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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ENERGY MANAGEMENT SYSTEM APPLICATION
PROGRAM INTERFACE (EMS-API) –****Part 301: Common information model (CIM) base****FOREWORD**

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DISCLAIMER

This Redline version is not an official IEC Standard and is intended only to provide the user with an indication of what changes have been made to the previous version. Only the current version of the standard is to be considered the official document.

This Redline version provides you with a quick and easy way to compare all the changes between this standard and its previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 61970-301 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This sixth edition cancels and replaces the fifth edition, published in 2013. This sixth edition constitutes a technical revision.

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

- a) new model for grounding including Petersen coils;
- b) models for HVDC;
- c) addition of Static Var Compensation models;
- d) phase shift transformer updates - the section has been added;
- e) short circuit calculations based on IEC 60909;
- f) addition of non-linear shunt compensator;
- g) addition of model for steady state calculation inputs, Steady State Hypothesis;
- h) addition of base frequency model;
- i) corrections of several smaller issues, e.g. issues found at ENTSO-E interoperability tests;
- j) UML clean up;
- k) new model for PowerElectronicUnits and their connection to the AC network added;
- l) new section on relation between TapChanger.ItcFlag and TapChanger.TapChangerControl;
- m) Annex A with custom extensions added.

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

FDIS	Report on voting
57/1779/FDIS	57/1788/RVD

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

A list of all parts of the IEC 61970 series, 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 publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication 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 document is one of the IEC 61970 series which defines an application program interface (API) for an energy management system (EMS). IEC 61970 was originally based upon the work of the EPRI Control Center API (CCAPI) research project (RP-3654-1). The principle objectives of the EPRI CCAPI project were to:

- reduce the cost and time needed to add new applications to an EMS;
- protect the investment of existing applications or systems that are working effectively with an EMS.

The principal objective of the IEC 61970 series is to produce standards which facilitate the integration of EMS applications developed independently by different vendors, between entire EMS systems developed independently, or between an EMS system and other systems concerned with different aspects of power system operations, such as generation or distribution management systems (DMS). This is accomplished by defining application program interfaces to enable these applications or systems access to public data and exchange information independent of how such information is represented internally.

The Common Information Model (CIM) specifies the semantics for this API. The Component Interface Specifications (CIS), which are contained in other parts of the IEC 61970 series, specify the content of the messages exchanged.

The CIM is an abstract model that represents all the major objects in an electric utility enterprise typically needed to model the operational aspects of a utility. This model includes public classes and attributes for these objects, as well as the relationships between them.

~~The objects represented in the CIM are abstract in nature and may be used in a wide variety of applications. The use of the CIM goes far beyond its application in an EMS. This standard should be understood as a tool to enable integration in any domain where a common power system model is needed to facilitate interoperability and plug compatibility between applications and systems independent of any particular implementation.~~

This document defines the CIM Base set of packages which provide a logical view of the functional aspects of an Energy Management System including **Supervisory Control and Data Acquisition (SCADA)**. Other functional areas are standardized in separate IEC documents that augment and reference this document. For example, IEC 61968-11 addresses distribution models and references this document. While there are multiple IEC standards dealing with different parts of the CIM, there is a single, unified information model comprising the CIM behind all these individual standards documents.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning a computer-based implementation of an object-oriented power system model in a relational database. As such, it does not conflict with the development of any logical power system model including the Common Information Model (CIM), where implementation of the model is not defined.

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

Part 301: Common information model (CIM) base

1 Scope

The common information model (CIM) is an abstract model that represents all the major objects in an electric utility enterprise typically involved in utility operations. By providing a standard way of representing power system resources as object classes and attributes, along with their relationships, the CIM facilitates the integration of ~~Energy Management System (EMS)~~ network applications developed independently by different vendors, between entire ~~EMS~~ systems running network applications developed independently, or between ~~an EMS~~ a system running network applications and other systems concerned with different aspects of power system operations, such as generation or distribution management. SCADA is modeled to the extent necessary to support power system simulation and inter-control centre communication. The CIM facilitates integration by defining a common language (i.e. semantics) based on the CIM to enable these applications or systems to access public data and exchange information independent of how such information is represented internally.

The object classes represented in the CIM are abstract in nature and may be used in a wide variety of applications. The use of the CIM goes far beyond its application in an EMS. This document should be understood as a tool to enable integration in any domain where a common power system model is needed to facilitate interoperability and plug compatibility between applications and systems independent of any particular implementation.

Due to the size of the complete CIM, the object classes contained in the CIM are grouped into a number of logical Packages, each of which represents a certain part of the overall power system being modeled. Collections of these Packages are progressed as separate International Standards. This document specifies a Base set of packages which provide a logical view of the functional aspects of Energy Management System (EMS) information within the electric utility enterprise that is shared between all applications. Other standards specify more specific parts of the model that are needed by only certain applications. Subclause 4.3 of this document provides the current grouping of packages into standards documents.

