



INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Energy management system application program interface (EMS-API) –
Part 452: CIM static transmission network model profiles**

**Interface de programmation d'application pour système de gestion d'énergie
(EMS-API) –
Partie 452: Profils du modèle de réseau de transport statique CIM**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.200

ISBN 978-2-8322-4506-4

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	8
3 Terms and definitions	8
4 Overview of data requirements	8
4.1 Overview.....	8
4.2 General requirements	9
4.3 Transformer modeling	9
4.4 Modeling authorities.....	11
4.5 Use of measurement classes	11
4.5.1 General	11
4.5.2 ICCP data exchange.....	12
4.6 Voltage or active power regulation	12
4.7 Use of curves.....	13
4.7.1 General	13
4.7.2 Generating unit reactive power limits	13
4.8 Definition of schedules.....	13
5 CIM Static Transmission Network Model Profiles	13
5.1 CIM Static Transmission Network Model Profiles General	13
5.2 Core Equipment Profile	14
5.2.1 Concrete Classes	14
5.2.2 Abstract Classes.....	66
5.2.3 Enumerations	83
5.2.4 Datatypes	88
5.3 Operation Profile.....	92
5.3.1 Concrete Classes	92
5.3.2 Abstract Classes.....	113
5.3.3 Enumerations	122
5.3.4 Datatypes	125
5.4 Short Circuit Profile.....	126
5.4.1 Concrete Classes	126
5.4.2 Abstract Classes.....	148
5.4.3 Enumerations	154
5.4.4 Datatypes	154
6 Amplifications and conventions.....	157
6.1 Overview.....	157
6.2 XML file validity	157
6.3 Normative string tables	157
6.4 Roles and multiplicity.....	158
Annex A (informative) Model exchange use cases	159
A.1 General.....	159
A.2 Regional security coordinators operating as peers	159
A.3 Hierarchical modeling	161
Annex B (informative) Modeling authorities	164
B.1 General.....	164

B.2	The ModelingAuthority Class and ModelingAuthoritySets	164
B.3	Full Model Exchange.....	164
B.4	Benefits of this approach	164
B.4.1	Generality.....	164
B.4.2	Naming & MRIDs	165
B.4.3	Processing efficiency.....	165
B.4.4	Verification of authority.....	165
Annex C (informative)	Boundary definition	166
Annex D (informative)	Multiple profile processing.....	167
Annex E (informative)	Common power system model (CPSM) minimum data requirements	168
E.1	Overview.....	168
E.2	Scope of the ENTSO-E Common Grid Model Exchange (CGMES) specification.....	168
E.3	Glossary of the ENTSO-E Common Grid Model Exchange (CGMES) specification.....	169
E.4	Recommended data model exchange attributes	170
Bibliography.....		174
Figure 1 – Two winding transformer impedance		10
Figure 2 – Three winding transformer impedance.....		10
Figure A.1 – Security coordinators		159
Figure A.2 – CIM model exchange		160
Figure A.3 – Revised CIM model exchange.....		161
Figure A.4 – Hierarchical modeling		162
Figure E.1 – Example model configuration		172
Table 1 – Valid measurementTypes		12
Table 2 – Profiles defined in this document.....		14
Table 3 – Valid attribute values.....		158

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 452: CIM static transmission network model profiles

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61970-452 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) The Equipment profile has been split into three separate profiles, CoreEquipment, Operation and ShortCircuit.
- b) The HVDC model has been replaced with the new model defined in Edition 6 of 61970-301.
- c) Added attribute IdentifiedObject.mRID.

- d) Added class BusNameMarker.
- e) Added attribute HydroPowerPlant.hydroPlantType.
- f) Removed attribute HydroGeneratingUnit.energyConversionCapability.
- g) Added classes related to grounding (PetersenCoil, GroundImpedance, GroundDisconnecter, GroundSwitch, and Ground).
- h) A number of changes have been made to whether specific attributes and associations are required or optional.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
57/1868/FDIS	57/1892/RVD

Full information on the voting for the approval of this International 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.

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

This part of IEC 61970 is part of the IEC 61970 series that define an application program interface (API) for an energy management system (EMS).

