

DIN EN IEC 61970-600-1

ICS 33.200; 35.240.50

Einsprüche bis 2022-01-05

Entwurf

**Schnittstelle der Anwendungsprotokolle von
Energieverwaltungssystemen (EMS-API) –
Teil 600-1: Standard für den Austausch von
Elektrizitätsversorgungssystemmodellen (CGMES) –
Strukturen und Regeln
(IEC 57/2169/CDV:2020);
Englische Fassung prEN IEC 61970-600-1:2020**

Energy management system application program interface (EMS-API) –
Part 600-1: Common Grid Model Exchange Specification (CGMES) –
Structure and rules
(IEC 57/2169/CDV:2020);
English version prEN IEC 61970-600-1:2020

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Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfs besonders zu vereinbaren.

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Gesamtumfang 54 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

Nationales Vorwort

Die Englische Fassung des europäischen Dokuments prEN IEC 61970-600-1:2020-01 "Schnittstelle der Anwendungsprotokolle von Energieverwaltungssystemen (EMS-API) – Teil 600-1: Standard für den Austausch von Elektrizitätsversorgungssystemmodellen (CGMES) – Strukturen und Regeln" (Entwurf in der Umfrage) ist unverändert in diesen Norm-Entwurf übernommen worden.

Die Internationale Elektrotechnische Kommission (IEC) und das Europäische Komitee für Elektrotechnische Normung (CENELEC) haben vereinbart, dass ein auf IEC-Ebene erarbeiteter Entwurf für eine Internationale Norm zeitgleich (parallel) bei IEC und CENELEC zur Umfrage (CDV-Stadium) und Abstimmung als FDIS (en: Final Draft International Standard) bzw. Schluss-Entwurf für eine Europäische Norm gestellt wird, um eine Beschleunigung und Straffung der Normungsarbeit zu erreichen. Dem entsprechend ist das internationale Dokument IEC 57/2169/CDV:2020-01 "Energy management system application program interface (EMS-API) – Part 600-1: Common Grid Model Exchange Specification (CGMES) – Structure and rules" unverändert in den Entwurf prEN IEC 61970-600-1:2020-01 übernommen worden.

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Für dieses Dokument ist das nationale Arbeitsgremium DKE/K 952 "Netzleittechnik" der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE (www.dke.de) zuständig.

Aktuelle Informationen zu diesem Dokument können über die Internetseiten von DKE (www.dke.de) und DIN (www.din.de) durch eine Suche nach der Dokumentennummer aufgerufen werden.

Für den Fall einer undatierten Verweisung im normativen Text (Verweisung auf ein Dokument ohne Angabe des Ausgabedatums und ohne Hinweis auf eine Abschnittsnummer, eine Tabelle, ein Bild usw.) bezieht sich die Verweisung auf die jeweils aktuellste Ausgabe des in Bezug genommenen Dokuments.

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Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für den vorliegenden Normentwurf erfüllt.

Da sich die Benutzer des vorliegenden Normentwurfs der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der IEC 57/2169/CDV veröffentlicht. Zur Einleitung, Abschnitt 1, der den Anwendungsbereich festlegt, und Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA des vorliegenden Norm-Entwurfs hinzugefügt. Für viele der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Norm-Entwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

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Nationaler Anhang NA (informativ)

Auszugsweise Übersetzung

Reihenfolge und Inhalt der folgenden Abschnitte sind identisch mit denen in den jeweiligen Abschnitten der Englischen Fassung.

Einleitung

Der Zweck dieses Standards für den Austausch von Elektrizitätsversorgungssystemmodellen (en: Common Grid Model Exchange Standard, CGMES) ist die Definition der Schnittstelle zwischen der Software von Übertragungsnetzbetreibern (en: Transmission System Operators, TSO), um Modellierungsinformationen von Elektrizitätsversorgungssystemen entsprechend der europäischen Gesetzgebung und den Geschäftsprozessen von TSO auszutauschen.

