IEC 61968-4

Edition 2.0 2019-03

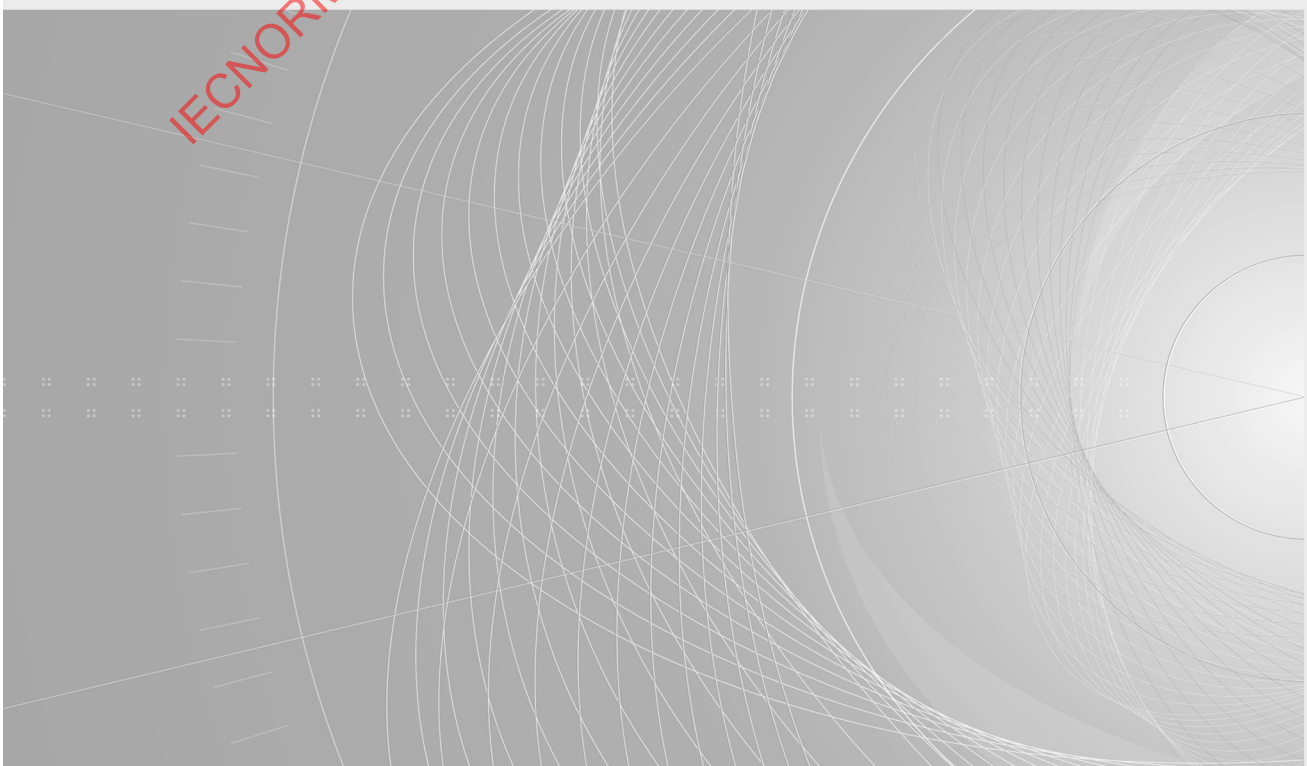
INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Application integration at electric utilities – System interfaces for distribution management –
Part 4: Interfaces for records and asset management

Intégration d'applications pour les services électriques – Interfaces système pour la gestion de la distribution –
Partie 4: Interfaces pour la gestion des dossiers et des actifs



IEC 61968-4:2019-03(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 33.200

ISBN 978-2-8322-6595-6

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 4: Interfaces for records and asset management

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

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

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

a) removal of edition 1 profiles whose functionality has been superseded by other parts of IEC 61970 and IEC 61968 standards. In particular, NetworkDataSet and ChangeSet have been superseded by standards such as CDPSM (IEC 61968-13) and other ongoing efforts such as change modelling; and Presentation has been superseded by Diagram Layout Profile (IEC 61970-453);
b) revision of the edition 1 profiles AssetList, AssetCatalogue and TypeAssetCatalogue to realign with current use cases and the latest CIM UML release. These profiles are based

on an old version of CIM UML and many of the classes in these profiles are no longer in the recent CIM UMLs;

c) addition of several new profiles to enable the exchange of asset condition data, analytics results and alerts, assets' physical, functional and lifecycle details, and assets' work;

d) informative annexes on how this document can be used to enable strategic asset management;

e) informative annexes with illustrative examples for the application of this document;

f) scope coordinated with IEC 61968-13 where applicable;

g) use cases in IEC 62559-2 use case template;

h) traceability of use cases to IEC 62913-2-1 use cases.

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

FDIS	Report on voting
57/2059/FDIS	57/2074/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.

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

The IEC 61968 standard series, taken as a whole, defines interfaces for the major elements of an interface architecture for Distribution Management Systems (DMS). IEC 61968-1, *Interface architecture and general recommendations*, identifies and establishes requirements for standard interfaces based on an Interface Reference Model (IRM). IEC 61968-3 to -9 define interfaces relevant to each of the major business functions described by the Interface Reference Model.

As used in IEC 61968, 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.

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

The purpose of this part of IEC 61968 is to define a standard for the integration of Records and Asset Management (AM), which would include Geographic Information Systems and Asset Risk Management Systems, with other systems and business functions within the scope of IEC 61968. The scope of this document is the exchange of information between Records and Asset Management Systems and other systems within the utility enterprise. The specific details of communication protocols those systems employ are outside the scope of this document. Instead, this document will recognize and model the general capabilities that can be potentially provided by records and asset management systems including asset risk assessment, asset planning, and condition-based asset management. In this way, this document will not be impacted by the specification, development and/or deployment of next generation records and asset management systems, either through the use of standards or proprietary means.

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, by 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, 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 listed in Table 1.

Table 1 – Document overview for IEC 61968-4

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	Terms and definitions	Description of concepts and terms pertinent to records and asset management.
4	Reference and information models	Description of general approach to records and asset management systems, reference model, use cases, interface reference model, records and asset management functions and components, message type terms and static information model.
5	Records and asset management message types	Message types related to the exchange of information for documents related to records and asset management.
Annex A	Description of message type verbs	Description of the verbs that are used for the message types.
Annex B	Use cases	Description of use cases pertaining to this standard.
Annex C	Asset management	Description of an example asset management framework that leverages this standard.
Annex D	Asset models and information exchange – The case for formal instance templates	Description of the use of CIM to model typical electrical power utility assets.
Annex E	Asset Models and information exchange	Illustration of asset related messages and typical information exchanges.
Annex F	Asset measurements models and information exchange	Illustration of asset measurements related messages and typical information exchanges.
Annex G	Analytics models and information exchange	Illustration of asset analytics related messages and typical information exchanges.

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

Part 4: Interfaces for records and asset management

1 Scope

This part of IEC 61968 specifies the information content of a set of message types that can be used to support many of the business functions related to records and asset management. Typical uses of the message types defined in this document include network extension planning, copying feeder or other network data between systems, network or diagram edits and asset inspection. Message types defined in other parts of IEC 61968 may also be relevant to these use cases.

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 61968-1:2012, *Application integration at electric utilities – System interfaces for distribution management – Part 1: Interface architecture and general recommendations*

IEC 61968-3:2017, *Application integration at electric utilities – System interfaces for distribution management – Part 3: Interface for network operations*

IEC 61968-6:2015, *Application integration at electric utilities – System interfaces for distribution management – Part 6: Interfaces for maintenance and construction*

IEC 61968-9:2013, *Application integration at electric utilities – System interfaces for distribution management – Part 9: Interfaces for meter reading and control*

IEC 61968-11:2018, *Application integration at electric utilities – System interfaces for distribution management – Part 11: Common information model (CIM) extensions for distribution*

IEC 61968-100:2013, *Application integration at electric utilities – System interfaces for distribution management – Part 100: Implementation profiles*

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

IEC 62361-100:2016, *Power systems management and associated information exchange – Interoperability in the long term – Part 100: CIM profiles to XML schema mapping*

IEC TR 62361-103:2018, *Power systems management and associated information exchange – Interoperability in the long term – Part 103: Standard profiling*

ISO 55000:2014, *Asset management – Overview, principles and terminology*

ISO 55001:2014, *Asset management – Management systems – Requirements*

ISO 55002:2014, *Asset management – Management systems – Guidelines for the application of ISO 55001*

3 Terms and definitions

No terms and definitions are listed in this document.

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

4 Reference and information models

4.1 General

The message types defined in this document are based on a logical partitioning of the utility enterprise 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 the information model classes in IEC 61968-11 and IEC 61970-301. This message definition is performed in accordance with IEC 62361-100 and IEC 62361-103. In particular, starting from the canonical model as described in IEC 61968-11 and IEC 61970-301, the contextual model is defined, and the profile/syntactic model is generated in the form of XSD schema.

The message types defined in this document are intended to satisfy a majority of typical applications. In some particular project implementations, it may be desirable to modify the set of fields using a methodology such as that described in IEC 61968-1.

4.2 Reference model

4.2.1 General

The diagrams shown in Figure 1 through Figure 3 serve as reference model and provide example of the logical components and data flows related to this document. The said diagrams describe the flows between the components in the reference model. The numbers in brackets provide linkages to the flow definitions. The reference architecture reflects several main logical components (potentially realized as systems or subsystems) that are part of records and asset management or are related to it through the need to exchange information. The logical components illustrated are:

a) Network Operation Monitoring (NMON)

b) Asset Monitoring and Measurement (AMM)

c) Asset Decision Support (ADS)

d) Substation and Network Inventory (EINV)

e) Geographical Inventory (GINV)

f) Maintenance and Inspection (MAI)

g) Work Scheduling and Dispatching (SCHD)

The data flows are split into three diagrams, each one depicting the data flow pertaining to a major area of this document. Figure 1 shows the data flows pertaining to Assets, such as their lifecycle information, location, ownership, nameplate information, and model information. Figure 2 shows the data flows pertaining to Measurements, such as procedures performed on assets or measurements made on them, and the corresponding datasets and measurement

values. Figure 3 shows the data flows pertaining to Analytics, such as the details of an analytic and the scores from an analytic.

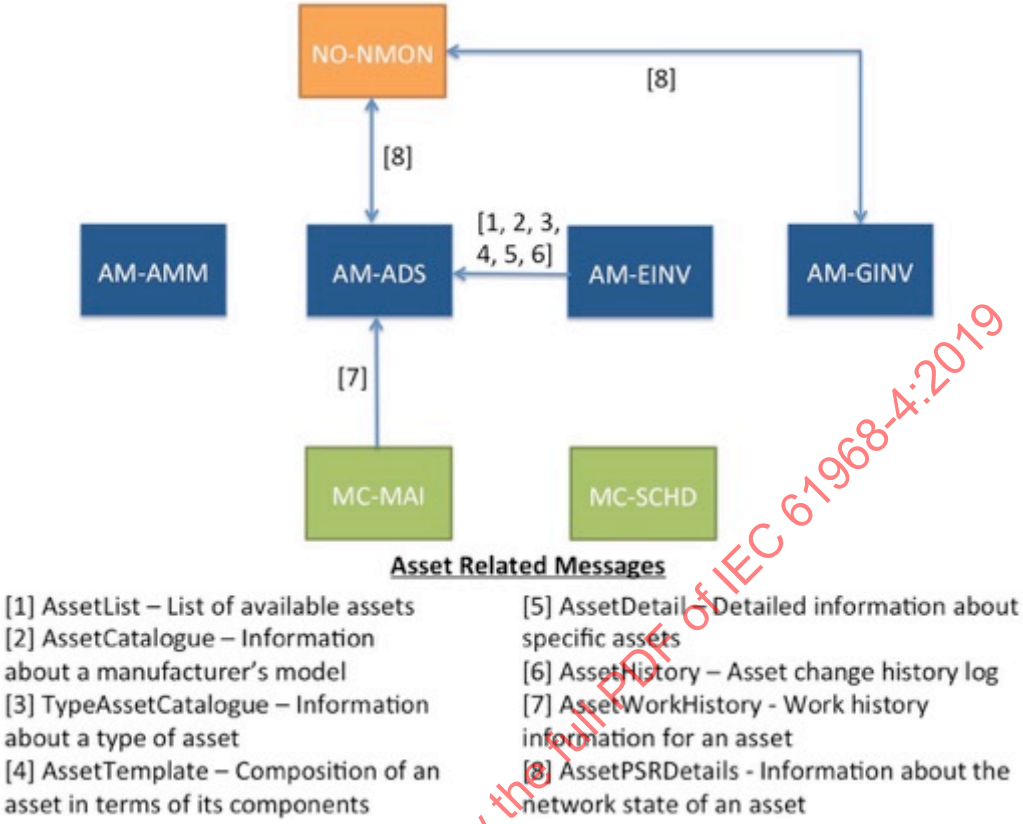

Figure 1 – Illustration of Asset-related message flows

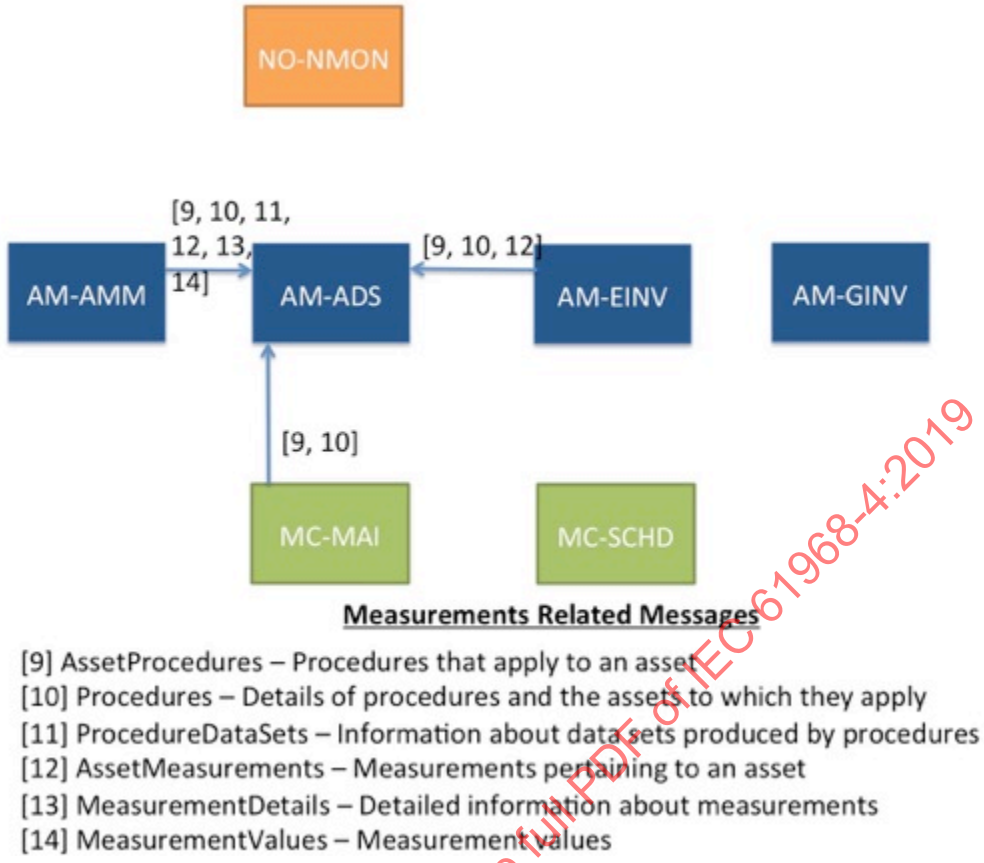

Figure 2 – Illustration of Measurements-related message flows

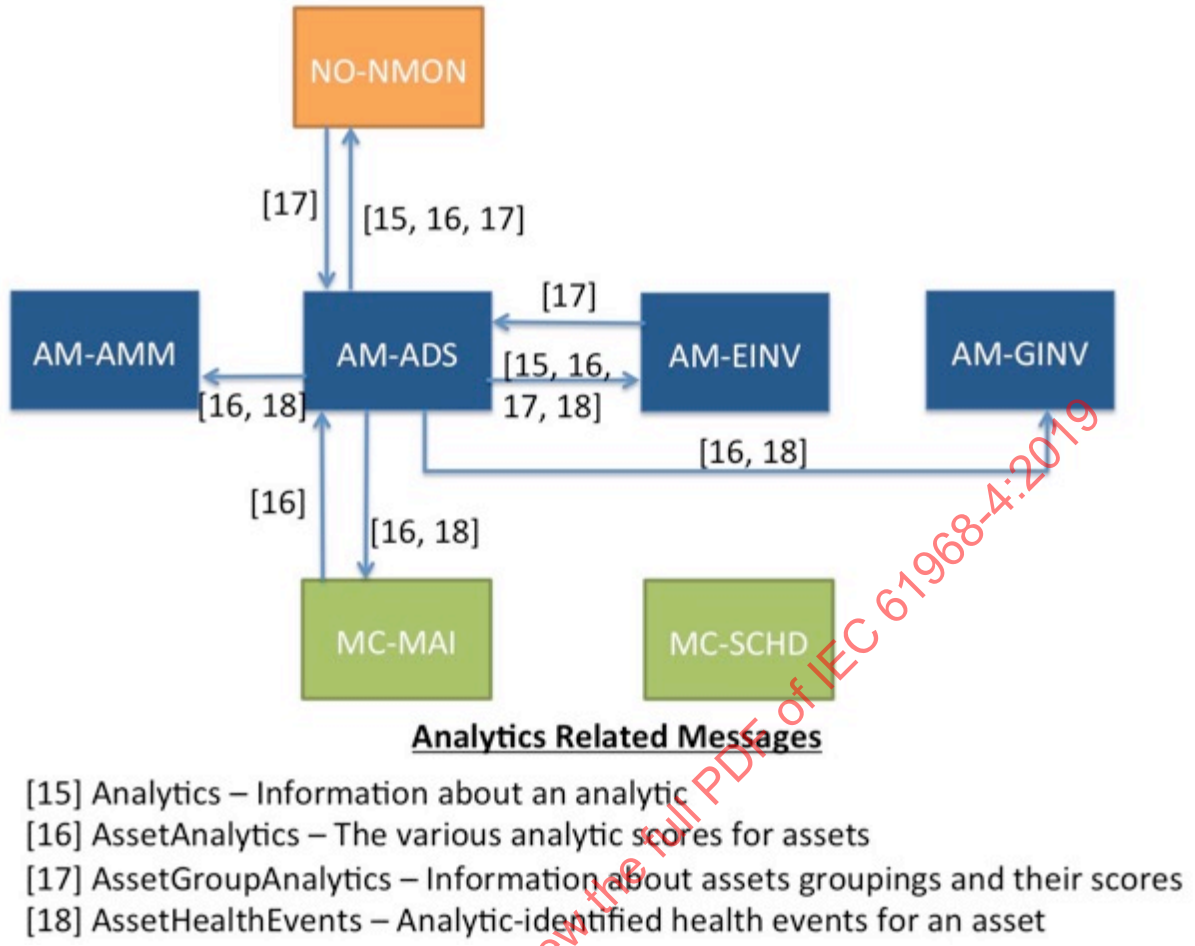

Figure 3 – Illustration of Analytics-related message flows

In Subclauses 4.2.2 to 4.2.8, we describe the logical components that participate in the illustrated data flows.

4.2.2 Network Operation Monitoring (NMON)

Provides the means for supervising main substation topology (breaker and switch state) and control equipment status. It also provides the utilities for handling network connectivity and loading conditions. It also makes it possible to locate customer telephone complaints and supervise the location of field crews.

4.2.3 Asset Monitoring and Measurement (AMM)

Asset monitoring and measurement involves inspection, testing, measurement, and monitoring of the assets in order to understand, assess and manage their condition and performance.

4.2.4 Asset Decision Support (ADS)

Asset decision support involves strategy definition and prioritisation, maintenance strategy planning, risk management, programme management and decision-making. The central aspect of asset decision support is analytics. It drives the condition, configuration, performance, operating costs, and flexibility of the asset base, with the aim of maximising value.

4.2.5 Substation and Network Inventory (EINV)

The electrical substation and network assets that a utility owns, or for which has legal responsibility, and will maintain an accurate asset register developed around an asset hierarchy that supports advanced asset management functions.

4.2.6 Geographical Inventory (GINV)

Management of geospatial data, typically by utilizing computer graphics technology to enter, store, and update graphic and non-graphic information. Geographic depictions and related non-graphic data elements for each entity are typically stored in some form of a data store. The graphic representations are referenced using a coordinate system that relates to locations on the surface of the earth. Information in the data store can be queried and displayed based upon either the graphic or non-graphic attributes of the entities.

4.2.7 Maintenance and Inspection (MAI)

Work involving inspection, cleaning, adjustment, or other service of equipment to enable it to perform better or to extend its service life. Examples of maintenance work are routine oil changes and painting. Examples of inspection work are pole inspections, vault inspections, and substation inspections.

4.2.8 Work Scheduling and Dispatching (SCHD)

Work scheduling and dispatching makes it possible, for a defined scope of work, to assign the required resources and keep track of work progress.

4.3 Interface Reference Model

It is not the intention of this document 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 document. These abstract components are grouped by the business functions of the Interface Reference Model.

In this document, 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 IEC 61968-3 to -9. It does not necessarily mean that compliant software is delivered either as separate modules or as a single system.

IEC 61968-1 describes infrastructure services common to all abstract components while IEC 61968-3 to -9 define the details of the information exchanged for specific types of abstract component.

IEC 61968 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 61968-3 to -9.

b) An application interface is compliant if it supports the interface standards defined in IEC 61968-3 to -9 for the relevant abstract components defined in the Interface Reference Model.

An application is only required to support interface standards of the applicable components listed under abstract components. An application 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 document 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.

4.4 Records and asset management

It should be noted that the message types defined in this document may be sent or received by any type of component within a distribution management system (DMS). 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.

Table 2 – Business functions and abstract components

Business Functions	Business Sub-functions	Abstract Components
Records and asset management (AM)	Substation and network inventory (EINV)	Equipment characteristics
		Connectivity model
		Substation display
		Telecontrol database
	Geographical inventory (GINV)	Network displays
		Geographic maps
	General inventory management (GIM)	Non-electrical asset inventory
		Materials inventory
		Vehicle inventory
	Asset decision support (ADS)	Maintenance strategy
		Life-cycle planning
		Reliability centered analysis
		Engineering and design standards
		Compliance standards and regulations management
		Performance measurements
		Risk management
		Environmental management
		Decision support systems
		Thermal ratings of network equipment and lines
		Maintain work triggers
		Asset maintenance groups (lists)
		Asset failure history
		Asset financial performance
		Budget allocation
	Asset monitoring and measurement (AMM)	Time and event series data management
		Laboratory information management
		Asset test information management
		Security configuration and event logs
		Field crew information visualization
		Compliance management and reporting

5 Records and asset management message types

5.1 General

The following are some general conventions in the message definitions provided in this document:

- Objects are identified by mRID and a multiplicity of Name.name members inherited from IdentifiedObject. Transacting systems may use one or both of the attributes to uniquely identify the objects being exchanged.
- Several CIM classes have a member called type to provide a string description of an instance of the class. Some CIM classes (such as Asset) also have an enumerated member called "kind". This is a recent addition for better interoperability. Messages in this document that incorporate such classes include both the "type" and "kind" members. Where an appropriate value is not available for "kind", the transacting systems may use the value "other" for "kind" in order to indicate that the string description in the "type" attribute should be used.
- The attributes in the message payloads are all optional. It is up to the transacting systems to implement the logic for any required fields.

The following are some general considerations regarding the artifacts in this document:

- The XSD schema were generated in accordance to IEC 62361-100 and IEC 62361-103. CIMTool[1] was used in this task.
- The diagrammatic description of the schema, such as Figure 5, Figure 7, etc., were generated in XMLSpy[2] from the XSD schema.
- The XML instance examples, such as those provided in Clause 5.2.3, 5.3.3, etc. were generated in XMLSpy from the XSD schema.

5.2 AssetList messages

5.2.1 General

An AssetList message can contain the list of utility assets. The retrieved Asset objects only contain identification information such as mRID, name, and type. AssetDetail message should be used to get detailed information about specific Asset objects of interest.

5.2.2 Applications

The purpose of AssetList message is to obtain a list of all the assets available in a system. For instance, a substation inventory system may have information about substation assets. Planning and analytics functions that are interested in a specific subset of the assets, such as power transformers, can use this message to obtain the list of all Asset objects in the substation inventory system. The planning and analytics functions can then use other messages such as AssetTemplate and AssetDetail to obtain more details about the Asset objects that are identified as power transformers. This message, in short, is intended to be a simple query to obtain the list of available assets so that the receiving system can then identify a subset of the available assets for further investigation. An example of an AssetList exchange is shown in Figure 4, where AM-ADS requests and gets an AssetList from AM-EINV.

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[1] CIMTool is the trade name of a product supplied by Langdale Consultants. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

[2] XMLSpy is the trademark of a product supplied by Altova. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

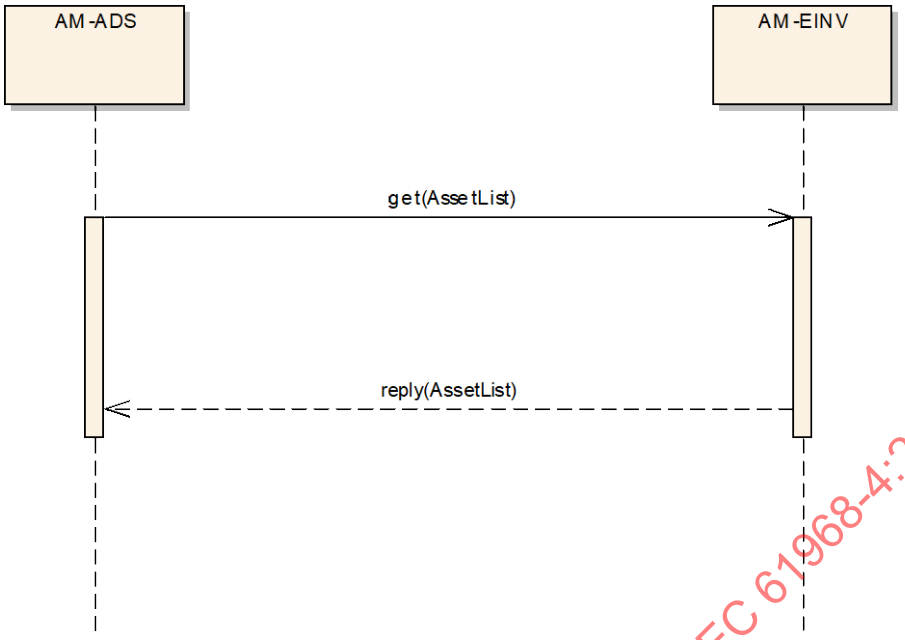


Figure 4 – AssetList message exchange

5.2.3 Message format

Figure 5 shows the message format used to obtain AssetList from a system that has a database of Asset objects. The responding system will return the list of Asset objects, which are identified by mRID and/or name. In addition, the asset's "kind" attribute (which is a selection from an enumerated list of assets) or "type" attribute (which is a string description of what the asset is) may be included. If a classification of the asset (such as PowerTransformer) is not available in the enumerated list, a value of "other" is typically used for the "kind" attribute to indicate that the description contained in the "type" attribute should be used instead.

