INTERNATIONAL STANDARD

IEC 61968-3

First edition
2004-03

Application integration at electric utilities – System interfaces for distribution management –

Part 3: Interface for network operations

Reference number
IEC 61968-3:2004(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE W

For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

APPLICATION INTEGRATION AT ELECTRIC UTILITIES – SYSTEM INTERFACES FOR DISTRIBUTION MANAGEMENT –

Part 3: Interface for network operations

FOREWORD

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International Standard IEC 61968-3 has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

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

FDIS	Report on voting
57/694/FDIS	57/714/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.

IEC 61968 consists of the following parts under the general title *Application integration at electric utilities – System interfaces for distribution management*:

Part 1: Interface architecture and general requirements

Part 2: Glossary

Part 3: Interface for network operations

Part 4: Interface for records and asset management[1]

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

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- withdrawn;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

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

1 Under consideration.

INTRODUCTION

The IEC 61968 series of standards is intended to facilitate *inter-application integration* as opposed to *intra-application integration*. Intra-application integration is aimed at programs in the same application system, usually communicating with each other using middleware that is embedded in their underlying runtime environment, and tends to be optimised for close, real-time, synchronous connections and interactive request/reply or conversation communication models. IEC 61968, in contrast, is intended to support the inter-application integration of a utility enterprise that needs to connect disparate applications that are already built or new (legacy or purchased applications), each supported by dissimilar runtime environments. Therefore, these interface standards are relevant to loosely coupled applications with more heterogeneity in languages, operating systems, protocols and management tools. This series of standards is intended to support applications that need to exchange data every few seconds, minutes, or hours rather than waiting for a nightly batch run. This series of standards, which are intended to be implemented with middleware services that exchange messages among applications, will complement, but not replace utility data warehouses, database gateways, and operational stores.

As used in IEC 61968, a Distribution Management System (DMS) consists of various distributed application components for the utility to manage electrical distribution networks. These capabilities include monitoring and control of equipment for power delivery, management processes to ensure system reliability, voltage management, demand-side management, outage management, work management, automated mapping and facilities management. Standard interfaces are defined for each class of applications identified in the Interface Reference Model (IRM), which is described in IEC 61968-1.

This Part of IEC 61968 contains the Clauses shown in Table 1.

Table 1 – Document overview for IEC 61968-3

Clause	Title	Purpose
1	Scope	The scope and purpose of the document are described.
2	Normative references	Documents that contain provisions which, through reference in this text, constitute provisions of this International Standard.
3	Reference and information models	Description of the relevant parts of the interface reference model, static information model and message type naming convention.
4	Message types – general	Requirements common to all message types described in Clause 5.
5	Network operations message types	Message types related to the exchange of information for operational documents namely operation restrictions, outage, safety and switching schedule.
Annex A	Message type verbs	Description of the verbs that are used for the message types.

APPLICATION INTEGRATION AT ELECTRIC UTILITIES – SYSTEM INTERFACES FOR DISTRIBUTION MANAGEMENT –

Part 3: Interface for network operations

1 Scope

The IEC 61968 series, taken as a whole, defines interfaces for the major elements of an interface architecture for Distribution Management Systems (DMS). IEC 61968-1 identifies and establishes requirements for standard interfaces based on an Interface Reference Model (IRM). Parts 3 to 10 of the IEC 61968 series define interfaces relevant to each of the major business functions described by the Interface Reference Model.

As used in the IEC 61968 series, a DMS consists of various distributed application components for the utility to manage electrical distribution networks. These capabilities include monitoring and control of equipment for power delivery, management processes to ensure system reliability, voltage management, demand-side management, outage management, work management, automated mapping and facilities management.

The IEC 61968 series is limited to the definition of interfaces and is implementation independent. It provides for interoperability among different computer systems, platforms, and languages. Methods and technologies used to implement a functionality conforming to these interfaces are considered outside of the scope of the IEC 61968 series; only the interface itself is specified in these standards.

This part specifies the information content of a set of message types that can be used to support many of the business functions related to network operations. Typical uses of the message types defined in this part include data acquisition by external systems, fault isolation, fault restoration, trouble management, maintenance of the plant, and the commissioning of the plant.

An additional part of IEC 61968 will document integration scenarios or use cases, which are informative examples showing typical ways of using the message types defined in this document as well as message types to be defined in other parts of the IEC 61968 series.

2 Normative references

The following referenced documents are indispensable for the application 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 61850-7-4:2003, *Communication networks and systems in substations – Part 7-4: Basic communication structure for substation and feeder equipment – Compatible logical node classes and data classes*

IEC 61968-1, *System interfaces for distribution management – Part 1: Interface architecture and general requirements*

3 Reference and information models

3.1 General

The message types defined in this document are based on a logical partitioning of the DMS business functions and components called the IEC 61968 interface reference model.

The contents of the message types are based on a static information model to ensure consistency of field names and data types. Each message type is defined as a set of fields copied from Common Information Model (CIM) classes. The message types defined in this standard are intended to satisfy a majority of typical applications. In some project implementations, it may be desirable to modify the set of fields using a methodology such as that described in IEC 61968-1.

3.2 Interface reference model

It is not the intention of this standard to define the applications and systems that vendors should produce. It is expected that a concrete (physical) application will provide the functionality of one or more abstract (logical) components as listed in this standard. These abstract components are grouped by the business functions of the interface reference model.

In this standard, the term abstract component is used to refer to that portion of a software system that supports one or more of the interfaces defined in Parts 3 to 10 of the IEC 61968 series. It does not necessarily mean that compliant software is delivered as separate modules.

IEC 61968-1 describes infrastructure services common to all abstract components whilst Parts 3 to 10 of the IEC 61968 series define the details of the information exchanged for specific types of abstract component.

The IEC 61968 series defines that:

a) An inter-application infrastructure is compliant if it supplies services defined in IEC 61968-1 to support at least two applications with interfaces compliant to IEC 61968 Parts 3 to 10.

b) An application interface is compliant if it supports the interface standards defined in IEC 61968 Parts 3 to 10 for the relevant abstract components defined in the interface reference model.

c) An application is only required to support interface standards of the applicable components listed under abstract components. It is not required to support interfaces required by other abstract components of the same business sub-function or within the same business function. While this standard primarily defines information exchanged among components in different business functions, it will occasionally also define information exchanged among components within a single business function when a strong market need for this capability has been realised.

3.3 Network operations functions and components

The message types defined in IEC 61968-3, may be sent or received by any type of component within a DMS system.

Table 2 shows these functions and typical abstract components that are expected to be producers of information for these message types. Typical consumers of the information include, but are not restricted to, the other components as listed in IEC 61968-1; for example, geographic information systems, energy management systems and customer information systems.

Table 2 – Business functions for network operations

Business Functions	Business sub-functions	Abstract components
Network operation (NO)	Network operation	Substation state supervision
	Monitoring (NMON)	Network state supervision for example by topology processing and network colouring
		Switching action supervision
		Management of data acquired from SCADA and metering systems
		Management of data acquired through operation (field crews, customers, scheduled and unscheduled outages)
		Alarm management including supervision, acknowledgement, and deletion
		Operator and event logs
	Network control (CTL)	User access control
		Automatic controls: Protection (fault clearance) Sectionalising Local voltage/reactive power control
		Assisted control: Remote switch control Load shedding Voltage regulation for example broadcast of voltage reduction command Local control through field crews
		Safety document management
		Safety checking and interlocks
		Major incident co-ordination
	Fault management (FLT)	Trouble call handling and coherency analysis (LV network)
		Protective relays analysis
		Fault location by analysis of fault detectors and/or trouble call localisation
		Supply restoration assessment
		Customer incident information
	Operation feedback Analysis (OFA)	Mal-operation analysis
		Network fault analysis
		Quality index analysis
		Device operation history
		Post-disturbance review
	Operation statistics and Reporting (OST)	Maintenance information
		Information for planning
		Information for management control
	Network calculations – real-time (CLC)	Load estimation
		Energy trading analysis
		Load flow/voltage profile
		Fault current analysis
		Adaptive relay settings
	Dispatcher training (TRN)	SCADA simulation

3.4 Message type terms

The message types defined in this standard are described using the following terms.

Message type name
Each message type has a name consisting of a verb and a noun.

Message type verb
The verb describes the purpose of the message. (See Annex A for the description of the verbs).

Message type noun
The noun describes the type of data in the message body. Each noun corresponds to a class name in the static information model. For most message types, the nouns are a type of document.

Message body
The body of each message type is based on the attributes (fields) of the classes described by the nouns.

Naming
"Naming" is a class that defines common attributes used to identify instances of common information model classes. The attributes are a set of human readable alphanumeric strings. It is usual for utilities to use unique alphanumeric codes to identify their substations and the equipment in each substation. In some implementations, these codes may have to be prefixed with additional characters to guarantee uniqueness across organisation boundaries.

Naming.name
This is a human readable alphanumeric string that identifies an entity with a specific scope, for example within a particular substation.