Der CGMES dient als Basis-Austauschspezifikation für die Umsetzung der Methoden des Elektrizitätsversorgungssystemmodells (en: Common Grid Model, CGM) entsprechend den Anforderungen für die Umsetzung verschiedener europäischer Netzkodizes und Richtlinien. Der CGMES gilt sowohl für Anwendungen, die sich mit dem Datenmanagement von Elektrizitätsversorgungssystemen befassen, als auch für Anwendungen, die die folgenden Analysen unterstützen:

- Lastfluss- und Kontingenzanalysen,
- Kurzschlussberechnungen,
- Marktinformationen und Transparenz,
- Kapazitätsberechnung für Kapazitätsverteilung und Engpassmanagement, und
- dynamische Sicherheitsbewertung.

Die Konformität der für den Austausch von Betriebs- und Systementwicklungen verwendeten Anwendungen mit dem CGMES ist für die erforderliche Interoperabilität dieser Anwendungen von wesentlicher Bedeutung. ENTSO-E hat daher den CGMES-Konformitätsbewertungsrahmen als Leitfaden für die Bewertung der CGMES-Konformität von Anwendungen entwickelt und genehmigt. Dieses Dokument stützt sich auf den vom ENTSO-E betriebenen CGMES-Konformitätsbewertungsprozess, um sicherzustellen, dass der CGMES von den Lieferanten der von den TSOs verwendeten Anwendungen ordnungsgemäß umgesetzt wird.

1 Anwendungsbereich

Diese internationale Norm zum CGMES beschreibt die wesentlichen Regeln und Anforderungen im Zusammenhang mit der CGMES, die für die Interoperabilität mit der CGMES und für zufriedenstellende Geschäftsprozesse erforderlich sind.

Die zum CGMES gehörenden Profile sind in IEC 61970-600-2 oder in den Normen oder Normentwürfen der IEC definiert, auf die in diesem Dokument verwiesen wird. Die zur Umsetzung des CGMES erforderlichen, dazugehörigen technischen Informationen und Dokumente (d. h. RDFS, OCL, XMI und HTML), welche nicht durch das Urheberrecht der IEC oder CENELEC geschützt sind, sind auf der Website der ENTSO-E verfügbar.

Die Definition des CGMES erfolgt mithilfe von Informationen zum Common Information Model (CIM), welche öffentlich verfügbar sind.

3 Begriffe und Abkürzungen

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- IEC Electropedia: verfügbar unter <http://www.electropedia.org/>
- ISO Online Browsing Platform: verfügbar unter <http://www.iso.org/obp>

ANMERKUNG: Für Begriffe, die in den CGMES nicht angegeben sind, sind die Begriffe in den Normen IEC 61970 anzuwenden.

3.1 Begriffe

3.1.1

Standard für den Austausch von Elektrizitätsversorgungssystemmodellen (en: Common Grid Model Exchange Standard)

CGMES

Europäische Norm für den Austausch von Elektrizitätsversorgungssystemmodellen unter TSOs für die Durchführung von bilateralen, regionalen oder gesamteuropäischen Studien oder Datenaustauschs im Rahmen des Systembetriebs, der Systementwicklung oder von Projekten der TSOs entsprechend der Definition in der EU-Gesetzgebung.

3.1.2

Profil

eindeutig benannte Teilmenge von Klassen, Beziehungen und Attributen, die benötigt wird, um einen speziellen Schnittstellentyp zu definieren, und auf einem kanonischen Modell beruht.

Anmerkung 1 zum Begriff: Dieser Begriff darf verwendet werden, um entweder das semantische Modell für die Nutzdaten einer Instanz oder das Syntax-Schema der Nutzdaten einer Instanz zu definieren. Ein Profil darf in XSD-, RDF- und/oder OWL-Dateien beschrieben werden. Die Konformität von Instanzdaten mit einem Profil kann durch Datenaustausch zwischen Anwendungen geprüft werden. Ein Profil ist notwendig, um das kanonische Modell „verwenden“ zu können.