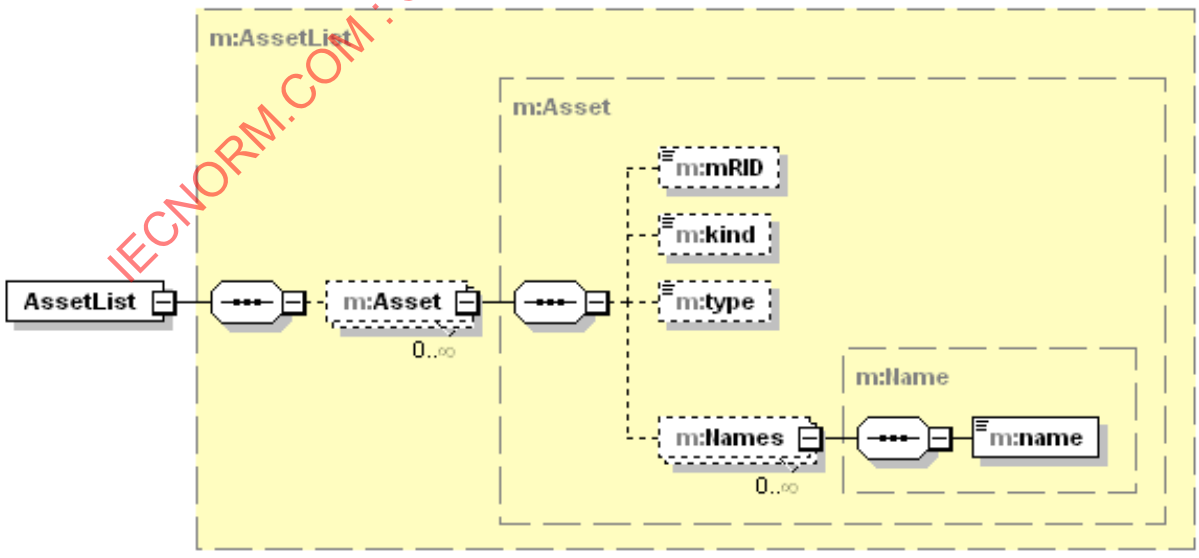


Figure 5 – AssetList message format

The following is an XML example for an AssetList.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetList xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetList.xsd">
	<m:Asset>
		<m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
		<m:kind>breakerSF6DeadTankBreaker</m:kind>
	</m:Asset>
	<m:Asset>
		<m:mRID>9ea05e0a-024a-495d-85bd-f2553b89dcaa</m:mRID>
		<m:kind>other</m:kind>
		<m:type>twoWindingTransformer</m:type>
	</m:Asset>
	<m:Asset>
		<m:mRID>6a9fb099-e67d-4c33-88f4-aa3e479ec1da</m:mRID>
	</m:Asset>
</m:AssetList>
```

5.3 AssetCatalogue messages

5.3.1 General

An AssetCatalogue is a collection of information regarding available types of products and materials that are used to build or install assets, to maintain assets or to operate assets. Each catalogue item is for a specific product available from a specific manufacturer. An AssetCatalogue message may contain reference information, such as drawingNumber and modelNumber about a specific ProductAssetModel, as well as the AssetInfo rating information for it.

5.3.2 Applications

The AssetCatalogue message is used to exchange asset catalogue information. Example applications include replacement of generic assets and long-term planning. While installing assets, a maintenance person may query the catalogue for a specific product model of interest. In long term planning, a project may have a set of requirements and the organisation's catalogue of approved product models is used as a basis of decision-making. An engineer or analytic queries the catalogue and applies the selection rules in order to identify catalogue items with specifications that meet the project requirements. A typical application for this message is for an asset analytic system to query and discover the desired catalogue information, as shown in Figure 6.

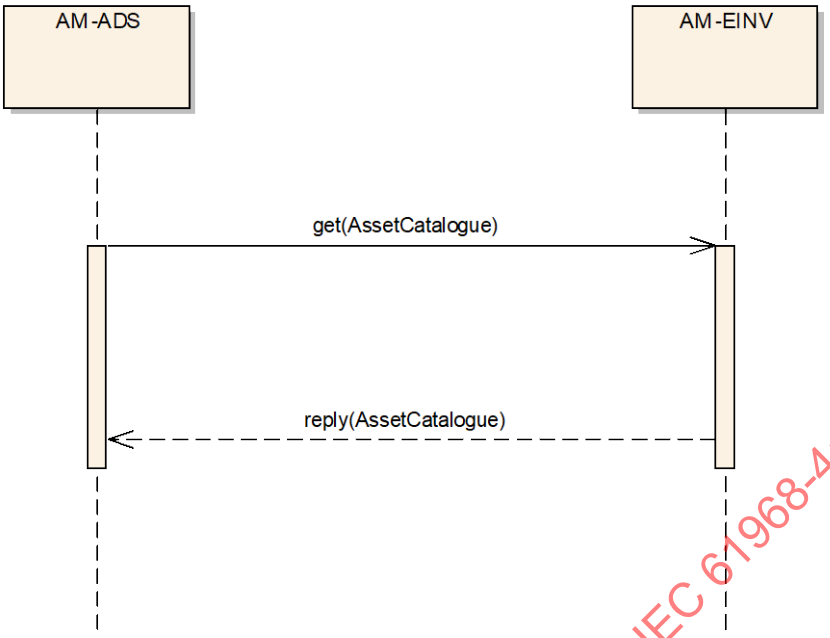


Figure 6 – AssetCatalogue message exchange

5.3.3 Message format

Figure 7 shows the message payload format used to obtain AssetCatalogue information. The message payload consists of a multiplicity of ProductAssetModel objects. In addition to the attributes of ProductAssetModel, the message can also contain the list of Asset objects that correspond to the product model. Figure 8 shows the Asset element. In addition to the identifying information, state information such as inUseState and lifecycleState can be provided, so that a querying system can identify if, for instance, the asset is an inventory item available for installation.

The message payload can also contain rating information from a child class of AssetInfo that the ProductAssetModel is associated with. Figure 9 shows the ratings information pertaining to a busbar section. Figure 10 shows the PowerTransferInfo element. Whereas the other AssetInfo child elements contain the attributes of the element, PowerTransformerInfo has a unique structure in that it contains a multiplicity of TransformerTankInfo elements, which in turn can contain a multiplicity of TransformerEndInfo elements.

The ProductAssetModel message can also contain the CatalogAssetType pertaining to the ProductAssetModel. Figure 11 shows the CatalogueAssetType element. This CatalogueAssetType is the generic type of product corresponding to functionally equivalent ProductAssetModel objects. This information can be used to discover, through the use of TypeAssetCatalogue message described in 5.4, equivalent product models.

Furthermore, the ProductAssetModel message can contain Manufacturer information, which is shown in more detail in Figure 12.

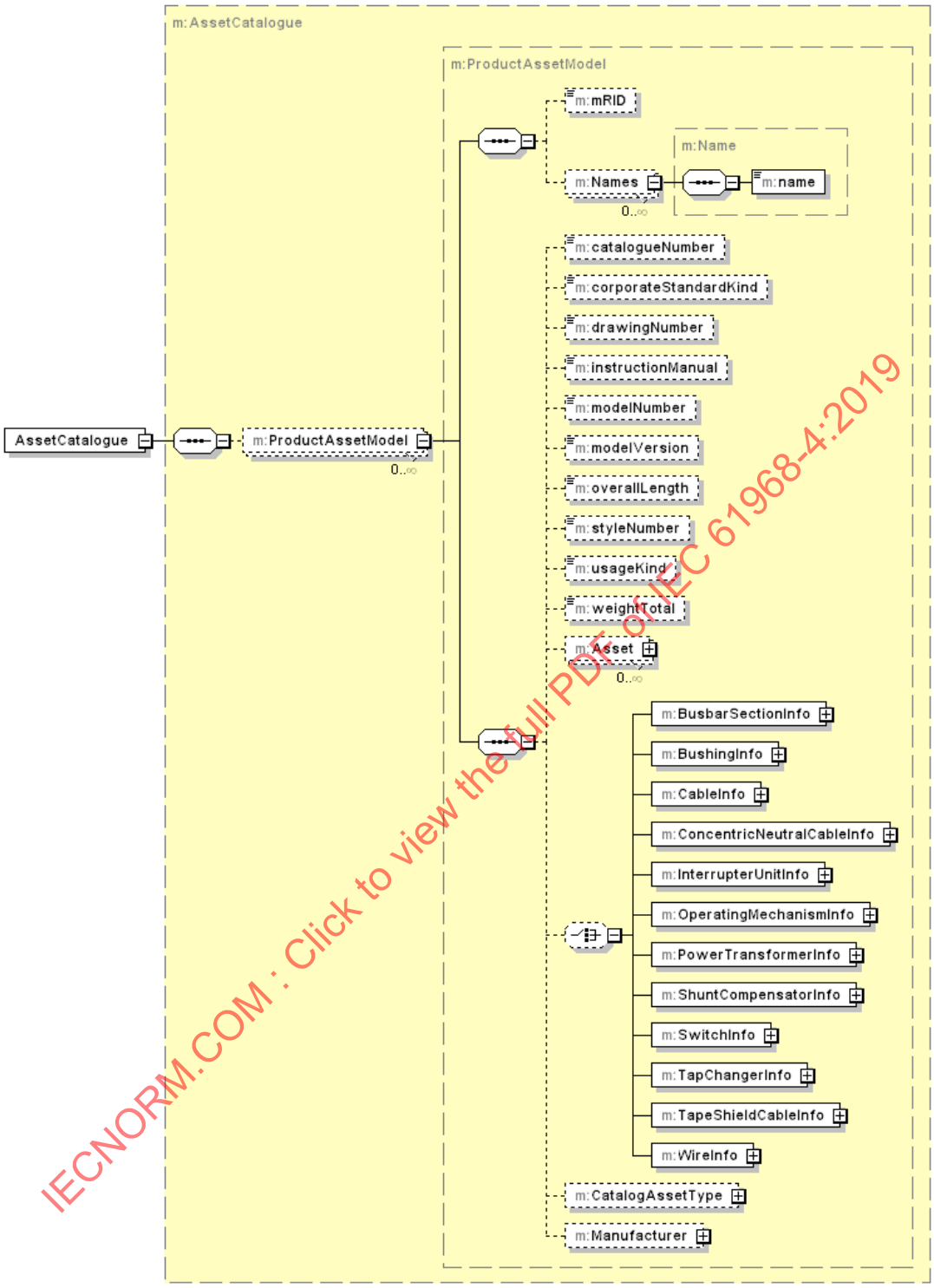


Figure 7 – AssetCatalogue message format

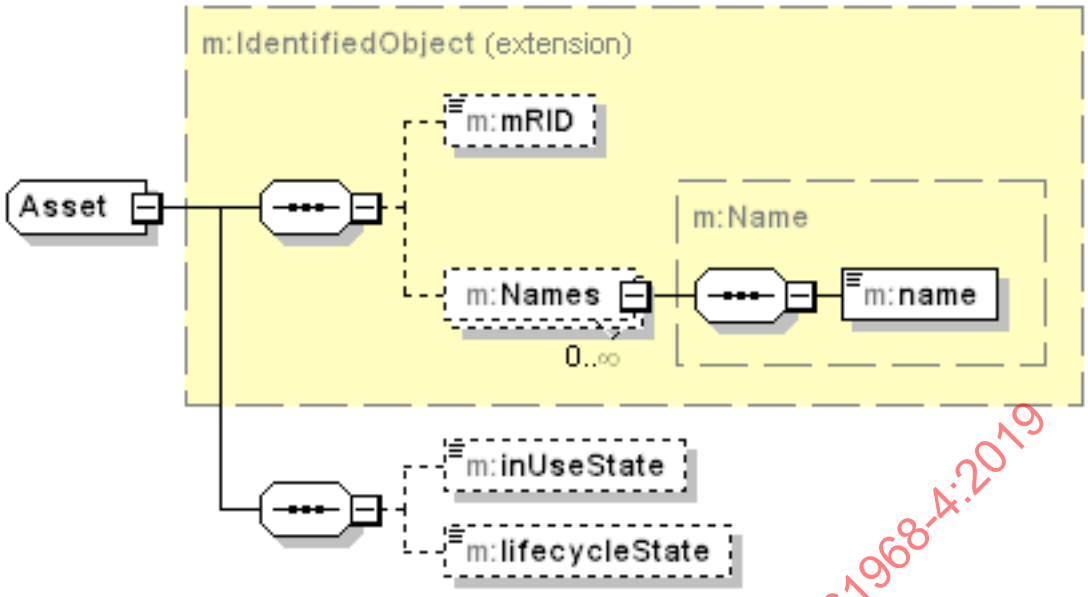


Figure 8 – AssetCatalogue message: Asset element

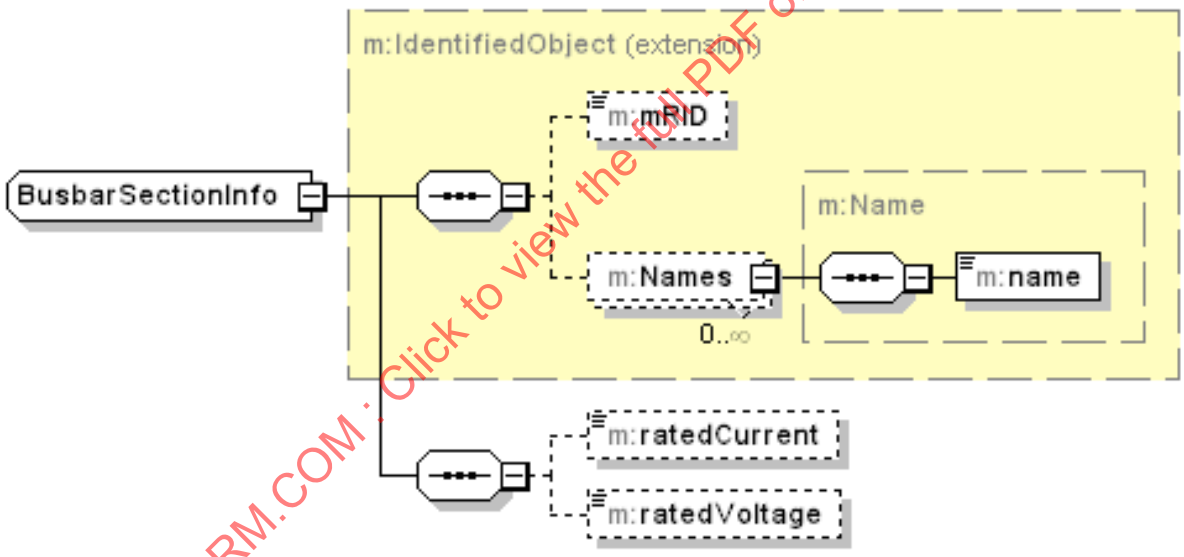


Figure 9 – AssetCatalogue message: BusbarSectionInfo element

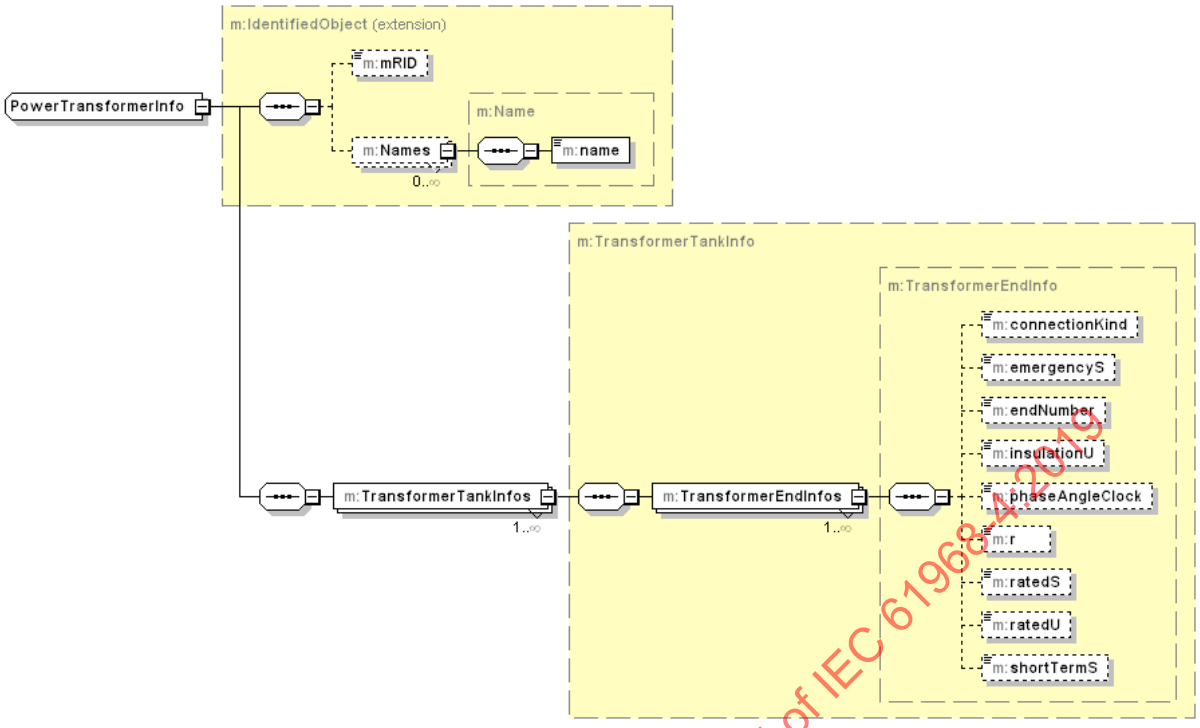


Figure 10 – AssetCatalogue message: PowerTransformerInfo element

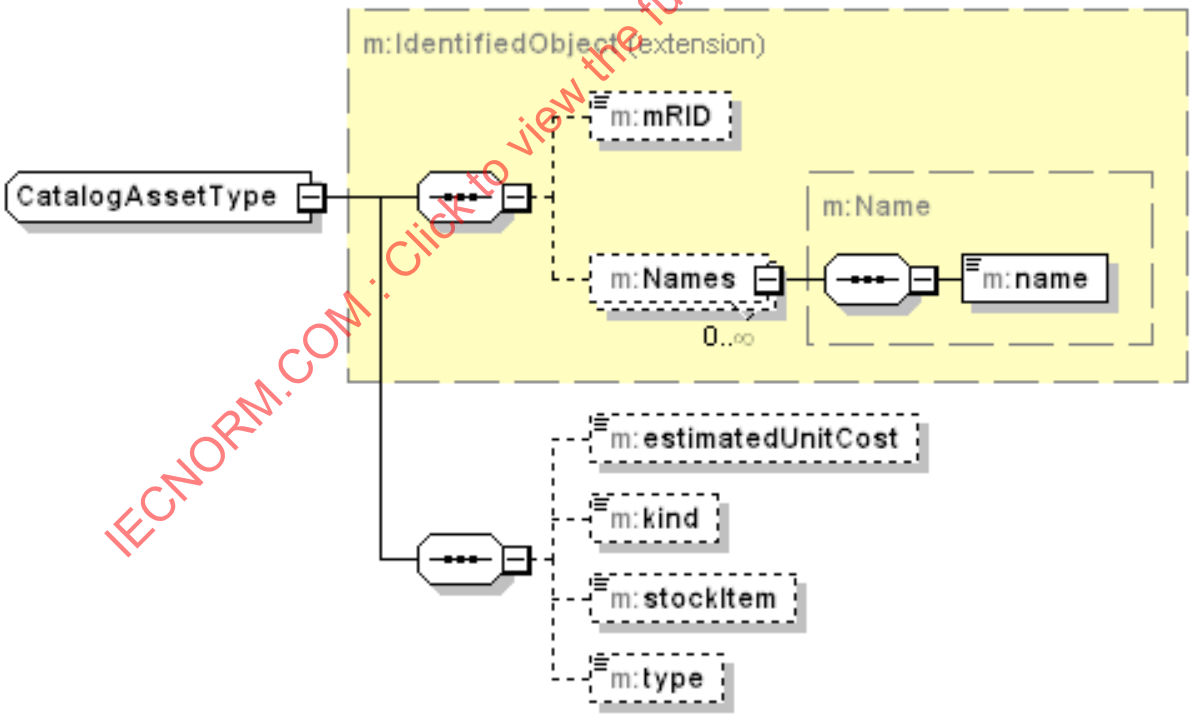


Figure 11 – AssetCatalogue message: CatalogAssetType element

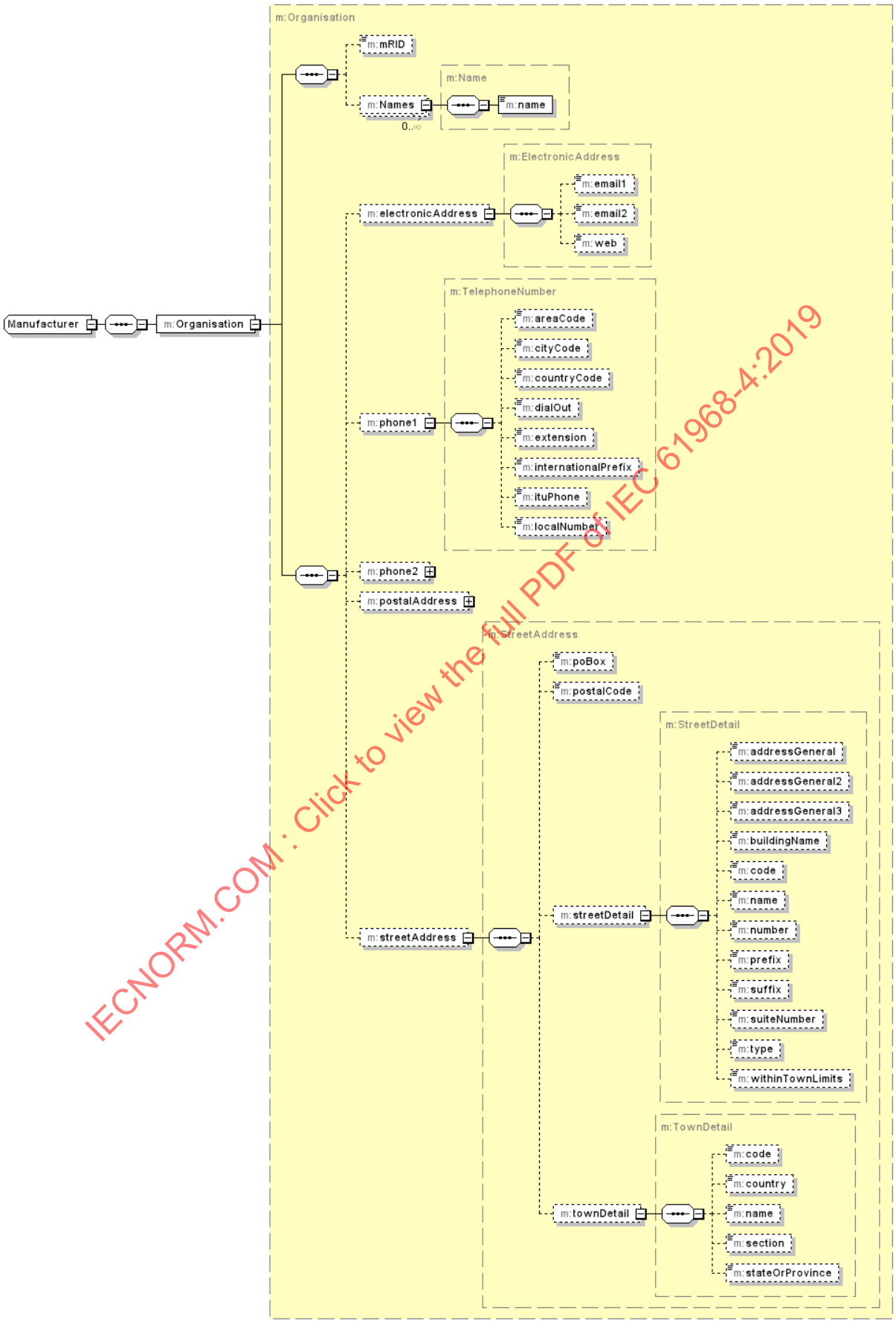


Figure 12 – AssetCatalogue message: Manufacturer element

The following is an XML example for an AssetCatalogue. It contains the model and rating information for a circuit breaker.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetCatalogue xmlns:m="http://iec.ch/TC57/2007/AssetCatalogue#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/AssetCatalogue# AssetCatalogue.xsd">
      <m:ProductAssetModel>
            <m:mRID>25fc985e-b658-11e5-9f22-ba0be0483c18</m:mRID>
            <m:modelNumber>UN45D3000</m:modelNumber>
            <m:modelVersion>2</m:modelVersion>
            <m:SwitchInfo>
                  <m:breakingCapacity>50000</m:breakingCapacity>
                  <m:ratedCurrent>3150</m:ratedCurrent>
                  <m:ratedFrequency>60</m:ratedFrequency>

      <m:ratedImpulseWithstandVoltage>1050000</m:ratedImpulseWithstandVoltage>
                  <m:ratedInterruptingTime>3</m:ratedInterruptingTime>
                  <m:ratedVoltage>253000</m:ratedVoltage>
            </m:SwitchInfo>
      </m:ProductAssetModel>
</m:AssetCatalogue>
```

5.4 TypeAssetCatalogue messages

5.4.1 General

A TypeAssetCatalogue message can contain data for a set of utility asset types. It is a collection of information regarding generic types of assets that may be used for design purposes, analysis, and so on. The CatalogAssetType in a TypeAssetCatalogue message is not associated with a particular manufacturer, but the message may contain references to ProductAssetModels that describe manufacturer-specific versions associated with the CatalogueAssetType.

5.4.2 Applications

The TypeAssetCatalogue message is used to exchange generic asset models. Example applications include design and analysis. In exploratory design, generic asset model may be used initially, which may then be replaced by specific product model information as the design advances. In analysis, the generic asset model may be utilized for exploratory coarse-grained analysis. In these cases, the generic model for the asset of interest may be obtained from a custodian system. A typical application for this message is for an asset analytic system to query and discover the desired TypeAssetCatalogue information, as shown in Figure 13.

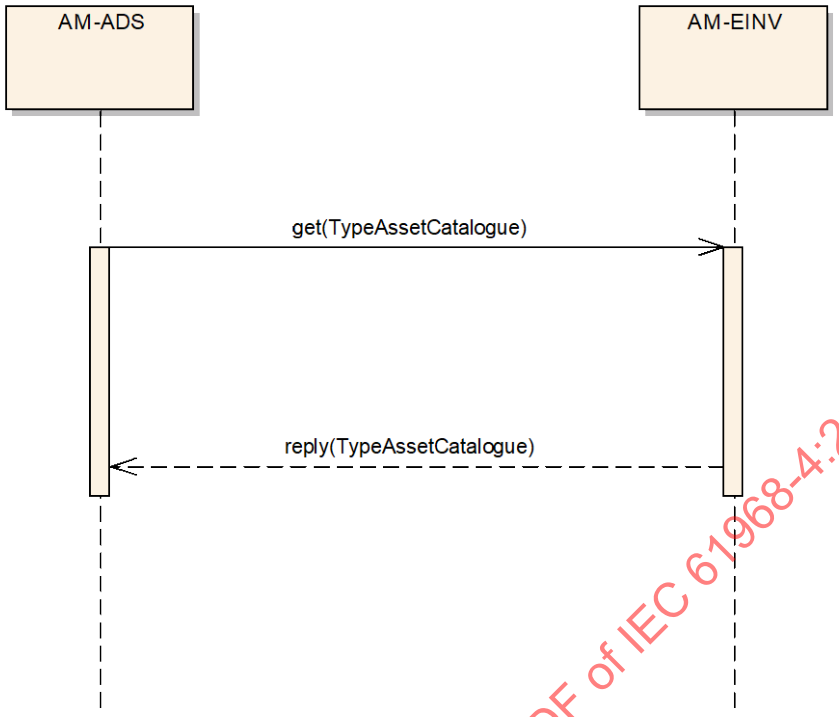


Figure 13 – Type Asset Catalogue message exchange

5.4.3 Message format

Figure 14 shows the message format used to obtain TypeAssetCatalogue information. The message payload consists of a multiplicity of CatalogueAssetType objects. In addition to the attributes of CatalogueAssetType, the payload can also contain ratings information for the CatalogueAssetType in the form of AssetInfo child classes such as BusbarSectionInfo and BushingInfo. Furthermore, the message can contain reference to the ProductAssetModels that the CatalogueAssetType is associated with.

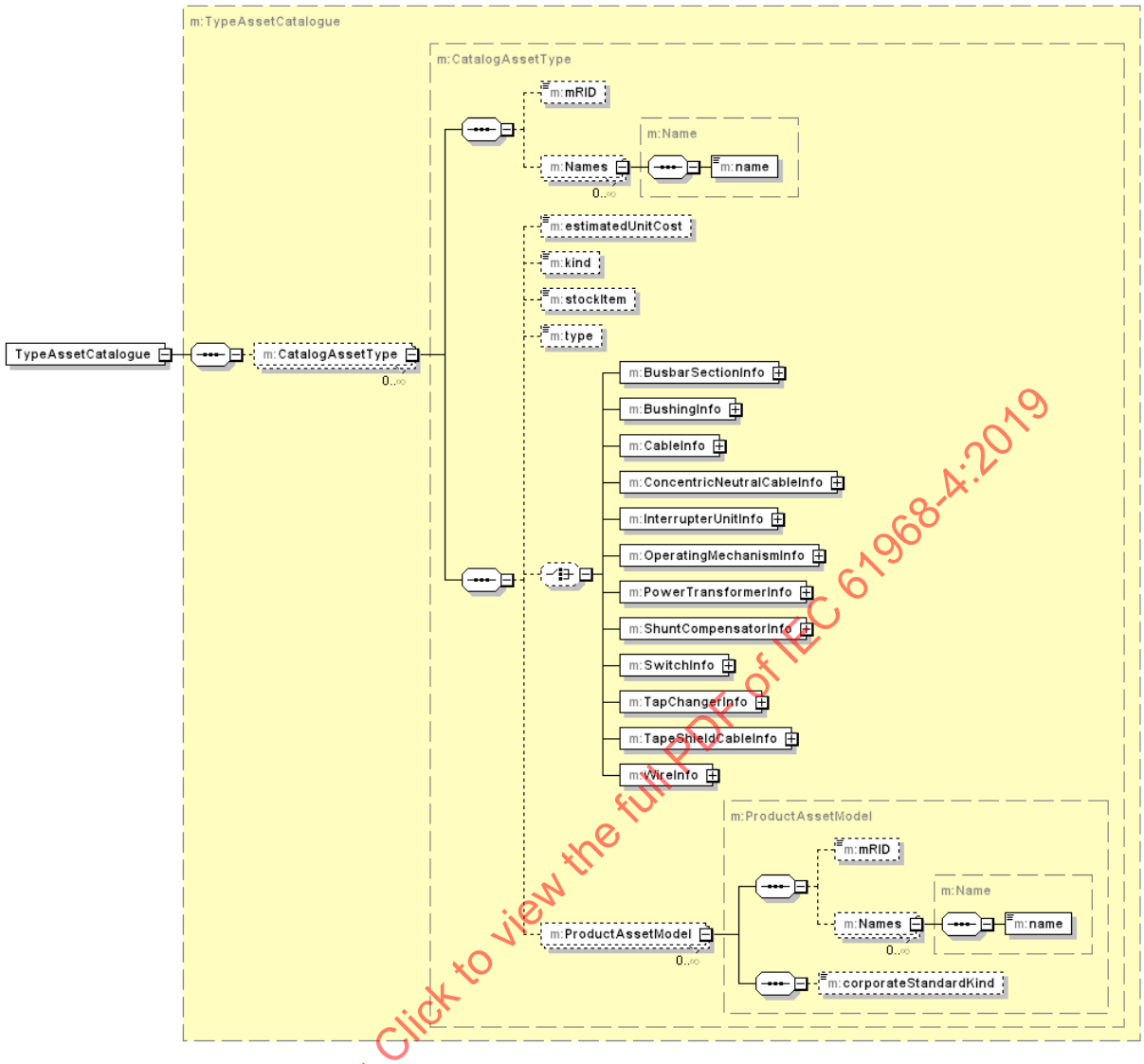


Figure 14 – TypeAssetCatalogue message format

The following is an XML example for a TypeAssetCatalogue.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:TypeAssetCatalogue xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:m="http://iec.ch/TC57/2007/TypeAssetCatalogue#"
xsi:schemaLocation="http://iec.ch/TC57/2007/TypeAssetCatalogue#
TypeAssetCatalogue.xsd">
      <m:CatalogAssetType>
            <m:mRID>b4ca7c94-ca02-4f9a-b405-31209ccbe1d1</m:mRID>
            <m:estimatedUnitCost>10000</m:estimatedUnitCost>
            <m:stockItem>true</m:stockItem>
            <m:ProductAssetModels >
                  <m:mRID>cfc68fef-ae54-408f-baa7-aaf04bdb3c92</m:mRID>
            </m:ProductAssetModels >
            <m:ProductAssetModels>
                  <m:mRID>25fc985e-b658-11e5-9f22-ba0be0483c18</m:mRID>
            </m:ProductAssetModels>
      </m:CatalogAssetType>
</m:TypeAssetCatalogue>
```

5.5 AssetTemplate messages

5.5.1 General

An AssetTemplate message contains data regarding the logical and informational composition of a particular asset kind. This message contains the information objects that comprise the asset and the relationships of the information objects with each other. The purpose of this message is to describe the specific manner in which the infinitely nested AssetContainer-Asset classes have been used in order to describe a specific utility asset. This would reveal to the querying system – e.g. an analytic that is assessing the condition of the asset – the object hierarchy for that asset, i.e. what information objects may be available for the various components of the asset and how they are related to each other.

5.5.2 Applications

The AssetTemplate message is used to discover the components that make up the information model of an asset kind. This information model is generally expected to reflect the logical composition of an asset. For instance, a Dead Tank SF6 circuit breaker may be comprised of one tank, six bushings, three interrupters, and one operating mechanism. Each one of these components may be modeled as an Asset or an Asset child class. The AssetTemplate message for this asset kind would then return the Asset objects pertaining to these components and how they associate with each other – i.e. which of these Asset/Asset child classes associate with which other Asset/Asset child classes – and which Asset object the Medium is associated with, when applicable.

A typical application for this message is for an asset analytic system to query and discover the composition and object hierarchy of an asset type it is assessing, as shown in Figure 15, wherein an asset analytic system is querying a network and substation inventory system to discover the information objects that comprise a particular asset type and their relationship.

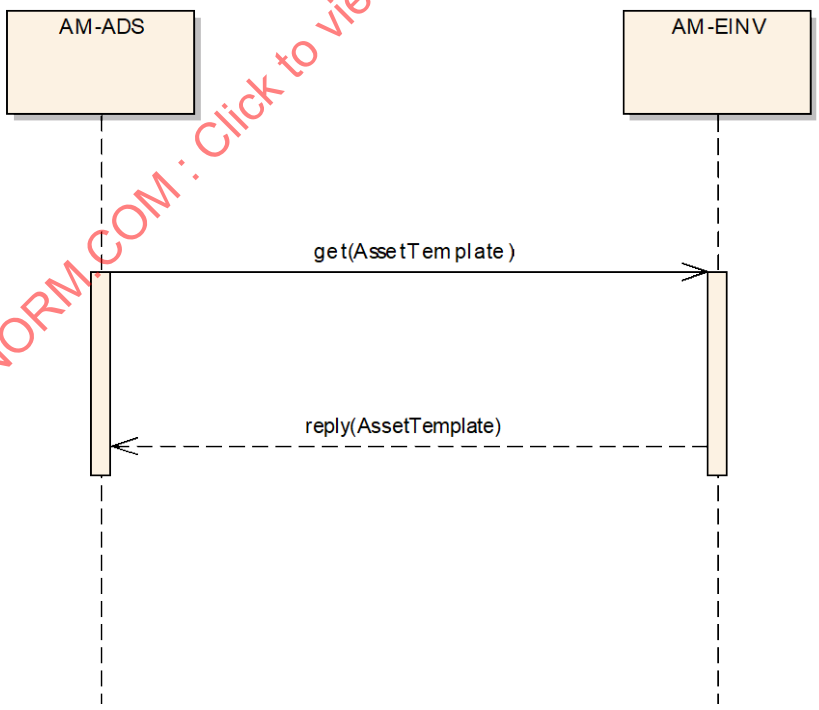


Figure 15 – Asset Template query exchange

Yet another application for this message is for an asset analytic system to create the composition and object hierarchy of an asset type, as shown in Figure 16, wherein an asset analytic system, which might be incorporated in a design software, is providing a network and

substation inventory system the information objects that comprise a particular asset type and their relationship.

Informative object hierarchies for some typical assets are provided in Annex D.

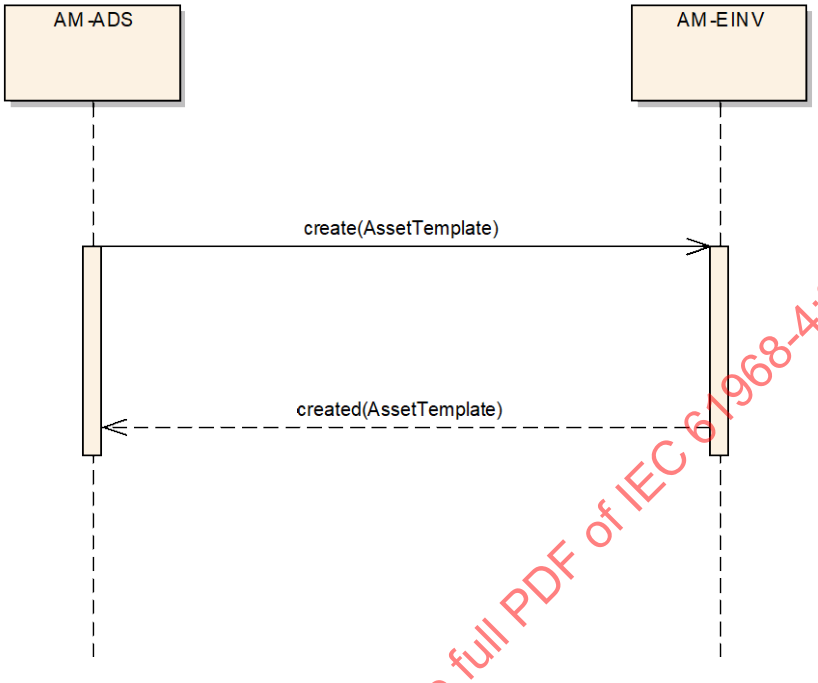


Figure 16 – Asset template creation exchange

5.5.3 Message format

Figure 17, Figure 18, and Figure 19 show the AssetTemplate message format. A root level AssetContainer object, as shown in Figure 17, can contain other AssetContainer objects in a nested fashion, with the hierarchical description terminating in Asset objects. Figure 18 shows the Asset and Medium elements of the AssetTemplate message. Figure 18 shows circuit breaker elements with the unique associations such as Bushing ends that are connected to FixedContact and MovingContact ends of an InterrupterUnit.

The AssetTemplate message can be used to describe the information object template for assets of varying complexity:

- complex assets such as substation main power transformers that have multiple nested levels of AssetContainer;
- simpler assets such as poletop transformers that may be one nested level of an AssetContainer with its component assets such as Bushing;
- component assets such as Bushing.

The AssetTemplate message has two possible realizations:

1) It only contains the "kind" and/or "type" attribute of the Asset, Asset child classes (AssetContainer, Bushing, etc.), and Medium. This realization allows for the description of the object hierarchy of a general asset.
2) It contains the identifying information such as mRID or unique name of instances of Asset, Asset child classes (AssetContainer, Bushing, etc.), and Medium. This realization allows for the description of the object hierarchy of a specific asset.

In the case of the second realization, i.e. the object hierarchy of a specific asset, the AssetDetail message can be utilized to obtain the properties of the asset's component objects.

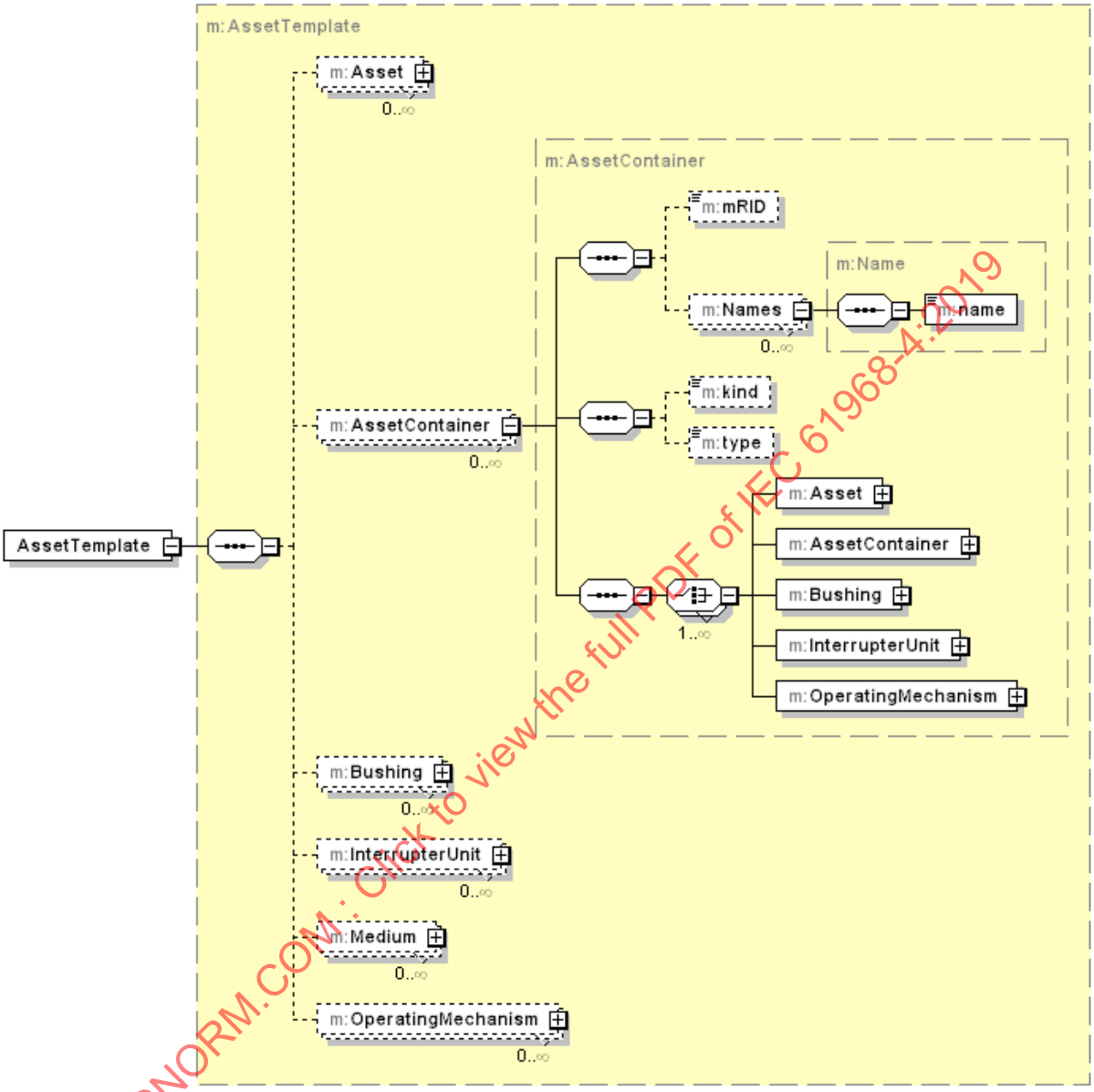


Figure 17 – AssetTemplate message showing the AssetContainer element

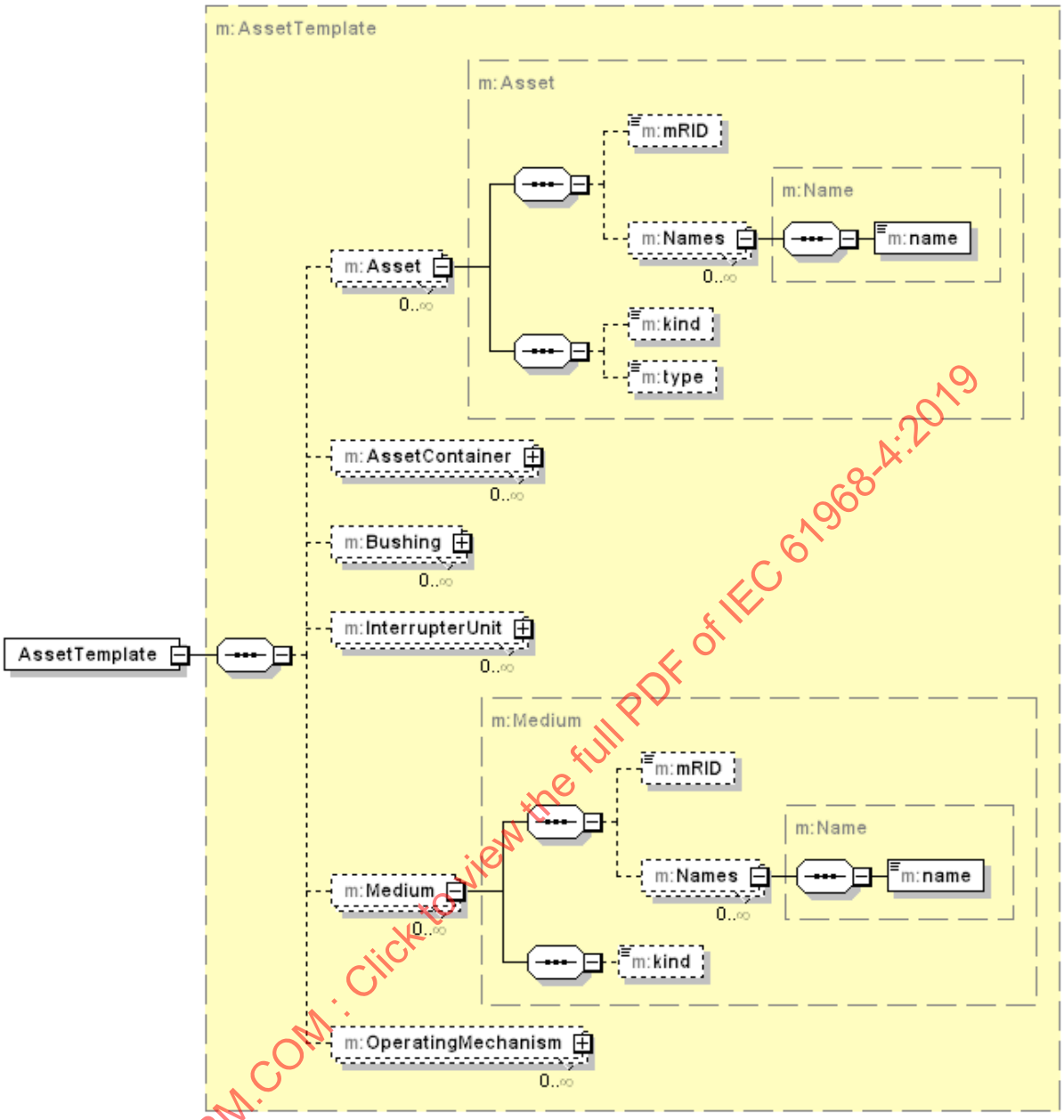


Figure 18 – AssetTemplate message showing the Asset and Medium elements

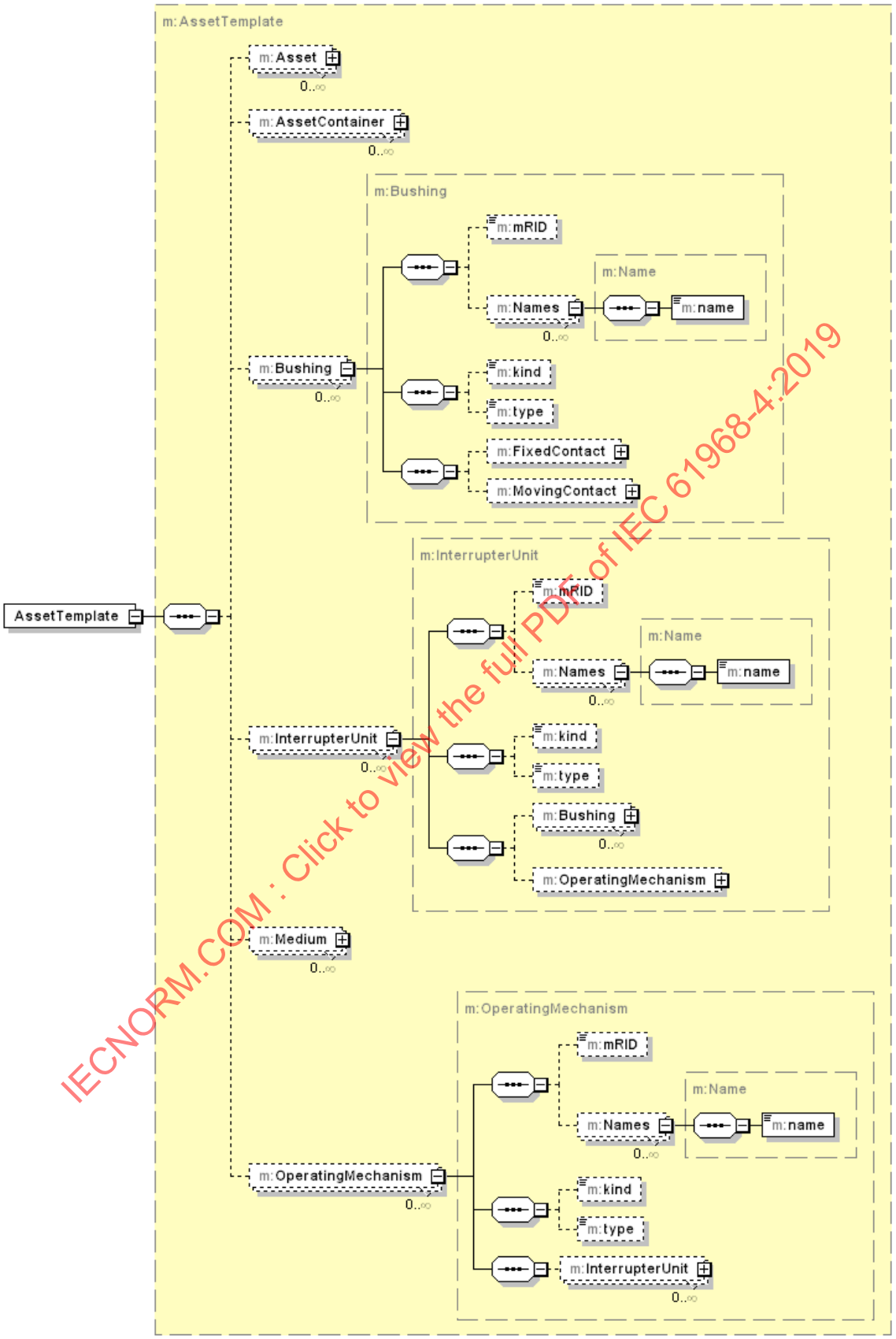


Figure 19 – AssetTemplate message showing the Bushing, InterrupterUnit, and OperatingMechanism elements

The following is an XML example for an AssetTemplate that describes an SF6 dead tank breaker.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetTemplate xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetTemplate.xsd">
	<m:AssetContainer>
		<m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
		<m:kind>breakerSF6DeadTankBreaker</m:kind>
		<m:AssetContainer ref="a49bd9e3-abba-4140-a202-200af5e134f8"/>
	</m:AssetContainer>
	<m:AssetContainer>
		<m:mRID>a49bd9e3-abba-4140-a202-200af5e134f8</m:mRID>
		<m:kind>breakerTankAssembly</m:kind>
		<m:Mediums ref="f5d3fc3d-041e-44c7-bda1-0c75b7c89a05"/>
		<m:Bushing ref="9343e63b-fcb1-4fb3-9e9a-e9b519754c13"/>
		<m:Bushing ref="fe37a60e-d8b7-49e5-8c12-93af7c58d223"/>
		<m:Bushing ref="c278ccba-3c18-4634-a54a-6d42379407a2"/>
		<m:Bushing ref="d5f14947-72b7-456b-8695-18577aebcc9e"/>
		<m:Bushing ref="0b2407fb-cd83-45f4-ba06-3cafc68f1f6d"/>
		<m:Bushing ref="1e98268b-411a-407a-813b-9a13abeab21e"/>
		<m:InterrupterUnit ref="397e055a-b6e1-469f-86bc-46235a67d638"/>
		<m:InterrupterUnit ref="5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc"/>
		<m:InterrupterUnit ref="312f340c-d430-4e52-8fef-7f4ead013493"/>
		<m:OperatingMechanism ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
	</m:AssetContainer>
	<m:Bushing>
		<m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:FixedContact ref="397e055a-b6e1-469f-86bc-46235a67d638"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>fe37a60e-d8b7-49e5-8c12-93af7c58d223</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:MovingContact ref="397e055a-b6e1-469f-86bc-46235a67d638"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>c278ccba-3c18-4634-a54a-6d42379407a2</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:FixedContact ref="5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>d5f14947-72b7-456b-8695-18577aebcc9e</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:MovingContact ref="5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>0b2407fb-cd83-45f4-ba06-3cafc68f1f6d</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:FixedContact ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>1e98268b-411a-407a-813b-9a13abeab21e</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:MovingContact ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
	</m:Bushing>
	<m:InterrupterUnit>
		<m:mRID>397e055a-b6e1-469f-86bc-46235a67d638</m:mRID>
		<m:OperatingMechanism ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
		<m:Bushing ref="9343e63b-fcb1-4fb3-9e9a-e9b519754c13"/>
		<m:Bushing ref="fe37a60e-d8b7-49e5-8c12-93af7c58d223"/>
```

```
        </m:InterrupterUnit>
        <m:InterrupterUnit>
            <m:mRID>5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc</m:mRID>
            <m:OperatingMechanism ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
            <m:Bushing ref="c278ccba-3c18-4634-a54a-6d42379407a2"/>
            <m:Bushing ref="d5f14947-72b7-456b-8695-18577aebcc9e"/>
        </m:InterrupterUnit>
        <m:InterrupterUnit>
            <m:mRID>312f340c-d430-4e52-8fef-7f4ead013493</m:mRID>
            <m:OperatingMechanism ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
            <m:Bushing ref="0b2407fb-cd83-45f4-ba06-3cafc68f1f6d"/>
            <m:Bushing ref="1e98268b-411a-407a-813b-9a13abeab21e"/>
        </m:InterrupterUnit>
        <m:Medium>
            <m:mRID>f5d3fc3d-041e-44c7-bda1-0c75b7c89a05</m:mRID>
            <m:kind>sF6</m:kind>
        </m:Medium>
        <m:OperatingMechanism>
            <m:mRID>e643467f-7c72-4384-9da2-b61956524cd5</m:mRID>
            <m:InterrupterUnit ref="397e055a-b6e1-469f-86bc-46235a67d638"/>
            <m:InterrupterUnit ref="5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc"/>
            <m:InterrupterUnit ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
        </m:OperatingMechanism>
</m:AssetTemplate>
```

