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SENSITIVITY MATRIX PROFILE SPECIFICATION

2023-05-10

APPROVED DOCUMENT
VERSION 2.2

European Network of
Transmission System Operators
for Electricity

17   **NOTE CONCERNING WORDING USED IN THIS DOCUMENT**

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

20   • SHALL: This word, or the terms "REQUIRED" or "MUST", means that the definition is an
21   absolute requirement of the specification.

22   • SHALL NOT: This phrase, or the phrase "MUST NOT", means that the definition is an
23   absolute prohibition of the specification.

24   • SHOULD: This word, or the adjective "RECOMMENDED", means that there may exist valid
25   reasons in particular circumstances to ignore a particular item, but the full implications must
26   be understood and carefully weighed before choosing a different course.

27   • SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED", means that there may
28   exist valid reasons in particular circumstances when the particular behaviour is acceptable
29   or even useful, but the full implications should be understood and the case carefully weighed
30   before implementing any behaviour described with this label.

31   • MAY: This word, or the adjective "OPTIONAL", means that an item is truly optional.

32

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33   Revision History

Version	Release	Date	Paragraph	Comments
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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83 **1   Introduction**

84   The sensitivity matrix profile is a profile to exchange sensitivity matrices that are needed within
85   the process.

86   The sensitivity matrix allows to define different kind of sensitivity matrix like Remedial Action
87   Influence Factor or PTDF amongst others.

88 **2   Application profile specification**

89 **2.1   Version information**

90   The   content   is   generated   from   UML   model   file   CIM100_CGMES31v01_501-
91   20v02_NC22v95_MM10v01.eap.

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

93   -   Title: Sensitivity Matrix Vocabulary

94   -   Keyword: SM

95   -   Description: This vocabulary is describing the sensitivity matrix.

96   -   Version IRI: http://entsoe.eu/ns/CIM/SensitivityMatrix-EU/2.2

97   -   Version info: 2.2.0

98   -   Prior version: http://entsoe.eu/ns/CIM/SensitivityMatrix-EU/2.1

99   -   Conforms to: urn:iso:std:iec:61970-600-2:ed-1|urn:iso:std:iec:61970-301:ed-
100   7:amd1|file://iec61970cim17v40_iec61968cim13v13a_iec62325cim03v17a.eap|urn:iso:
101   std:iec:61970-401:draft:ed-1|urn:iso:std:iec:61970-501:draft:ed-2|file://CGMES-
102   30v25_501-20v01.eap

103   -   Identifier: urn:uuid:d89a8510-528b-49a9-81f1-c51be51caa6f

104

105 **2.2   Constraints naming convention**

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

108   "{rule.Type}:{rule.Standard}:{rule.Profile}:{rule.Property}:{rule.Name}"

109   where

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

111   rule.Standard: the number of the standard e.g. 301 for 61970-301, 456 for 61970-456, 13 for
112   61968-13. 61970-600 specific constraints refer to 600 although they are related to one or
113   combination of the 61970-450 series profiles. For NC profiles, NC is used.

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

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

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

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

121   **2.3   Profile constraints**

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

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

127   •   C:452:ALL:NA:datatypes

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

130   •   R:452:ALL:NA:exchange

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

133   •   R:452:ALL:NA:exchange1

134   If an optional attribute does not exist in the imported file, it does not have to be exported
135   in case exactly the same data set is exported, i.e. the tool is not obliged to automatically
136   provide this attribute. If the export is resulting from an action by the user performed after
137   the import, e.g. data processing or model update the export can contain optional
138   attributes.

139   •   R:452:ALL:NA:exchange2

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

148   •   R:452:ALL:NA:exchange3

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

152   •   R:452:ALL:NA:exchange4

153   From the standpoint of the model import used by a data recipient, the document
154   describes a subset of the CIM that importing software shall be able to interpret in order
155   to import exported models. Data providers are free to exceed the minimum requirements
156   described herein as long as their resulting data files are compliant with the CIM Schema
157   and the conventions established in Clause 5. The document, therefore, describes
158   additional classes and class data that, although not required, exporters will, in all
159   likelihood, choose to include in their data files. The additional classes and data are
160   labelled as required (cardinality 1..1) or as optional (cardinality 0..1) to distinguish them
161   from their required counterparts. Please note, however, that data importers could
162   potentially receive data containing instances of any and all classes described by the
163   CIM Schema.