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 60050 (all parts), *International Electrotechnical Vocabulary (IEV)* (available at www.electropedia.org)

~~IEC 60870-6 (all parts), Telecontrol equipment and systems – Part 6: Telecontrol protocols compatible with ISO standards and ITU-T recommendations~~

IEC 61850 (all parts), *Communication networks and systems for power utility automation*

~~IEC 61850-7-3:2010, Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes~~

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*

IEC 61968 (all parts), *Application integration at electric utilities – System interfaces for distribution management*

IEC TS 61970-2, *Energy management system application program interface (EMS-API) – Part 2: Glossary*

~~IEC 62325 (all parts), *Framework for energy market communications*~~

Object Management Group: UML 2.0 Specification – <http://www.omg.org>

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

**Interface de programmation d'application pour système de gestion d'énergie
(EMS-API) –
Partie 301: Base de modèle d'information commun (CIM)**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ENERGY MANAGEMENT SYSTEM APPLICATION
PROGRAM INTERFACE (EMS-API) –****Part 301: Common information model (CIM) base****FOREWORD**

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International Standard IEC 61970-301 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

This sixth edition cancels and replaces the fifth edition, published in 2013. This sixth edition constitutes a technical revision.

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

- a) new model for grounding including Petersen coils;
- b) models for HVDC;
- c) addition of Static Var Compensation models;
- d) phase shift transformer updates - the section has been added;
- e) short circuit calculations based on IEC 60909;
- f) addition of non-linear shunt compensator;

- g) addition of model for steady state calculation inputs, Steady State Hypothesis;
- h) addition of base frequency model;
- i) corrections of several smaller issues, e.g. issues found at ENTSO-E interoperability tests;
- j) UML clean up;
- k) new model for PowerElectronicUnits and their connection to the AC network added;
- l) new section on relation between TapChanger.ItcFlag and TapChanger.TapChangerControl;
- m) Annex A with custom extensions added.

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

FDIS	Report on voting
57/1779/FDIS	57/1788/RVD

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

A list of all parts of the IEC 61970 series, 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 publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication 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 document is one of the IEC 61970 series which defines an application program interface (API) for an energy management system (EMS). IEC 61970 was originally based upon the work of the EPRI Control Center API (CCAPI) research project (RP-3654-1). The principle objectives of the EPRI CCAPI project were to:

- reduce the cost and time needed to add new applications to an EMS;
- protect the investment of existing applications or systems that are working effectively with an EMS.

The principal objective of the IEC 61970 series is to produce standards which facilitate the integration of EMS applications developed independently by different vendors, between entire EMS systems developed independently, or between an EMS system and other systems concerned with different aspects of power system operations, such as generation or distribution management systems (DMS). This is accomplished by defining application program interfaces to enable these applications or systems access to public data and exchange information independent of how such information is represented internally.

The Common Information Model (CIM) specifies the semantics for this API. The Component Interface Specifications (CIS), which are contained in other parts of the IEC 61970 series, specify the content of the messages exchanged.

The CIM is an abstract model that represents all the major objects in an electric utility enterprise typically needed to model the operational aspects of a utility. This model includes public classes and attributes for these objects, as well as the relationships between them.

This document defines the CIM Base set of packages which provide a logical view of the functional aspects of an Energy Management System including Supervisory Control and Data Acquisition (SCADA). Other functional areas are standardized in separate IEC documents that augment and reference this document. For example, IEC 61968-11 addresses distribution models and references this document. While there are multiple IEC standards dealing with different parts of the CIM, there is a single, unified information model comprising the CIM behind all these individual standards documents.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning a computer-based implementation of an object-oriented power system model in a relational database. As such, it does not conflict with the development of any logical power system model including the Common Information Model (CIM), where implementation of the model is not defined.

The IEC takes no position concerning the evidence, validity and scope of this patent right.

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ISO (www.iso.org/patents) and IEC (http://www.iec.ch/tctools/patent_decl.htm) maintain on-line data bases of patents relevant to their standards. Users are encouraged to consult the data bases for the most up to date information concerning patents.

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

Part 301: Common information model (CIM) base

1 Scope

The common information model (CIM) is an abstract model that represents all the major objects in an electric utility enterprise typically involved in utility operations. By providing a standard way of representing power system resources as object classes and attributes, along with their relationships, the CIM facilitates the integration of network applications developed independently by different vendors, between entire systems running network applications developed independently, or between a system running network applications and other systems concerned with different aspects of power system operations, such as generation or distribution management. SCADA is modeled to the extent necessary to support power system simulation and inter-control centre communication. The CIM facilitates integration by defining a common language (i.e. semantics) based on the CIM to enable these applications or systems to access public data and exchange information independent of how such information is represented internally.