3.1.3

CIM-Erweiterung

Sammlung von Klassen, Attributen und Beziehungen, die das herkömmliche CIM-Modell der IEC erweitert, um Anwendungsfälle abzudecken, die zurzeit nicht durch IEC-Normen unterstützt werden und nicht als internationale Anwendungsfälle gelten oder erst von einer neueren Version der Norm erfasst werden, welche noch nicht unterstützt wird

3.1.4

Europäische Erweiterung

Spezifisch für Europa entwickelte CIM-Erweiterung unter Verwaltung der ENTSO-E

3.1.5

Grenzsatz

Satz, der alle Grenzpunkte enthält, die für einen gegebenen Netzmodell austausch benötigt werden

Anmerkung 1 zum Begriff: Ein Grenzsatz kann je nach Anforderungen für den Austausch von Elektrizitätsversorgungssystemmodellen unterschiedliche Bereiche abdecken. Für die Definition eines gesamteuropäischen Elektrizitätsversorgungssystemmodells ist ein vollständiger Grenzsatz erforderlich.

3.1.6

Grenzpunkt

BP

Anschlusspunkt zwischen zwei Model Authority Sets (MAS)

Anmerkung 1 zum Begriff: Ein Grenzpunkt könnte eine ConnectivityNode oder eine TopologicalNode auf einer Verbindungsleitung oder in einer Station sein. Ein Grenzpunkt muss Bestandteil eines Grenzsatzes sein und darf nicht Bestandteil des MAS eines TSO sein. Ein Grenzpunkt wird durch Anschlusspunkte im MAS eines TSO referenziert. ConnectivityNode und TopologicalNode sind Begriffe, die in den CIM-Normen der IEC festgelegt werden. Wenn der Grenzpunkt auf einer Verbindungsleitung liegt, wird statt Grenzpunkt oft der Begriff X-Node verwendet. Eine X-Node ist somit eine spezielle Art von Grenzpunkt.

3.2 Abkürzungen

IEC	Die Internationale Elektrotechnische Kommission mit Sitz in Genf
DSO	Verteilungsnetzbetreiber (en: Distribution System Operator)
TSO	Übertragungsnetzbetreiber (en: Transmission System Operator)
ENTSO-E	Verband Europäischer Übertragungsnetzbetreiber (ENTSO-E hat 43 TSO-Mitglieder)
mRID	CIM Master Resource Identifier
CIM	Common Information Model (Energiebranche)
CGMES	Standard für den Austausch von Elektrizitätsversorgungssystemmodellen (en: Common Grid Model Exchange Standard)
MAS	Model Authority Set
IOP	Interoperabilitätsprüfung
RDF	Resource Description Framework
EQ_BD	Grenzbetriebsmittelprofil- oder Instanzdatei
EQ_TD	Grenztopologieprofil- oder Instanzdatei
EQCO	Kern-Betriebsmittelprofil- oder Instanzdatei
OP	Betriebsprofil- oder Instanzdatei
TP	Topologieprofil- oder Instanzdatei
SSH	Steady State Hypothesis-Profil- oder Instanzdatei
SV	Zustandsvariablenprofil- oder Instanzdatei
SC	Kurzschlussprofil- oder Instanzdatei
DL	Diagrammlayout-Profil- oder Instanzdatei
GL	Standortprofil- oder Instanzdatei
DY	Dynamikprofil- oder Instanzdatei
BP	Grenzpunkt

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ENERGY MANAGEMENT SYSTEM APPLICATION
PROGRAM INTERFACE (EMS-API) –**

**Part 600-1: Common Grid Model Exchange Standard (CGMES) –
Structure and rules**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This edition includes the following significant technical changes with respect to the previous Edition (IEC TS 61970-600-1 Ed1:2017), which was a technical specification:

- The “Type” column in all tables was deleted to increase readability of the document as all the rule are considered required, hence categorisation is not necessary.
- Requirement HGEN4 was added to define additional rules to the file header compared to IEC 61970-552:2016.
- Annex B on “Summary of specific rules for naming conventions” was deleted as the information was either integrated in the UML or considered outdated.
- Annex D referring to the PST modelling is deleted as it is fully integrated in IEC 61970-301 Ed7
- Annex E “Implementation guide” is deleted as all rules and implementation guidance is integrated in either clause 5.11 of this document or IEC 61970-301 Ed7 or IEC 61970-301 Ed7

or IEC 61970-456 as referenced by this document. Note that former section E.11.2 on ConformLoadGroup and NonConformLoadGroup was implemented differently due to another issue, please refer to IEC TS 61970-600-2 Ed2.