5.6 AssetDetail messages

5.6.1 General

An AssetDetail message can contain the properties of an Asset as well as other related objects that describe its characteristics such as the ratings information, ownership, and location. This message is the principal means of exchanging detailed information about asset characteristics, whose unique identity may have been obtained using messages such as AssetList and AssetTemplate. Note that this message is for only asset characteristic information. For exchange of asset test and measurement data, use AssetProcedures and AssetMeasurements messages.

5.6.2 Applications

The AssetDetail message is used to obtain the details pertaining to one or more assets. These details include the attributes of Asset class as well as those of associated classes such as AssetInfo, Location, and Ownership.

A typical application for this message is for an asset analytic system to query and discover the details of the assets it is interested in assessing, as shown in Figure 20. In this figure, an asset analytic system is querying a network and substation inventory system to discover the detailed information pertaining to the assets of interest.

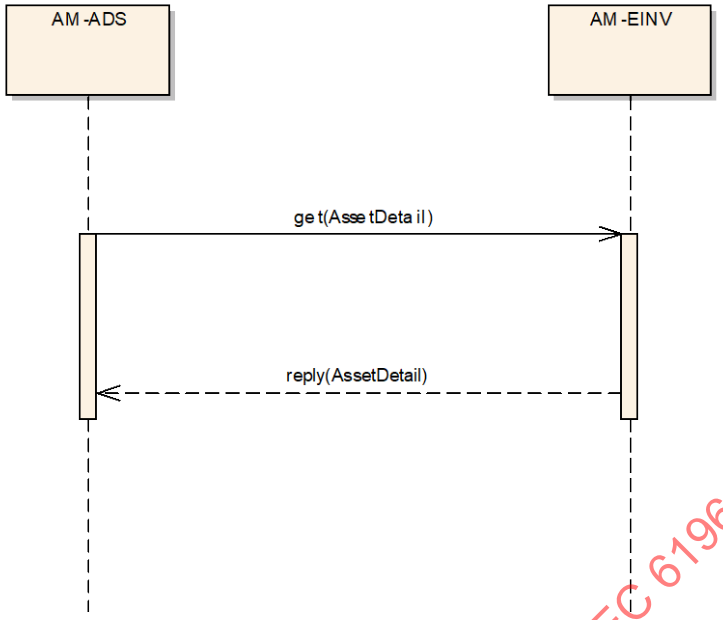


Figure 20 – Asset Detail message exchange

5.6.3 Message format

Figure 21 through Figure 30 show the AssetDetail message format. The message payload shown in the figure consists of a multiplicity of Asset or Asset child objects. The Asset object may contain attributes of the Asset class, nameplate information in the form of AssetInfo child classes, Location information, and a multiplicity of Ownership information (to account for assets that are co-owned by more than one entity.) In the case of the Asset element, shown in Figure 22, AssetDeployment details could be provided as well (Figure 23). If this Asset is a breaker, SwitchOperationSummary could also be included (Figure 24).

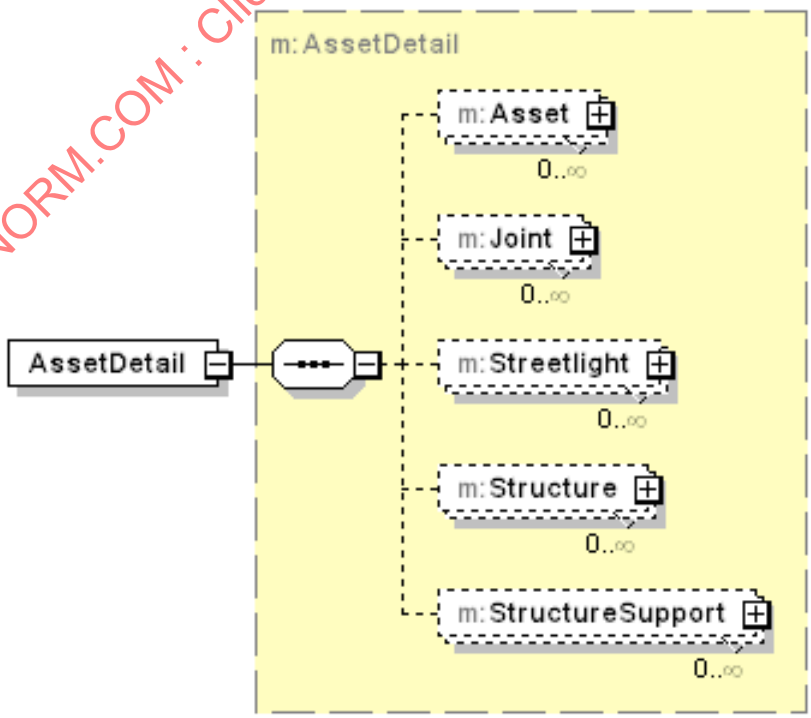


Figure 21 – Asset Detail message format

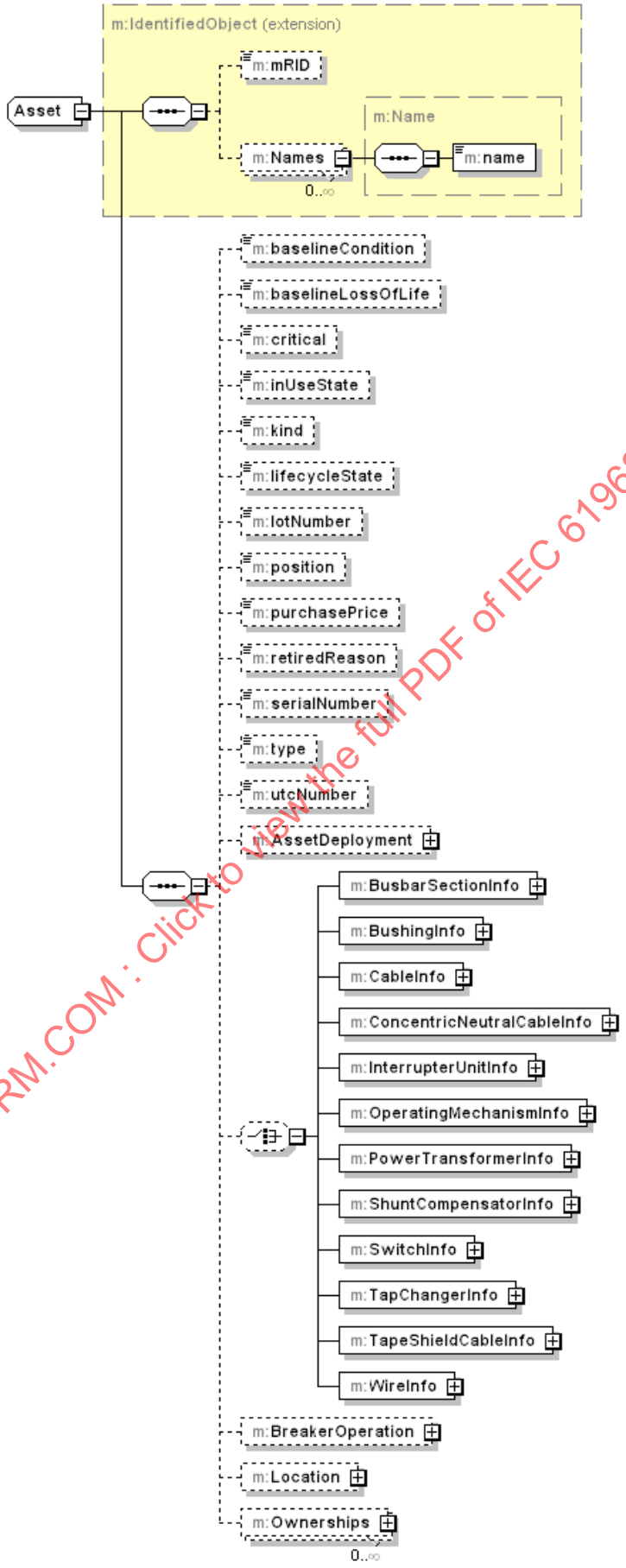


Figure 22 – AssetDetail message: Asset element

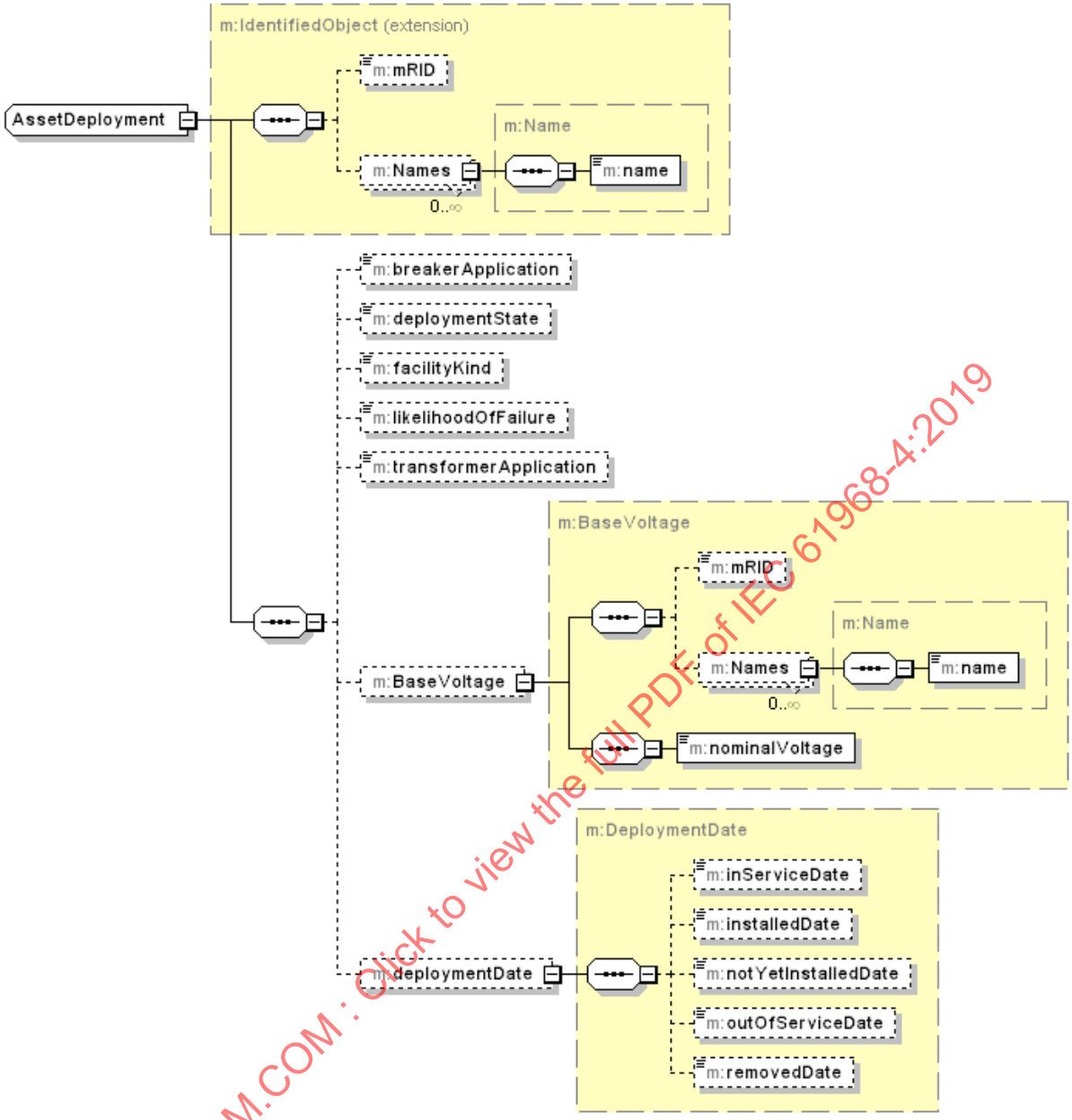


Figure 23 – AssetDetail message: AssetDeployment element (included in the Asset element shown in Figure 22)

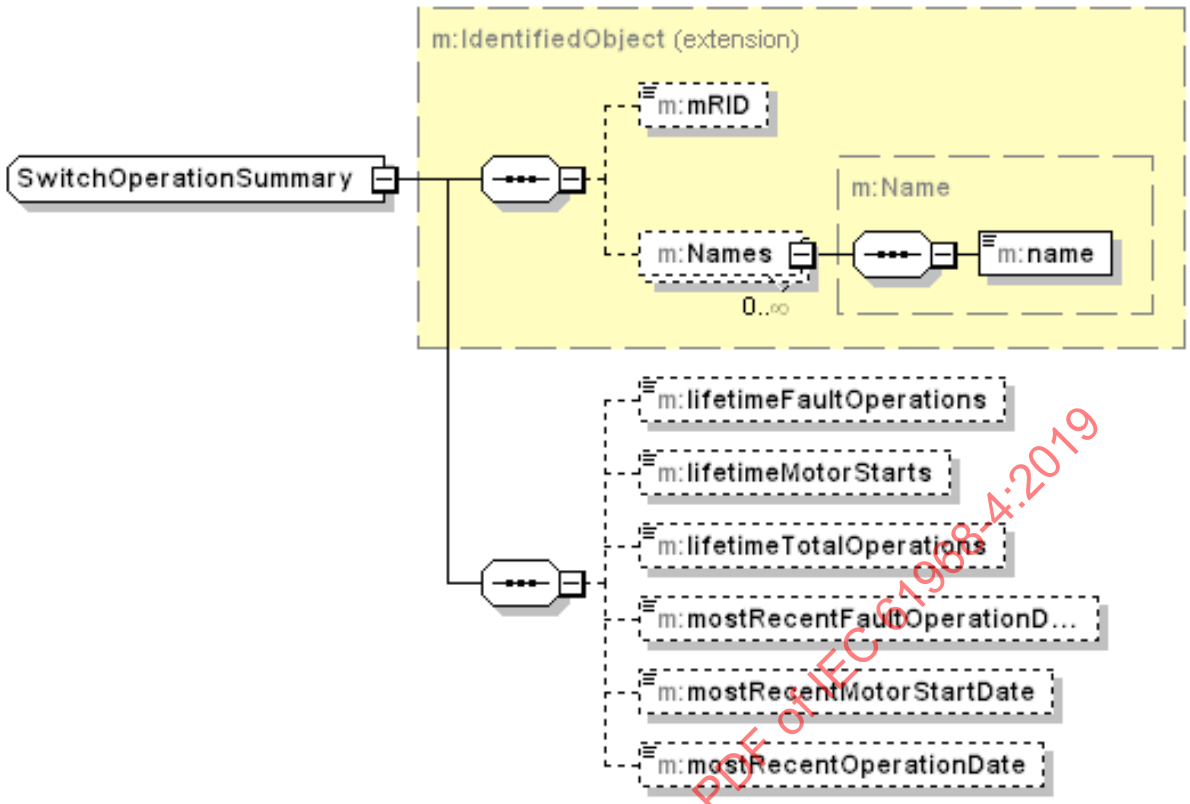


Figure 24 – AssetDetail message: SwitchOperationSummary element (included as BreakerOperation association within the Asset element shown in Figure 22)