Naming.pathname
This is a human readable alphanumeric string that identifies an entity with global scope, for example a concatenation of zone, substation and equipment names.

Naming.aliasname
This is an alternative name that is expected to be used to contain other identifiers, for example a machine allocated identification number. The aliasname may be used by a computer system as an index to name translation tables when information is exchanged between different organisations.

Naming.description
This is a human readable alphanumeric string that provides additional information but is not intended for automatic processing by computer systems.

Document
"Document" is a class that defines common attributes used in all message types.

Document.type
The document type is the name of the class that is the actual instance, for example "SwitchingSchedule", "ActivityRecord".

Document.subtype
This is additional information that may be utility specific, for example "Planned", "OnDemand" for SwitchingSchedule, "Planned", "Unplanned" for OutageRecords, "PermitToWork" for a SafetyDocument.

Document.status
The document status is a string indicating the status of the document. This is expected to be specific to the document type, for example "Draft", "In Progress", "Approved".

3.5 Static information model

The information model relevant to network operations consists of classes that provide a template for the attributes for each message.

The classes are defined in detail in another part of IEC 61968.

3.5.1 Operational documents model

The message types are based on a common model of a document that includes information on the person (ErpContact) and organisation that created and/or modified the document.

Operational documents inherit from the base document class and have associations with other classes such as PowerSystemResource or Asset.

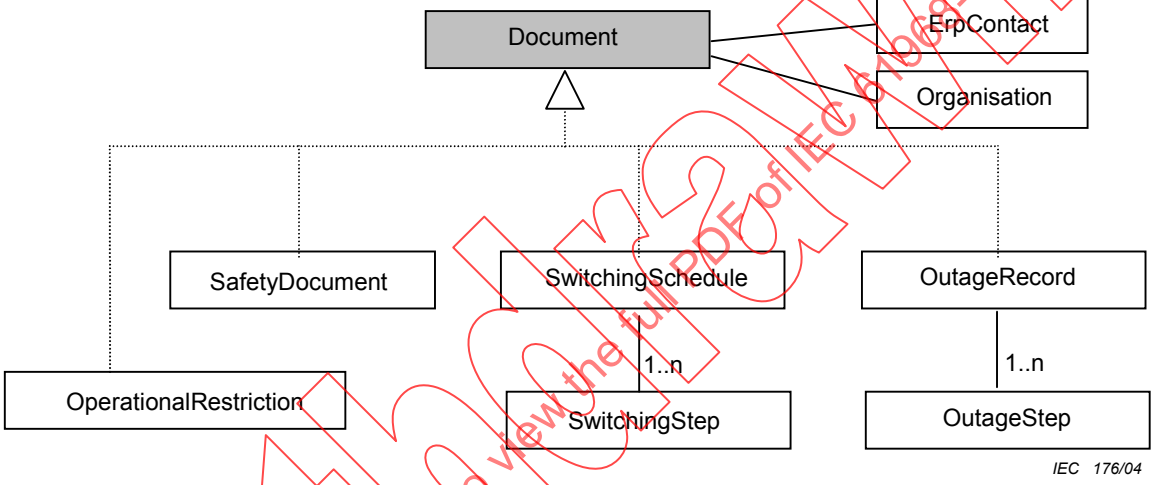


Figure 1 – Simplified operational documents model

3.5.2 Classes for network operations

Table 3 lists classes that are used within message types. Usually all the attributes of these classes are contained within a message type.

Classes described as type "document" are top-level container entities. Message type names are based on these entities.

Classes described as type "part" are lower level entities that are associated with a containing document.

Table 3 – Classes for Network Operations

Class name	Type	Description
ActivityRecord	Document	A general purpose document that provides a chronological list of textual remarks. An ActivityRecord may be used to describe events and actions taken to restore an outage.
MeasurementValueList	Document	A document providing header information for a list of measurement values.
MeasurementValue	Part	The name, value, quality and timestamp for a measurement.
OutageRecord	Document	A document describing details of an outage in part of the distribution network. An OutageRecord is typically produced as part of a planned activity (for example work order for maintenance) or following a breaker trip detected by SCADA or within a trouble call system by grouping customer calls.
OutageStep	Part	An outage step lists each supply point, for example distribution transformer or metered switch, that is affected by an outage defined in an OutageRecord document.
OperationalRestriction	Document	A document describing how one or more items of a plant should be operated at less than the manufacturers' ratings. It is assumed that these messages are in the network operations domain and hence are associated with power system resources only. Cross-referencing of assets to PowerSystemResources is covered by the GetAssetList, ShowAssetList message types. These are defined in another part of IEC 61968.
SafetyDocument	Document	A document restricting or authorising works on electrical equipment, for example a permit to work, sanction for test, limitation of access, certificate of isolation.
SwitchingSchedule	Document	A document describing a set of steps to perform an item of work for example to isolate some plant with regard to safety, equipment ratings, and standards of customer service.
SwitchingStep	Part	A step within a SwitchingSchedule that describes a control action to be applied to an item of a plant, or a SafetyDocument to be issued or cancelled or simple text.

3.5.3 Classes related to network operations

Table 4 lists those classes that are associated with network operations classes but only the name of an instance is given within messages defined in this standard. The detailed attributes of these classes are used in message types defined in other parts of IEC 61968.

Table 4 – Classes related to network operations

Related Class	Reference	Description
Asset	Another part of IEC 61968 covering records and asset management	An entity that describes the physical view of a component part of the utility business. Assets may be classified as PointAssets for example a switch or LinearAssets for example cable sections. Instances of type asset may be related to instances of type PowerSystemResource.
Crew	Another part of IEC 61968 covering maintenance and construction	A crew is a collection of people (ErpContacts) with specific skills, tools, and vehicles.
Customer	Another part of IEC 61968 covering customer support	The customer class holds information about individual customers that are served electric power i.e. with a metered connection to the network.
ErpContact	Another part of IEC 61968 covering maintenance and construction	Information about a person and their role within a utility organisation. ErpContacts may include external purchasers and suppliers of equipment and services.
Organisation	Another part of IEC 61968 covering records and asset management	This class is used to identify companies or divisions within companies. Organisations might have roles as utilities, contractors, suppliers, manufacturers, etc.
PowerSystemResource	Another part of IEC 61968 covering records and asset management	An entity that describes the logical view of a component part of the utility business. PowerSystemResources are further classified as EquipmentContainers for example Substations, ConductingEquipment, ProtectionEquipment etc. Instances of type PowerSystemResource may be related to instances of type asset.
TroubleTicket	Another part of IEC 61968 covering customer support	A type of document that contains the information of one or more customer calls.
Work	Another part of IEC 61968 covering maintenance and construction	A type of document that contains information used to request, initiate, track and record work, particularly construction and maintenance tasks.

4 Message types – General

This clause defines the general features of message types. Specific message types for Network Operations are covered in Clause 5.

4.1 Message usage

This standard defines the format of a set of message types which applications may send or receive but does not define any particular order or interaction between messages. Typical scenarios are Request-Reply and Publish-Subscribe. See Annex A for details of standard verbs.

For Request-Reply scenarios, a client application is expected to issue a Get or Create type of message and then receive a Show or Created message type in return.

For the Publish-Subscribe scenarios, client applications will issue a Subscribe type of message and then receive one or more relevant Show, Created, or Changed message types asynchronously.

4.2 Compliance

This standard defines the logical names of message types and fields within message types.

Compliance can be assessed separately for each message type. However it is expected that vendors will offer compliance for all messages defined in this part of IEC 61968.

A software component is deemed to be compliant to any specific message type if

a) The component can produce an XML message for a message type including all required fields with names and data types as defined in this standard. Data may be set to a default value if it is not available within a component. Optional data shall be passed in the appropriate optional fields. Message type extensions are compliant as long as the correct CIM fields are used when applicable.

b) The component can read an XML message produced for a message type defined in this standard and correctly interpret the fields in the message.

4.3 Message formats

In general, message types have been defined with fields that may hold different representations of the same data. It is expected that producer applications will set some fields with default null values.

In the message format descriptions, message elements ending in “Seg,” such as “DocumentSeg,” mean that instance data may be provided for some or all of the attributes of that class in the static information model. Elements that are required have solid line boxes around them whereas option elements have dashed line boxes. When an element may have an unlimited number of instances, this is indicated by the expression [0..∞].

4.4 Common message type fields

The following subclauses describe the fields that shall be part of all message types defined in this standard.

4.4.1 Message organisation

In accordance with IEC 61968-1, message types are organized according to the generic pattern shown in Figure 2. The message payload, on the other hand, is normative and is the primary subject matter of this standard. It is described in the remaining clauses.