The object classes represented in the CIM are abstract in nature and may be used in a wide variety of applications. The use of the CIM goes far beyond its application in an EMS. This document should be understood as a tool to enable integration in any domain where a common power system model is needed to facilitate interoperability and plug compatibility between applications and systems independent of any particular implementation.

Due to the size of the complete CIM, the object classes contained in the CIM are grouped into a number of logical Packages, each of which represents a certain part of the overall power system being modeled. Collections of these Packages are progressed as separate International Standards. This document specifies a Base set of packages which provide a logical view of the functional aspects of Energy Management System (EMS) information within the electric utility enterprise that is shared between all applications. Other standards specify more specific parts of the model that are needed by only certain applications. Subclause 4.3 of this document provides the current grouping of packages into standards documents.

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 60050 (all parts), *International Electrotechnical Vocabulary (IEV)* (available at www.electropedia.org)

IEC 61850 (all parts), *Communication networks and systems for power utility automation*

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes*

IEC 61968 (all parts), *Application integration at electric utilities – System interfaces for distribution management*

IEC TS 61970-2, *Energy management system application program interface (EMS-API) – Part 2: Glossary*

Object Management Group: UML 2.0 Specification – <http://www.omg.org>

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

INTERFACE DE PROGRAMMATION D'APPLICATION POUR SYSTÈME DE GESTION D'ÉNERGIE (EMS-API) –

Partie 301: Base de modèle d'information commun (CIM)

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La Norme internationale IEC 61970-301 a été établie par le comité d'études 57 de l'IEC: Gestion des systèmes de puissance et échanges d'informations associés

Cette sixième édition annule et remplace la cinquième édition parue en 2013. Cette sixième édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) un nouveau modèle de mise à la terre, y compris les bobines Petersen;
- b) des modèles de courant continu à haute tension (CCHT);
- c) l'ajout de modèles de compensation de var statique;
- d) des mises à jour concernant les transformateurs déphaseurs; la section a été ajoutée;
- e) des calculs de courts-circuits issus de l'IEC 60909;

- f) l'ajout d'un compensateur shunt non linéaire;
- g) l'ajout d'un modèle pour les données d'entrée des calculs du régime établi, Steady State Hypothesis (hypothèse en régime établi);
- h) l'ajout d'un modèle de fréquence de base;
- i) des corrections relatives à des problèmes de moindre importance, par exemple problèmes trouvés lors des essais d'interopérabilité de l'ENTSO-E;
- j) le nettoyage de l'UML;
- k) l'ajout d'un nouveau modèle de PowerElectronicUnits et de leur connexion au réseau en courant alternatif;
- l) une nouvelle section concernant la relation entre TapChanger.ItcFlag et TapChanger.TapChangerControl;
- m) une Annexe A comprenant l'ajout d'extensions personnalisées.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
57/1779/FDIS	57/1788/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61970, publiées sous le titre général: *Interface de programmation d'application pour système de gestion d'énergie (EMS-API)*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives à la publication recherchée. À cette date, la publication sera

- reconduite,
- supprimée,
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- amendée.

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INTRODUCTION

Le présent document est l'une des parties de la série IEC 61970 qui définit une interface de programmation d'application (API – Application program interface) pour un système de gestion d'énergie (EMS – Energy management system). L'IEC 61970 a été initialement fondée sur les travaux réalisés dans le cadre du projet de recherche (RP-3654-1) sur les API de centres de conduite (CCAPI) de l'EPRI. Le projet CCAPI de l'EPRI avait principalement pour objet de:

- réduire les coûts et le temps nécessaires à l'ajout de nouvelles applications à un EMS;
- protéger l'investissement dans les applications ou systèmes existant(e)s qui fonctionnent efficacement dans un EMS.

Le principal objet de la série IEC 61970 est de produire les normes destinées à faciliter l'intégration d'applications EMS développées de façon indépendante par différents fournisseurs, entre des systèmes EMS complets développés de façon indépendante ou entre un système EMS et d'autres systèmes concernés par différents aspects de l'exploitation d'un système de puissance, tels que les systèmes de gestion de la distribution (DMS – Distribution management systems) ou de la production. Cela est réalisé en définissant des API pour permettre à ces applications ou systèmes d'accéder aux données publiques et d'échanger des informations indépendamment de la représentation interne de ces informations.