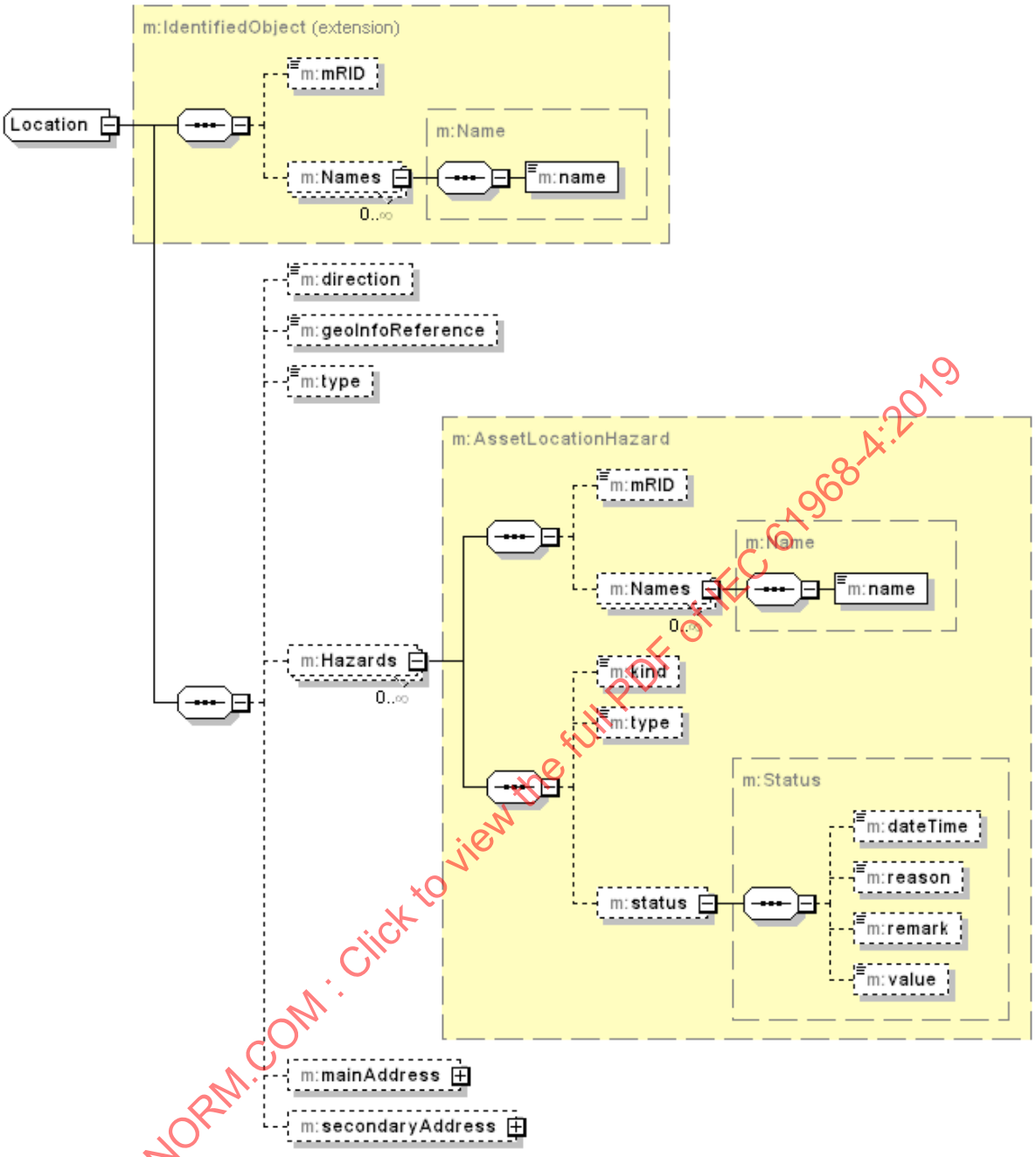


Figure 25 – AssetDetail message: Location element

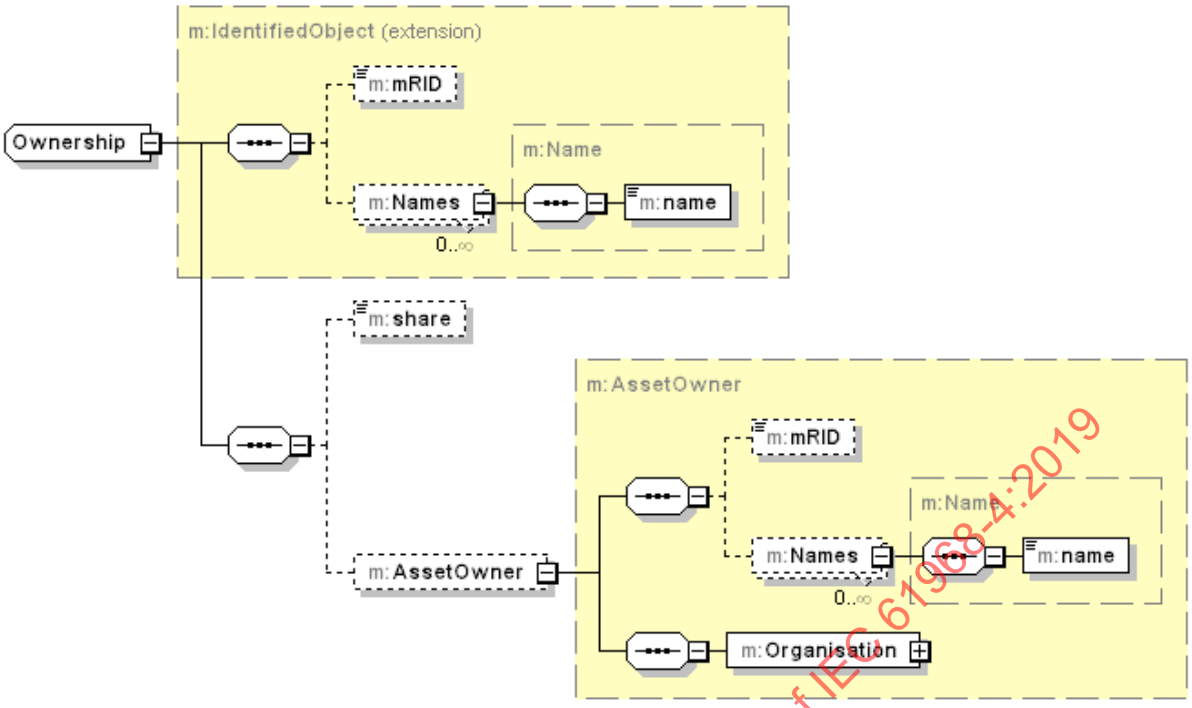


Figure 26 – AssetDetail message: Ownership element

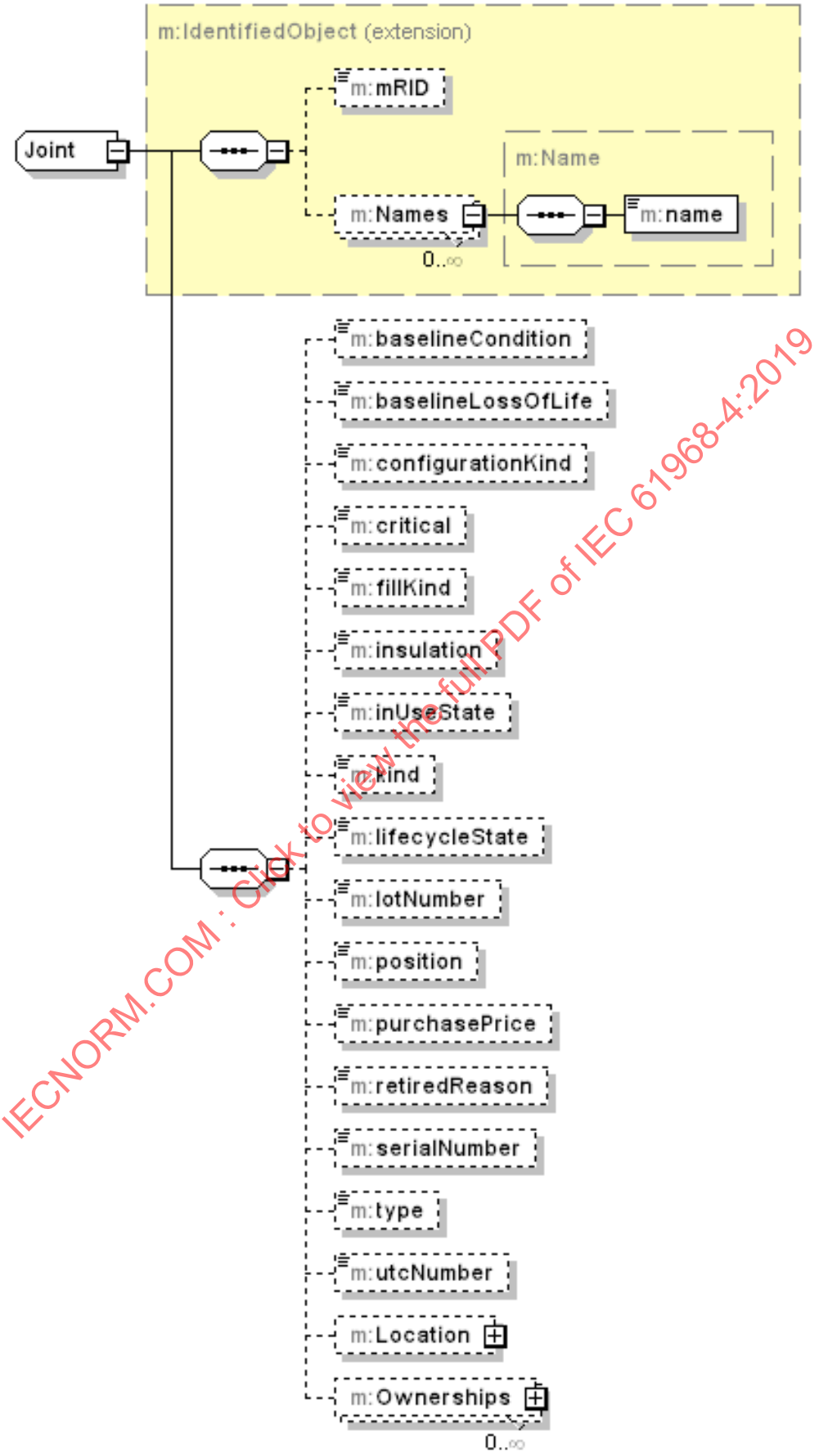


Figure 27 – AssetDetail message: Joint element

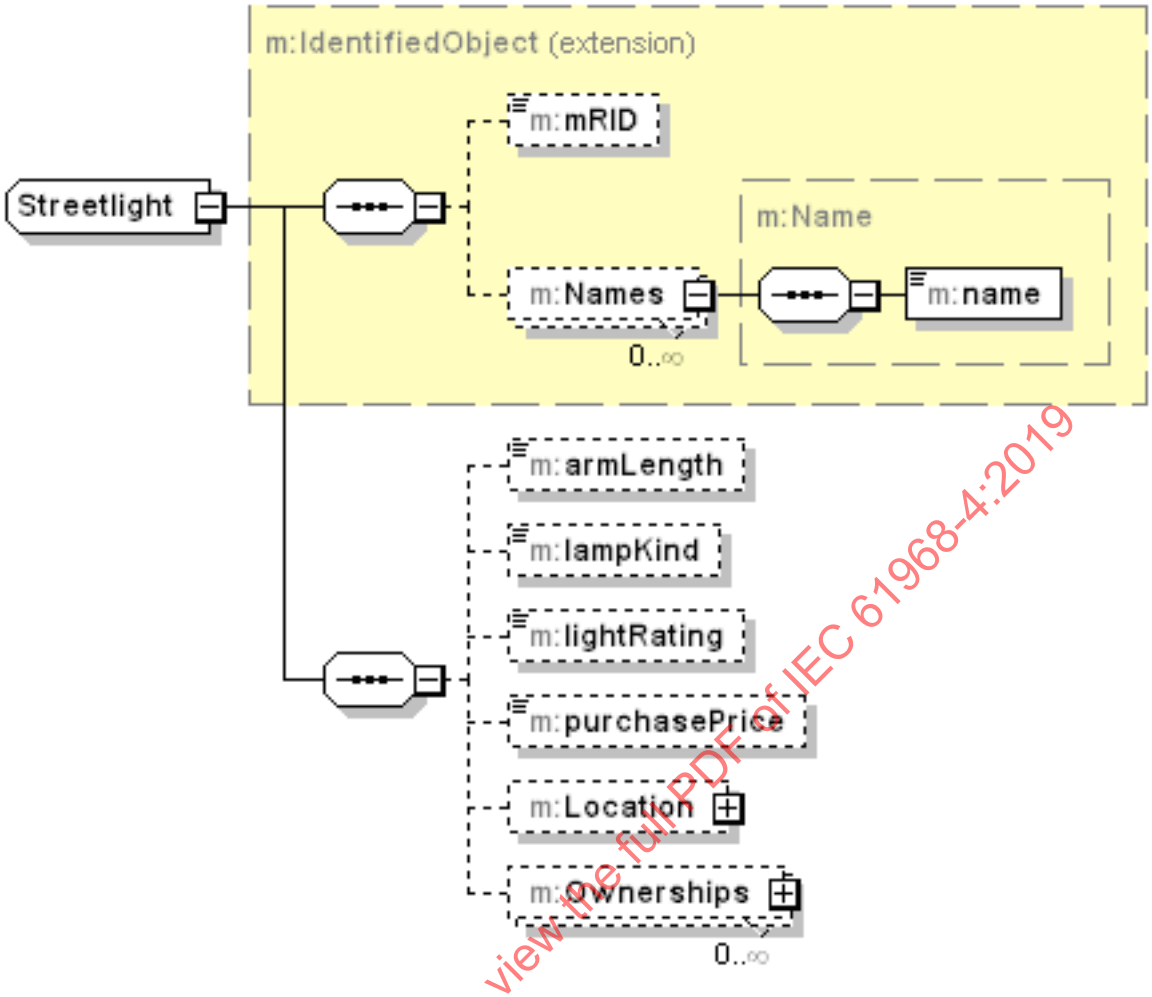


Figure 28 – AssetDetail message: Streetlight element

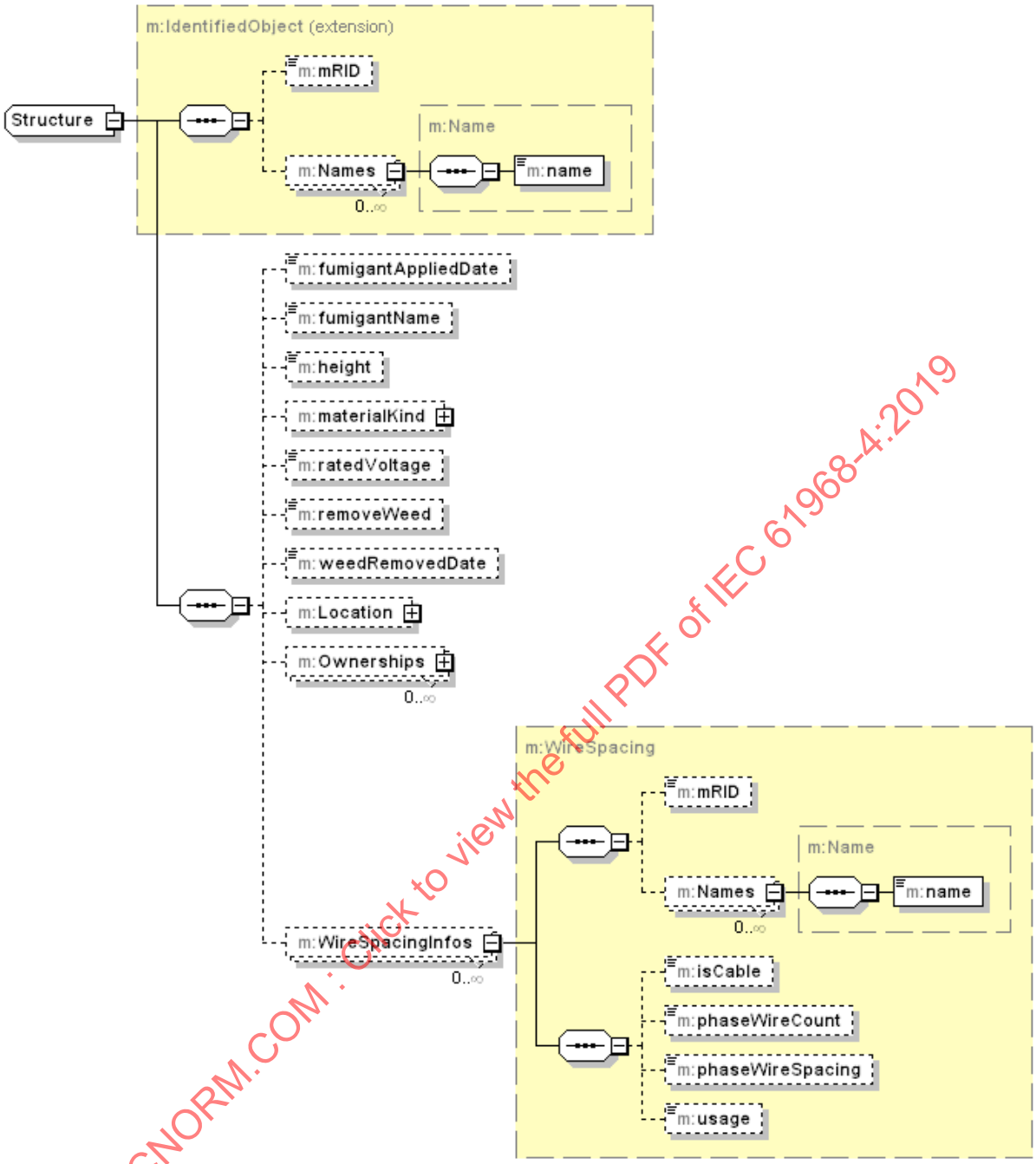


Figure 29 – AssetDetail message: Structure element

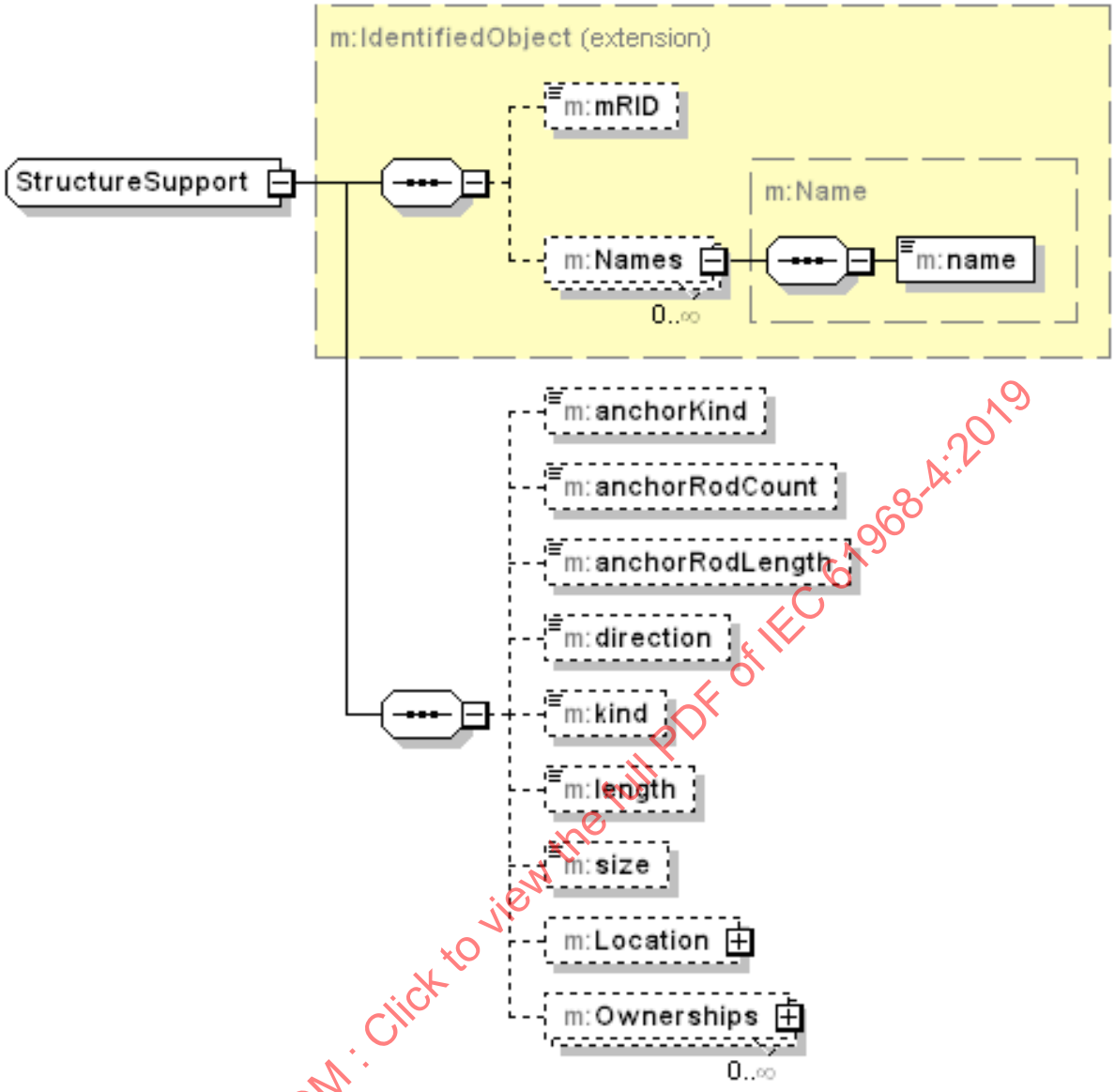


Figure 30 – AssetDetail message: StructureSupport element

The following is an XML example for an AssetDetail, which contains the details of a 550 kV SF6 live tank breaker.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetDetail xmlns:m="http://iec.ch/TC57/2007/AssetDetail#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/AssetDetail# AssetDetail.xsd">
      <m:Asset>
            <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            <m:baselineLossOfLife>50</m:baselineLossOfLife>
            <m:critical>true</m:critical>
            <m:kind>breakerSF6LiveTankBreaker</m:kind>
            <m:lifecycleState>inService</m:lifecycleState>
            <m:name>ElectricSomervilleCB8</m:name>
            <m:SwitchInfo>
                  <m:breakingCapacity>63000</m:breakingCapacity>
                  <m:isSinglePhase>true</m:isSinglePhase>
                  <m:isUnganged>true</m:isUnganged>
                  <m:ratedCurrent>5000</m:ratedCurrent>
                  <m:ratedFrequency>60</m:ratedFrequency>
```

```
            <m:ratedImpulseWithstandVoltage>1175000</m:ratedImpulseWithstandVolt
        age>
            <m:ratedInterruptingTime>0.033333</m:ratedInterruptingTime>
            <m:ratedVoltage>550000</m:ratedVoltage>
        </m:SwitchInfo>
        <m:Location>
            <m:mainAddress>
                <m:streetDetail>
                    <m:name>Electric</m:name>
                    <m:number>88</m:number>
                    <m:type>Avenue</m:type>
                    <m:withinTownLimits>true</m:withinTownLimits>
                </m:streetDetail>
                <m:townDetail>
                    <m:code>02144</m:code>
                    <m:country>USA</m:country>
                    <m:name>Somerville</m:name>
                    <m:stateOrProvince>Massachusetts</m:stateOrProvince>
                </m:townDetail>
            </m:mainAddress>
        </m:Location>
        <m:Ownerships>
            <m:share>100</m:share>
            <m:AssetOwner>
                <m:mRID>f5d3fc3d-041e-44c7-bda1-0c75b7c89a05</m:mRID>
                <m:Names>
                    <m:name>Grid Corporation</m:name>
                </m:Names>
            </m:AssetOwner>
        </m:Ownerships>
    </m:Asset>
</m:AssetDetail>
```

5.7 AssetHistory message

5.7.1 General

An AssetHistory message can contain the history of an asset – i.e. log entries on changes to the states of Asset, as well as the Location and Ownership of a particular asset. While the AssetDetail message enables the exchange of the current details of assets, the AssetHistory message enables for the exchange of the history of the assets.

5.7.2 Applications

The AssetHistory message is used to obtain the historical details pertaining to assets. These details include changes made to attributes of Asset class as well as those of the associated classes Location and Ownership.

A typical application for this message is for an asset analytic system to query and discover the historical details of the asset it is interested in assessing, as shown in Figure 31. In this figure, an asset analytic system is querying a network and substation inventory system to discover the historical information pertaining to the asset of interest.

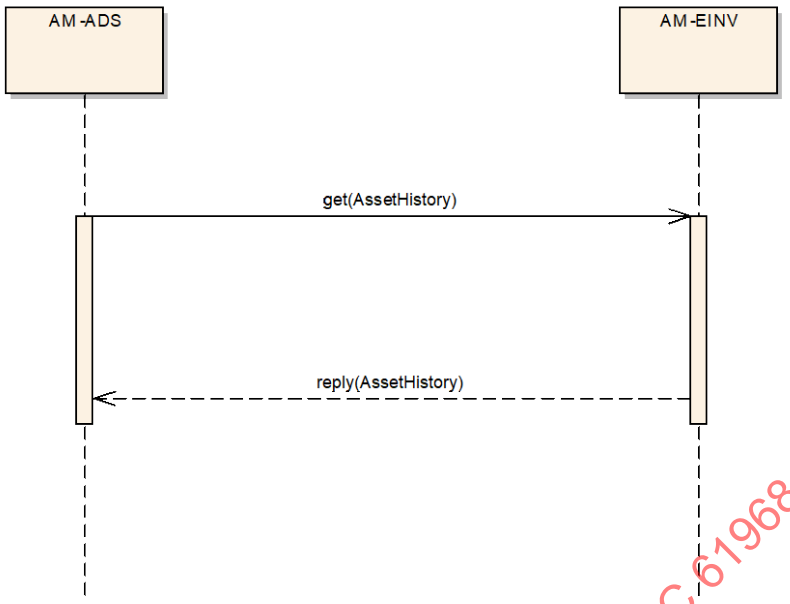


Figure 31 – Asset History message exchange

5.7.3 Message format

Figure 32 shows the AssetHistory message format. The message payload shown in the figure consists of an Asset that is uniquely identified by mRID. ConfigurationEvent objects within the Asset are log records of change in a piece of information regarding the Asset. The timeline of the referenced information is provided by the ConfigurationEvent that references it – e.g. the ConfigurationEvent.effectiveDateTime is the DateTime starting when the included information was valid.

ActivityRecord (Figure 33) and FailureEvent (Figure 34) objects can also be provided within Asset to convey relevant activity and failures. The Author object (Figure 35) provides attribution as to who captured the event.

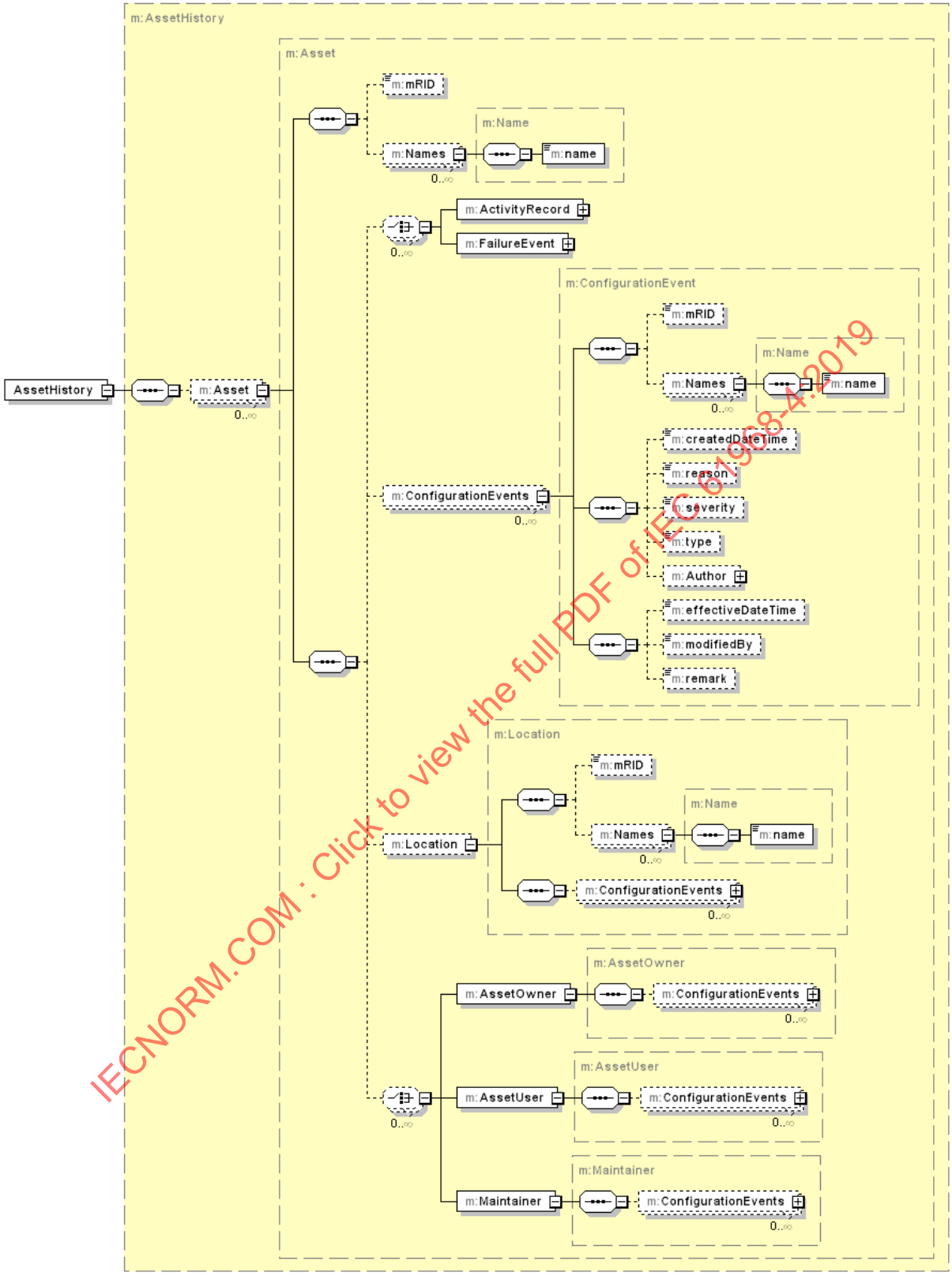


Figure 32 – AssetHistory message format

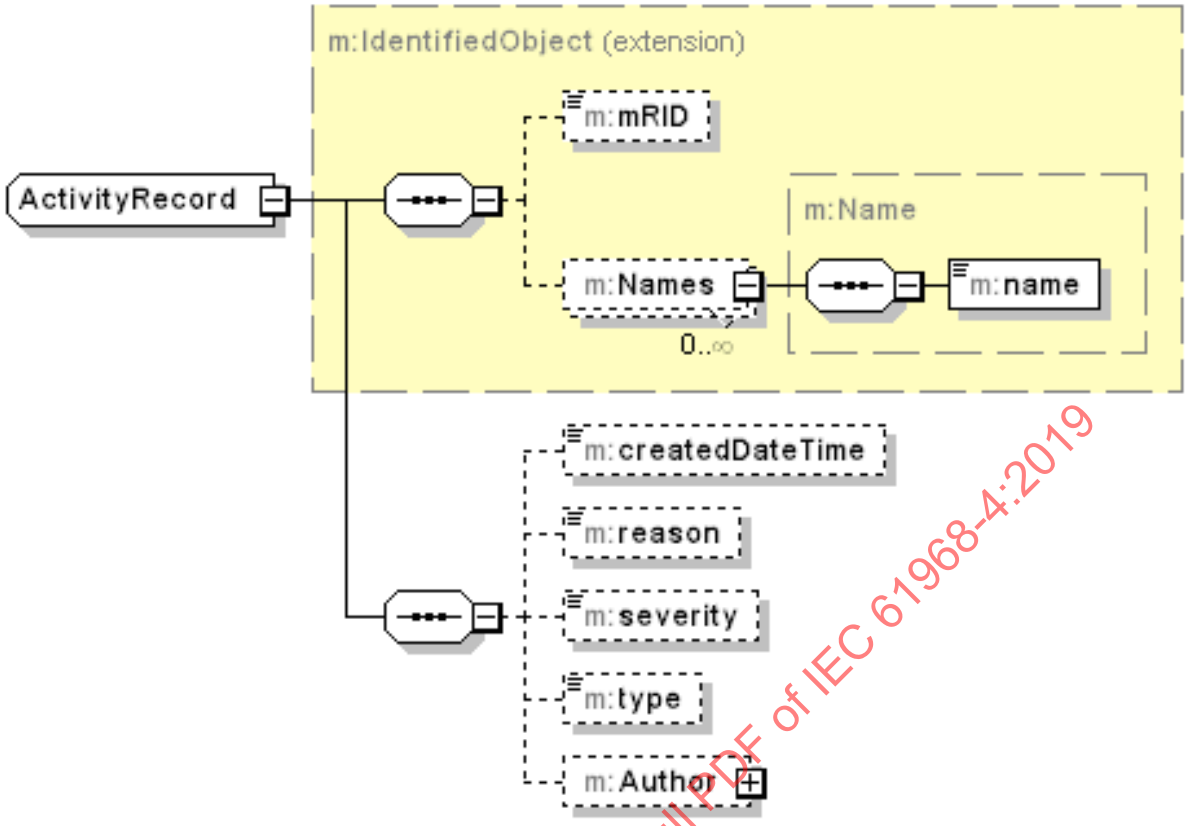


Figure 33 – AssetHistory message: ActivityRecord element

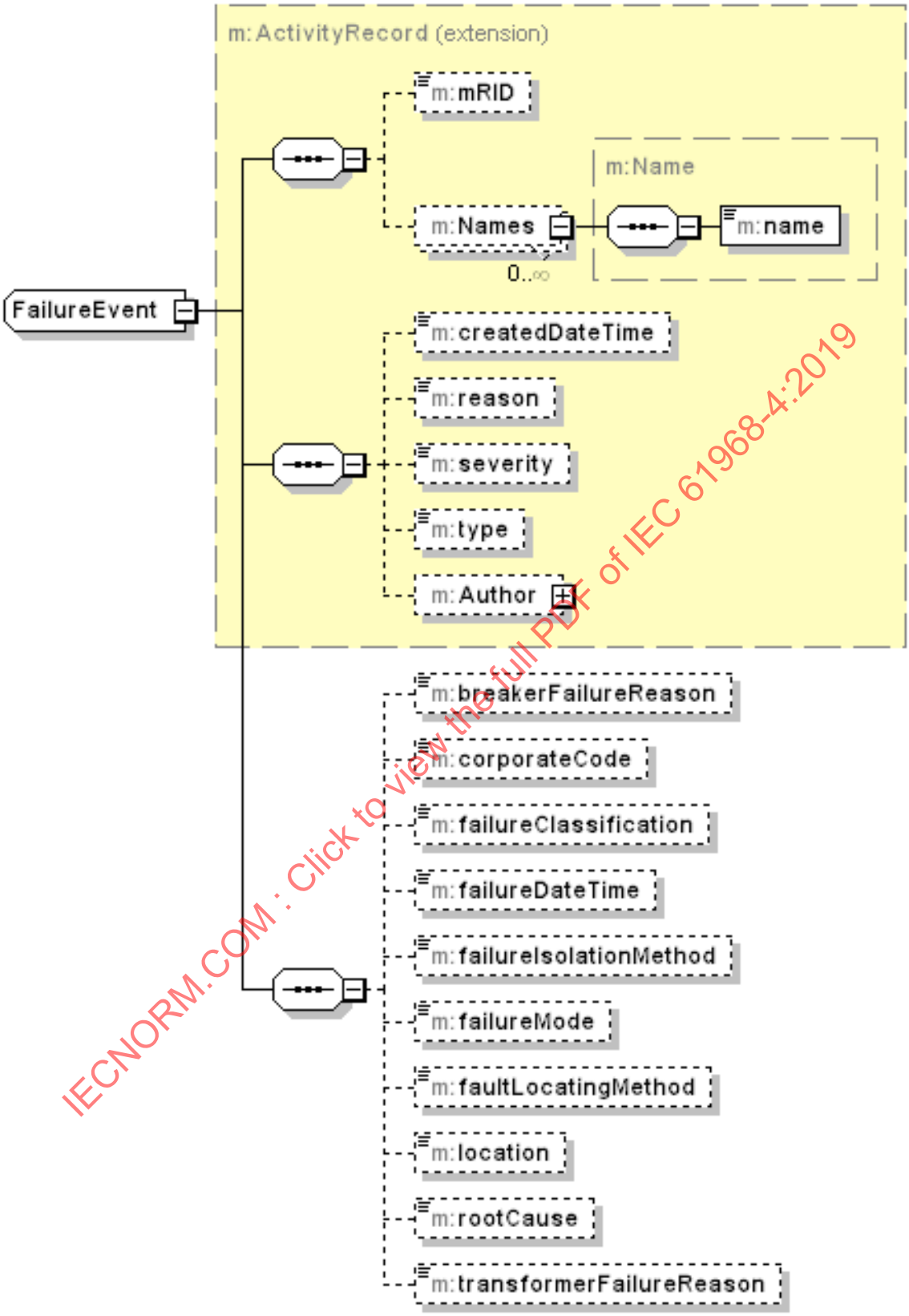


Figure 34 – AssetHistory message: FailureEvent element

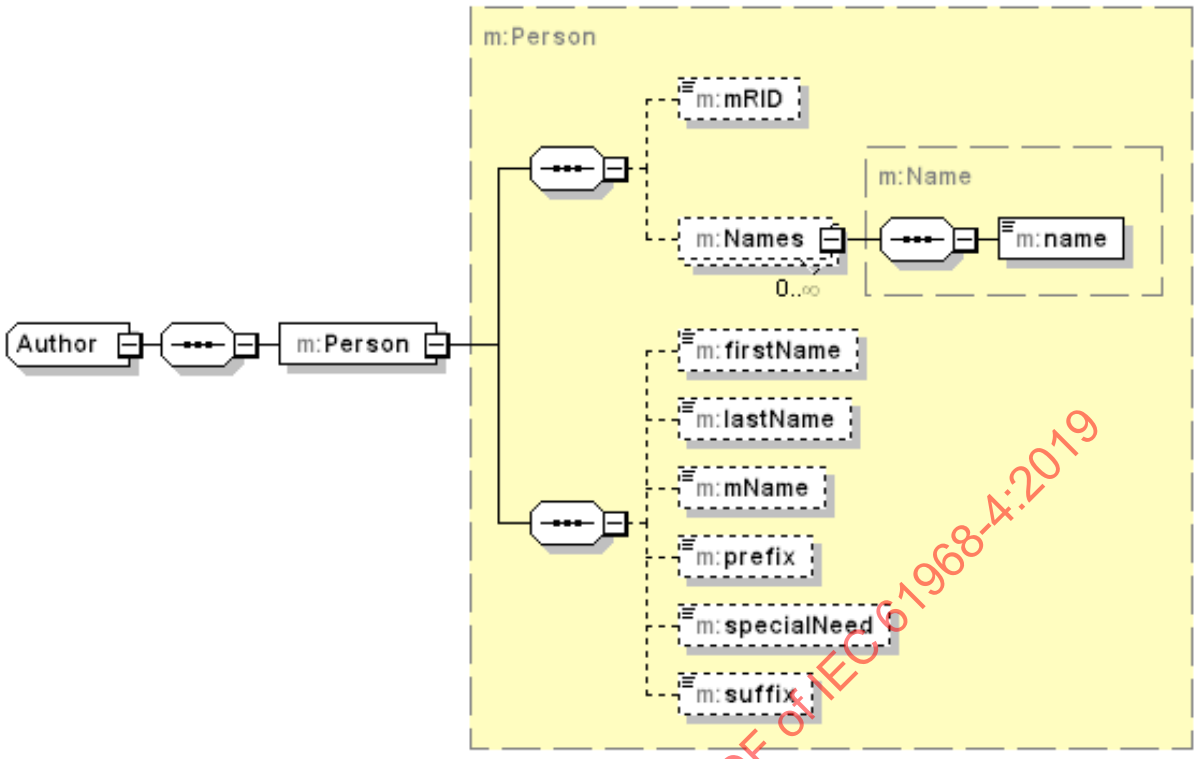


Figure 35 – AssetHistory message: Author element

The following is an XML example for an AssetHistoryLog, which shows the Asset being changed to critical in 2004 by Critical Infrastructure Protection (CIP) Manager; and the baselineLossOfLife being changed to 28% and 40% in 2007 and 2011, respectively, by Asset Manager. CIP Manager and Asset Manager are example roles meant to illustrate the use of this message.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetHistory xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetHistory.xsd">
      <m:Asset>
            <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            <m:ConfigurationEvents>
                  <m:createdDateTime>2004-12-17T09:30:47Z</m:createdDateTime>
                  <m:effectiveDateTime>2004-12-17T09:30:47Z</m:effectiveDateTime>
                  <m:modifiedBy>CIP Manager</m:modifiedBy>
                  <m:reason>critical changed from false to true</m:reason>
            </m:ConfigurationEvents>
            <m:ConfigurationEvents>
                  <m:createdDateTime>2007-02-15T11:21:07Z</m:createdDateTime>
                  <m:effectiveDateTime>2007-02-15T11:21:07Z</m:effectiveDateTime>
                  <m:modifiedBy>Asset Manager</m:modifiedBy>
                        <m:reason>baselineLossOfLife changed from 10 to 28</m:reason>
            </m:ConfigurationEvents>
            <m:ConfigurationEvents>
                  <m:createdDateTime>2011-02-10T08:32:40Z</m:createdDateTime>
                  <m:effectiveDateTime>20011-02-10T08:32:40Z</m:effectiveDateTime>
                  <m:modifiedBy>Asset Manager</m:modifiedBy>
                  <m:reason>baselineLossOfLife changed from 28 to 40</m:reason>
            </m:ConfigurationEvents>
      </m:Asset>
</m:AssetHistory>
```

5.8 Asset Work History

5.8.1 General

An AssetWorkHistory message can contain the history of work performed on assets of interest. This information is valuable when, for instance, assessing the condition of an asset or generating compliance reports.

5.8.2 Applications

The AssetWorkHistory message is used to exchange the prior work done on one or more assets. A typical application for this message is for an asset analytic system to query and discover the available work history for the assets it is interested in assessing, as shown in Figure 36. Such data may be indicative of the condition of the asset and therefore of value in management of the assets. In Figure 36, an asset analytic system is querying a maintenance and inspection system to discover the work history pertaining to the assets of interest.

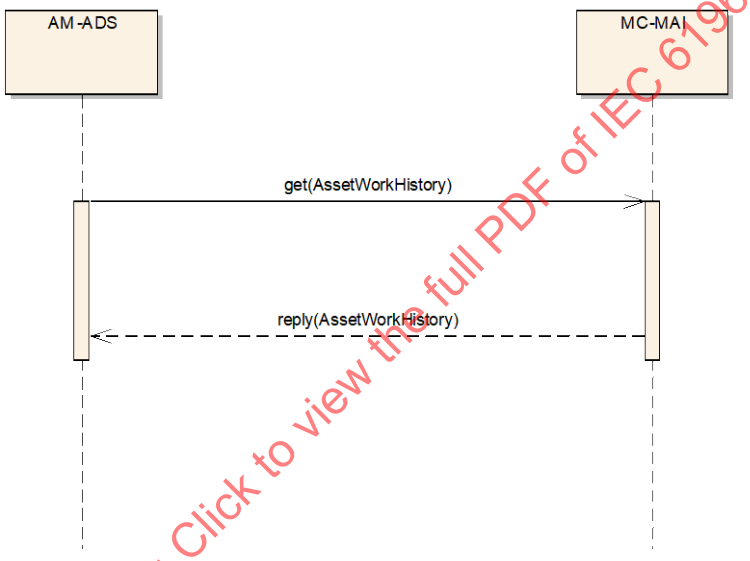


Figure 36 – Asset Work History message exchange

5.8.3 Message format

Figure 37 is an illustration of the AssetWorkHistory message format. The root element of this message is Asset. There can be a multiplicity of Asset objects, which can contain a multiplicity of WorkTasks that pertain to the particular Asset. The details of the pertinent WorkTask are depicted in Figure 38, MaintenanceWorkTask in Figure 39, and RepairWorkTask in Figure 40.