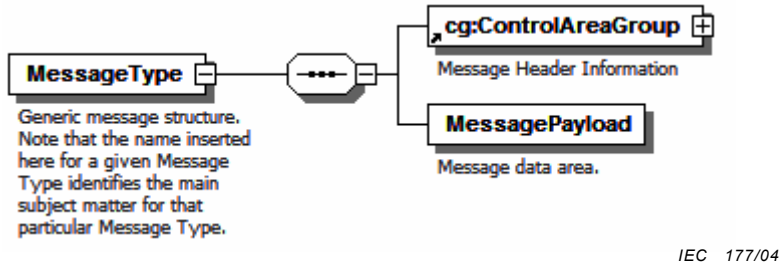


Figure 2 –Generic pattern used for all message types

The control area contains the message type verb, noun, revision, and other information about the message. The control area shown in Figure 3 is for illustrative purposes; it is informative as it varies according to the specific implementation technologies. Appropriate verbs are listed in Annex A.

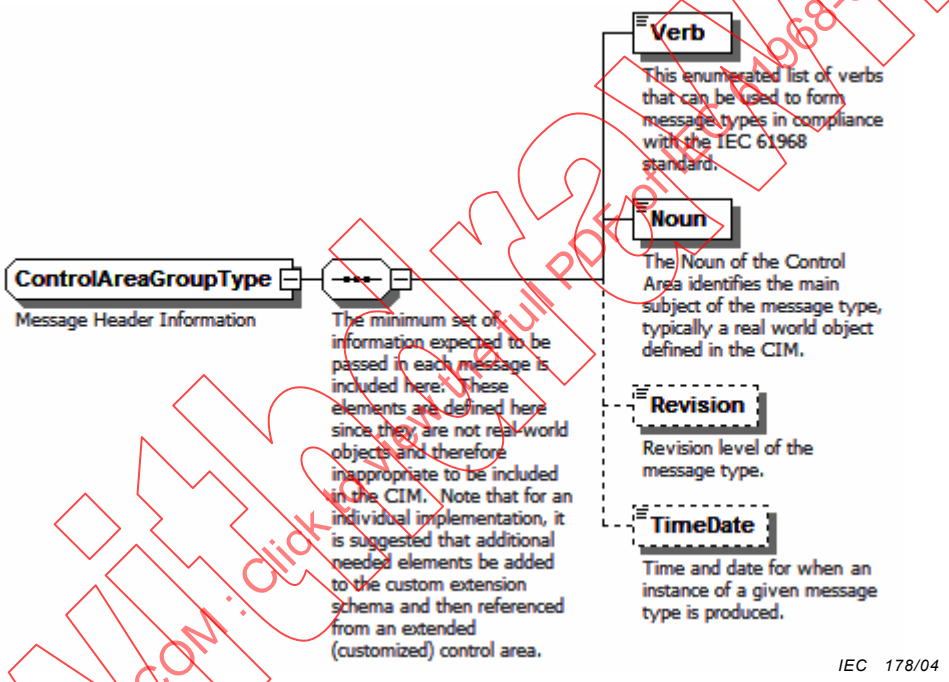


Figure 3 – Example (informative) of a control area used for all message types

4.4.2 Namespaces

Each message attribute name has a prefix called a namespace. This provides an extendable way of indicating the design authority for particular attributes.

The cim: namespace is reserved for attributes defined explicitly within the Common Information Model (CIM).

The cs: namespace is used to specify the CIM segment groupings.

If message type formats are customised by software suppliers or for specific utilities, then any additional attributes shall be prefixed with different namespaces. To support this, the ce: namespace is used for custom extensions.

4.4.3 Naming class

Most IEC 61970 and IEC 61968 CIM classes inherit from the Naming class (depicted in Figure 4) which provides a consistent way of identifying instances. This scheme is compatible with the generic eventing services that will be defined in part of IEC 61970.

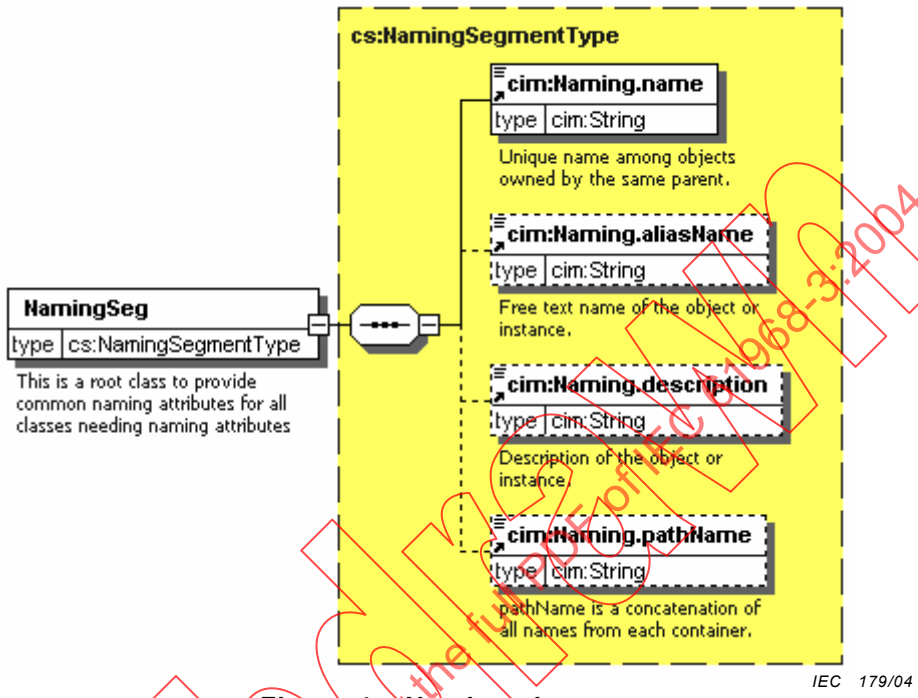


Figure 4 – Naming class

This notation shows that the NamingSeg is defined as an instance of NamingSegmentType, which contains four attributes from the CIM. Naming.name is mandatory as indicated by the solid line. The other three attributes are optional, indicated by the dotted line.

4.4.4 Document class

The Document class defines common attributes used in all message types. See 3.4.

The document and its associations is shown in Figure 5.

