltageInjectionControlFunction root class

Voltage injection control function is a function block that calculates the operating point of the controlled equipment to achieve the target voltage injection. The controlled point is the Terminal with sequenceNumber =1.
Table 66 shows all attributes of VoltageInjectionControlFunction.

Table 66 – Attributes of SteadyStateInstructionProfile::VoltageInjectionControlFunction

name	mult	type	description
targetValue	1..1	Voltage	(NC) Target value for the voltage that the control function is calculating to achieve by adjusting

name	mult	type	description
			the operational setting to the controlled equipment.

3.68 (NC) CompensatorControlModeKind enumeration

Kind of compensator controller mode.
Table 67 shows all literals of CompensatorControlModeKind.

Table 67 – Literals of SteadyStateInstructionProfile::CompensatorControlModeKind

literal	value	description
reactivePower		Reactive power control.
voltage		Voltage control.

3.69 (NC) DCControlModeKind enumeration

Kind of DC control mode.
Table 68 shows all literals of DCControlModeKind.

Table 68 – Literals of SteadyStateInstructionProfile::DCControlModeKind

literal	value	description
acEmulation		An AC emulation control aims to reproduce the behaviour of an AC line by means of a function of the difference between angles in both converter stations in HVDC links embedded within a single synchronous AC grid. For changes in the phase angle on either station, the response of this control is to ‘emulate the behaviour of an AC line’ in both steady and transient states. The AC emulation control needs measurement signals for the angles at both ends of the HVDC. In practice, the angle difference is measured by built-in devices in the converters and the synchronization of angle measurements on both stations is done by means of GPS.
activePower		Control is active power control at AC side, at point of common coupling.
reactivePower		Control is reactive power control at AC side, at point of common coupling.
dcVoltage		Control is DC voltage.
dcCurrent		Control is DC current.
powerFactorPcc		Control is power factor at point of common coupling.
pPccAndUdcDroop		Control is active power at point of common coupling and local DC voltage, with the droop.
pPccAndUdcDroopWithCompensation		Control is active power at point of common coupling and compensated DC voltage, with the droop. Compensation factor is the resistance, as an approximation of the DC voltage of a common (real or virtual) node in the DC network.
pulseWidthModulation		No explicit control. Pulse-modulation factor is directly set in magnitude and phase.
pPccAndUdcDroopPilot		Control is active power at point of common coupling and the pilot DC voltage, with the droop. The mode is used for Multi Terminal High Voltage DC (MTDC) systems where multiple

literal	value	description
		HVDC Substations are connected to the HVDC transmission lines. The pilot voltage is then used to coordinate the control the DC voltage across the HVDC substations.
phasePcc		Control is phase at point of common coupling.

3.70 (NC) InjectionControlModeKind enumeration

Kind of injection controller mode.
Table 69 shows all literals of InjectionControlModeKind.

Table 69 – Literals of SteadyStateInstructionProfile::InjectionControlModeKind

literal	value	description
reactivePower		Reactive power control.
activePower		Active power is specified.
voltage		Voltage control.
powerFactor		Power factor is specified.

3.71 (NC) RotatingMachineControlModeKind enumeration

Kind of rotating machine controller mode.
Table 70 shows all literals of RotatingMachineControlModeKind.

Table 70 – Literals of SteadyStateInstructionProfile::RotatingMachineControlModeKind

literal	value	description
reactivePower		Reactive power control.
activePower		Active power is specified.
voltage		Voltage control.
powerFactor		Power factor is specified.

3.72 (NC) SubstationControllerModeKind enumeration

Kind of substation controller mode.
Table 71 shows all literals of SubstationControllerModeKind.

Table 71 – Literals of SteadyStateInstructionProfile::SubstationControllerModeKind

literal	value	description
reactivePower		Reactive power control is the primary control of the substation.
voltage		Voltage control is the primary control of the substation.
activePower		Active power control is the primary control of the substation..

3.73 (NC) SSSCControlModeKind enumeration

Control modes of the Static Synchronous Series Compensator (SSSC).
Table 72 shows all literals of SSSCControlModeKind.