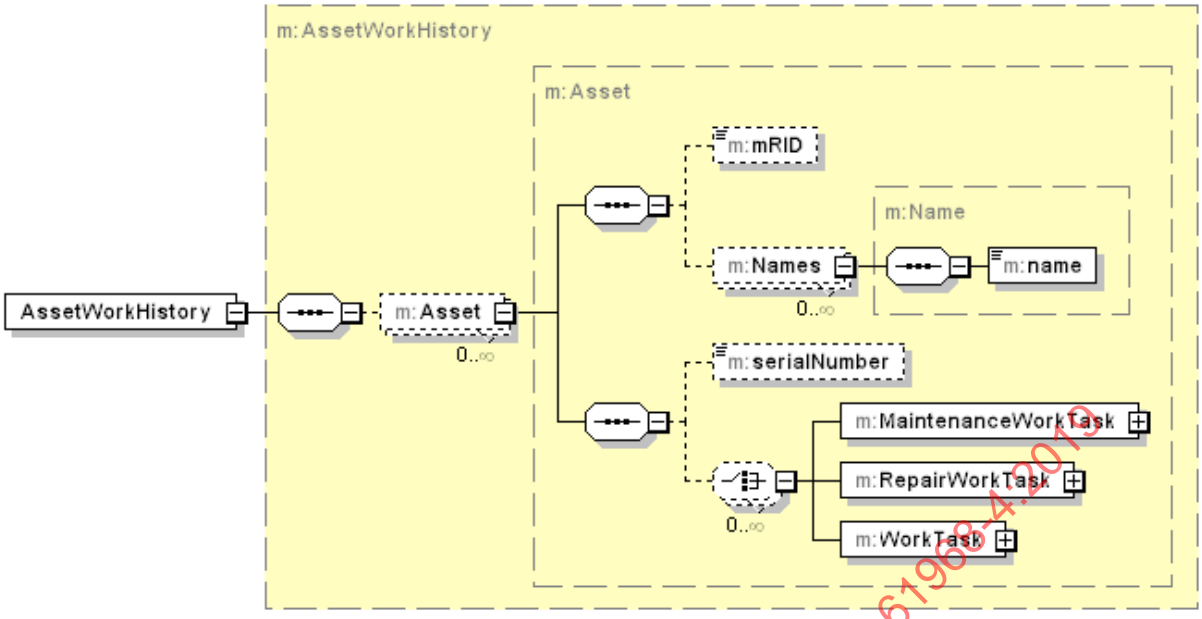


Figure 37 – AssetWorkHistory message format

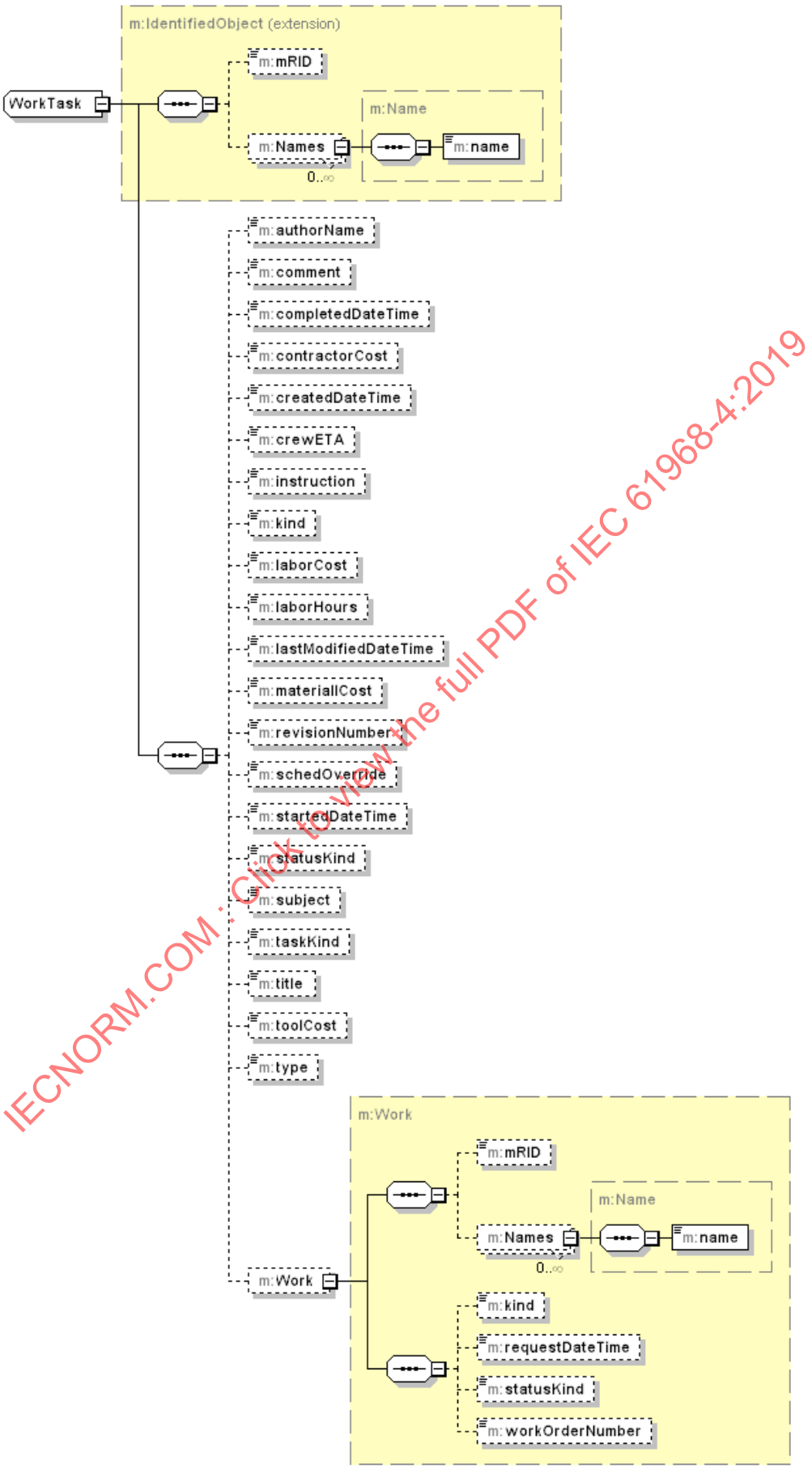


Figure 38 – AssetWorkHistory message: WorkTask element

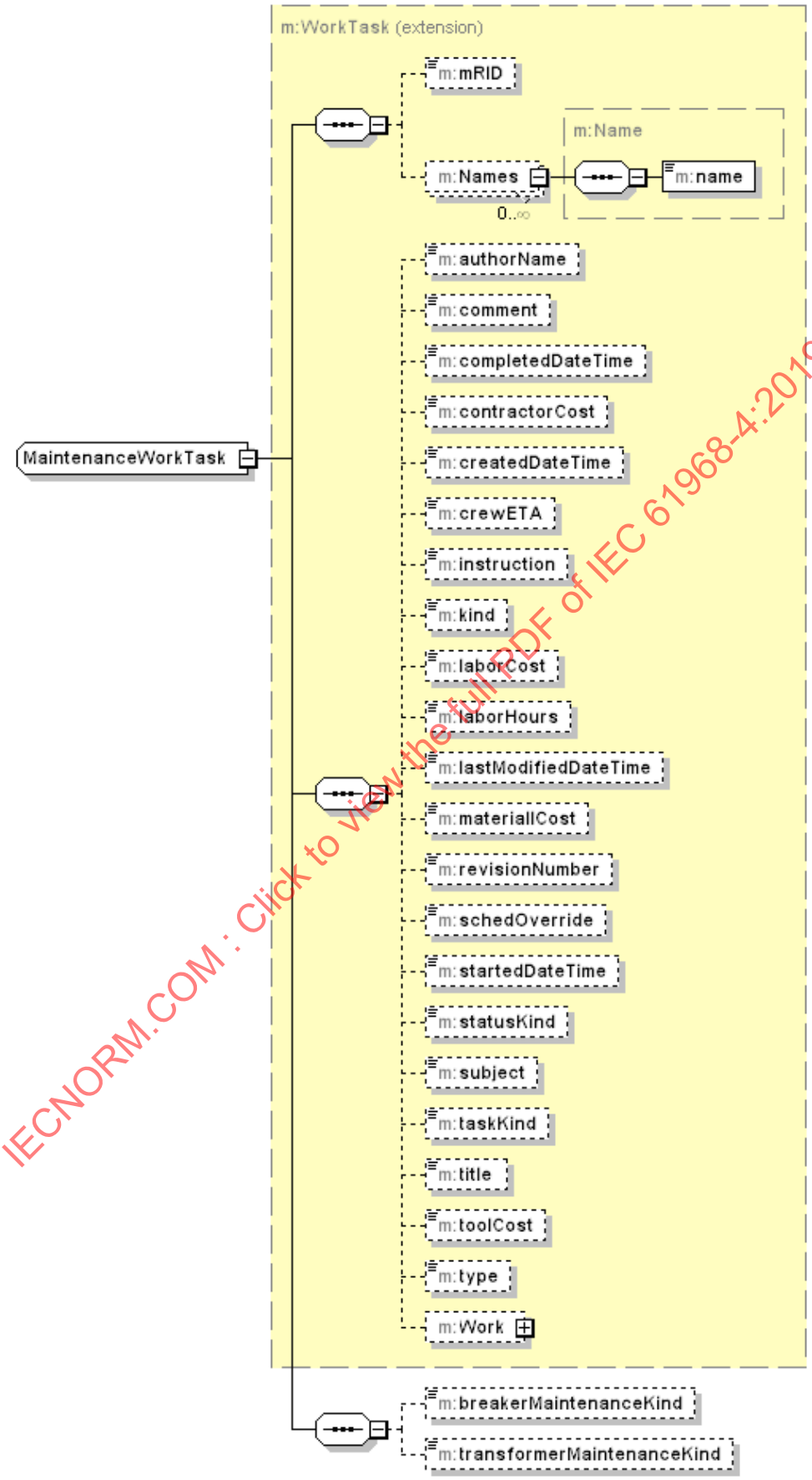


Figure 39 – AssetWorkHistory message: MaintenanceWorkTask element

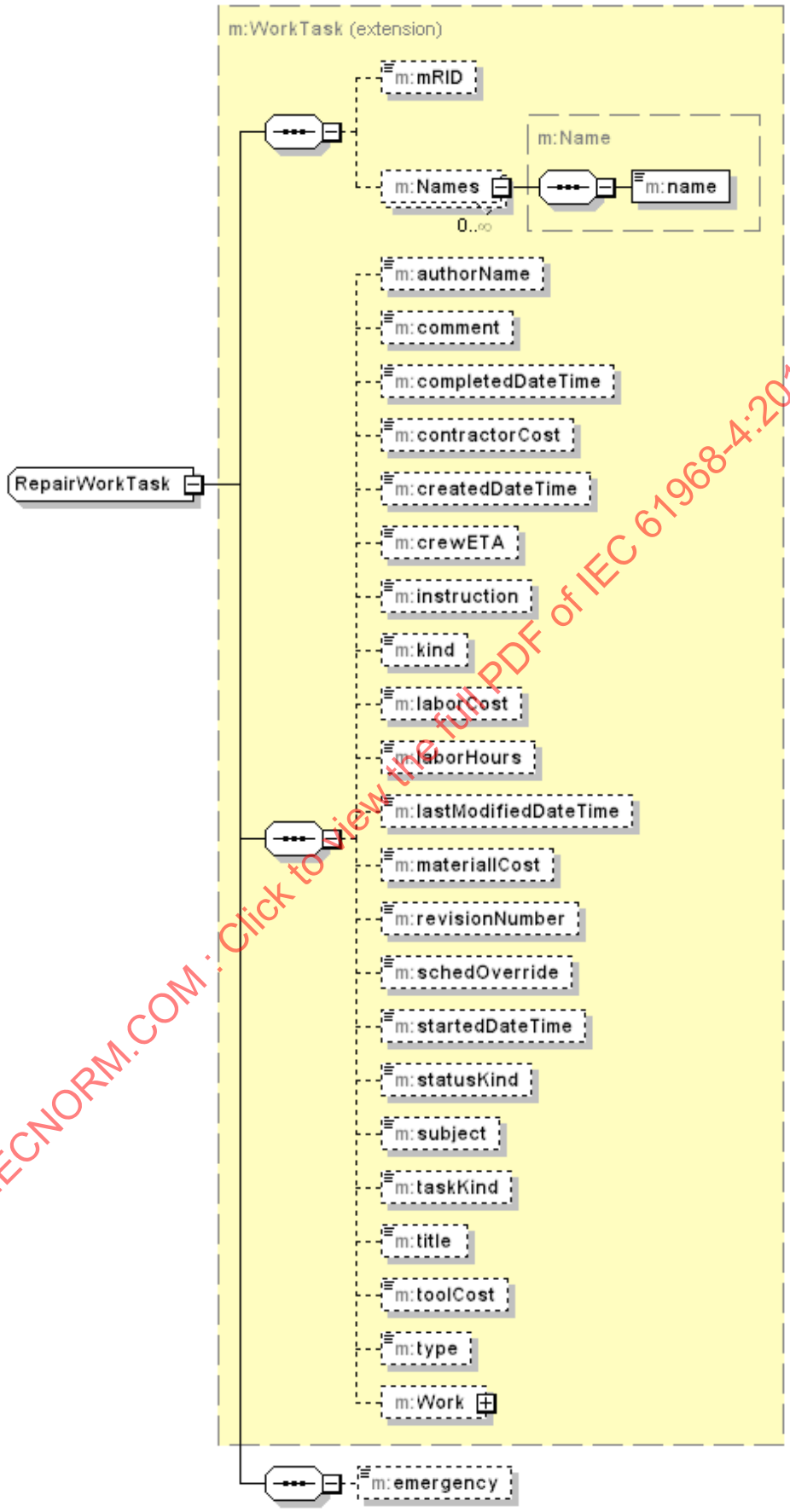


Figure 40 – AssetWorkHistory message: RepairWorkTask element

The detailed XML schema is provided in Annex B. The following is an XML example for an AssetWorkHistory message payload.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetWorkHistory xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetWorkHistory.xsd">
      <m:Asset>
            <m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
            <m:WorkTasks>
                  <m:createdDateTime>2015-12-17T09:30:47Z</m:createdDateTime>
                  <m:instruction>Check the warning alert from bushing
monitor</m:instruction>
                  <m:taskKind>investigate</m:taskKind>
            </m:WorkTasks>
            <m:WorkTasks>
                  <m:createdDateTime>2015-11-15T11:05:00Z</m:createdDateTime>
                  <m:instruction>Replace the main oil tank temperature transducer that is
acting unreliable</m:instruction>
                  <m:taskKind>exchange</m:taskKind>
            </m:WorkTasks>
      </m:Asset>
</m:AssetWorkHistory>
```

5.9 AssetPSRDetails message

5.9.1 General

An AssetPSRDetails message can contain the information pertaining to the state of an asset as it is in the field. This information is valuable for exchanging the current asset state for situational awareness purposes: for instance, to retrieve the as-built state of the asset in order to compare and correct the as-designed state.

5.9.2 Applications

The AssetPSRDetails message is used to exchange information pertaining to the current state of one or more assets. A typical application for this message is for a geographical inventory system to query the network monitoring system to discover the current state of the asset, as shown in Figure 41, so that it may be made available to asset management personnel. In this application, the network monitoring system may convey any changes in the asset state as