164 - R:452:ALL:NA:cardinality

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

170 - R:452:ALL:NA:associations

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

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

174 The attribute "name" inherited by many classes from the abstract class IdentifiedObject
175 is not required to be unique. It must be a human readable identifier without additional
176 embedded information that would need to be parsed. The attribute is used for purposes
177 such as User Interface and data exchange debugging. The MRID defined in the data
178 exchange format is the only unique and persistent identifier used for this data exchange.
179 The attribute IdentifiedObject.name is, however, always required for CoreEquipment
180 profile and Short Circuit profile.

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

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

185 - R:452:ALL:NA:uniqueIdentifier

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

188 - R:452:ALL:NA:unitMultiplier

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

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

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

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

194 The string IdentifiedObject.description is maximum 256 characters.

195 - C:452:ALL:NA:float

196 An attribute that is defined as float (e.g. has a type Float or a type which is a Datatype
197 with .value attribute of type Float) shall support ISO/IEC 60559:2020 for floating-point
198 arithmetic using single precision floating point. A single precision float supports 7
199 significant digits where the significant digits are described as an integer, or a decimal
200 number with 6 decimal digits. Two float values are equal when the significant with 7
201 digits are identical, e.g. 1234567 is equal 1.234567E6 and so are 1.2345678 and
202 1.234567E0.