Le modèle d'information commun (CIM – Common Information Model) spécifie la sémantique de cette API. Les spécifications des composants d'interface (CIS – Component Interface Specifications), qui sont contenues dans d'autres parties de la série de normes IEC 61970, précisent le contenu des messages échangés.

Le CIM est un modèle abstrait contenant tous les objets principaux d'une entreprise de service public d'électricité habituellement nécessaires pour représenter les opérations d'une entreprise de service public d'électricité. Ce modèle inclut les classes et les attributs publics de ces objets, ainsi que les relations entre eux.

Le présent document définit la base du CIM constituée d'un ensemble de paquetages qui offrent une vue logique des aspects fonctionnels d'un EMS incluant SCADA (Supervisory control and data acquisition – système de supervision, contrôle et acquisition de données). D'autres domaines fonctionnels sont normalisés dans des documents IEC distincts qui complètent et référencent le présent document. Par exemple, l'IEC 61968-11 traite des modèles de distribution et référence le présent document. Alors qu'il existe plusieurs normes de l'IEC qui traitent des différentes parties du CIM, un seul modèle d'information unifié comprenant le CIM est sous-jacent à tous ces documents normatifs individuels.

La commission électrotechnique internationale (IEC) attire l'attention sur le fait qu'il est déclaré que la conformité au présent document peut impliquer l'utilisation d'un brevet intéressant une mise en œuvre gérée par ordinateur d'un modèle de système de puissance orienté objet dans une base de données relationnelle. À ce titre, elle n'est en conflit avec aucun développement de modèle logique de système de puissance incluant le CIM, lorsque la mise en œuvre du modèle n'est pas définie.

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INTERFACE DE PROGRAMMATION D'APPLICATION POUR SYSTÈME DE GESTION D'ÉNERGIE (EMS-API) –

Partie 301: Base de modèle d'information commun (CIM)

1 Domaine d'application

Le modèle d'information commun (CIM – common information model) est un modèle abstrait qui représente tous les objets principaux d'une entreprise de service public d'électricité habituellement nécessaires aux opérations d'une entreprise de service public d'électricité. La représentation normalisée des ressources de systèmes de puissance comme classes et attributs d'objets ainsi que leurs relations que fournit le CIM facilite l'intégration des applications réseau développées de façon indépendante par différents fournisseurs, entre des systèmes complets exploitant des applications réseau développés de façon indépendante ou entre un système exploitant des applications réseau et d'autres systèmes concernés par différents aspects des opérations d'un système de puissance tels que la gestion de la production ou de la distribution. Le système SCADA (système de supervision, contrôle et acquisition de données – supervisory control and data acquisition) est modélisé dans toute la mesure nécessaire pour prendre en charge la simulation des systèmes de puissance et la communication entre des centres de conduite. Le CIM facilite l'intégration en définissant un langage commun (c'est-à-dire une sémantique) fondé sur le modèle CIM pour permettre à ces applications ou systèmes d'accéder aux données publiques et d'échanger des informations indépendamment de la représentation interne de ces informations.

Les classes d'objets représentées dans le CIM sont de nature abstraite et peuvent être utilisées dans une large gamme d'applications. L'utilisation du CIM n'est pas limitée à son application dans un EMS. Il convient de considérer le présent document comme un outil permettant l'intégration dans tout domaine nécessitant d'appliquer un modèle commun de système de puissance pour faciliter l'interopérabilité et la compatibilité de connexion entre des applications et des systèmes indépendants de toute mise en œuvre particulière.

En raison de la taille du CIM complet, les classes d'objets qui le composent sont regroupées en un certain nombre de Paquetages logiques, qui représentent chacun une certaine partie du système de puissance global modélisé. Les ensembles de ces Paquetages sont fournis progressivement sous forme de Normes internationales distinctes. Le présent document spécifie un ensemble de Base de paquetages qui offrent une vue logique sur les aspects fonctionnels des informations relatives à un EMS d'une entreprise de service public d'électricité qui sont partagées par toutes les applications. D'autres normes spécifient des aspects plus spécifiques du modèle qui ne sont nécessaires qu'à certaines applications. Le Paragraphe 4.3 du présent document définit le découpage actuel des paquetages dans les documents normatifs.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050 (toutes les parties), *Vocabulaire électrotechnique international (IEV)* (disponible sous www.electropedia.org)

IEC 61850 (toutes les parties), *Réseaux et systèmes de communication pour l'automatisation des systèmes électriques*

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes* (disponible en anglais seulement)

IEC 61968 (toutes les parties), *Intégration d'applications pour les services électriques – Interfaces système pour la gestion de distribution*

IEC TS 61970-2, *Energy management system application program interface (EMS-API) – Part 2: Glossary* (disponible en anglais seulement)

Object Management Group: UML 2.0 Specification – <http://www.omg.org>