- Rules GENC17, GENC18, GENC19, EQ__4, EQ__5, SV__4, BPPL12, MVAL5, were added.
- Rules GENC3, GENC6, PROF4, PROF5, are deleted as they are considered not relevant due to other changes.
- The following rules were modified: GENC1, GENC2, GENC4, GENC5, GENC7, GENC8, GENC9, GENC10, EQBD2, BPPL11, EXCH6, EXCH7, EXCH8, FBOD5, PROF10, PROF11, BPPL1, BPPL2, BPPL3.
- Explicit boundary profile definitions (EQ_BD and TP_BD) have been deprecated in this edition in favour of using their full profile counterparts (EQ and TP, respectively) for exchange of boundary datasets.
- Annex F becomes Annex C and it is modified.

The text of this standard is based on the following documents:

Enquiry draft	Report on voting

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61970 series, published under the general title *Energy management system application program interface (EMS-API)*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The purpose of the Common Grid Model Exchange Standard (CGMES) is to define the interface between Transmission System Operators (TSO) software in order to exchange power system modelling information as required by the European legislation and TSO business processes.

The CGMES is used as a baseline exchange specification for the implementation of the Common Grid Model (CGM) methodologies in accordance with the requirements for the implementation of various European network codes and guidelines. The CGMES applies to applications dealing with power system data management, as well as applications supporting the following analyses:

- load flow and contingency analyses,
- short circuit calculations,
- market information and transparency,
- capacity calculation for capacity allocation and congestion management, and
- dynamic security assessment.

The conformity of the applications used for operational and system development exchanges with the CGMES is crucial for the needed interoperability of these applications. ENTSO-E therefore developed and approved the CGMES Conformity Assessment Framework as the guiding principles for assessing applications' CGMES conformity. This document relies on the CGMES Conformity Assessment Process operated by ENTSO-E in order to ensure that the CGMES is properly implemented by suppliers of the applications used by TSOs.

ENERGY MANAGEMENT SYSTEM APPLICATION PROGRAM INTERFACE (EMS-API) –

Part 600-1: Common Grid Model Exchange Standard (CGMES) – Structure and rules

1 Scope

This international standard on the CGMES defines the main rules and requirements related to the CGMES which are mandatory for achieving interoperability with the CGMES and for satisfying business processes.

The profiles which belong to CGMES are defined in IEC 61970-600-2 or in IEC standards or draft IEC standards references by this document. The related technical information and documentation (i.e. RDFS, OCL, XMI and HTML) needed for the implementation of the CGMES, which is not copyrighted by either IEC or CENELEC, is available at the ENTSO-E web site.

The CGMES is defined using information on the Common Information Model (CIM) available in the public domain.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC/CDV 61970-452, *Energy management system application program interface (EMS-API) – Part 452: CIM model exchange specification*

IEC 61970-453:2014AMD1:2018, *Energy management system application program interface (EMS-API) – Part 453: Diagram layout profile*

IEC/CDV 61970-456, *Energy management system application program interface (EMS-API) – Part 456: Solved power system state profiles*

IEC 61970-552:2016, *Energy management system application program interface (EMS-API) – Part 552: CIMXML Model exchange format*

IEC 61968-4, *Application integration at electric utilities – System interfaces for distribution management – Part 4: Interfaces for records and asset management*

IEC 61970-301:Ed7, *Energy management system application program interface (EMS-API) – Part 301: Common information model (CIM) base*

IEC 61968-11, *Application integration at electric utilities - System interfaces for distribution management - Part 11: Common information model (CIM) extensions for distribution*

IEC 61968-13, *Application integration at electric utilities - System interfaces for distribution management - Part 13: CIM RDF Model exchange format for distribution*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE For definitions which are not specified in the CGMES the definitions in the IEC 61970 standards shall be applied.