Table 72 – Literals of SteadyStateInstructionProfile::SSSCControlModeKind

literal	value	description
effectiveReactance		The device injects a voltage proportional to the line current to achieve the specified target value defined by the ImpedanceControlFunction. The voltage will vary according to the line current level.
voltageInjection		The device injects a fixed voltage that is either inductive or capacitive according to the specified target value of the VoltageInjectionControlFunction. The effective reactance varies according to the flow of the line current.
monitoring		The device bypasses and a voltage injection is close to zero. In monitoring mode current is monitored.
currentDroop		The device injects a voltage proportional to the difference between the line current and the target value of the CurrentDroopControlFunction. There are capacitive and inductive operational regions.

3.74 (NC) TCSCControlModeKind enumeration

Kind of TCSC control mode.
Table 73 shows all literals of TCSCControlModeKind.

Table 73 – Literals of SteadyStateInstructionProfile::TCSCControlModeKind

literal	value	description
activePower		Control is active power.
current		Control is current.
impedance		Control is impedance.

3.75 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 74 shows all literals of UnitMultiplier.

Table 74 – Literals of SteadyStateInstructionProfile::UnitMultiplier

literal	value	description
none	0	No multiplier or equivalently multiply by 1.
k	3	Kilo 10**3.
M	6	Mega 10**6.

3.76 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 75 shows all literals of UnitSymbol.

Table 75 – Literals of SteadyStateInstructionProfile::UnitSymbol

literal	value	description
none	0	Dimension less quantity, e.g. count, per unit, etc.
A	5	Current in amperes.
deg	9	Plane angle in degrees.
V	29	Electric potential in volts (W/A).
ohm	30	Electric resistance in ohms (V/A).
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.
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

literal	value	description
		the method in use and the suitability of the measurement for the intended purpose.
Wh	72	Real energy in watt hours.

3.77 ActivePower datatype

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

Table 76 shows all attributes of ActivePower.

Table 76 – Attributes of SteadyStateInstructionProfile::ActivePower

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

3.78 AngleDegrees datatype

Measurement of angle in degrees.

Table 77 shows all attributes of AngleDegrees.

Table 77 – Attributes of SteadyStateInstructionProfile::AngleDegrees

name	mult	type	description
value	0..1	Float	
unit	0..1	UnitSymbol	(const=deg)
multiplier	0..1	UnitMultiplier	(const=none)

3.79 CurrentFlow datatype

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

Table 78 shows all attributes of CurrentFlow.

Table 78 – Attributes of SteadyStateInstructionProfile::CurrentFlow

name	mult	type	description
multiplier	0..1	UnitMultiplier	(const=none)
unit	0..1	UnitSymbol	(const=A)
value	0..1	Float	

3.80 Impedance datatype

Ratio of voltage to current.

Table 79 shows all attributes of Impedance.

Table 79 – Attributes of SteadyStateInstructionProfile::Impedance

name	mult	type	description
value	0..1	Float	
unit	0..1	UnitSymbol	(const=ohm)
multiplier	0..1	UnitMultiplier	(const=none)

3.81 PerCent datatype

Percentage on a defined base. For example, specify as 100 to indicate at the defined base.
Table 80 shows all attributes of PerCent.

Table 80 – Attributes of SteadyStateInstructionProfile::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)

3.82 RealEnergy datatype

Real electrical energy.
Table 81 shows all attributes of RealEnergy.

Table 81 – Attributes of SteadyStateInstructionProfile::RealEnergy

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

3.83 ReactivePower datatype

Product of RMS value of the voltage and the RMS value of the quadrature component of the current.
Table 82 shows all attributes of ReactivePower.

Table 82 – Attributes of SteadyStateInstructionProfile::ReactivePower

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

3.84 Voltage datatype

Electrical voltage, can be both AC and DC.
Table 83 shows all attributes of Voltage.

Table 83 – Attributes of SteadyStateInstructionProfile::Voltage

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

3.85 Boolean primitive

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

3.86 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.

3.87 Float primitive

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

3.88 Integer primitive

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

3.89 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

Test data files are available in the CIM EG SharePoint.