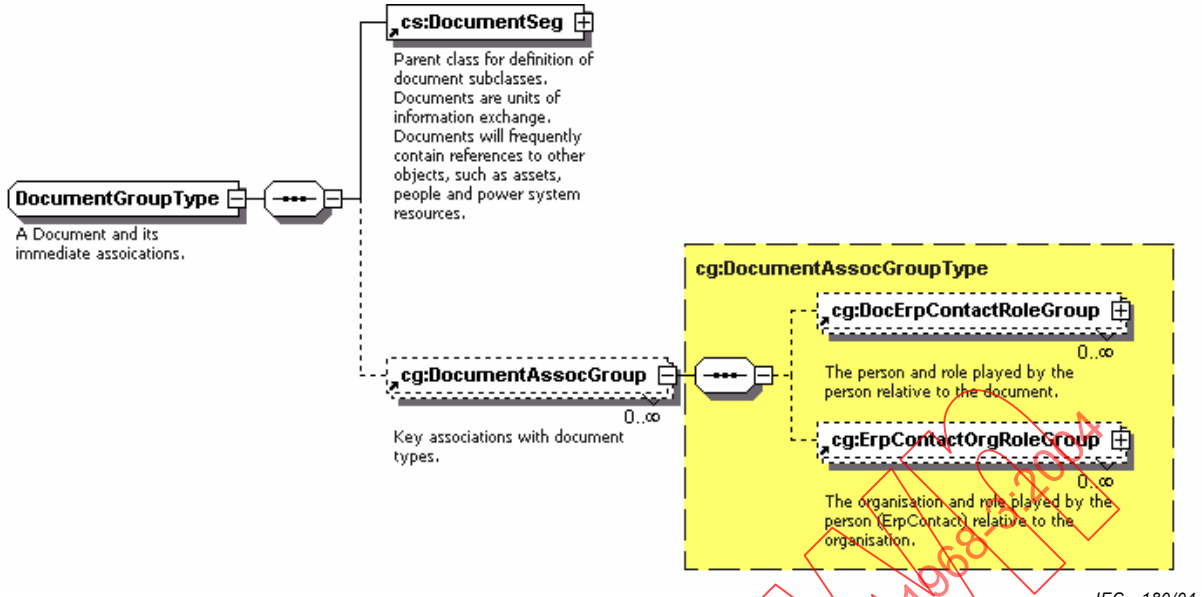
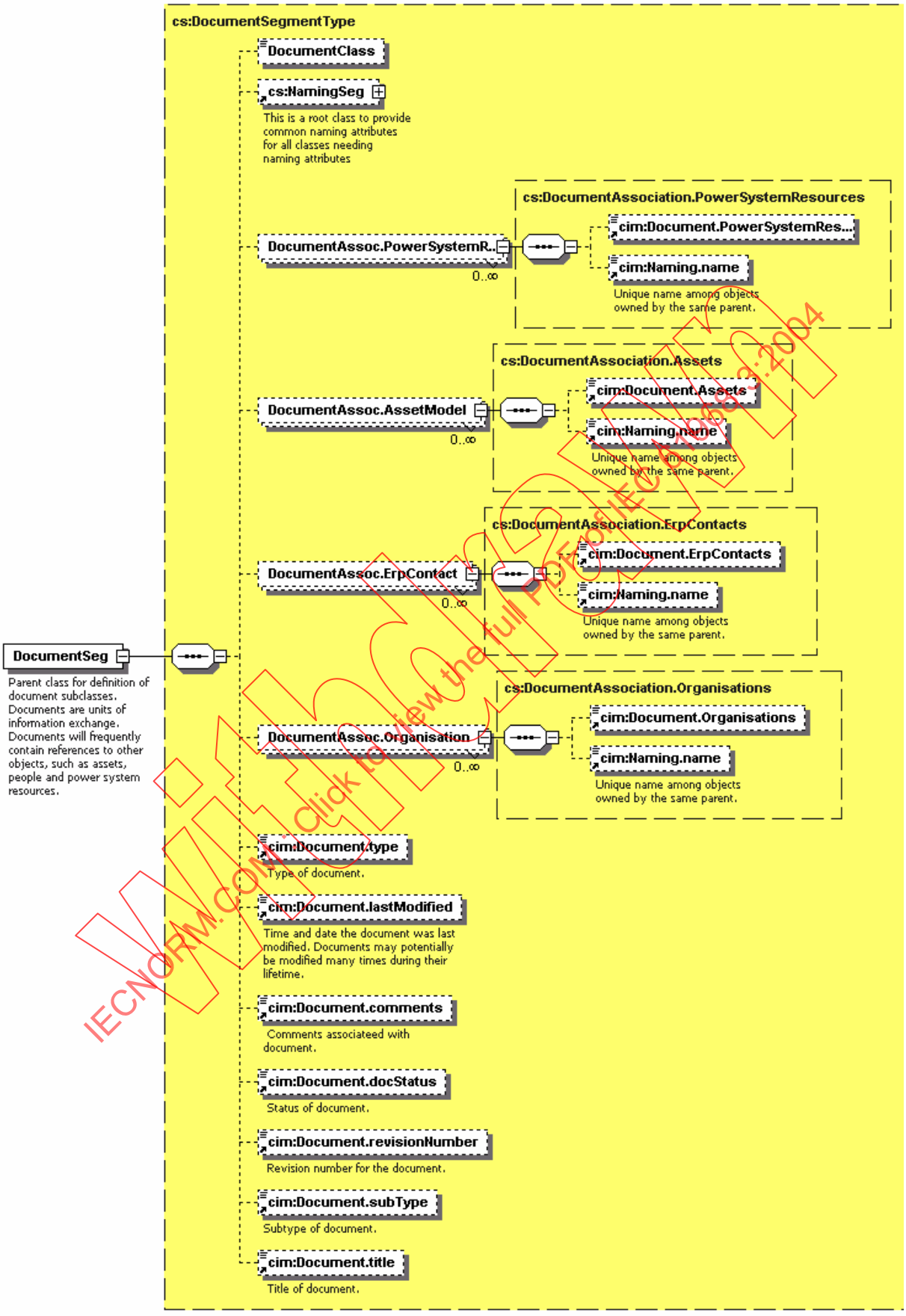


Figure 5 – Document associations

The *Document Class* inherits from the *Naming Class* and, in similar fashion as PowerSystemResource and Asset, is the top of a large hierarchy. At the root of many utility real world objects is a type of document.

Definitions of relevant classes, which are any elements beginning with the “cs” namespace, are made in another part of IEC 61968 covering the Distribution Information Exchange Model (DIEM). As the Document class is referenced extensively throughout this document, it is shown in Figure 6 for convenience. Note that associations between classes in the CIM are indicated with “Assoc” following the name of the source class and the destination class following the period (“.”) delimiter. For example, “cim:Document.PowerSystemResources” in DocumentSeg indicates that an instance of Document can be associated with zero to many instances of PowerSystemResource. The same pattern for various groups of information elements are frequently encountered across multiple message types; the “cg” namespace, for CIM Groups, indicates such a reusable pattern. The two such patterns referenced in Figure 5 are shown in Figures 7 and 8.



IEC 181/04

Figure 6 – Document Class class details

4.4.5 ErpContact and organisation roles

Documents may be created or modified by several persons (ErpContact) or organisations. Some types of document may have specific roles, for example CheckedBy, ApprovedBy.

As it is not practical to define an explicit association for every type of role a person may play for various types of documents, the following construct (depicted in Figure 7) that may be used to describe each relevant role a person plays for each document is provided.

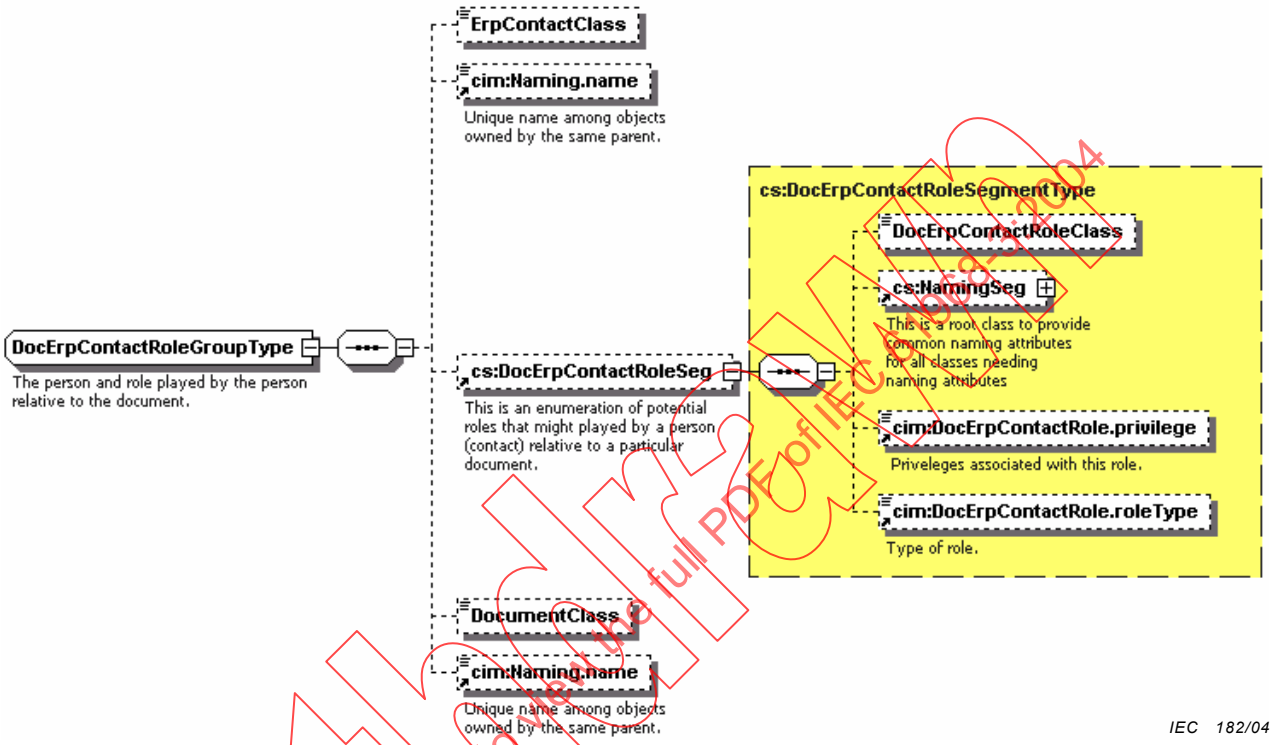


Figure 7 – Person and role played by person relative to a document

As it is not practical to define an explicit association for every type of role a person may play for various organisations, the following construct (depicted in Figure 8) is provided that may be used to describe each relevant role a person plays for each organisation.