3.1 Terms and definitions

3.1.1

Common Grid Model Exchange Standard

CGMES

European standard used for the exchange of power system models between TSOs for the purpose of performing bilateral, regional or pan-European studies or data exchanges in the frame of system operation, system development or TSOs' projects as defined in the EU legislation.

3.1.2

profile

uniquely named subset of classes, associations and attributes needed to accomplish a specific type of interface and based upon a canonical model

Note 1 to entry: This term may be used to define either the semantic model for an instance data payload or the syntactic schema for an instance data payload. A profile may be expressed in XSD, RDF, and/or OWL files. An instance data conforming to a profile can be tested in exchanges between applications. A profile is necessary in order to "use" the canonical model.

3.1.3

CIM Extension

collection of classes, attributes and associations, which extend the standard IEC CIM model in order to cover use cases not currently supported by IEC standards, and which are not considered to be international use cases or are covered by a later version of the standard which is not yet supported

3.1.4

European Extension

CIM Extension, specifically designed for Europe and managed by ENTSO-E

3.1.5

boundary set

set containing all boundary points necessary for a given grid model exchange

Note 1 to entry: A Boundary set can have different coverage depending on the requirements of the common grid model exchange. A complete boundary set is necessary to assemble a pan-European power system model.

3.1.6

boundary point

BP

connection point between two Model Authority Sets (MAS)

Note 1 to entry: A Boundary point could be a ConnectivityNode or a TopologicalNode placed on a tie-line or in a substation. A Boundary point must be contained in a Boundary Set and must not be contained in the MAS of a TSO. A Boundary point is referenced by Terminals in the MAS of a TSO. ConnectivityNode and TopologicalNode are terms specified in IEC CIM standards. If a Boundary point is placed on a tie-line, the term X-Node is often used instead of Boundary point. X-Node is therefore a specific type of Boundary point.

88 **3.2 Abbreviated terms**

89	IEC	The International Electrotechnical Commission, headquartered in Geneva
90	DSO	Distribution System Operator
91	TSO	Transmission System Operator
92	ENTSO-E	European Network of Transmission System Operators for Electricity
93		(ENTSO-E has 43 TSO members)
94	mRID	CIM Master Resource Identifier
95	CIM	Common Information Model (electricity)
96	CGMES	Common Grid Model Exchange Standard
97	MAS	Model Authority Set
98	IOP	Interoperability Test
99	RDF	Resource Description Framework
100	EQ_BD	Boundary equipment profile or instance file
101	TP_BD	Boundary topology profile or instance file
102	EQCO	Core Equipment profile or instance file
103	OP	Operation profile or instance file
104	TP	Topology profile or instance file
105	SSH	Steady State Hypothesis profile or instance file
106	SV	State Variables profile or instance file
107	SC	ShortCircuit profile or instance file
108	DL	Diagram Layout profile or instance file
109	GL	Geographical Location profile or instance file
110	DY	Dynamics profile or instance file
111	BP	Boundary point

112 **4 Exchange process**

113 There are various levels at which an exchange of power system data/models is necessary. A
114 pan-European model exchange level covers the territory of all TSOs. Regional model
115 exchanges can be realised between different TSOs in one or more synchronous areas. A model
116 exchange on the national level includes interfaces between TSOs and DSOs, as well as
117 between different DSOs.

118 The purpose of model exchanges is not only to exchange the data from one authority to another
119 but also to satisfy the ultimate goal, namely to perform common studies using shared data. All
120 parties involved in the process should be able to perform the same types of studies and share
121 project tasks between different parties which are using different power system analysis
122 applications. Indeed, the interoperability between different applications used in the exchange
123 process is therefore crucial in both reaching seamless data exchange and obtaining comparable
124 study results when using this data.

125 The CGMES covers these European and TSO business processes by defining the following
126 main types of exchanges valid for a particular study or process:

- 127 • Exchange of boundary set: An exchange of a boundary Set is necessary to prepare an
128 exchange of an internal TSO model and to assemble a common grid model. The latest
129 information on Boundary Sets covering the pan-European area is available to TSOs and
130 maintained in the ENTSO-E Network Modelling Database (NMD) where all TSOs negotiate
131 and agree on the boundary information.