well, such as the normally open state of a switch being changed to normal closed owing to seasonal switching, as and when such changes occur. As shown in Figure 42, another application for this message is for the geographical inventory system to convey the as-built state of the asset to a network monitoring system, since this as-built state may be different from the as-designed description in the network monitoring system.

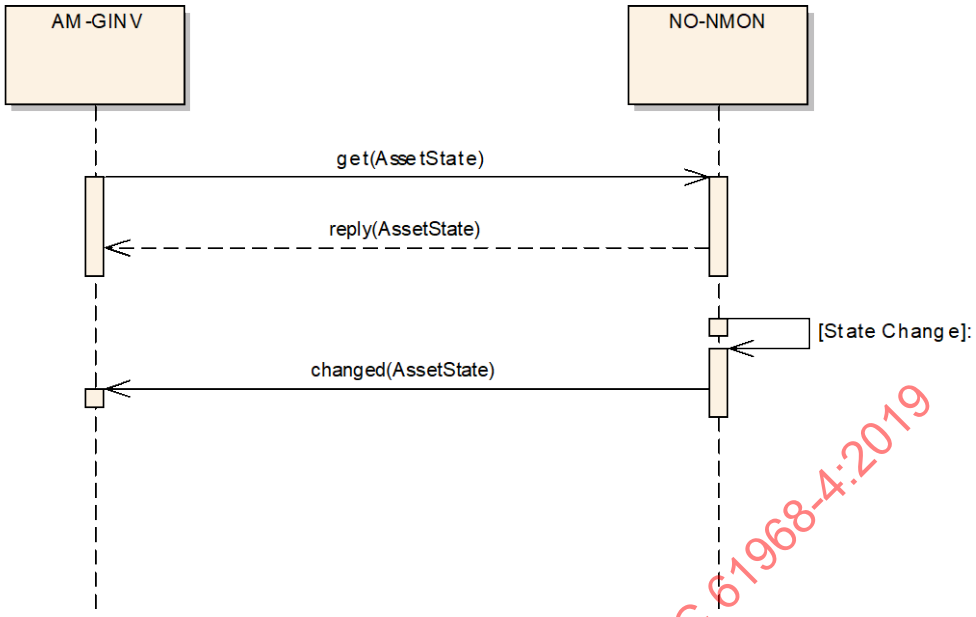


Figure 41 – AssetPSRDetails message exchange 1

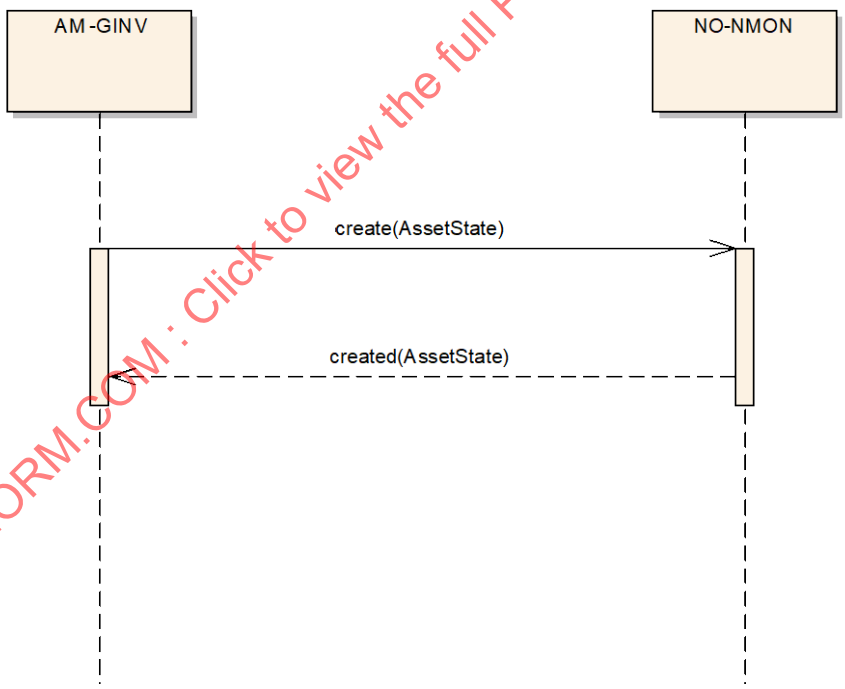


Figure 42 – AssetPSRDetails message exchange 2

5.9.3 Message format

Figure 43 is an illustration of the AssetState message format. The root element of this message is Asset. There can be a multiplicity of the Asset objects and they can contain one or more objects of type PowerSystemResource (Conductor, EnergyConsumer, etc.) These contained objects provide network state information pertaining to the Asset. Figure 44 through Figure 67 show the elements of type PowerSystemResource that can be contained by the Asset element of the AssetState message.

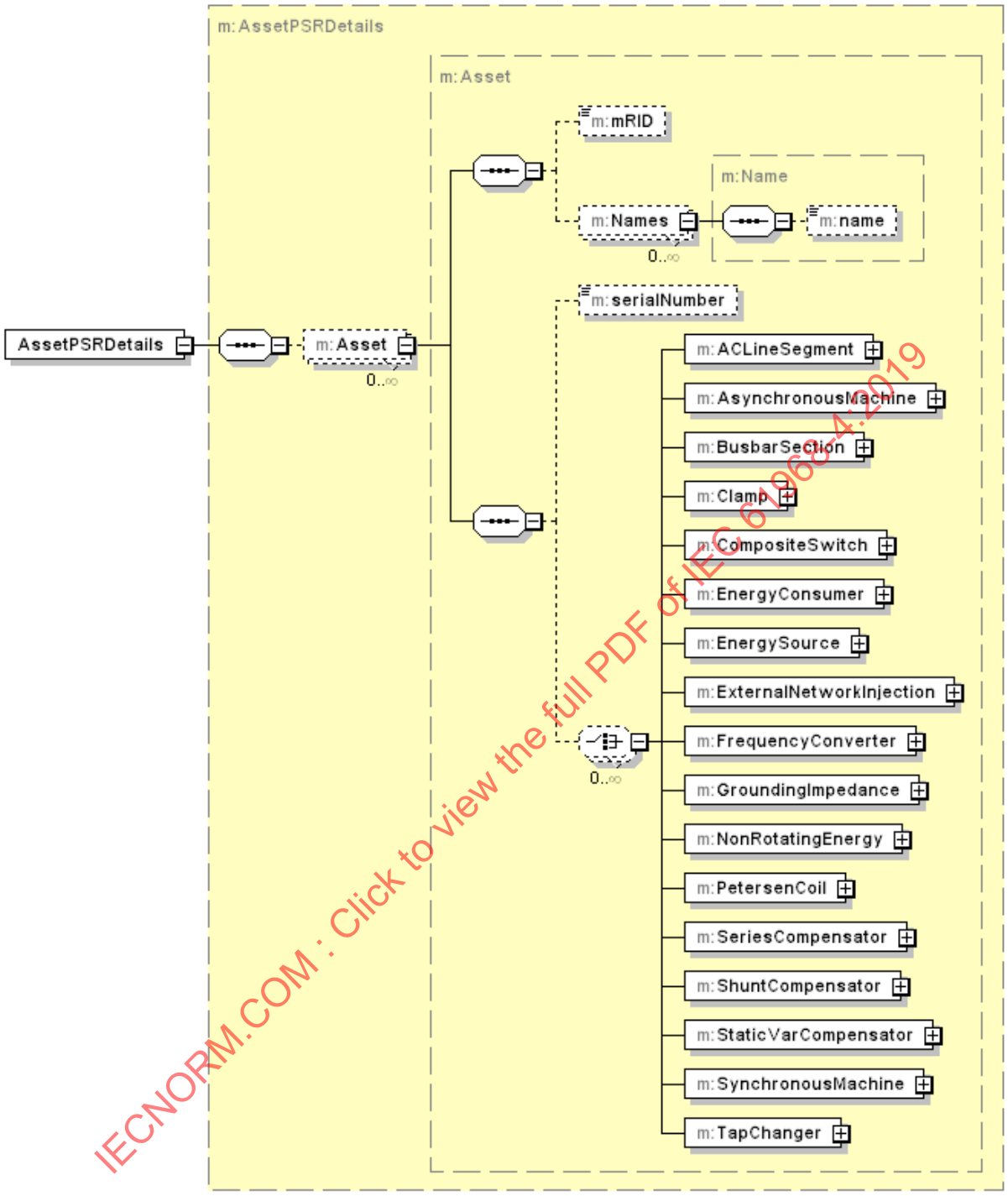


Figure 43 – AssetPSRDetails message format

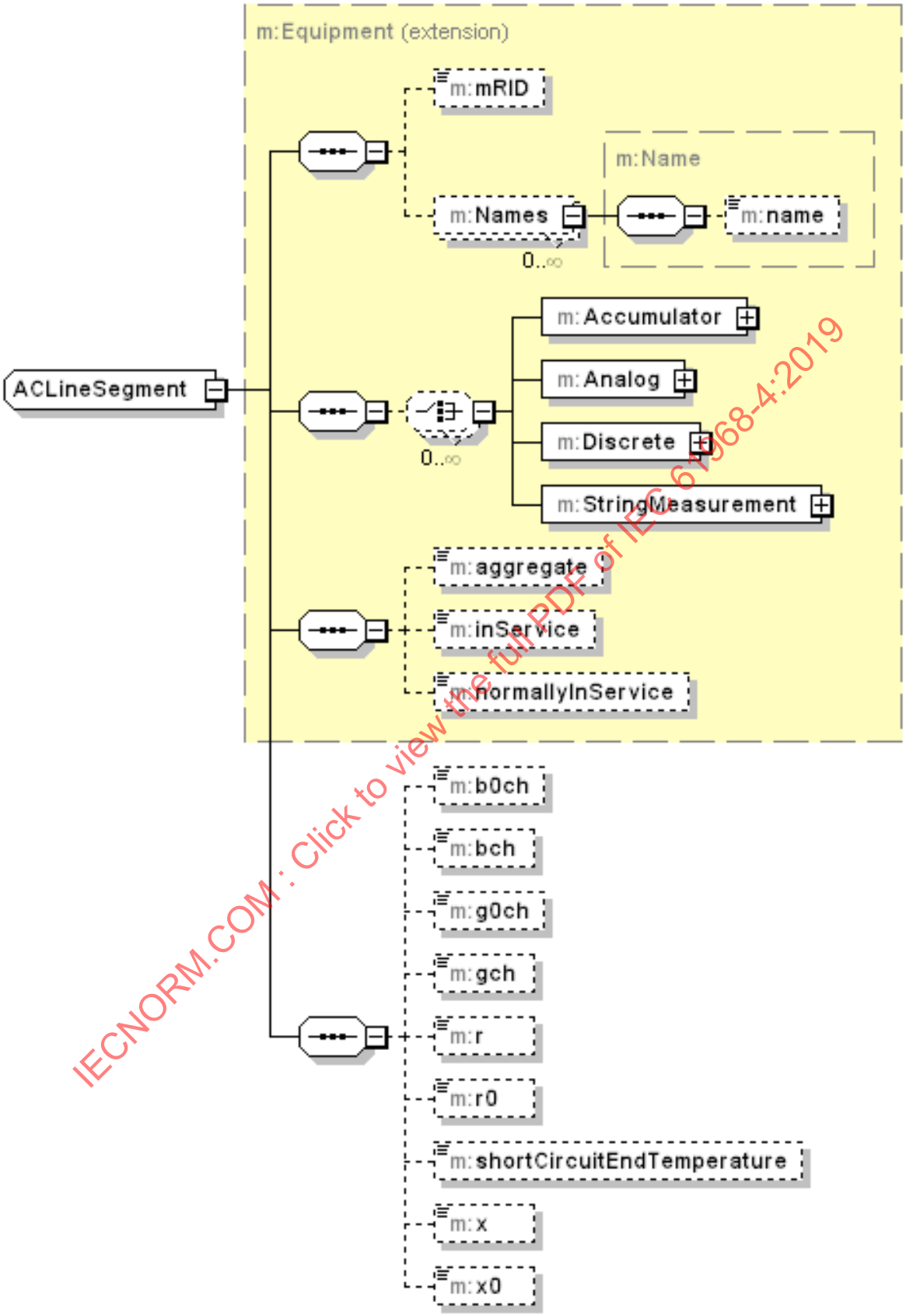


Figure 44 – AssetPSRDetails message: ACLineSegment element

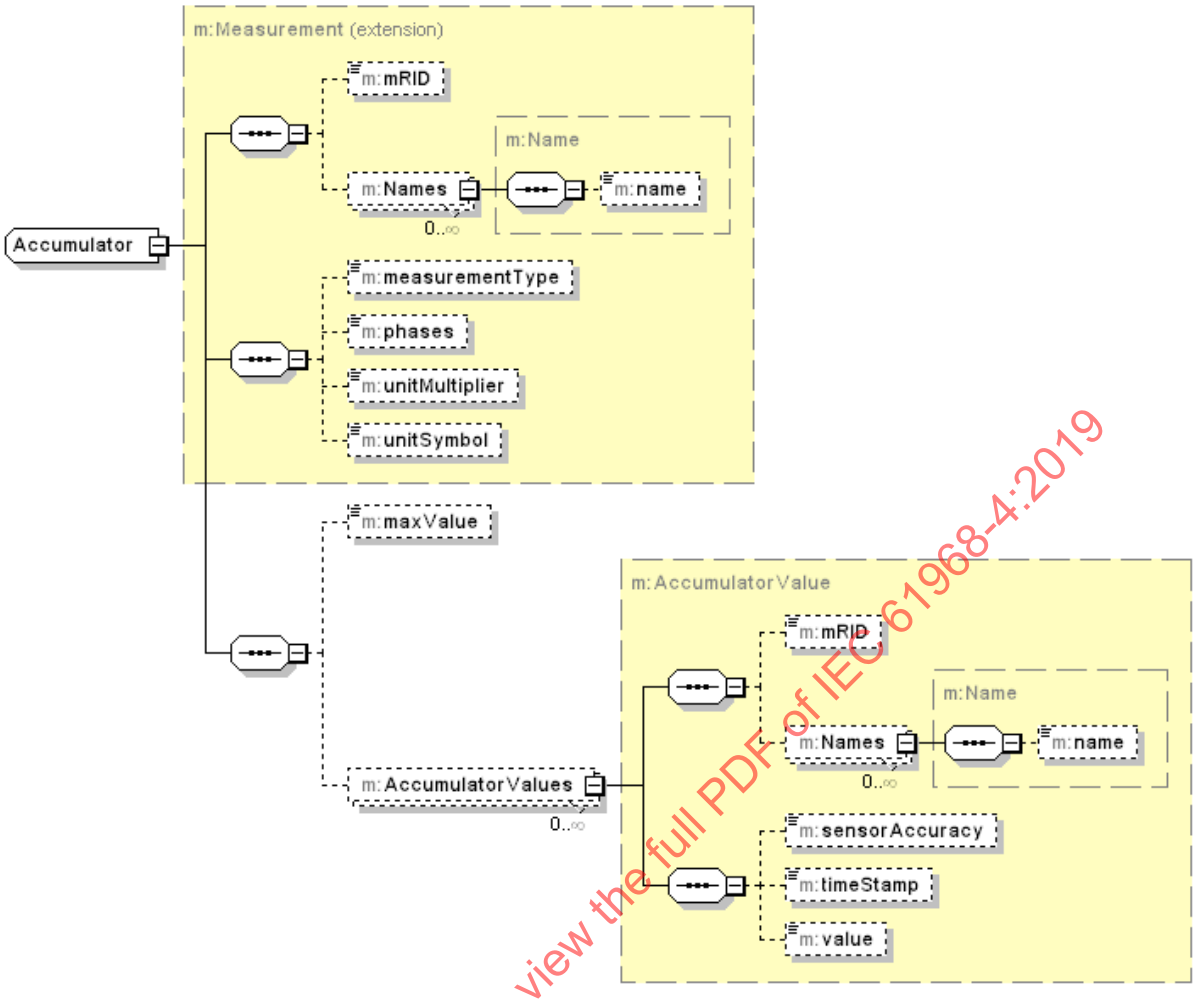


Figure 45 – AssetPSRDetails message: Accumulator element

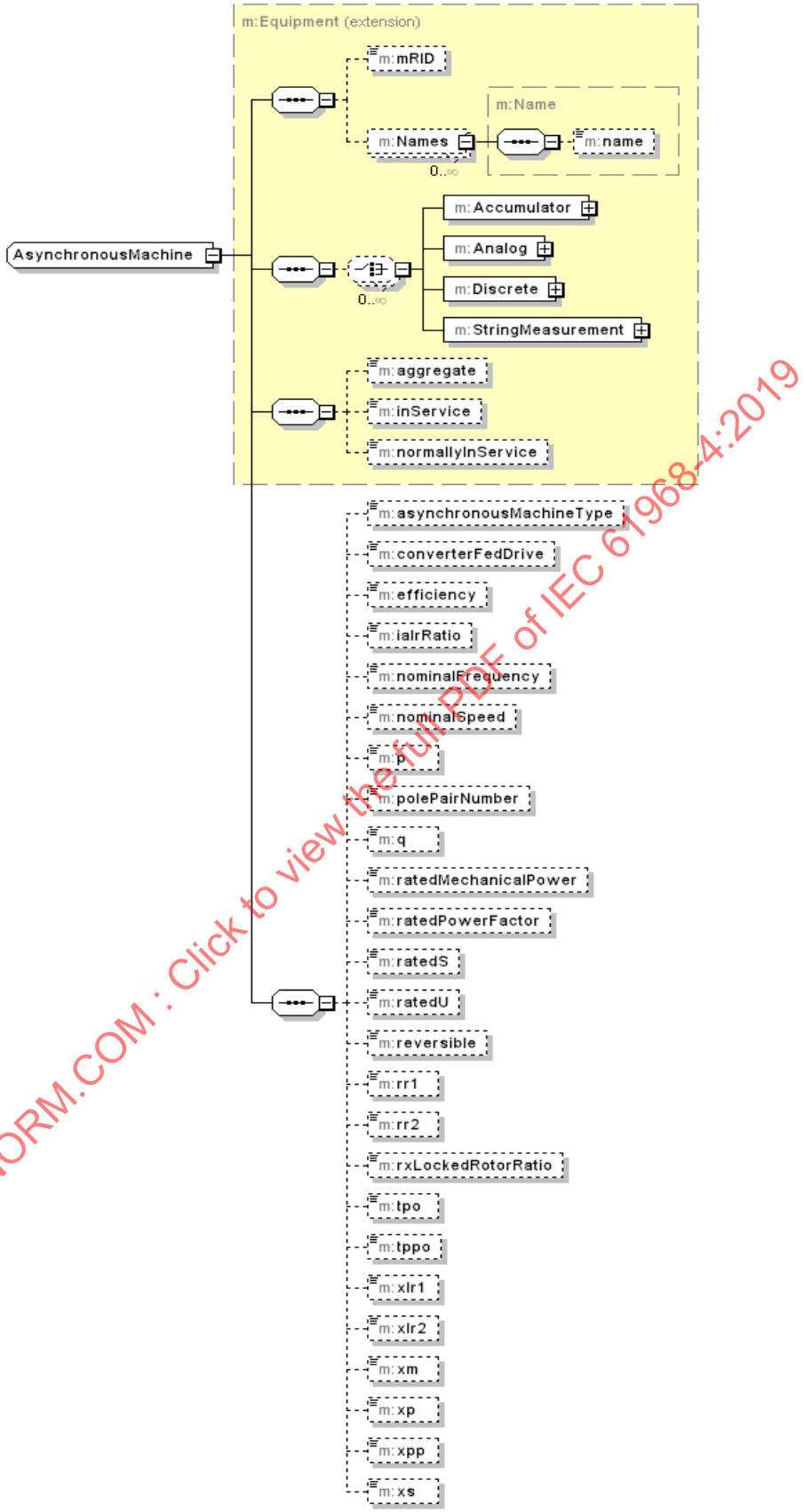


Figure 46 – AssetPSRDetails message: AsynchronousMachine element

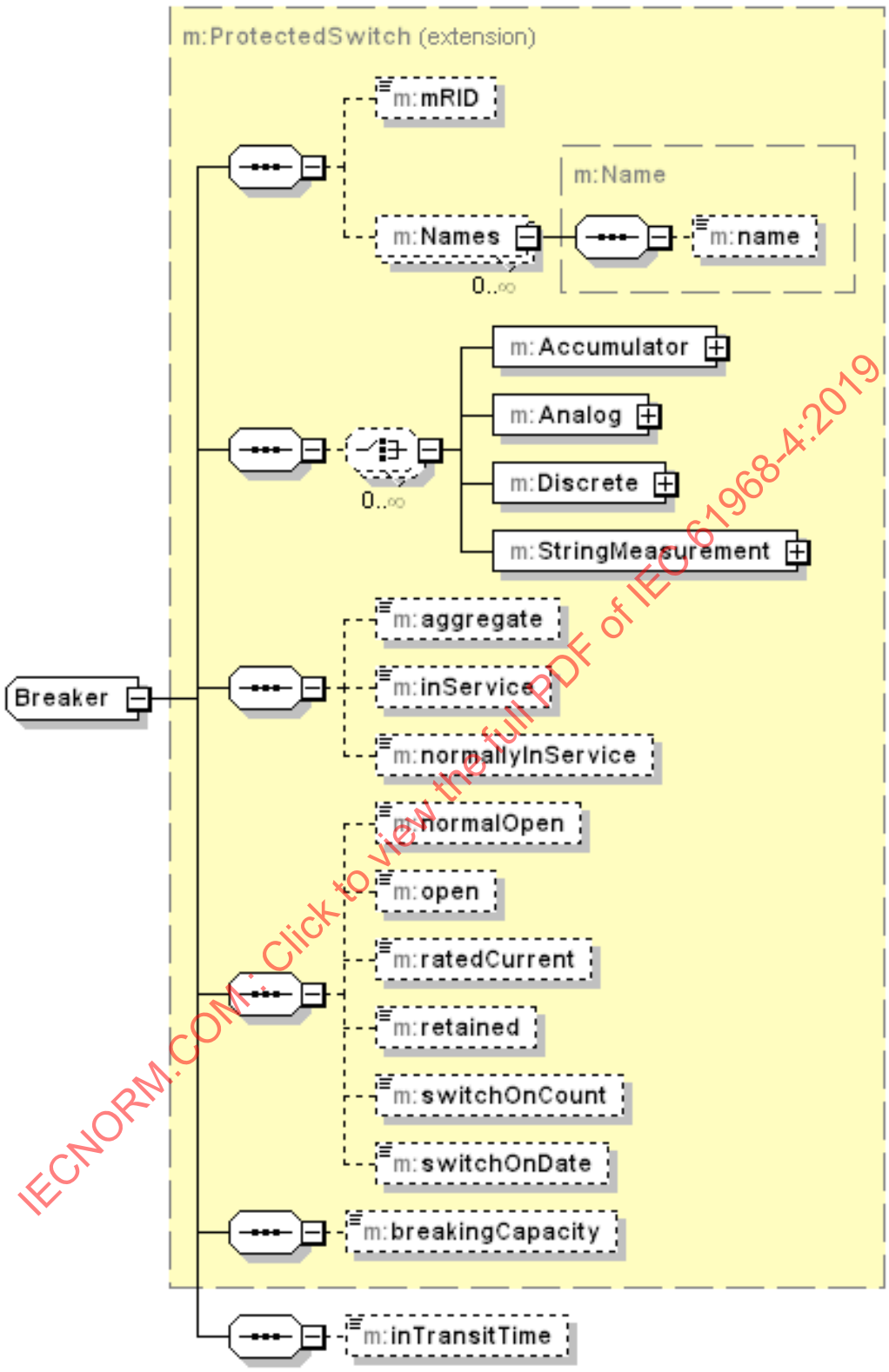


Figure 47 – AssetPSRDetails message: Breaker element

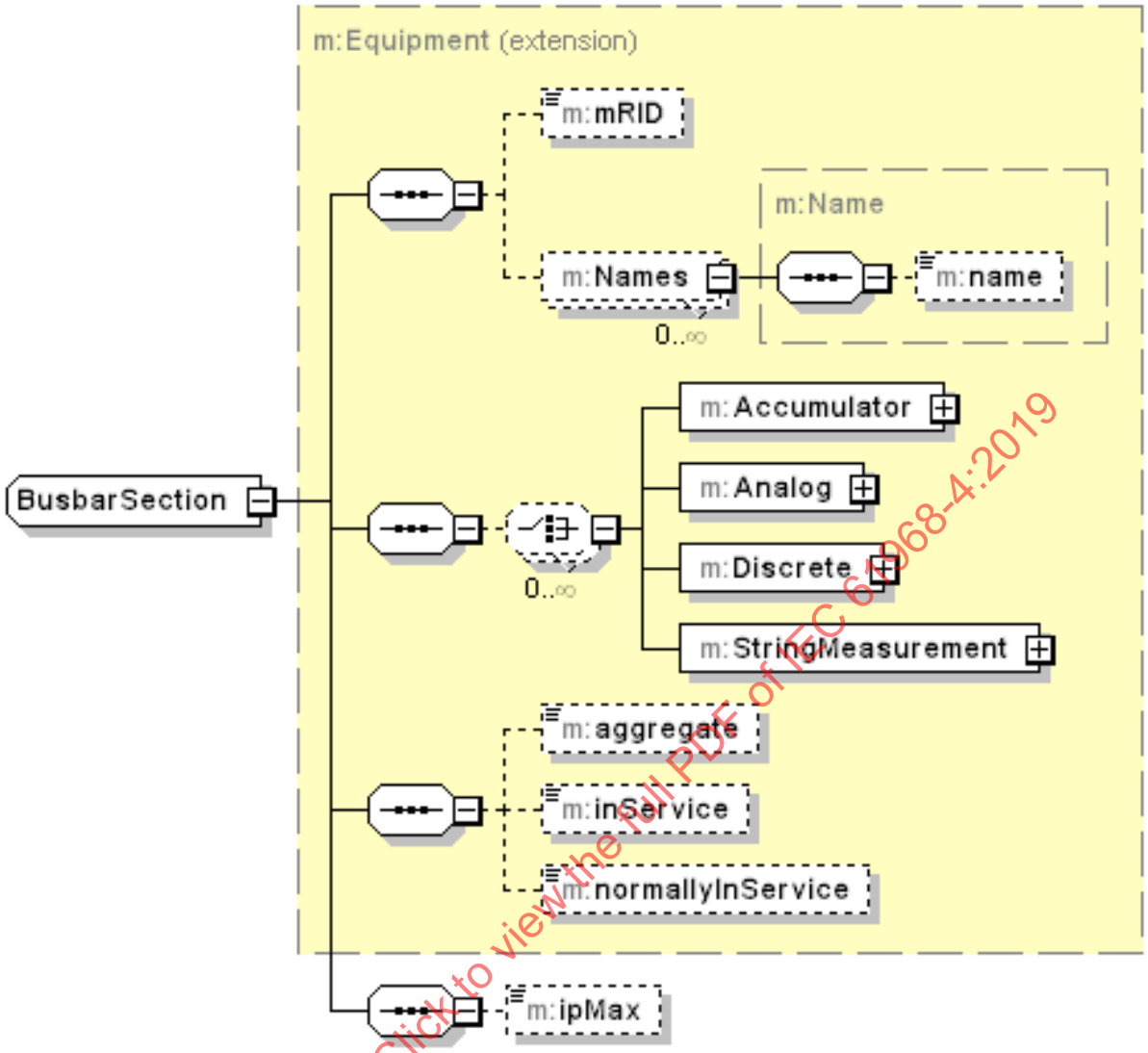


Figure 48 – AssetPSRDetails message: BusbarSection element

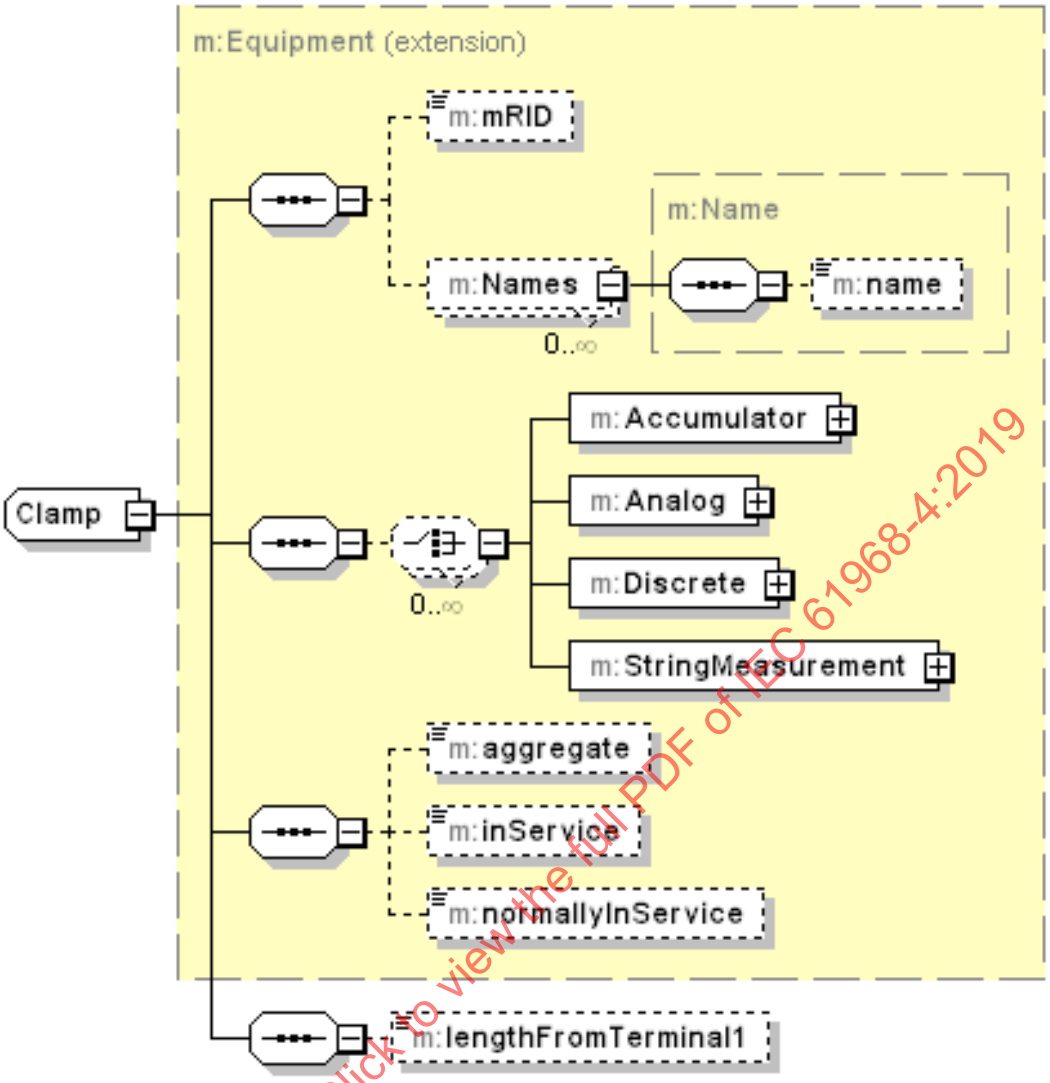


Figure 49 – AssetPSRDetails message: Clamp element

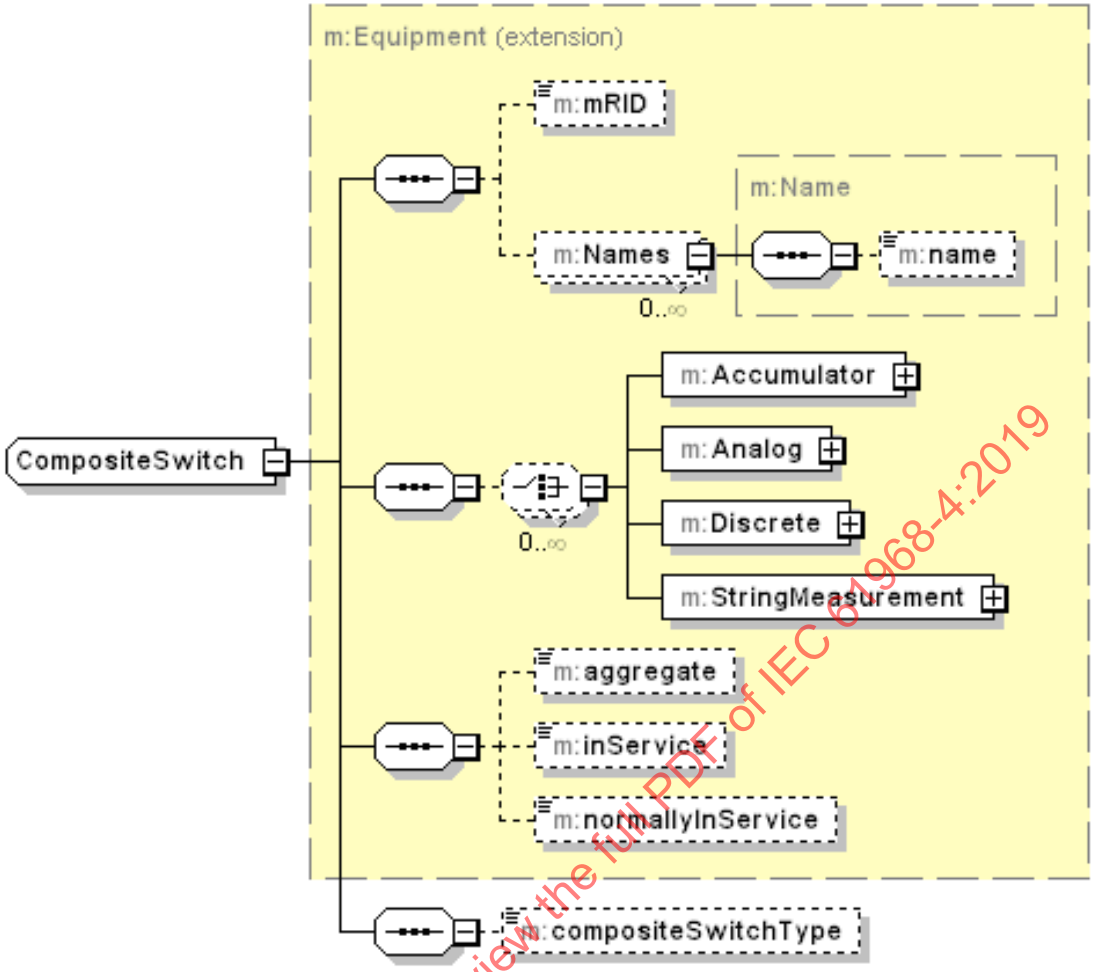


Figure 50 – AssetPSRDetails message: CompositeSwitch element

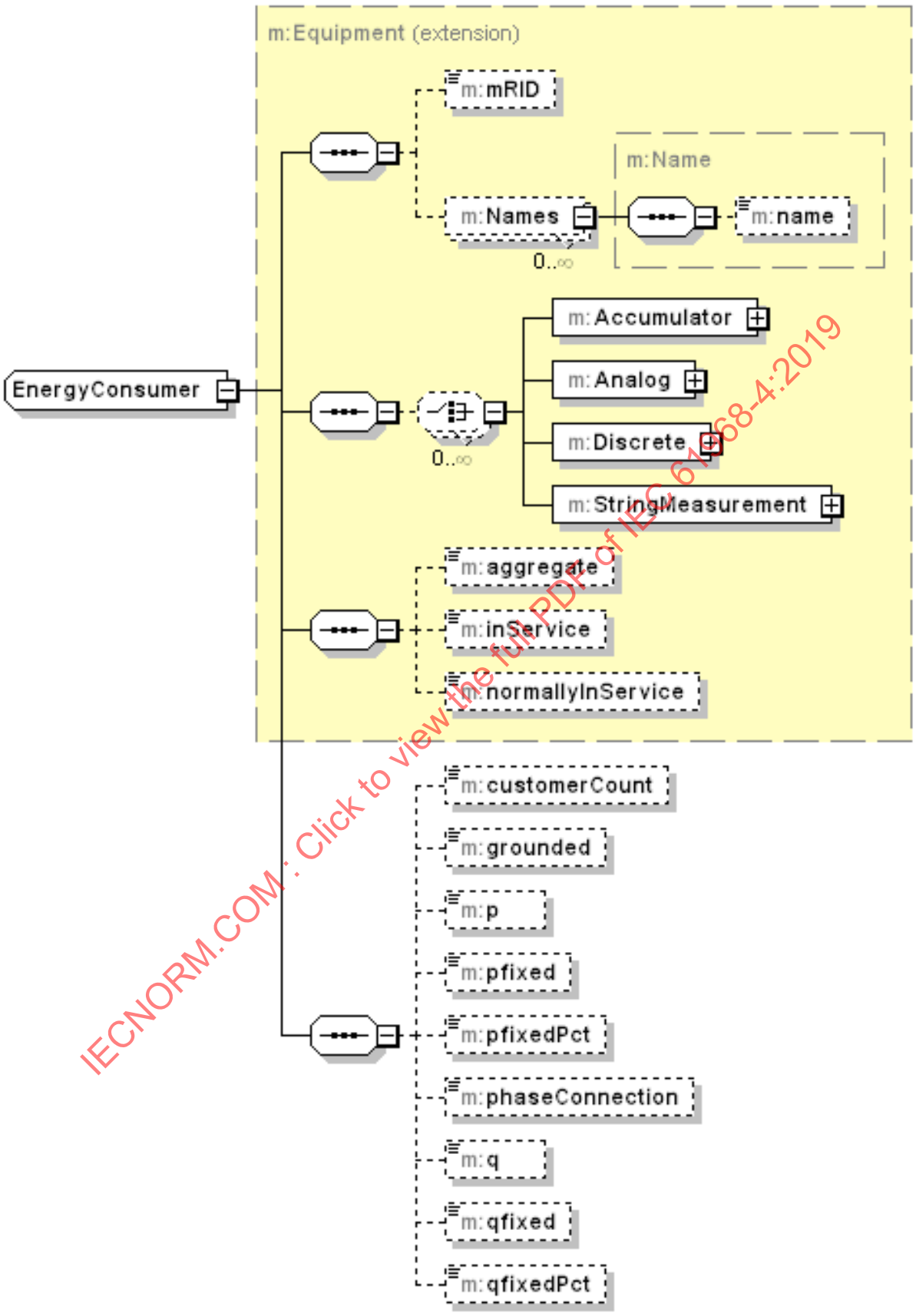


Figure 51 – AssetPSRDetails message: EnergyConsumer element

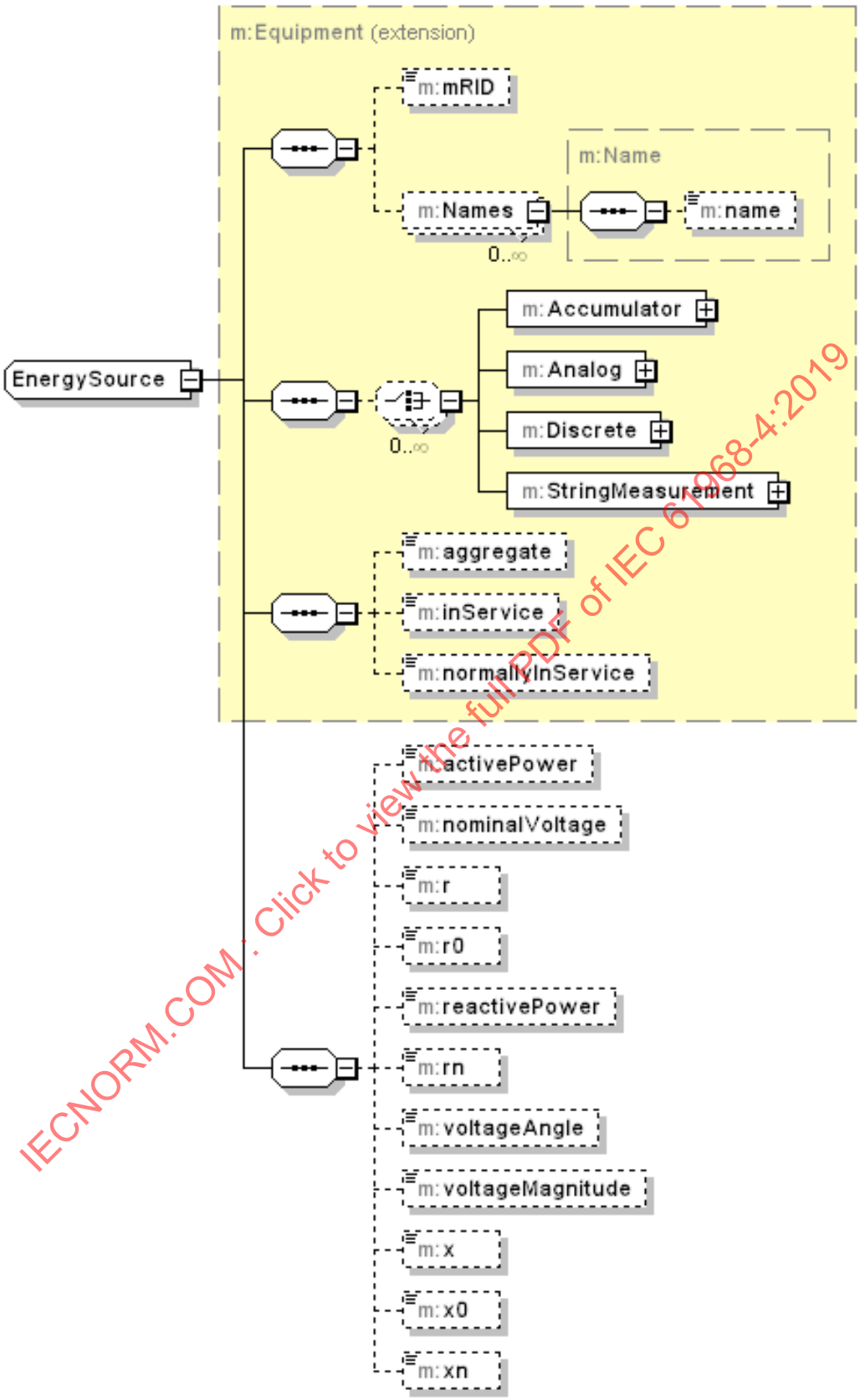


Figure 52 – AssetPSRDetails message: EnergySource element

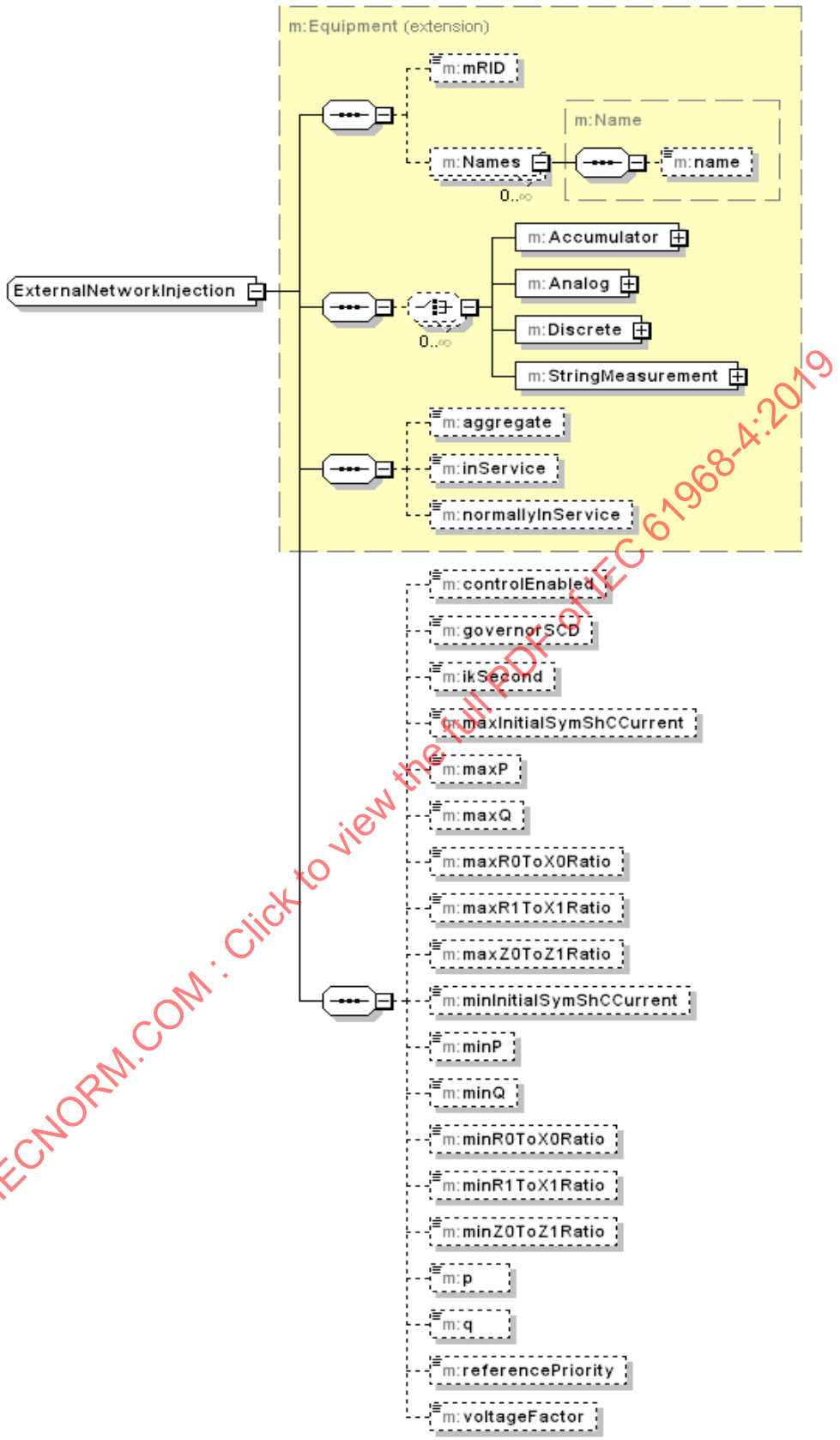


Figure 53 – AssetPSRDetails message: ExternalNetworkInjection element