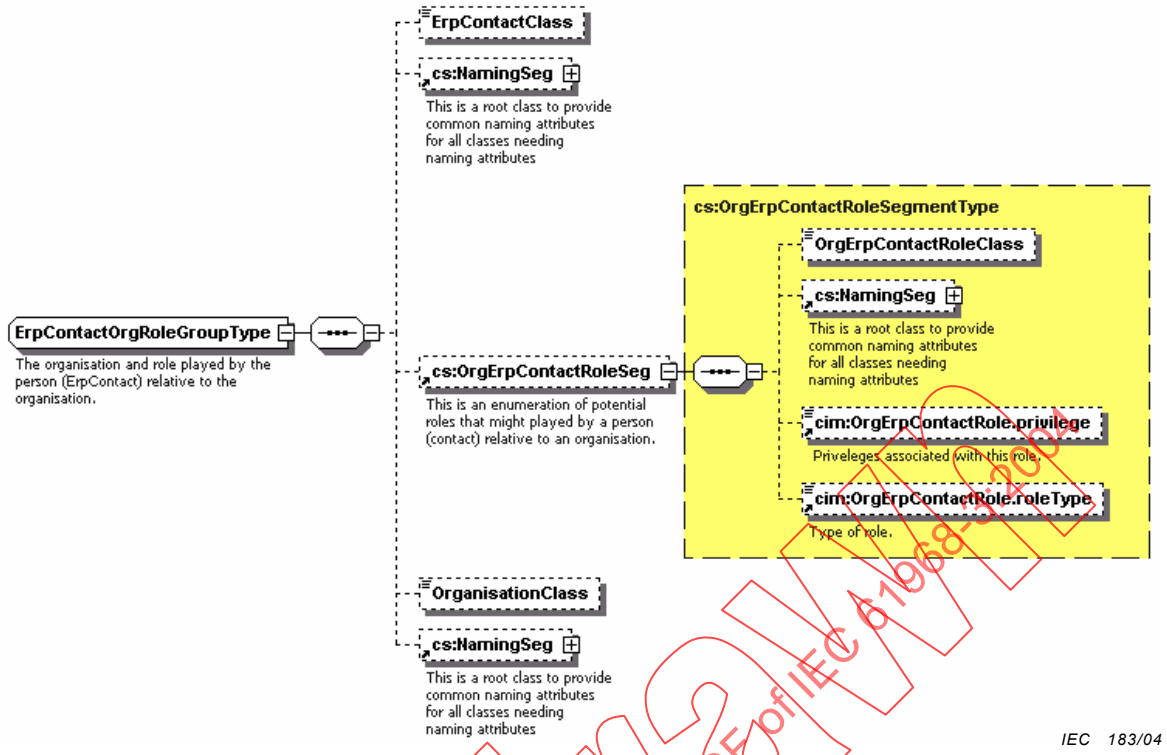


Figure 8 – Person and role played by person relative to an organisation

Note that each person, referred to as "ErpContact," is only referenced in the elements given in Figure 8. For detailed information about the person, the <verb>ErpContact message type is used, where the verb is create, show, etc.

5 Network operations message types

5.1 Summary

The network operations message types describe information for the following types of document:

- measurement list;
- operational restrictions;
- outage records;
- safety documents;
- switching schedules.

5.2 Measurement list message types

The measurement list document is a simple way of transferring measurement value data. This is intended to complement the more comprehensive facilities for measurement data exchange that will be described in an appropriate part of IEC 61970.

Measurement values may be either scalar (analogue) values or discrete keywords for status measurements.

5.2.1 Message format

Created MeasurementList, changed MeasurementList and show MeasurementList have the message format shown in Figures 9 to 14.