- Exchange of an internal TSO model, i.e. individual grid model (IGM): A number of business processes require each TSO to provide models of its internal territory. To describe its internal territory in a single stand-alone exchange, a TSO is treated as a single model authority set and shall be able to exchange datasets complying with profiles defined in the CGMES. The TSO prepares its internal model in such a way that it is easily and unambiguously combined with other TSO internal models to make up complete models for analytical purposes. This type of exchange can also be applied for the interface between a TSO and a DSO, where models covering transmission or distribution parts of the power system can be exchanged based on a mutual agreement between the TSOs and the DSOs. In this case, and if a TSO requests a DSO model, the DSO would provide its model in accordance with CGMES definitions which might be extended by the TSO requesting this type of exchange.
 - Exchange of a common grid model: A common grid model refers to the concept of having one model which can be used for multiple purposes. The specification describes what is needed to create an assembly of multiple TSOs' Individual Grid Models (IGM) of their responsible territory into a regional or pan-European model. Different business processes will require specific implementation of the profiles part of the CGMES and the exchange of respective instance files to meet interoperability inside the business process. The Common Grid Model meta-model description will ensure interoperability across the business process.
- Business processes (e.g. system development planning, protection planning, operational planning, operation, fault study/simulation, market operation, etc.) are, of course, more complex than these operations, but what is important to note is that all processes are supported using only these basic kinds of interoperation.
- Note that each power system model in CIM normally consists of multiple datasets (instance files) as defined in IEC CIM standards and further specified by CGMES.
- The CGMES supports node-breaker and bus-branch model exchanges. Moving forward the procedures of the model exchanges using the CGMES, it is expected that equipment and steady state hypothesis data (EQ and SSH instance files) will be the input source data for all processes. This type of model should be the fully detailed model with all disconnectors/breakers, etc. Any configuration changes are made by changing switch statuses.

ID	Specification
EXCH1.	The CGMES defines equipment and steady state hypothesis profiles as an input, meaning that all results, whether topology or state variables profiles data, must refer to the equipment and steady state hypothesis objects. Therefore, in the case that both equipment and steady state hypothesis instance files are available for a node-breaker model representation, there is no need to exchange topology or state variables instance files in order to obtain a load flow solution.
EXCH2.	For node-breaker model exchanges the TopologicalNodes represent the output from a topology processing on the detailed input source operational data. These can be optionally exchanged to be used by tools which have an interest in the computed buses.
EXCH3.	For node-breaker model exchanges mRID (rdfIDs in serialisation) of the TopologicalNodes are not persistent.
EXCH4.	For node-breaker model exchanges a topology instance file is not exchanged using a difference file.
EXCH5.	For bus-branch model exchanges the TopologicalNodes must be persistent.
EXCH6.	If a contingency list is exchanged outside CGMES for a bus-branch model, it shall refer to relevant persistent information according to CGMES bus-branch model representation. This results in a constraint on interoperability between planning and operation processes.
EXCH7.	If a contingency list is exchanged outside CGMES for a node-breaker model, it shall refer to relevant persistent information according to CGMES node-breaker model representation.
EXCH8.	<p>This document supports node-breaker, bus-branch and mixed or so-called hybrid (bus-branch and node-breaker) model representation. This is enabled by the presence of the ConnectivityNode class in Core Equipment profile and the cardinality of the following associations: Terminal.ConnectivityNode (which is optional), ConnectivityNode.TopologicalNode (which is required) and Terminal.TopologicalNode (which is optional at the side of TopologicalNode and required at the side of Terminal).</p> <p>The choice of instantiating ConnectivityNode-s in Core Equipment profile instance file is independent from the type of model exchanged. It is legitimate to have a bus-branch model with ConnectivityNode-s in Core Equipment instance file as well as a mixed bus-branch and node-breaker model representation that is built using ConnectivityNodes. The profile URI of Operation profile shall be used in the file header in cases where ConnectivityNodes-s are used as a basis for defining connectivity independently from the type of the model (bus-branch, node-breaker or mixed). The presence of Operation profile URI in the file header does not require instantiation of schedules and measurement related classes from Operation profile.</p> <p>In cases where the reason for including Operation profile URI in the header is the building of a bus-branch or a mixed model using ConnectivityNodes PROF11 would be fully satisfied only when the data exchange requires an exchange of schedules and measurement data or a complete node-breaker model with schedules and measurement data is exchanged.</p> <p>In case of exchange of a pure bus-branch model (no ConnectivityNodes in Core Equipment instance file) the association Terminal.TopologicalNode is required.</p> <p>In general, a Terminal shall have an association to either ConnectivityNode or TopologicalNode or both. The association Terminal.TopologicalNode is also required in cases where a Terminal is associated with a RegulatingControl.</p>