203 - R:NC:ALL:Region:reference

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

206 **2.4   Metadata**

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

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

217 **2.4.1   Constraints**

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

220   •   R:NC:ALL:wasAttributedTo:usage

221   The prov:wasAttributedTo should normally be the "X" EIC code of the actor (prov:Agent).

222

223 **2.4.2   Reference metadata**

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

232 **3   Detailed Profile Specification**

233 **3.1   General**

234 This package contains sensitivity matrix profile.
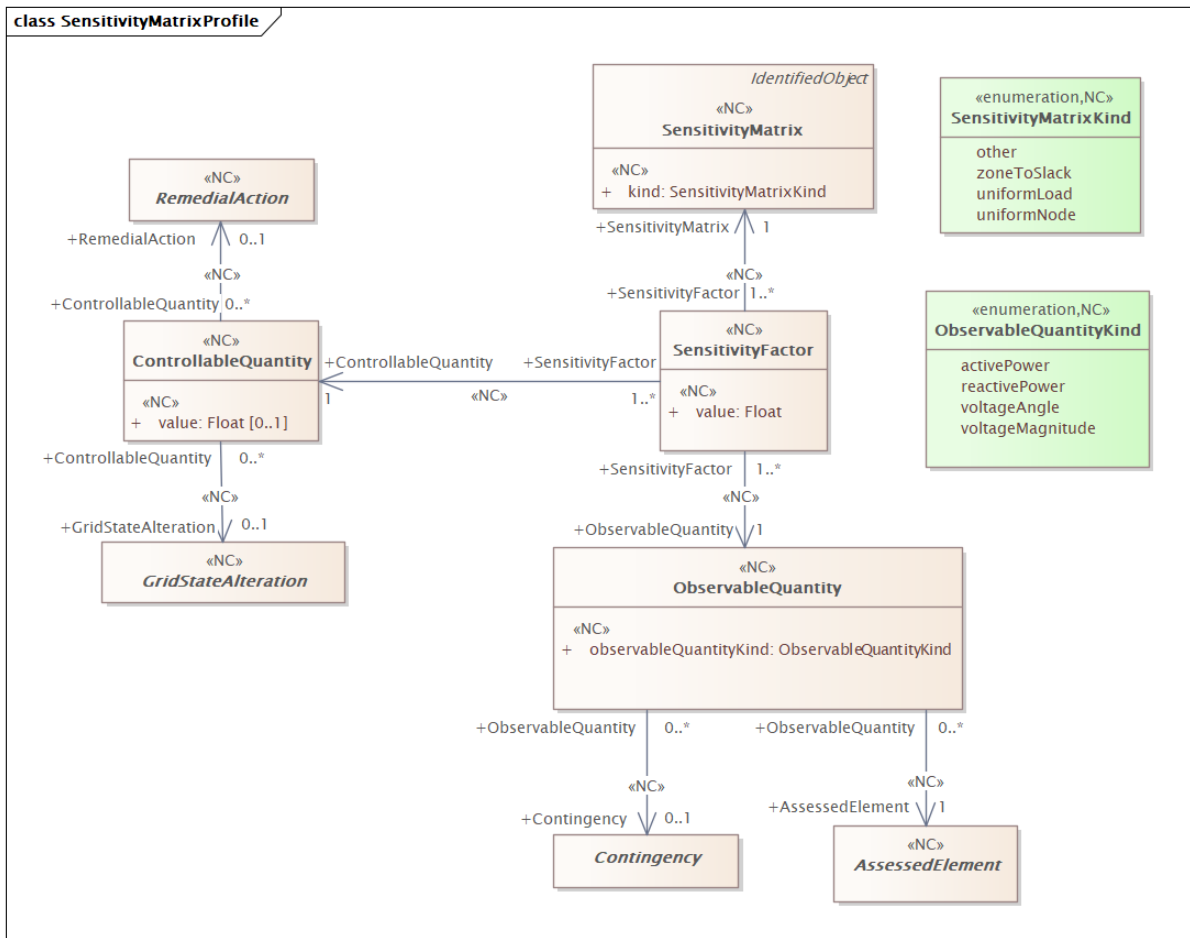
235

236 **Figure 1 – Class diagram SensitivityMatrixProfile::SensitivityMatrixProfile**

237 Figure 1: The diagram shows classes related to the sensitivity matrix profile.

238 **3.2   (abstract,NC) AssessedElement root class**

239 Assessed element is a network element for which the electrical state is evaluated in the regional
240 or cross-regional process and which value is expected to fulfil regional rules function of the
241 operational security limits.
242 The measurements and limits are as defined in the steady state hypothesis.

243 **3.3   (abstract) Contingency root class**

244 An event threatening system reliability, consisting of one or more contingency elements.

245 **3.4   (NC) ControllableQuantity root class**

246 Controllable quantity is a set point quantity on a grid state alteration or on a remedial action.
247 Table 1 shows all attributes of ControllableQuantity.

248 **Table 1 – Attributes of SensitivityMatrixProfile::ControllableQuantity**

name	mult	type	description
value	0..1	Float	(NC) The value of the change applied to the grid state alteration or remedial action. In the case of multiple changes or non-quantifiable changes (e.g. Topology changes) the value needs to represent the suitable value that makes the derivable value given in the observable quantity for the purpose of the calculation of the sensitivity factor. The value can be integer, float

name	mult	type	description
			or boolean. In case of boolean 1 equals true and 0 equals false.

249
250 Table 2 shows all association ends of ControllableQuantity with other classes.

251 **Table 2 – Association ends of SensitivityMatrixProfile::ControllableQuantity with other**
252 **classes**

mult from	name	mult to	type	description
0..*	RemedialAction	0..1	RemedialAction	(NC) Remedial action which is associated with the controllable quantity.
0..*	GridStateAlteration	0..1	GridStateAlteration	(NC) The grid state alteration for this controllable quantity.

253

3.5 (abstract,NC) GridStateAlteration root class

255 Grid state alteration is a change of values describing state (operating point) of one element in
256 the grid model compared to the base case.

3.6 (abstract) IdentifiedObject root class

258 This is a root class to provide common identification for all classes needing identification and
259 naming attributes.
260 Table 3 shows all attributes of IdentifiedObject.

261 **Table 3 – Attributes of SensitivityMatrixProfile::IdentifiedObject**

name	mult	type	description
description	0..1	String	The description is a free human readable text describing or naming the object. It may be non unique and may not correlate to a naming hierarchy.
mRID	1..1	String	Master resource identifier issued by a model authority. The mRID is unique within an exchange context. Global uniqueness is easily achieved by using a UUID, as specified in RFC 4122, for the mRID. The use of UUID is strongly recommended. For CIMXML data files in RDF syntax conforming to IEC 61970-552, the mRID is mapped to rdf:ID or rdf:about attributes that identify CIM object elements.
name	0..1	String	The name is any free human readable and possibly non unique text naming the object.