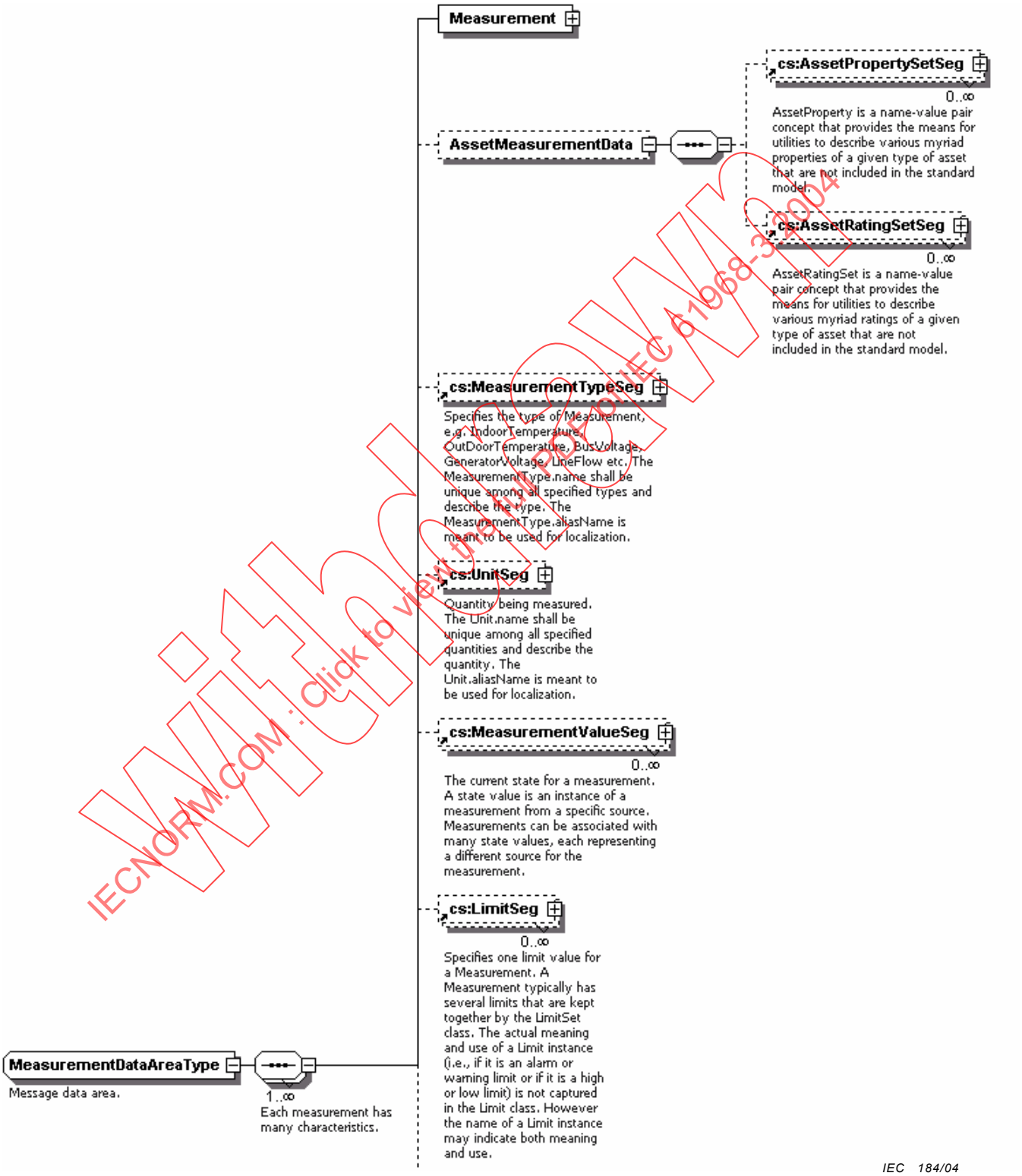


Figure 9 – Measurement list message format

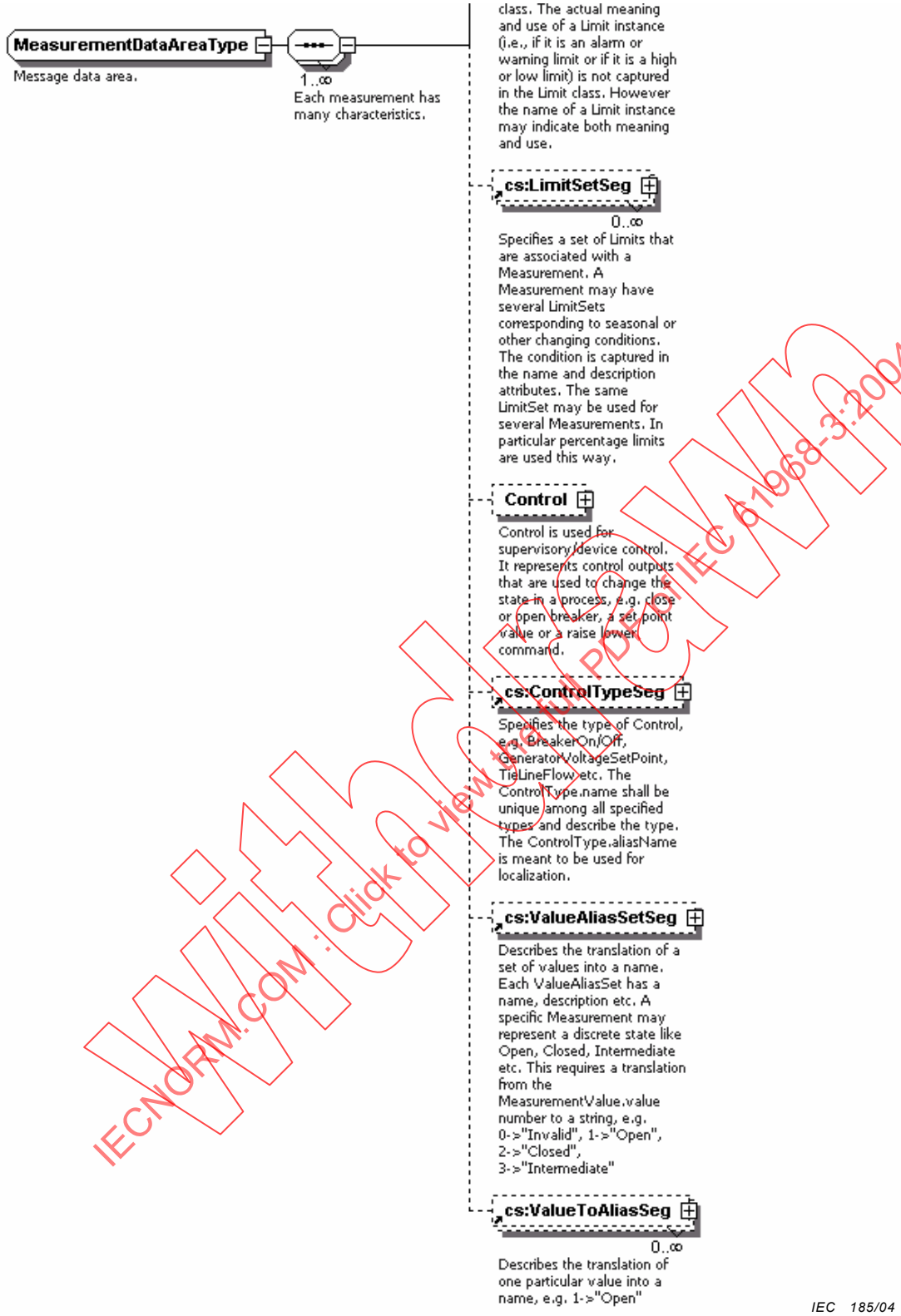
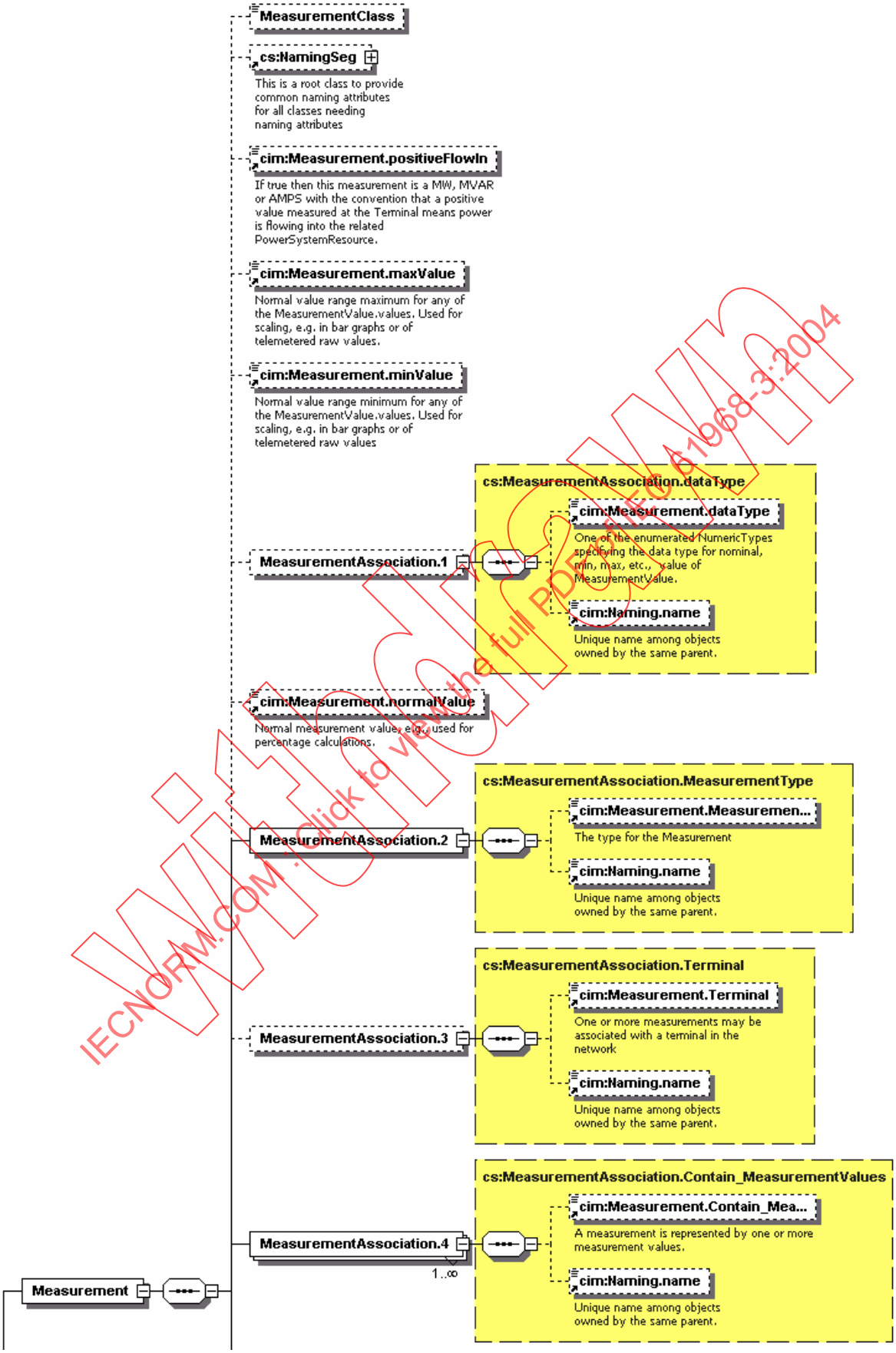
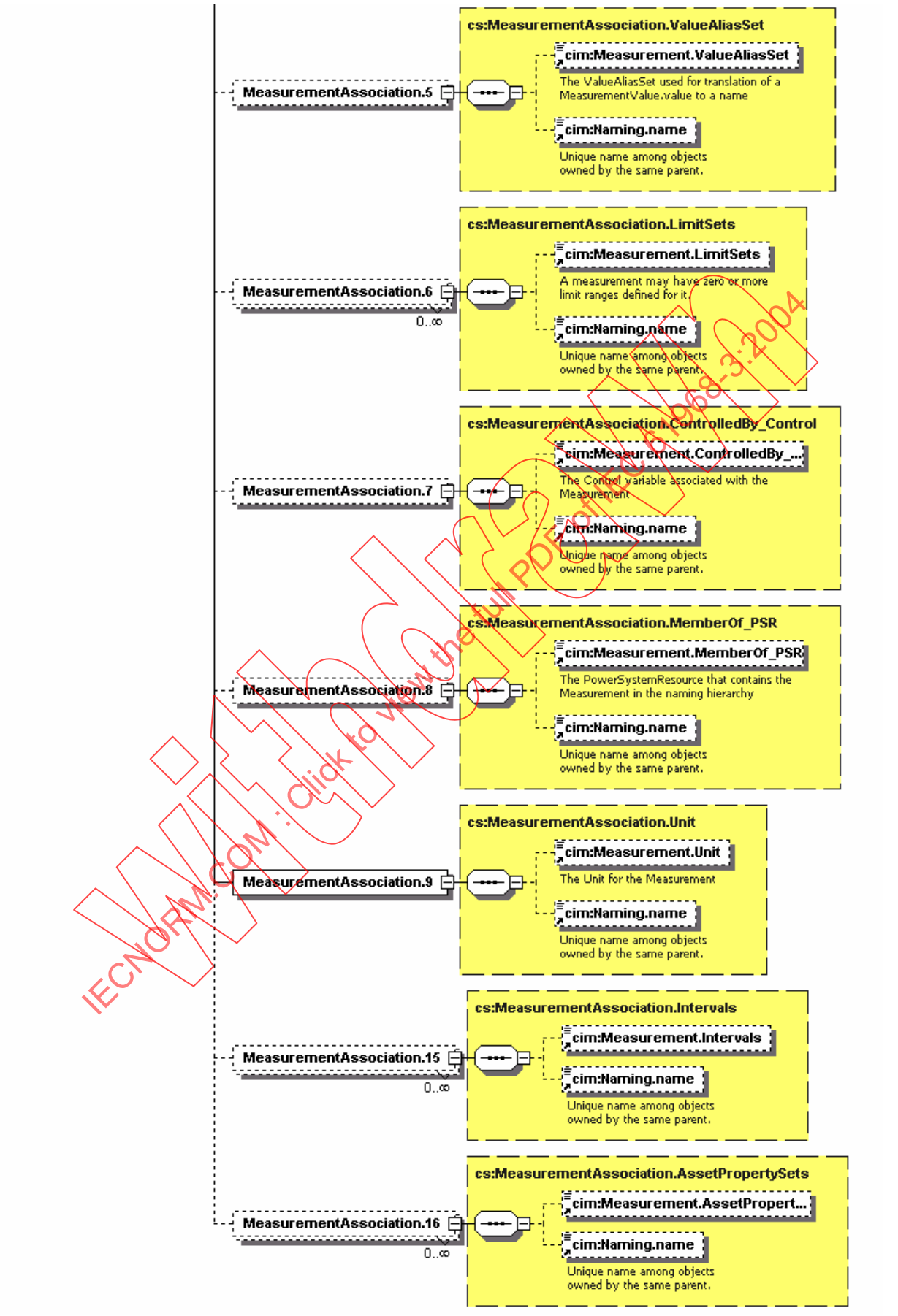