162

163 5 Specifications and functionalities

164 5.1 General constraints

165 The following rules are general in nature or involve multiple classes. Additional rules are defined
166 in the notes to the individual classes in the profiles part of the CGMES.

ID	Specification
GENC1.	All objects shall have a persistent and globally unique identifier (Master Resource Identifier - mRID) (see 5.2). According to IEC 61970-552 the mRID is exchanged as rdf:ID.
GENC2.	Name related attributes (name, shortName, description, etc. inherited by many classes from the abstract class IdentifiedObject) shall never be used as persistent identifiers.
GENC3.	Left blank intentionally.
GENC4.	The IEC 61970-301 strongly recommends to use UUID, as specified in RFC 4122, for the IdentifiedObject.mRID. CGMES requires the usage of UUID, however GENC5 is defined as an exception to ensure transition.

ID	Specification
GENC5.	A requirement to ensure transition until all systems and entities fully comply with GENC4. The CGMES defines the identifier as a non-case sensitive string which conforms to W3C (ISO 8859-1:1998 Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1; http://www.w3.org/MarkUp/html3/specialchars.html). A prefix could be added, if necessary, to ensure global uniqueness. The rdf:ID is the mRID plus an underscore “_” added in the beginning of the string. The maximum character limit of the string is 60 characters (including an underscore and a prefix, if any).
GENC6.	Left blank intentionally.
GENC7.	Each modelling authority is responsible for ensuring that the mRID is globally unique. The role of entities such as ENTSO-E or other regional authorities is limited to coordination and harmonisation of the approaches used in different data exchanges and which shall conform to GENC4 and GENC5.
GENC8.	mRIDs shall be kept persistent between series of exchanges for all objects in all profiles with the following exceptions: -objects created in the Topology profile dataset when it represents the result of topological processing as part of a node-breaker model, in contrast a Topology profile dataset that is designed as part of a bus-branch (EXCH3, EXCH4, EXCH8).: - objects created in the State Variable profile dataset that is dependent on a non-persistent Topology profile created object, e.g. SvPowerFlow, SvVoltage, etc. - objects created in the Diagram Layout profile dataset, e.g. DiagramObjectPoint and DiagramObject (in some cases, see DL__1). —
GENC9.	Some objects in profiles define additional attributes to objects defined in other profiles, e.g. SSH extends objects defined in EQ profile. In profile definition these classes are tagged with “Description” stereotype. The objects of these classes shall be serialised using rdf:about which the additional attributes. Related requirements are MVAL4 and MVAL5.
GENC10.	Instance files shall be encoded according to UTF-8. UTF-16 is currently not supported.
GENC11.	Instance data to be exchanged must make use of the most detailed class possible within a profile, i.e. using sub-typed classes rather than general classes e.g. NuclearGeneratingUnit instead of GeneratingUnit.
GENC12.	Optional and required attributes and associations must be imported and exported if they are in the model file prior to import.
GENC13.	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.
GENC14.	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 CGMES. This provides flexibility for the business processes to adapt to different business requirements and base the exchanges on CGMES compliant applications.
GENC15.	Breakers represent busbar couplers in a bus-branch model exchange. In this case, breakers are only included if they are to be retained. In case of a node-breaker model exchange the rules defined in IEC 61970-452 and in the CGMES profiles shall be applied.