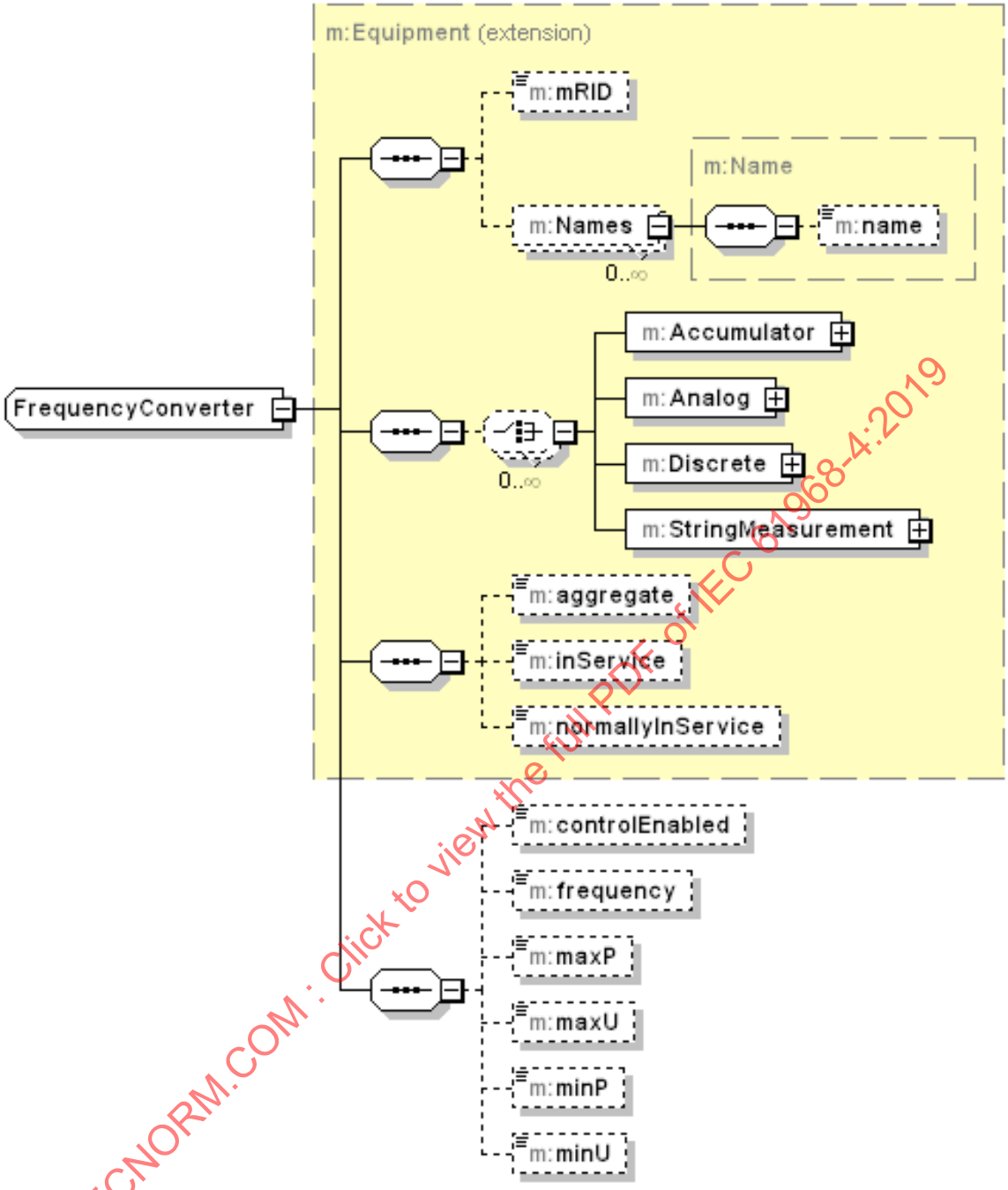


Figure 54 – AssetPSRDetails message: FrequencyConverter element

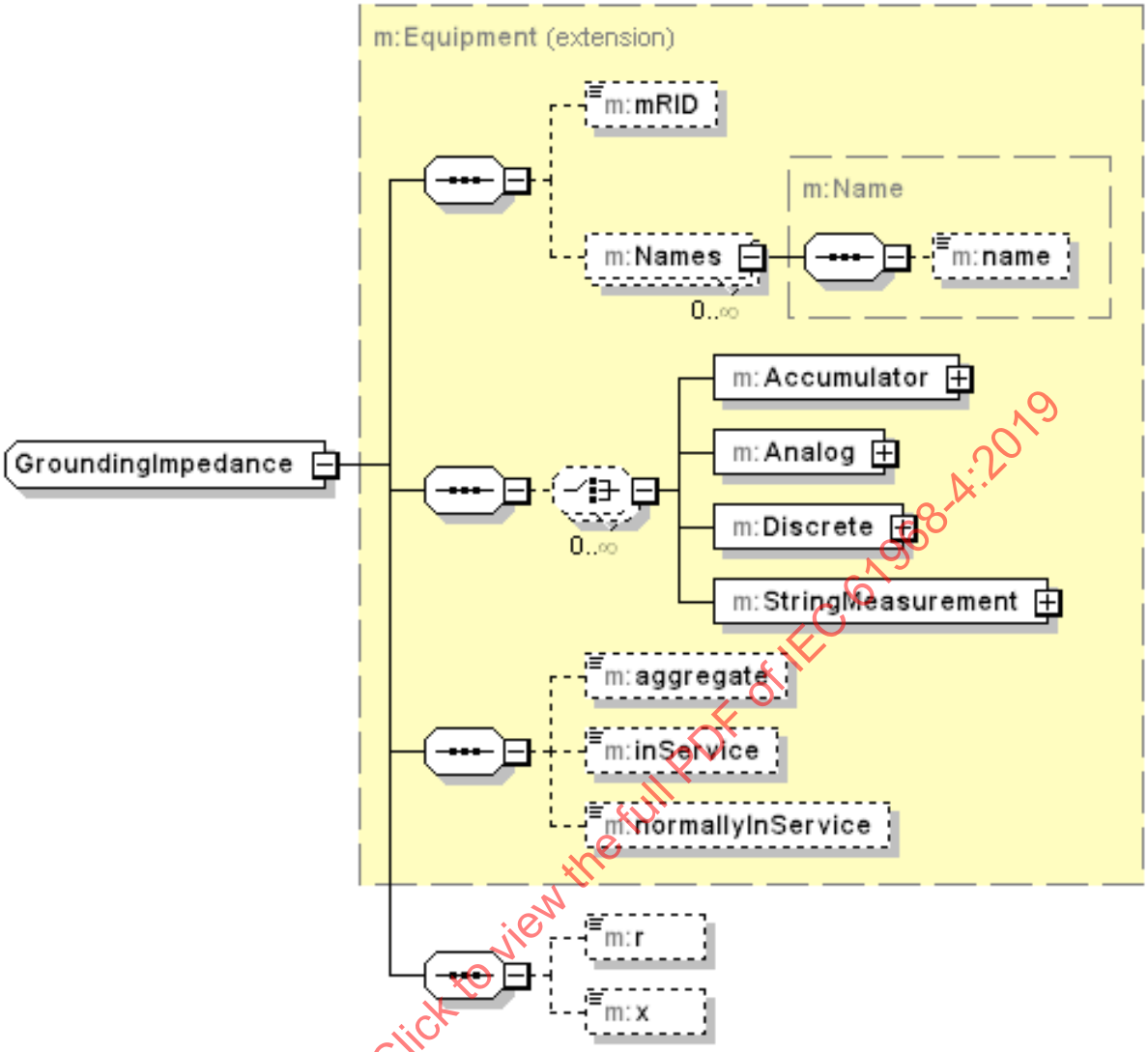


Figure 55 – AssetPSRDetails message: GroundingImpedance element

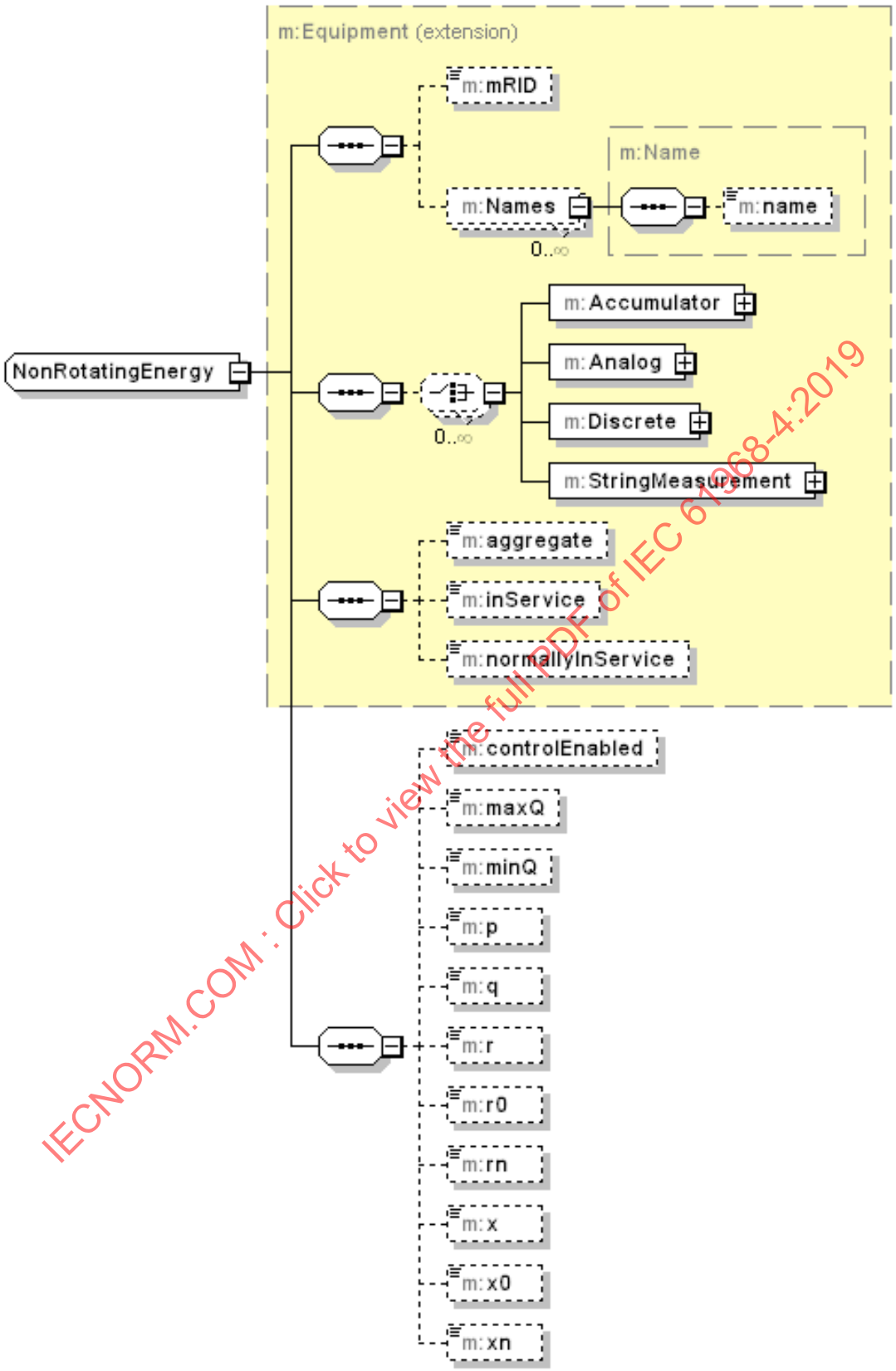


Figure 56 – AssetPSRDetails message: NonRotatingEnergy element

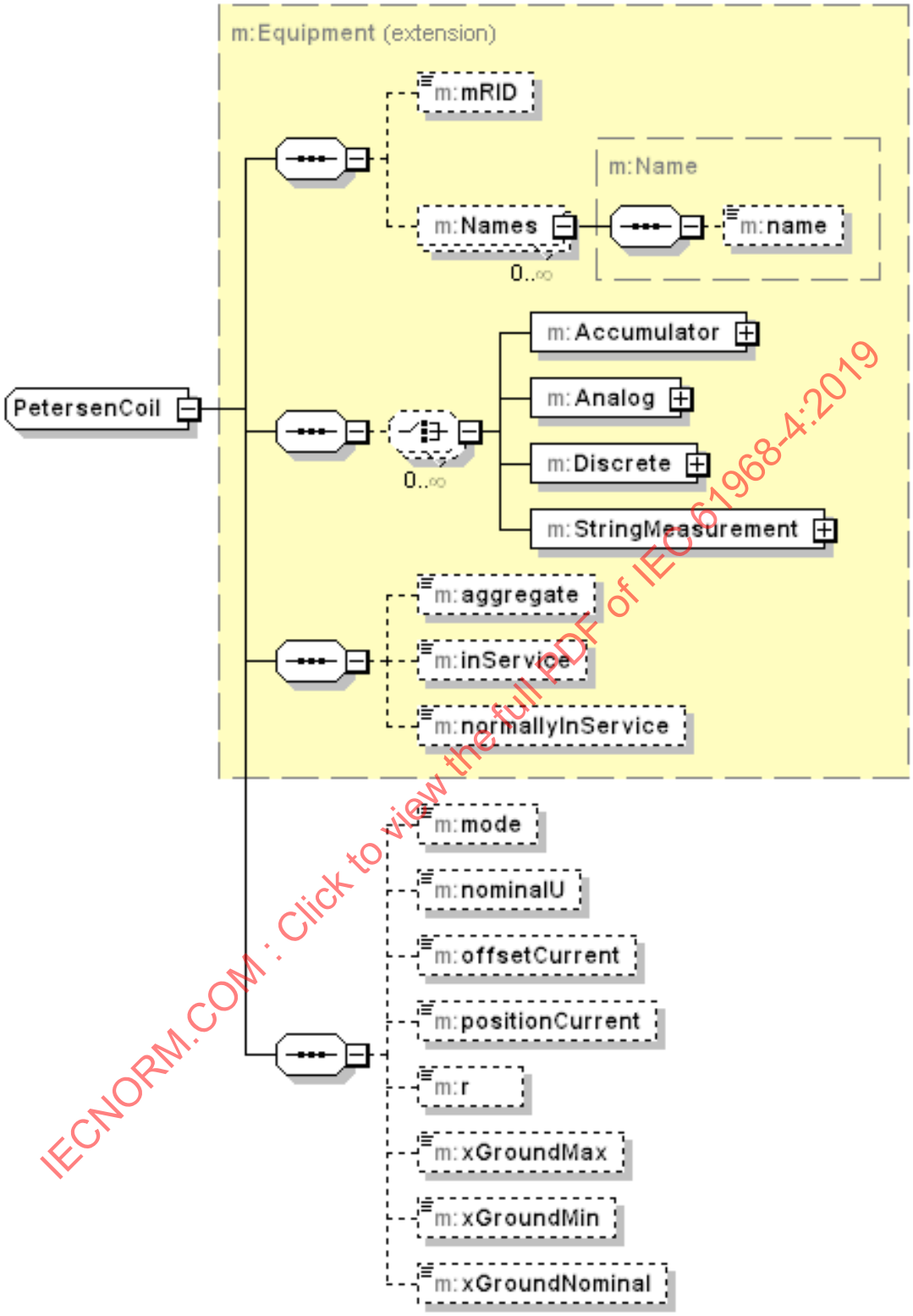


Figure 57 – AssetPSRDetails message: PetersenCoil element

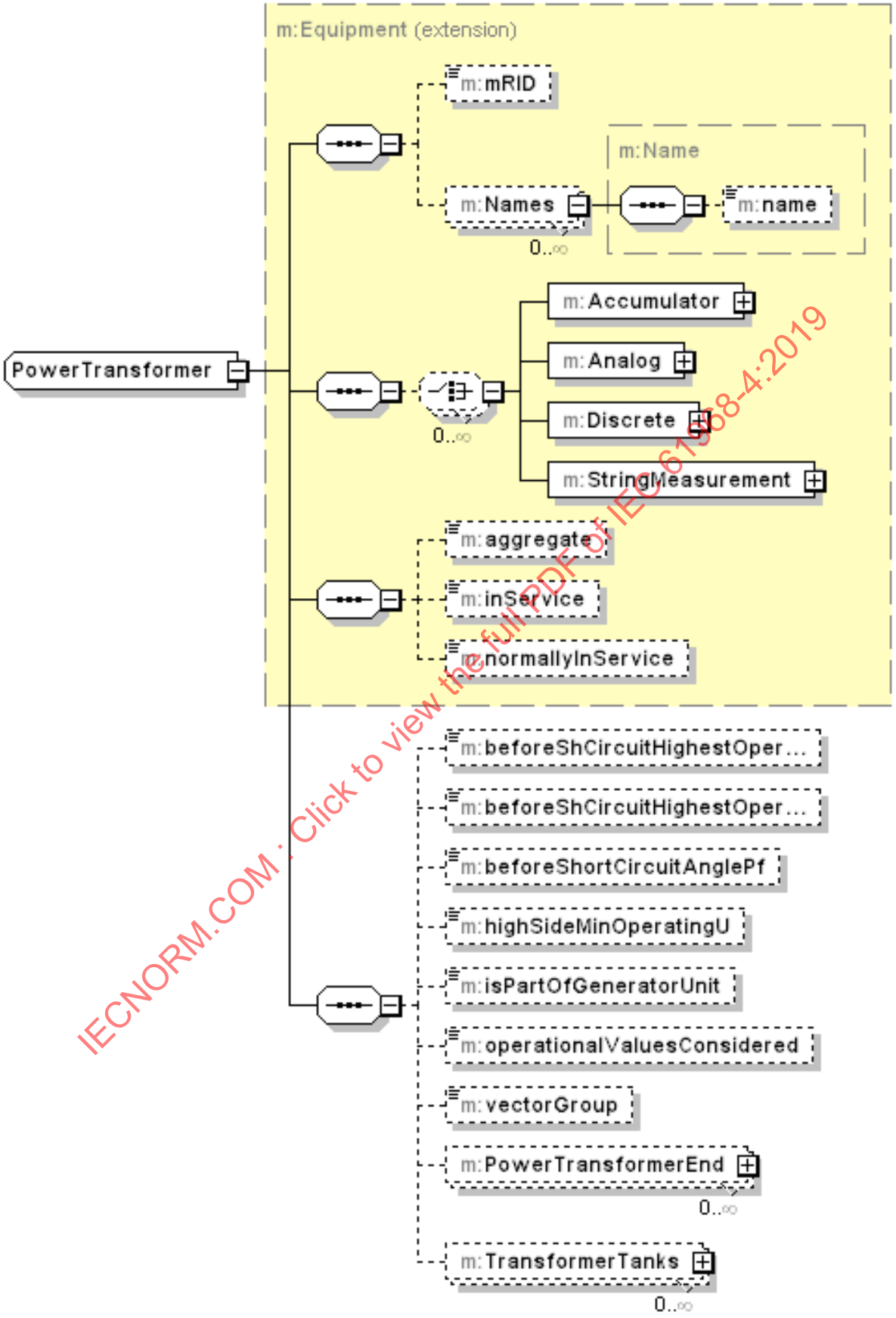


Figure 58 – AssetPSRDetails message: PowerTransformer element

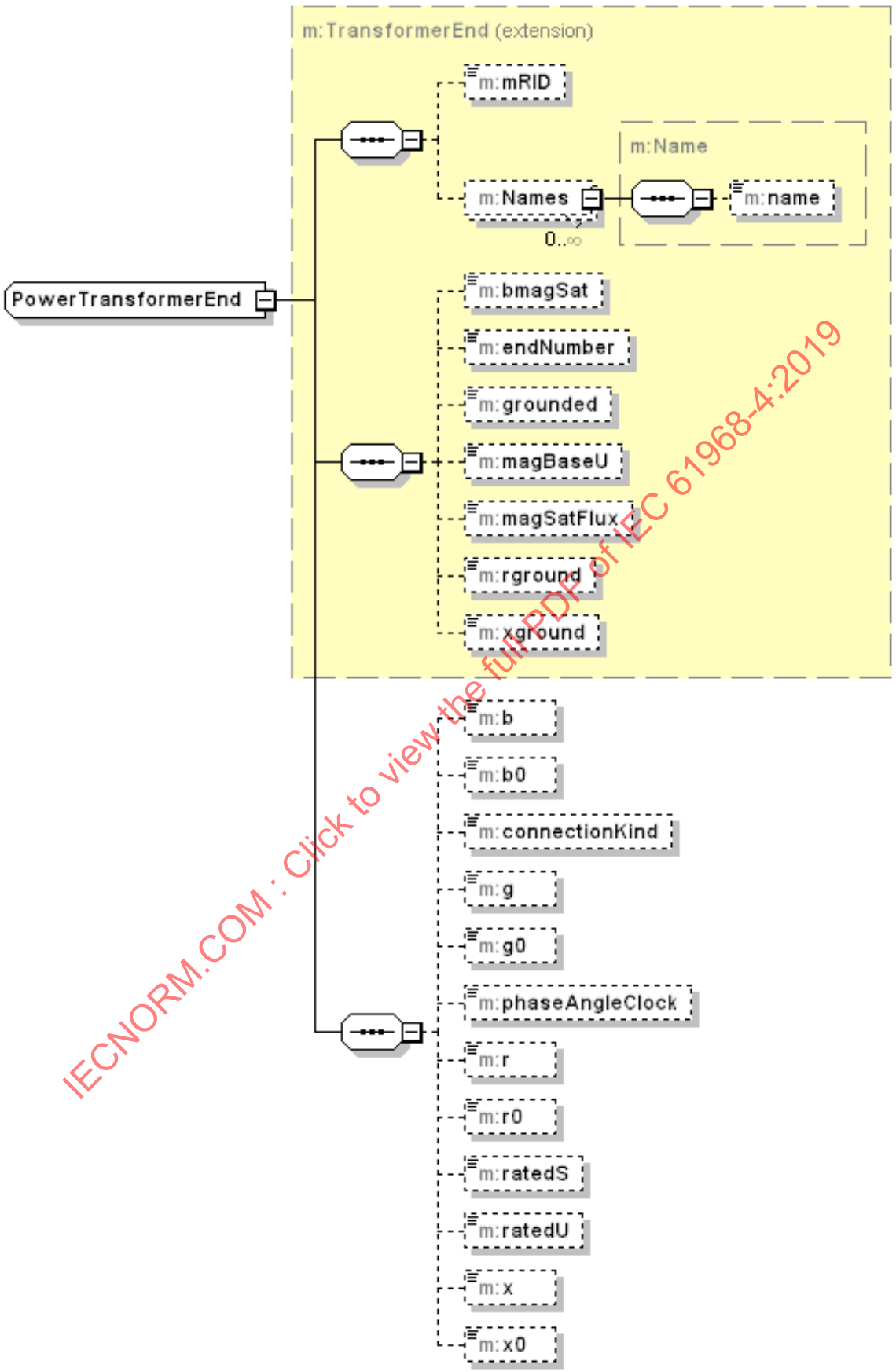


Figure 59 – AssetPSRDetails message: PowerTransformerEnd element

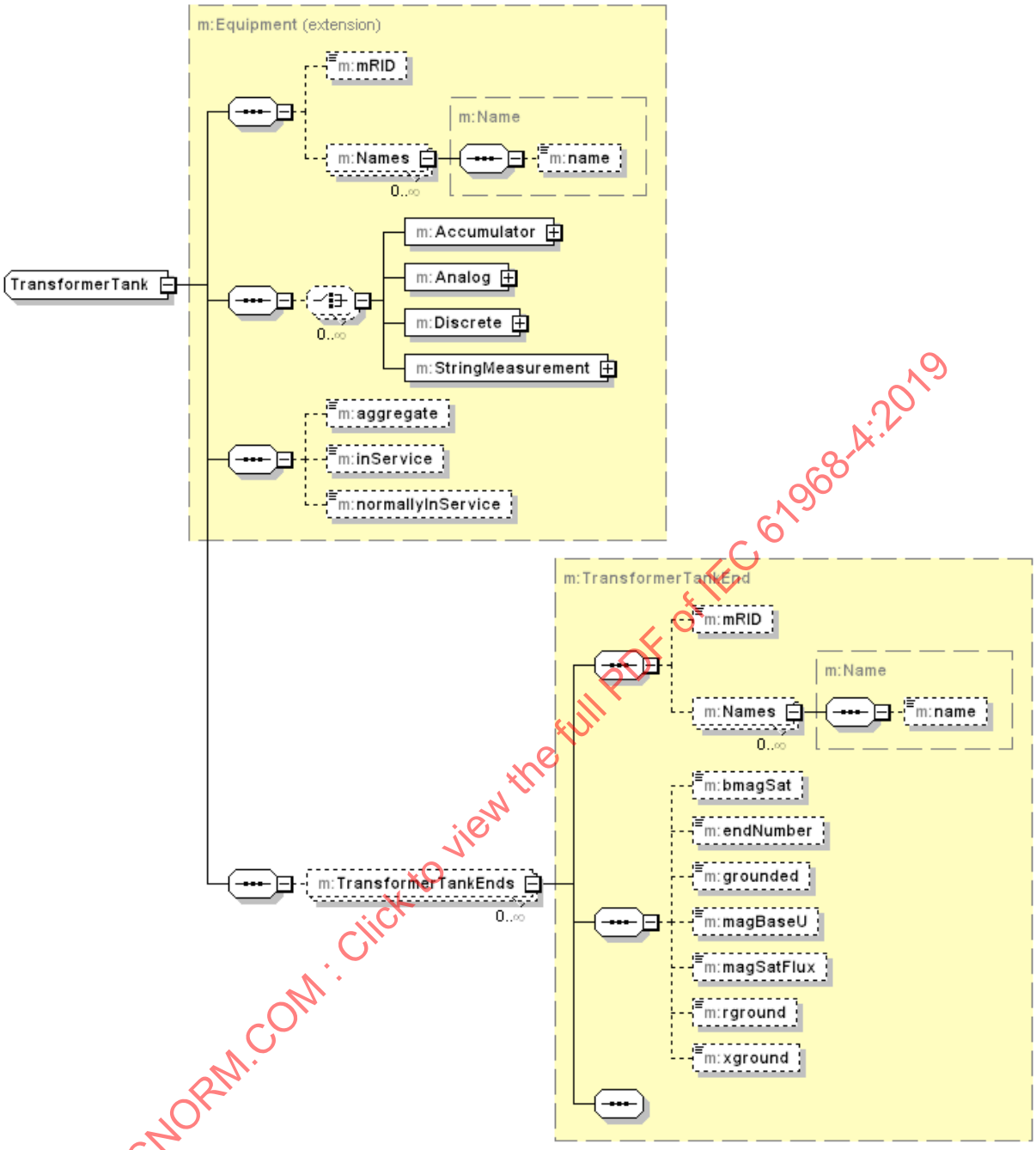


Figure 60 – AssetPSRDetails message: TransformerTank element

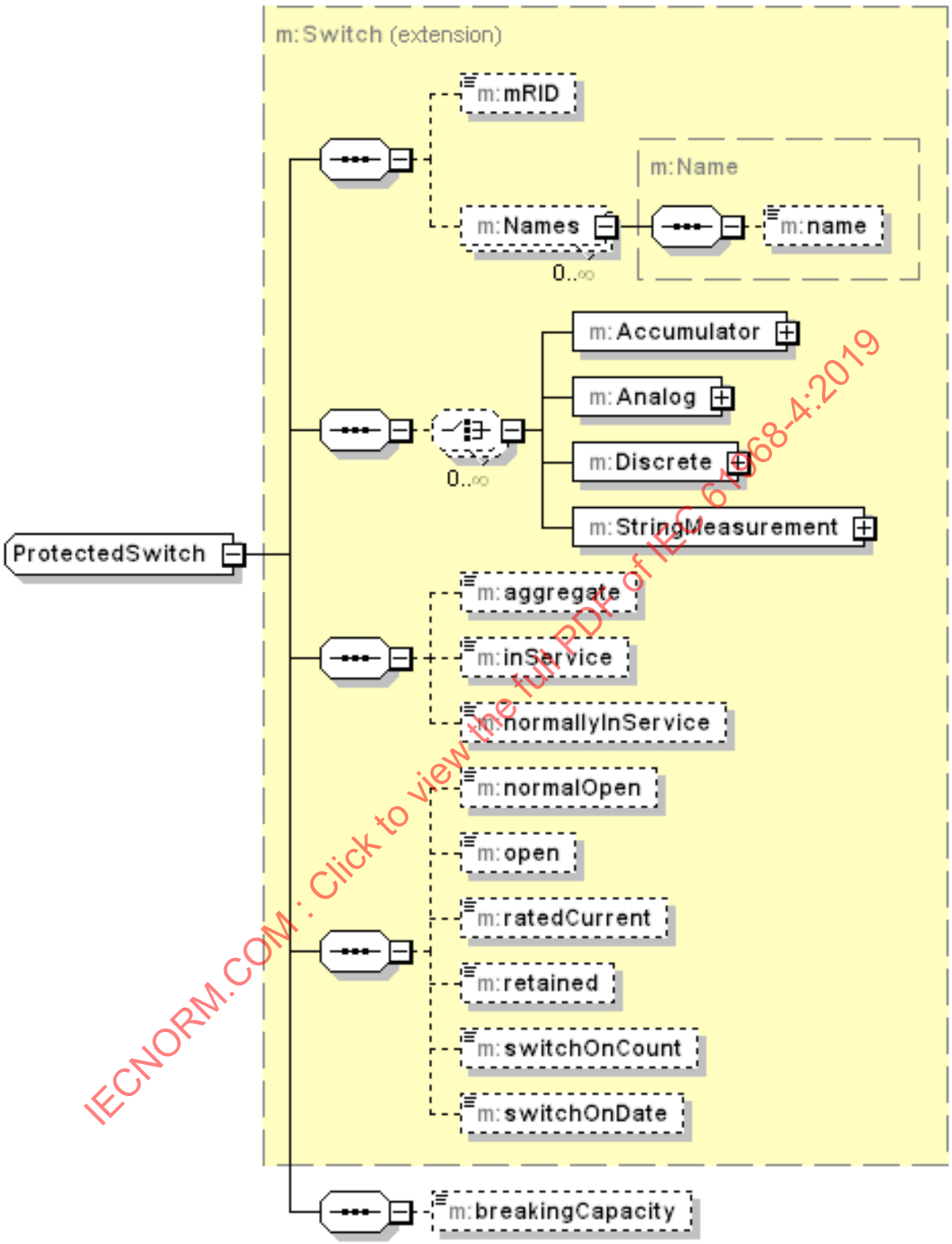


Figure 61 – AssetPSRDetails message: ProtectedSwitch element

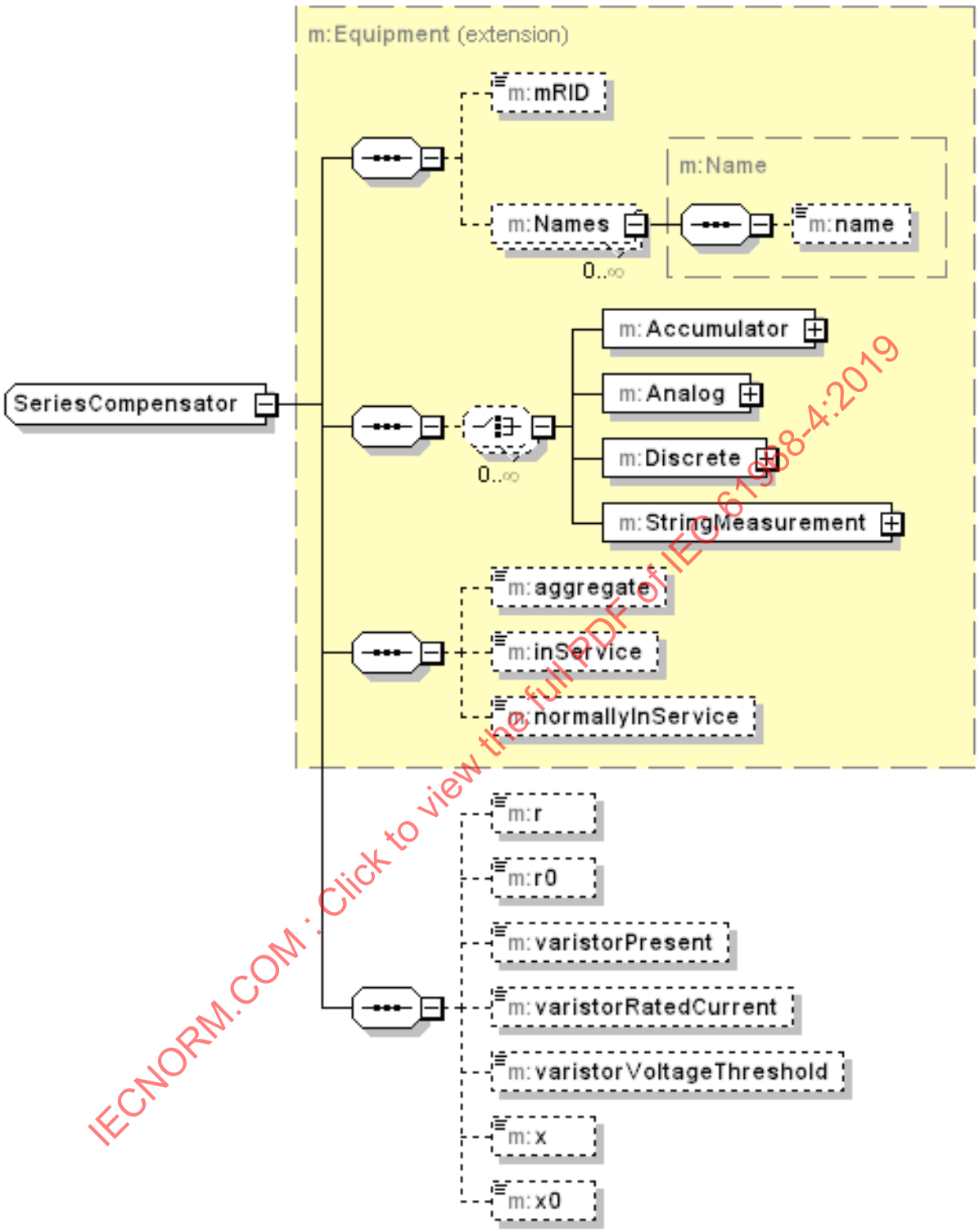


Figure 62 – AssetPSRDetails message: SeriesCompensator element

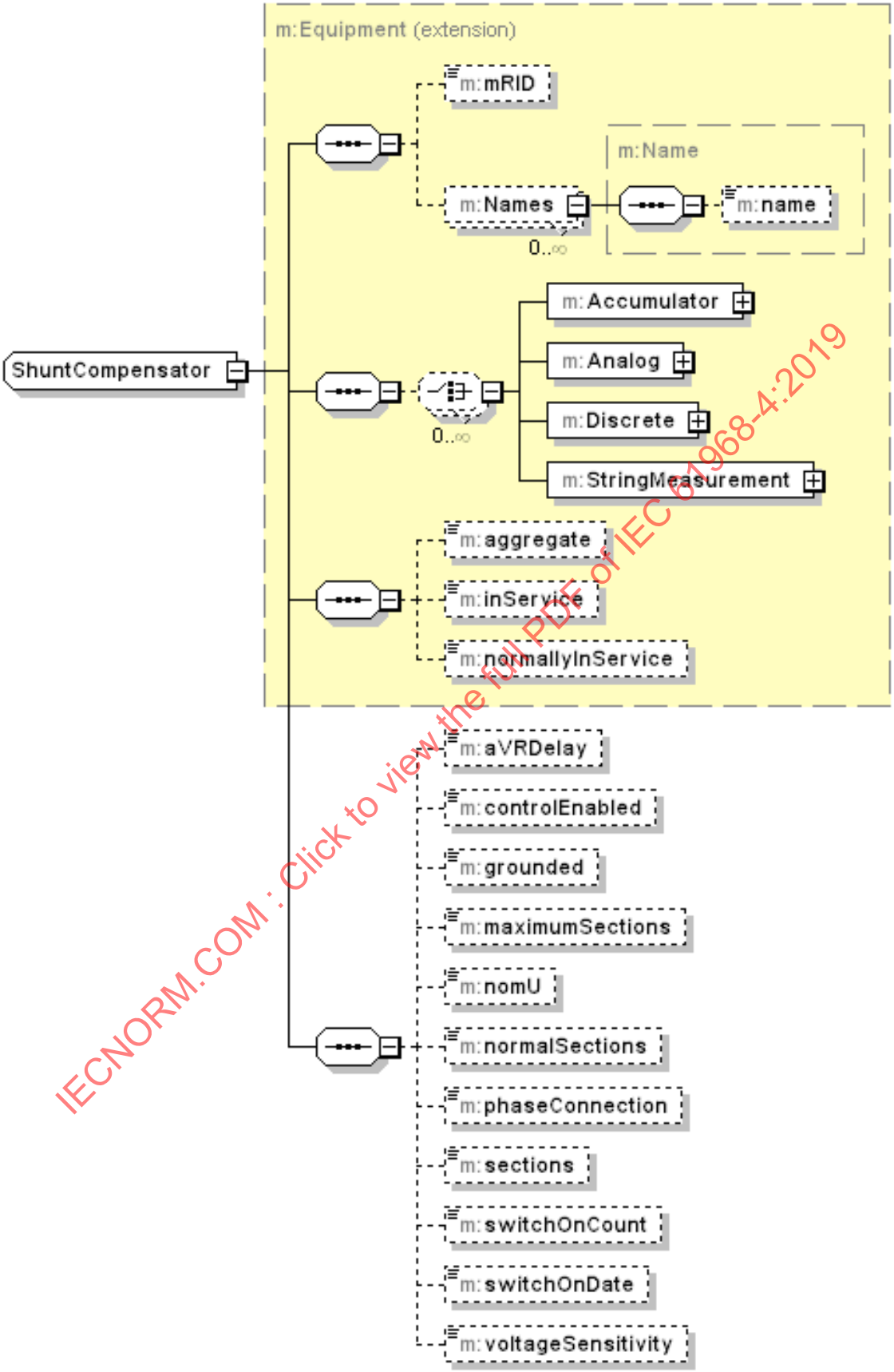


Figure 63 – AssetPSRDetails message: ShuntCompensator element

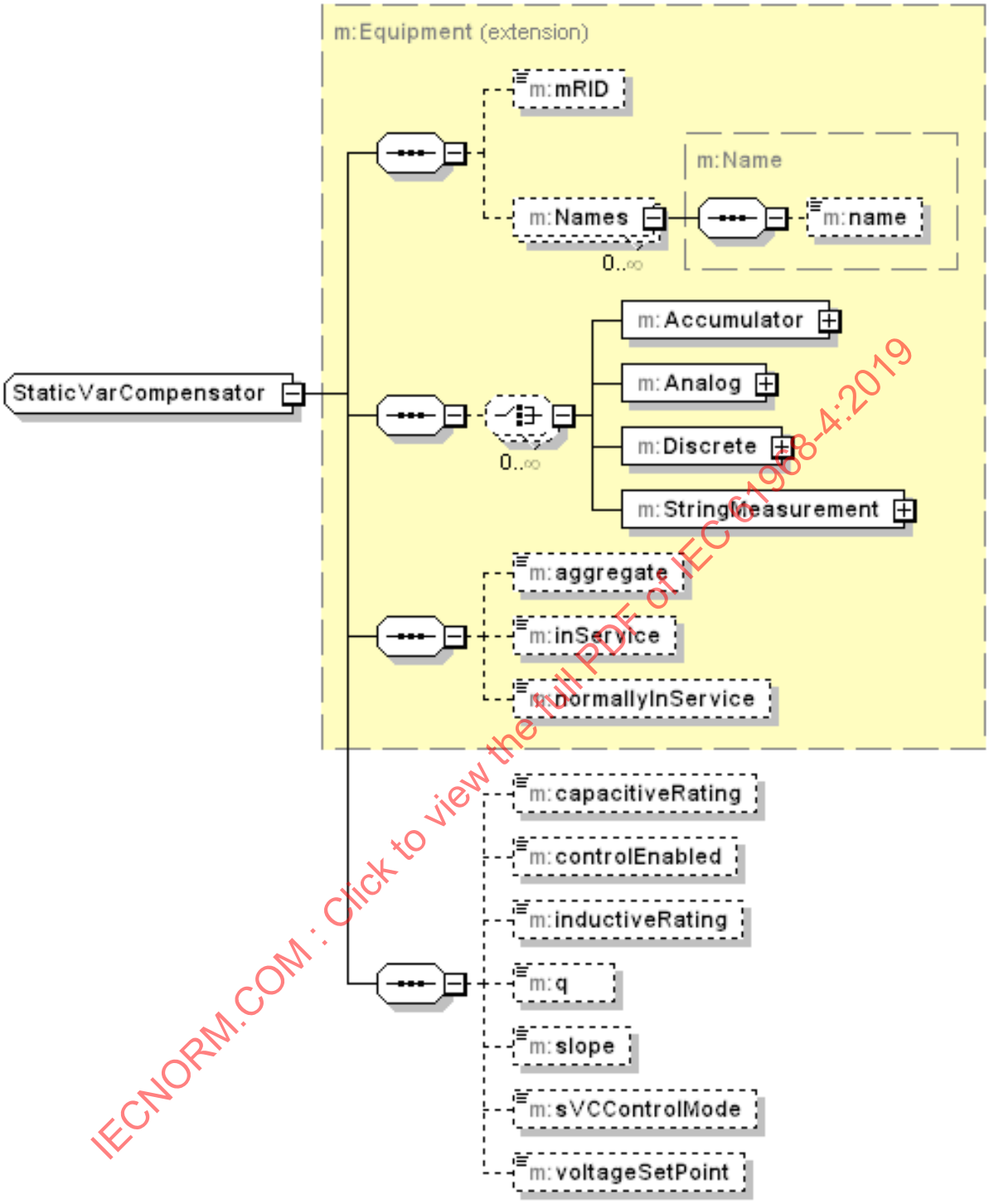


Figure 64 – AssetPSRDetails message: StaticVarCompensator element

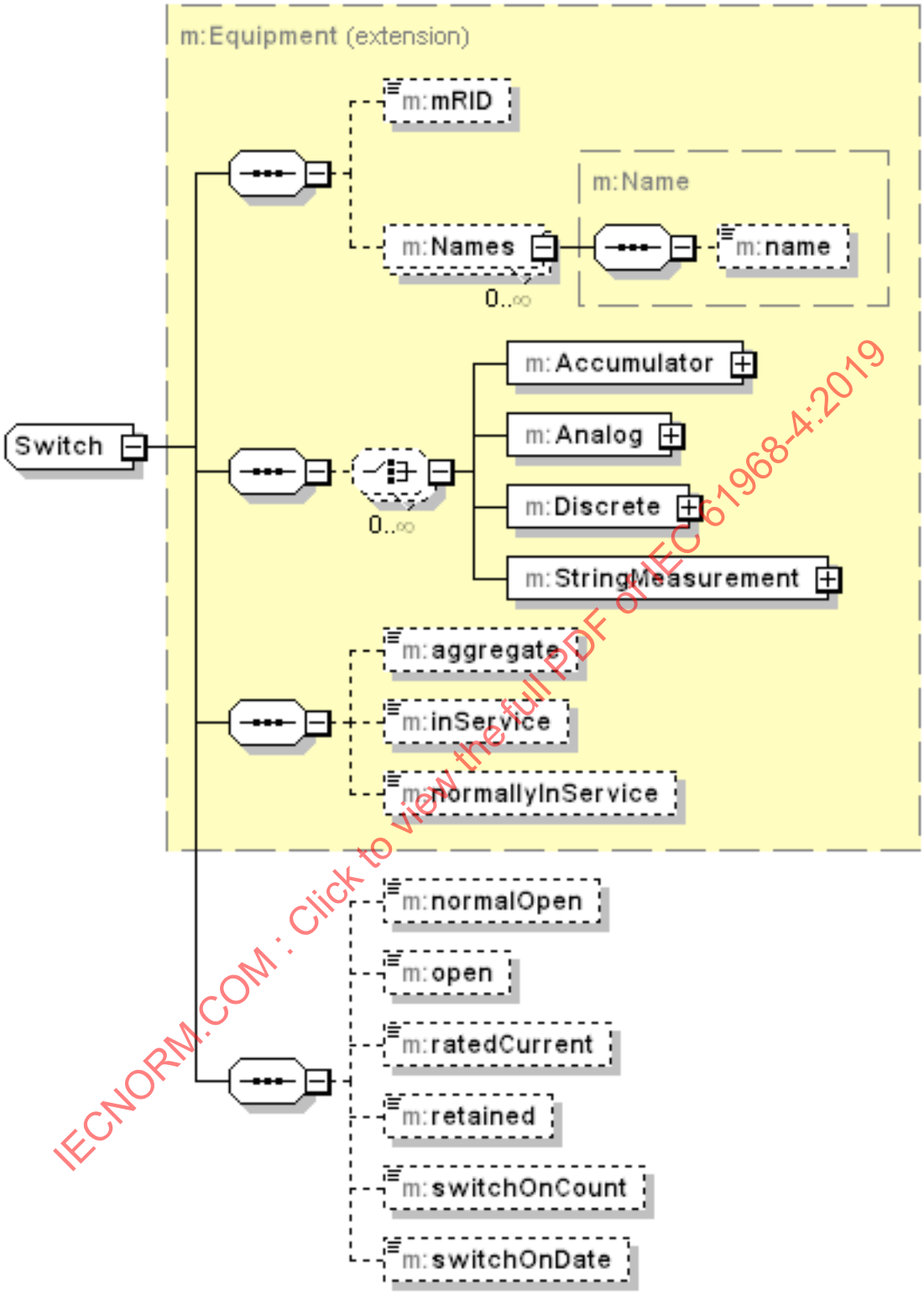


Figure 65 – AssetPSRDetails message: Switch element

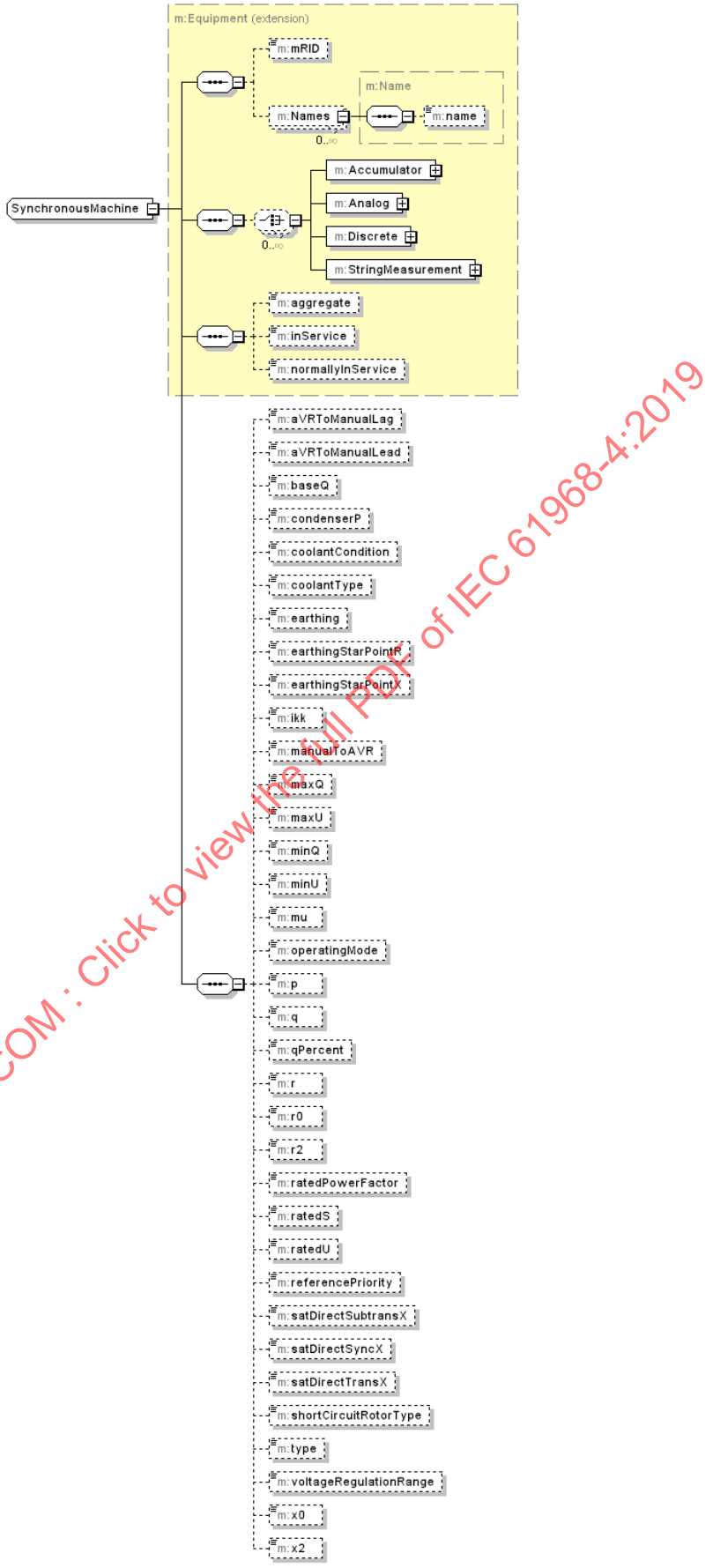


Figure 66 – AssetPSRDetails message: SynchronousMachine element

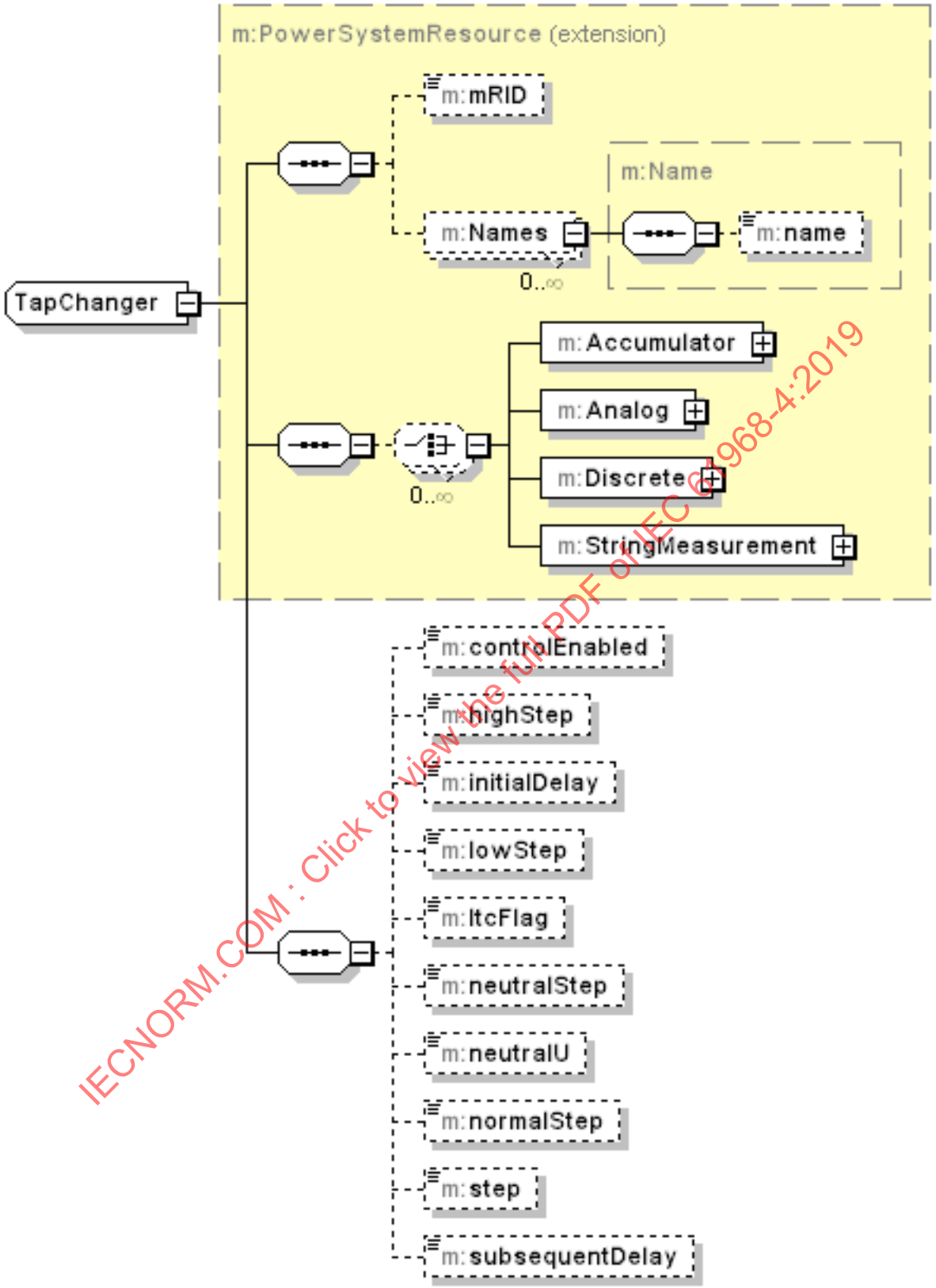


Figure 67 – AssetPSRDetails message: TapChanger element

The following is an XML example for an AssetState message payload, which shows the normalOpen state of a switch, which may need to be exchanged between systems when updated for seasonal switching; and the length of a conductor, which may be the as-designed length being exchanged to check against the as-built length.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetState xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetState.xsd">
	<m:Asset>
		<m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
		<m:Switch>
			<m:normalOpen>true</m:normalOpen>
		</m:Switch>
	</m:Asset>
	<m:Asset>
		<m:mRID>6a9fb099-e67d-4c33-88f4-aa3e479ec1da</m:mRID>
		<m:Conductor>
			<m:length>4025</m:length>
		</m:Conductor>
	</m:Asset>
</m:AssetState>
```