Figure 10 – Continuation of measurement list message format



IEC 186/04

Figure 11 – Measurement list – Measurement details



IEC 187/04

Figure 12 – Continuation of Measurement list – Measurement details

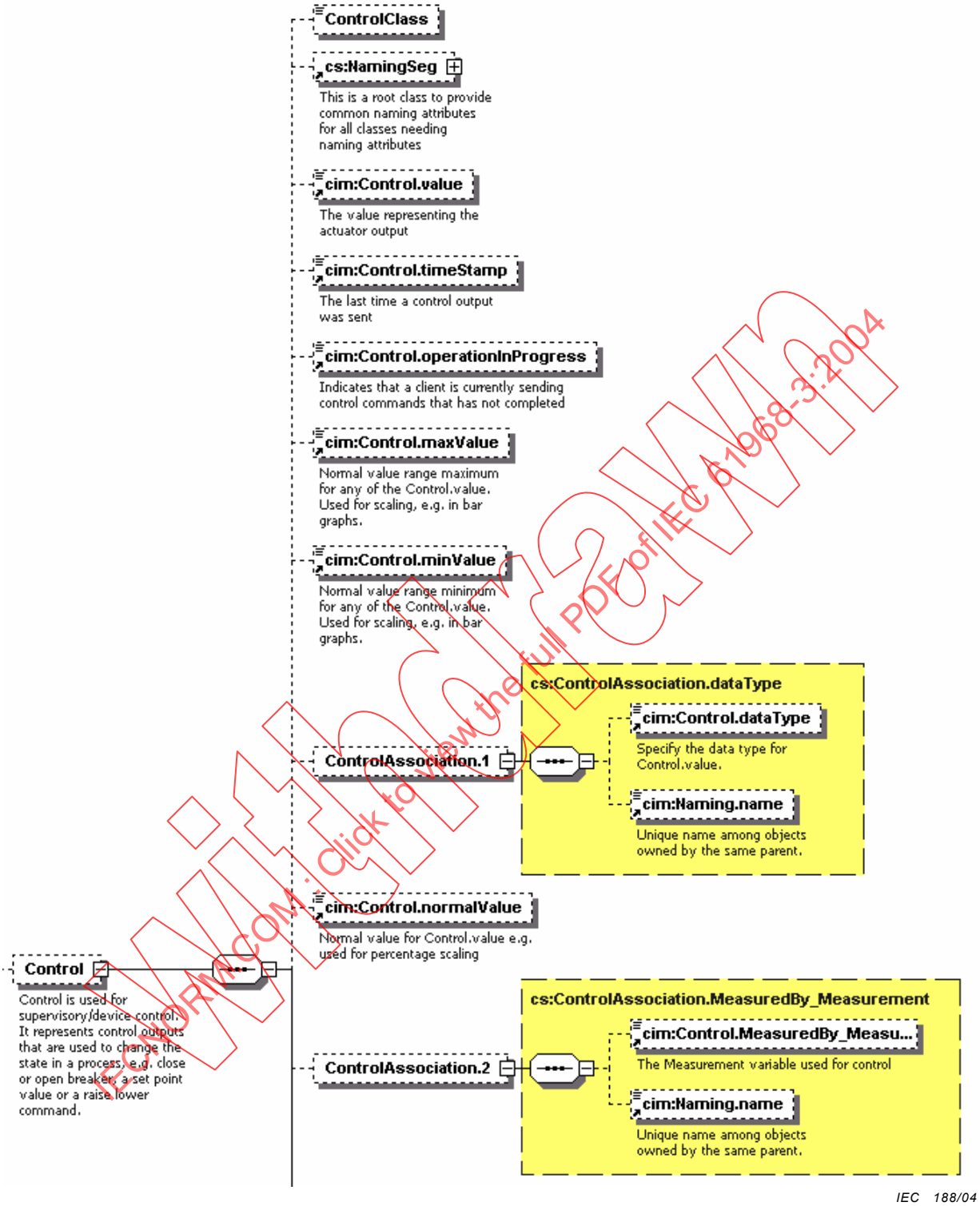


Figure 13 – Measurement list – Control details

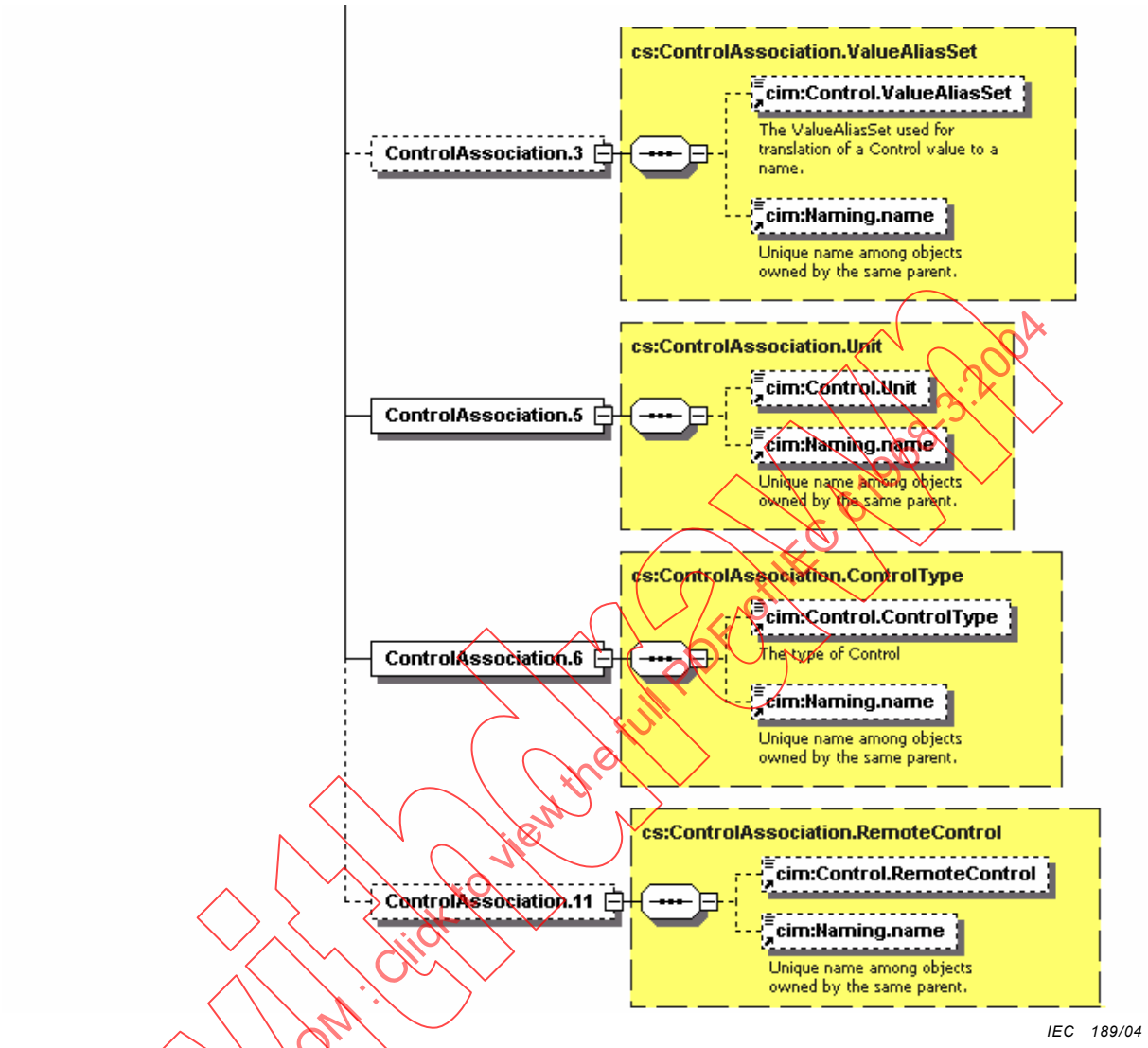


Figure 14 – Continuation of measurement list – Control details

5.2.2 Recommended measurement names

Some measurement names suitable for distribution management applications are defined in IEC 61850-7-4. Table 5 shows a set of recommended measurement names. Vendors or utilities may specify additional names.