262

3.7 (NC) ObservableQuantity root class

264 Observable quantity is an electrical quantity on an assessed element or an assessed element
265 with contingency.
266 Table 4 shows all attributes of ObservableQuantity.

267 **Table 4 – Attributes of SensitivityMatrixProfile::ObservableQuantity**

name	mult	type	description
observableQuantityKind	1..1	ObservableQuantityKind	(NC) Kind of observable quantity.

268
269 Table 5 shows all association ends of ObservableQuantity with other classes.

270
271 **Table 5 – Association ends of SensitivityMatrixProfile::ObservableQuantity with other classes**

mult from	name	mult to	type	description
0..*	AssessedElement	1..1	AssessedElement	(NC) The assessed element with contingency associated with this observable quantity.
0..*	Contingency	0..1	Contingency	(NC) The contingency associated with this observable quantity.

272

273 **3.8 (abstract,NC) RemedialAction root class**

274 Remedial action describes one or more actions that can be performed on a given power system
275 model situation to eliminate one or more identified breaches of constraints. The remedial action
276 can be costly, and have a cost characteristic, or non costly.

277 **3.9 (NC) SensitivityFactor root class**

278 The sensitivity factor which represents the sensitivity between observable and controllable
279 elements.
280 Table 6 shows all attributes of SensitivityFactor.

281 **Table 6 – Attributes of SensitivityMatrixProfile::SensitivityFactor**

name	mult	type	description
value	1..1	Float	(NC) The value of the sensitivity factor.

282
283 Table 7 shows all association ends of SensitivityFactor with other classes.

284 **Table 7 – Association ends of SensitivityMatrixProfile::SensitivityFactor with other**
285 **classes**

mult from	name	mult to	type	description
1..*	ControllableQuantity	1..1	ControllableQuantity	(NC) The controllable quantity for this sensitivity factor.
1..*	ObservableQuantity	1..1	ObservableQuantity	(NC) The observable quantity for this sensitivity factor.
1..*	SensitivityMatrix	1..1	SensitivityMatrix	(NC) The sensitivity matrix which contains this sensitivity factor.

286

287 **3.10 (NC) SensitivityMatrix**

288 Inheritance path = IdentifiedObject
289 The sensitivity matrix which represents the sensitivity factors between observable and
290 controllable elements.
291 Table 8 shows all attributes of SensitivityMatrix.

292 **Table 8 – Attributes of SensitivityMatrixProfile::SensitivityMatrix**

name	mult	type	description
kind	1..1	SensitivityMatrixKind	(NC) The kind of sensitivity matrix.
description	0..1	String	inherited from: IdentifiedObject
mRID	1..1	String	inherited from: IdentifiedObject
name	0..1	String	inherited from: IdentifiedObject

293

294   **3.11 (NC) ObservableQuantityKind enumeration**

295   Kind of observable quantity.
296   Table 9 shows all literals of ObservableQuantityKind.

297   **Table 9 – Literals of SensitivityMatrixProfile::ObservableQuantityKind**

literal	value	description
activePower		The observable quantity is the active power.
reactivePower		The observable quantity is the reactive power.
voltageAngle		The observable quantity is the angle of terminal voltage.
voltageMagnitude		The observable quantity is the magnitude of terminal voltage.

298

299   **3.12 (NC) SensitivityMatrixKind enumeration**

300   Kinds of sensitivity matrix.
301   Table 10 shows all literals of SensitivityMatrixKind.

302   **Table 10 – Literals of SensitivityMatrixProfile::SensitivityMatrixKind**

literal	value	description
other		Other kind of sensitivity matrix.
zoneToSlack		Zone to slack kind of sensitivity matrix.
uniformLoad		Uniform load matrix.
uniformNode		Uniform node matrix.

303

304   **3.13 Float primitive**

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

306   **3.14 String primitive**

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

309

310

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

312   **A.1   General**

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

317   **A.2   Sample instance data**

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