The IEC 61970-3x series specifies a Common Information Model (CIM). The CIM is an abstract model that represents all of the major objects in an electric utility enterprise typically needed to model the operational aspects of a utility. It provides the semantics for the IEC 61970 APIs specified in the IEC 61970-4x series of Component Interface Standards (CIS). The IEC 61970-3x series includes IEC 61970-301, *Common Information Model (CIM) base* and draft standard IEC 61970-302¹, *Common Information Model (CIM) for Dynamics*.

This document is one of the IEC 61970-4x series of Component Interface Standards that specify the functional requirements for interfaces that a component (or application) shall implement to exchange information with other components (or applications) and/or to access publicly available data in a standard way. The component interfaces describe the specific message contents and services that can be used by applications for this purpose. The implementation of these messages in a particular technology is described in the IEC 61970-5x series.

This document specifies the specific profiles (or subsets) of the CIM for exchange of static power system data between utilities, security coordinators and other entities participating in an interconnected power system, such that all parties have access to the modeling of their neighbor's systems that is necessary to execute state estimation or power flow applications. Currently three profiles, the CoreEquipment Profile, the Operation Profile and the Short Circuit Profile, have been defined. A companion standard, IEC 61970-552, defines the CIM XML Model Exchange Format based on the Resource Description Framework (RDF) Schema specification language. IEC 61970-552 is the common industry approach and is recommended to be used to transfer power system model data for the IEC 61970-452 profile.

1 Under preparation. Stage at the time of publication: IEC/AFDIS 61970-302:2017.

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

Part 452: CIM static transmission network model profiles

1 Scope

This IEC document is one of the IEC 61970-450 to 499 series that, taken as a whole, defines at an abstract level the content and exchange mechanisms used for data transmitted between control centers and/or control center components, such as power systems applications.

The purpose of this document is to define the subset of classes, class attributes, and roles from the CIM necessary to execute state estimation and power flow applications. The North American Electric Reliability Council (NERC) Data Exchange Working Group (DEWG) Common Power System Modeling group (CPSM) produced the original data requirements, which are shown in Annex E. These requirements are based on prior industry practices for exchanging power system model data for use primarily in planning studies. However, the list of required data has been extended to facilitate a model exchange that includes parameters common to breaker-oriented applications. Where necessary this document establishes conventions, shown in Clause 6, with which an XML data file must comply in order to be considered valid for exchange of models.

This document is intended for two distinct audiences, data producers and data recipients, and may be read from two perspectives.

From the standpoint of model export software used by a data producer, the document describes a minimum subset of CIM classes, attributes, and associations which must be present in an XML formatted data file for model exchange. This standard does not dictate how the network is modelled, however. It only dictates what classes, attributes, and associations are to be used to describe the source model as it exists.

Optional and required classes, attributes and associations must be imported if they are in the model file prior to import. 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 any mandatory attribute or association is missing, the exchanged data is considered invalid. Specific business processes may relax restrictions of the profile, but such exchanges would not be considered to be compliant with the standard. Business processes governing different exchanges can also require mandatory exchange of certain optional attributes or associations.

Furthermore, an exporter may, at his or her discretion, produce an XML data file containing additional class data described by the CIM RDF Schema but not required by this document provided these data adhere to the conventions established in Clause 6.

From the standpoint of the model import used by a data recipient, the document describes a subset of the CIM that importing software must be able to interpret in order to import exported models. As mentioned above, data providers are free to exceed the minimum requirements described herein as long as their resulting data files are compliant with the CIM RDF Schema and the conventions established in Clause 6. 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 labeled 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 RDF Schema.

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.

NOTE For general glossary definitions, see IEC 60059, *International Electrotechnical Vocabulary*.

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

IEC 61970-301:2016, *Energy management system application program interface (EMS-API) – Part 301: Common information model (CIM) base*

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

IEC 61970-501, *Energy management system application program interface (EMS-API) – Part 501: Common Information Model Resource Description Framework (CIM RDF) schema*

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

Extensible Markup Language (XML) 1.0 (Second Edition), <http://www.w3.org/TR/REC-xml>