Table 5 – Recommended measurement names

Name	Description	Type
Amps	Current *I* (r.m.s.) of a non-three phase circuit	Analogue
TotAmps	Total current *I* (r.m.s.) in a three phase circuit	Analogue
Hz	Frequency (*f*)	Analogue
PwrFact	Power factor (*pf*)	Analogue
TotPF	Average power factor (*pf*) in a three phase circuit	Analogue
TotVA	Total apparent power (*S*) in a three phase circuit	Analogue
TotVAr	Total reactive power (*Q*) in a three phase circuit	Analogue
TotW	Total real power (*P*) in a three phase circuit	Analogue

Name	Description	Type
VoltAmp	Apparent power (*S*) in a non-three phase circuit	Analogue
VoltAmpR	Reactive power (*Q*) in a non-three phase circuit	Analogue
Volts	Voltage (*V*) (r.m.s.)	Analogue
Watts	Real power (*P*) in a non-three phase circuit	Analogue
Pres	Pressure	Analogue
Temp	Temperature	Analogue
TotAng	Angle (phi) (in a three phase circuit)	Analogue
TotVAh	Apparent energy	Integer
TotVArh	Reactive energy	Integer
TotWh	Real energy	Integer
TapPos	Tap position of power transformer or phaseshifter	Integer
OperCnt	Operation count – typically for switches	Integer
Auto	Automatic operation (not manual). Automatic = TRUE	MANUAL,AUTO
Loc	Local operation (not remote). Local =TRUE	REMOTE,LOCAL
Pos	Switch position i.e. topology state	IGNORE, OPEN, CLOSE, TRAVEL
LTCBlk	Automatic control of LTC blocked (inhibited). Blocked = TRUE	FREE, BLOCKED
Parallel	Transformers in parallel operating mode	INDEPENDENT, PARALLEL
GenOperMode	Generator operating mode	OFF, STARTING, STOPPING, AGC, etc.
VoltRegMode	Voltage regulation mode	OFF, MVAR, VOLT
NotInService	Equipment not in service	INSERVICE, NIS
LockAndCaution	Indicates whether the equipment has had a lock and caution tag applied	NONE, LKCAUTION
AutoReclose	Indicates whether breaker auto-reclose exists and is enabled	NONE, AROFF, ARON
AutoChangeOver	Indicates whether this equipment has an auto-changeover scheme	NONE, ACOFF, ACON
BusBarSelector	Indicates which bus of a double busbar is selected	NONE, BUS1, BUS2
OverCurrentTrip	Indicates that a breaker has tripped on over-current, or that a fault passage indicator has detected over-current	NONE, OCTRIP
GroundFaultTrip	Indicates that a breaker has tripped for a ground fault, or that a fault passage indicator has detected a ground fault. Also known as Sensitive Earth Fault state	NONE, SEFTRIP
IsolationState	Whether or not equipment is isolated from a source of power	UNKNOWN, ISOLATED, CONNECTED
AppEnergization	Energization state applied to conducting equipment for example by grounding switches or generators. Switch cabinets that may ground either a circuit or a busbar may also have a BusBarSelector state	NONE, GROUND, ENERGIZE, FAULT
Energization	Calculated or measured energization state of conducting equipment	UNKNOWN, DEAD, GROUNDED, ENERGIZED, FAULTED
QuotedState	Indicates whether equipment is quoted on a safety document	NONE, QUOTED
ControlState	Status of a control or command	PROPOSED, INSTRUCTED, CONFIRMED, CANCELLED, SKIPPED

5.3 OperationalRestriction message types

An operational restriction document describes how one or more items of plant should be operated at less than the manufacturers' ratings. It is assumed that these messages are in the network operations domain and hence are associated with power system resources only.

There can be a severity level associated with a restriction for example a highest form of restriction may exclude the device from any live operation.

Once a restriction is applied, facilities are required to remove the restriction from all the PowerSystemResources or individually from a device.

5.3.1 General

There are no general requirements.

5.3.2 Message format

Created OperationalRestriction, changed OperationalRestriction, show OperationalRestriction and deleted OperationalRestriction have the same message formats as shown in Figure 15.

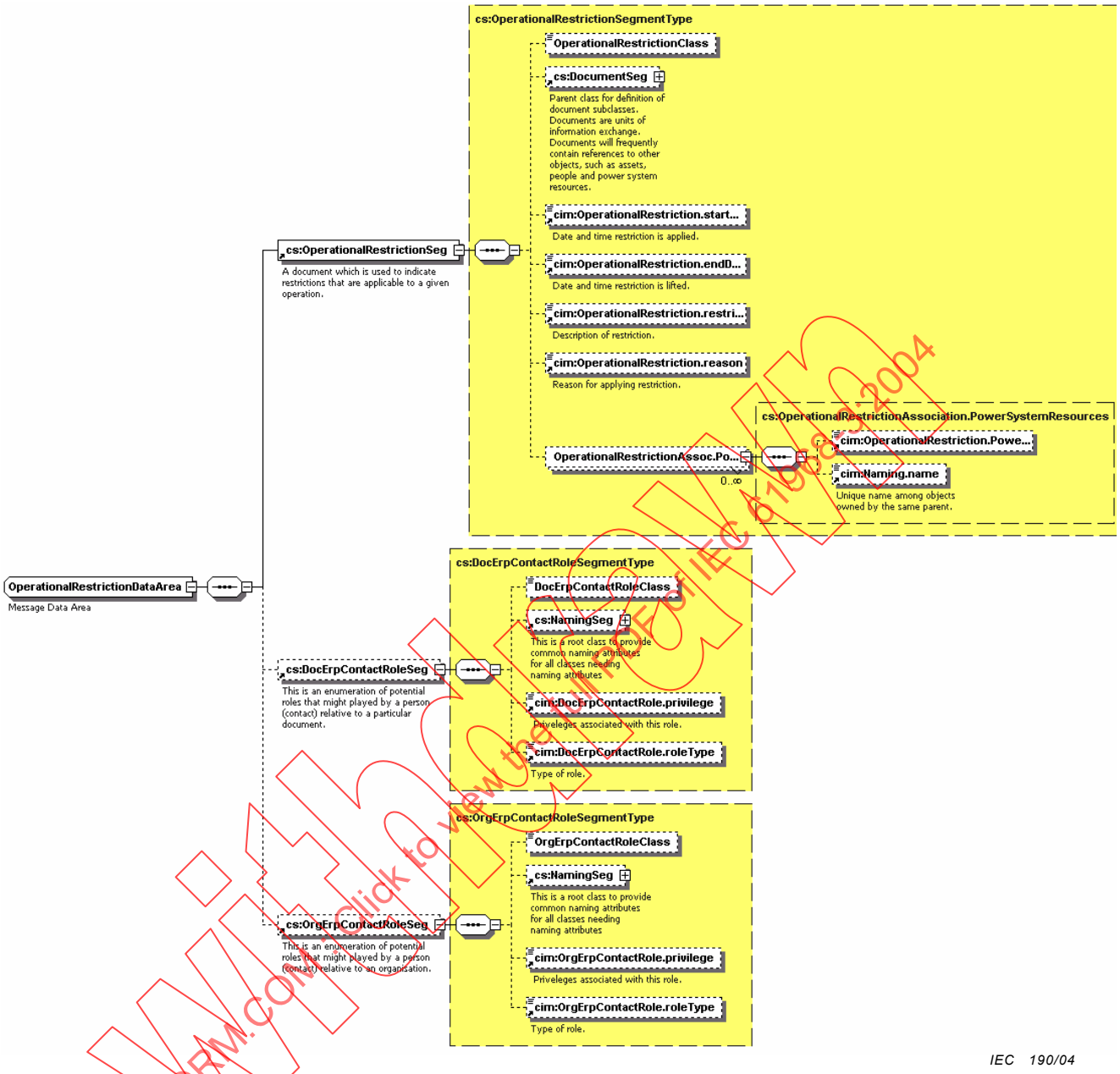


Figure 15 – Operational restriction message format

5.4 OutageRecord message types

5.4.1 General

An OutageRecord document describes details of an outage in part of the distribution network.

An OutageRecord is typically produced as part of a planned activity (for example work order for maintenance) or following a breaker trip detected by SCADA or within a trouble call system by grouping calls from customers.

OutageRecords may be created automatically following detection of breaker trip by a SCADA system. Any subsequent trouble calls may be grouped with the same OutageRecord.

OutageRecords may also be created solely based on the location of trouble calls. In this case, the document status may be used to indicate whether a fault has been confirmed.

An OutageRecord has an associated OutageStep for each supply point, for example distribution transformer or metered switch that is affected by the outage. This list is either calculated by topology processing of the network or from grouping of customer calls.

An OutageRecord may have an associated ActivityRecord to record remarks or comments about the progress of the outage restoration process and any follow-up work. This may be presented as a chronological list of all the actions/events.

To allow for different country or utility practices, an OutageRecord may refer to either crew and/or ErpContacts, for example the crew foreman.

There may also be additional work associated with an outage. When this is the case, the outage may not be allowed to "close to history" until the additional work has been completed even though the supply to all affected customers has been restored.

Some of the fields for example OutageStep fatality, may be specific to particular utilities and systems. It should be noted that the Document.Comments field is available for general-purpose text that can characterise the outage.

5.4.2 Message format

Created OutageRecord, changed OutageRecord and show OutageRecord message types have the same message formats as shown in Figure 16 and 17.

Get OutageRecord, canceled OutageRecord, closed OutageRecord and deleted Outage Record identify only the document name.