5.10 AssetProcedures message

5.10.1 General

An AssetProcedures message can contain the procedures that are applicable to an asset and the datasets that were produced from such procedures. While this message contains the identifying information of the Procedures and ProcedureDataSets, further details are obtained using Procedures and ProcedureDataSets messages.

5.10.2 Applications

The AssetProcedures message is used to identify the Procedures that are applicable to one or more Assets as well as the ProcedureDataSets (or child classes thereof) produced from application of the Procedures.

A typical application for this message is for an asset analytic system to query and discover the applicable Procedures and resultant ProcedureDataSets for assets of interest, as shown in Figure 68. In this figure, an asset analytic system is querying a maintenance and inspection system to discover the Procedure / ProcedureDataSet information pertaining to the asset of interest.

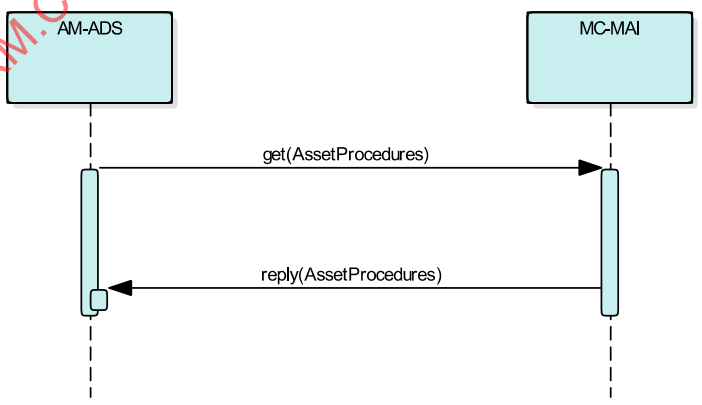


Figure 68 – AssetProcedures message exchange

5.10.3 Message format

Figure 69 shows the AssetProcedures message format. The message payload shown in the figure consists of one or more Assets, which contain a multiplicity of Procedures. Furthermore, the Asset objects can contain the ProcedureDataSet (or child class) that are

available for that Asset. These ProcedureDataSet (or child class) objects reference the Procedure that produced the dataset.

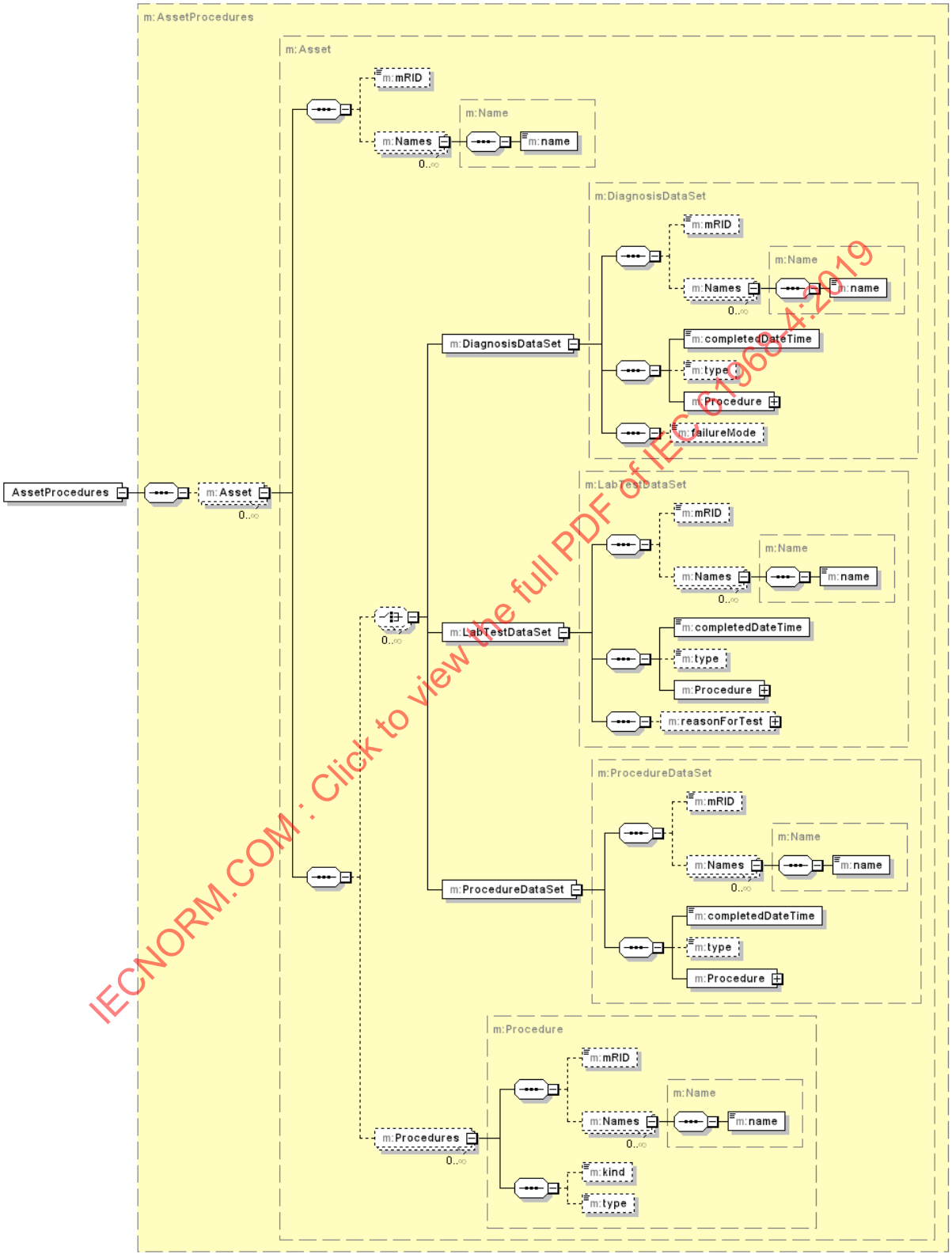


Figure 69 – AssetProcedures message format

The following is an XML example for an AssetProcedures message payload. This shows an Asset with a LabTestDataSet object, which was produced by a diagnosis Procedure (Procedures.kind = diagnosis).

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetProcedures xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetProcedures.xsd">
      <m:Asset>
            <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            <m:LabTestDataSet>
                  <m:mRID> fe37a60e-d8b7-49e5-8c12-93af7c58d223</m:mRID>
                  <m:completedDateTime>2015-12-19T09:30:47Z</m:completedDateTime>
                  <m:Procedure ref="e0be245f-92d8-4817-8672-48710e3835f2"/>
            </m:LabTestDataSet>
            <m:Procedures>
                  <m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
                  <m:kind>diagnosis</m:kind>
            </m:Procedures>
      </m:Asset>
</m:AssetProcedures>
```

5.11 Procedures message

5.11.1 General

A Procedures message can contain the details of Procedure, such as the attributes that describe the Procedure, the Assets to which the Procedure applies, and the Measurements that the Procedure produces. Further details of the Measurements are obtained using the MeasurementDetails message.

5.11.2 Applications

The Procedures message is used to exchange details of Procedures of interest. A Procedure element in this message can also contain identifying information of the Assets to which the Procedure applies and the Measurements that are obtained from the Procedure.

A typical application for this message is for an asset analytic system to query a maintenance and inspection system to discover details of the Procedures and identity of the resultant Measurements. This exchange is similar to Figure 68, with the AssetProcedures message replaced by the Procedures message.

5.11.3 Message format

Figure 70 shows the Procedures message format. The message payload shown in the figure consists of one or more Procedure, with its attributes. As shown in the figure, the Procedure element can contain identifying information for the Assets to which the Procedure applies. The Procedure element can also contain the Measurement child classes that result from execution of the Procedure. The identifying details of one of the Measurement child classes, namely AssetTemperaturePressureAnalog, is shown in Figure 71. As can be seen, this contains the identifying attributes inherited from parent classes, such as measurementType, as well as any more specific identifying attribute available, such as the enumerated "kind" attribute.

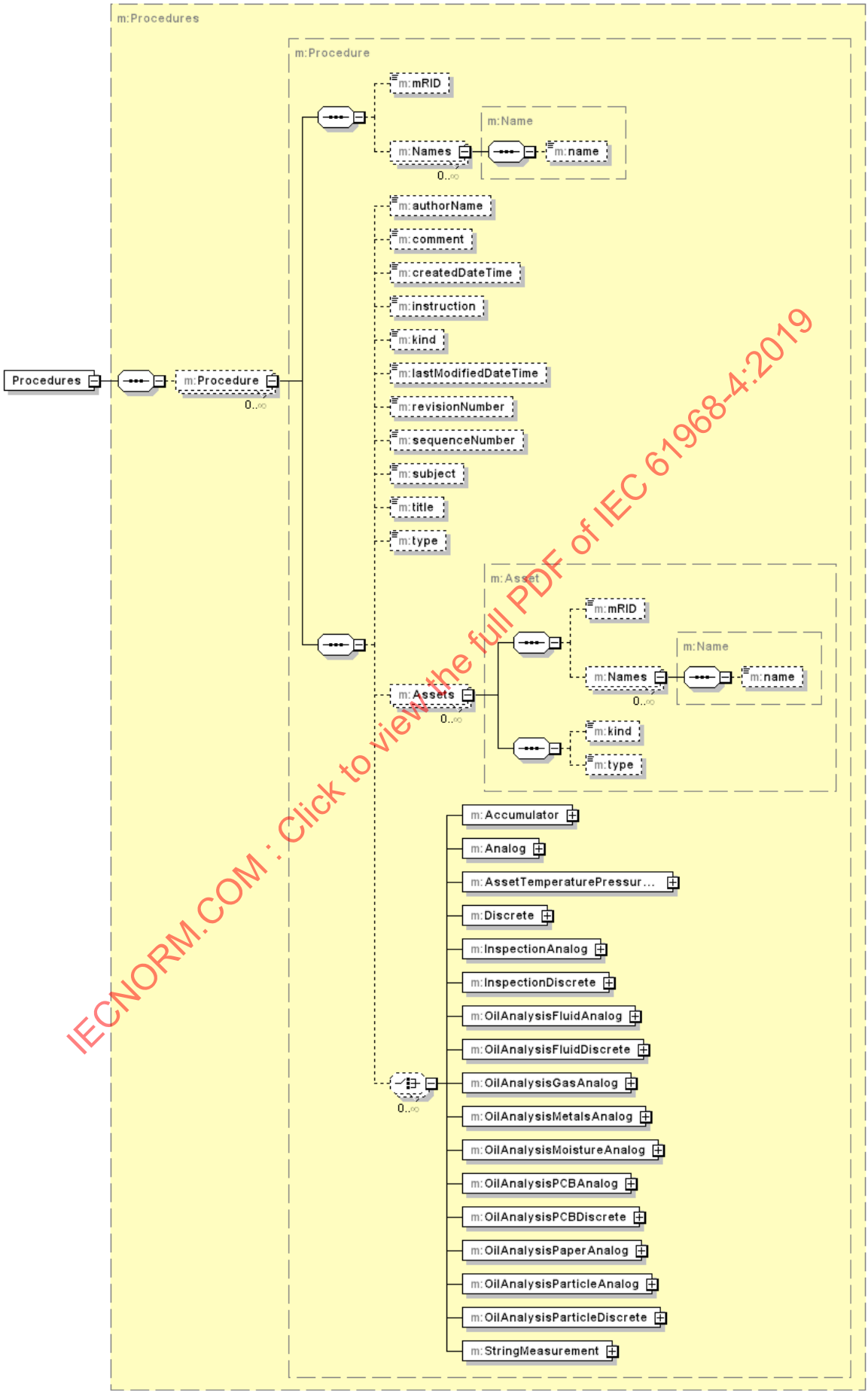


Figure 70 – Procedures message format

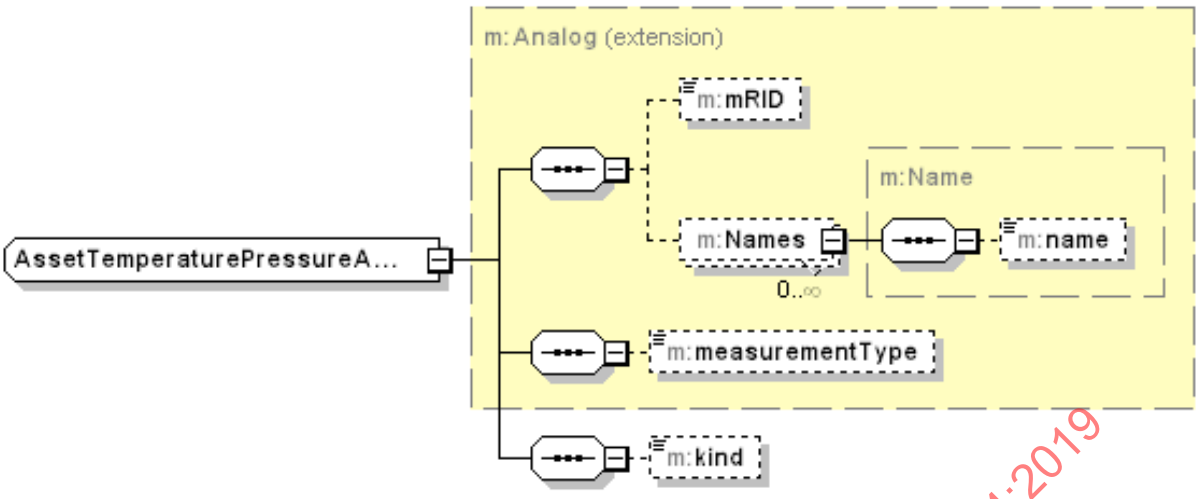


Figure 71 – Procedures message format: AssetTemperaturePressureAnalog element

The following is an XML example for a Procedures message payload. This shows a diagnosis Procedure (Procedures.kind = diagnosis), in particular the one that was identified in the AssetProcedures XML example in 5.10.3. The Procedure is shown to apply to the Asset in 5.10.3 and the Procedure contains an object of type OilAnalysisPaperAnalog, which is a child class of Measurement.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:Procedures xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# Procedures.xsd">
      <m:Procedure>
            <m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
            <m:createdDateTime>2001-12-17T09:30:47Z</m:createdDateTime>
            <m:kind>diagnosis</m:kind>
            <m:Assets>
                  <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            </m:Assets>
            <m:OilAnalysisPaperAnalog>
                  <m:mRID>d5f14947-72b7-456b-8695-18577aebcc9e</m:mRID>
                  <m:kind>degreeOfPolymerization</m:kind>
            </m:OilAnalysisPaperAnalog>
      </m:Procedure>
</m:Procedures>
```


5.12 ProcedureDataSets message

5.12.1 General

A ProcedureDataSets message can contain ProcedureDataSets, its child class LabTestDataSet, associated information such as details about the specimen that was tested, and the MeasurementValue child classes that comprise the dataset.

5.12.2 Applications

The ProcedureDataSets message is used to exchange details of one or more ProcedureDataSet objects. A typical application for this message is for an asset analytic system to query and obtain the ProcedureDataSets of interest, as shown in Figure 72. In this figure, an asset analytic system is querying as system with asset monitoring and measurement function to discover the ProcedureDataSet information.

Figure 72 – ProcedureDataSets message exchange

5.12.3 Message format

Figure 73 shows the ProcedureDataSets message format. The message payload shown in the figure consists of a multiplicity of ProcedureDataSet and LabTestDataSet (which is a specialization of ProcedureDataSet) elements. Figure 73 also shows the ProcedureDataSet element expanded. In addition to the attributes of ProcedureDataSet, this element also contains one or more instances of MeasurementValue child classes that make up the dataset. As shown in Figure 74, the AnalogValue element (as well as the other MeasurementValue specializations) contains identifying information, the actual measurement value, and identifying information of the Measurement specialization to which the MeasurementValue pertains.

As shown in Figure 75, the LabTestDataSet element, in addition to the information that can be contained in ProcedureDataSet element, also has the additional attributes such as "conclusion" and objects of type AssetTestLab and Specimen. AssetTestLab identifies the Organization that performed the testing. As shown in Figure 76, Specimen provides details about the specimen that was tested.

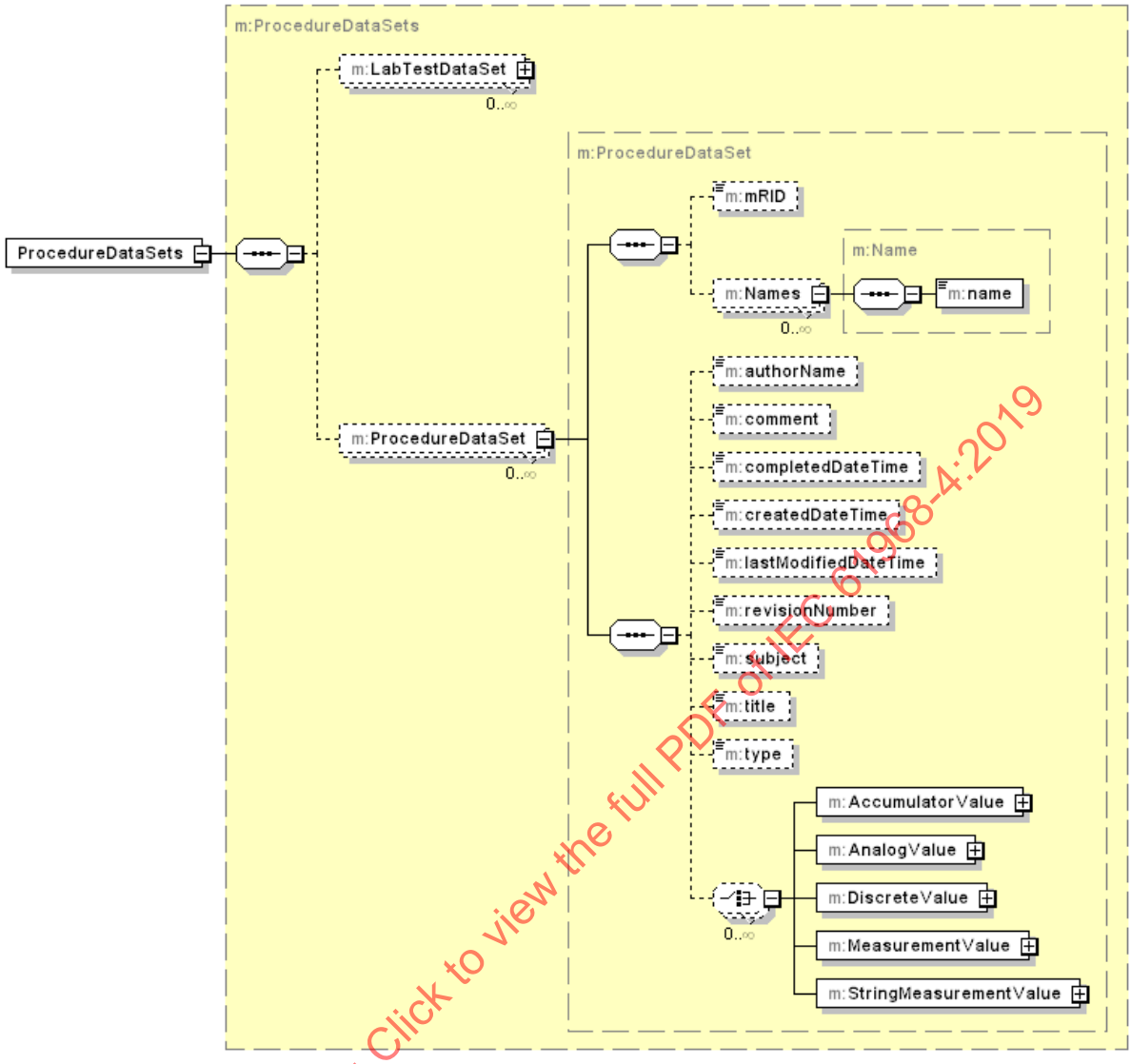


Figure 73 – ProcedureDataSets message format

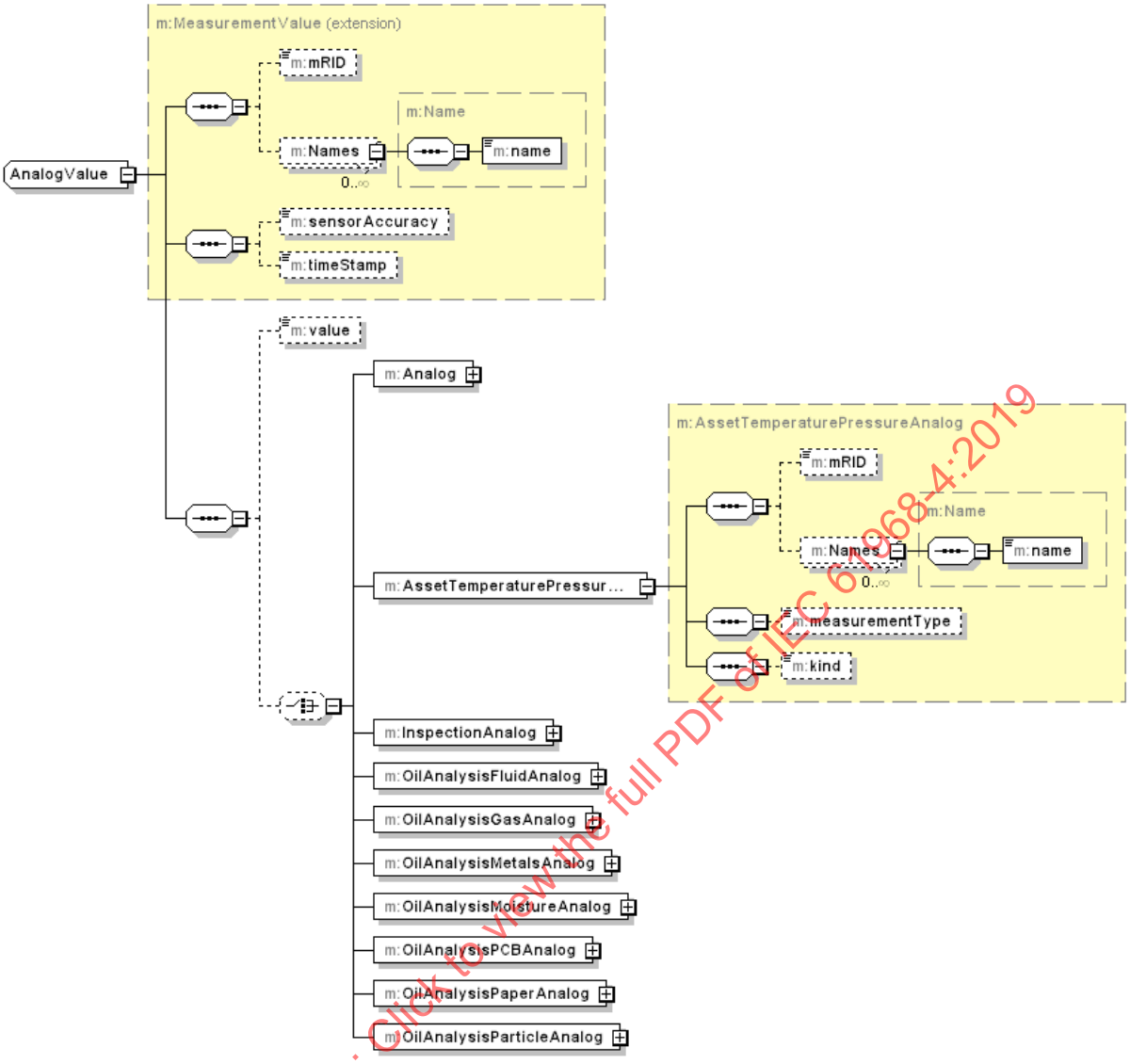


Figure 74 – ProcedureDatasets message: AnalogValue element

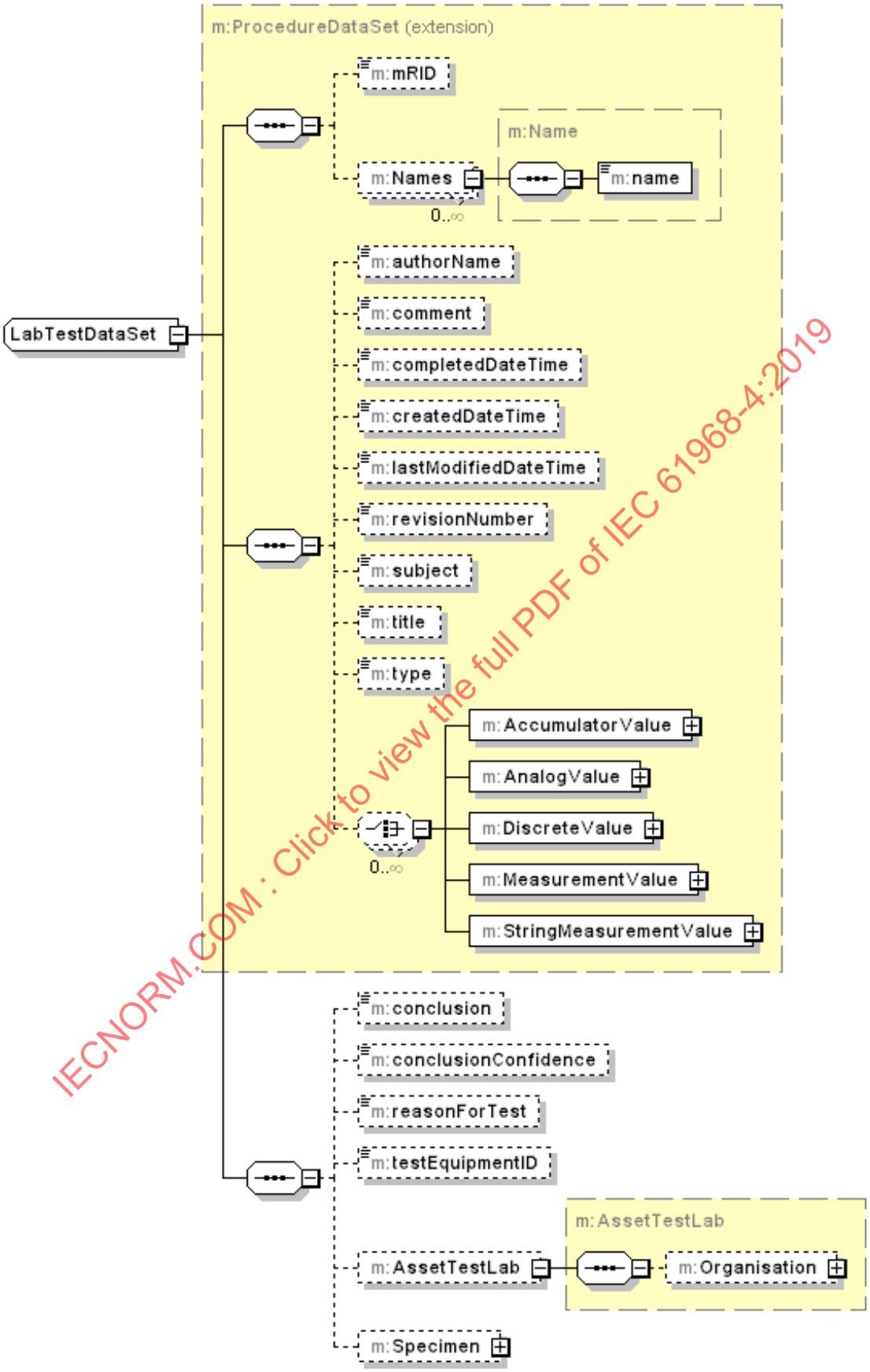


Figure 75 – ProcedureDataSets message: LabTestDataSet element

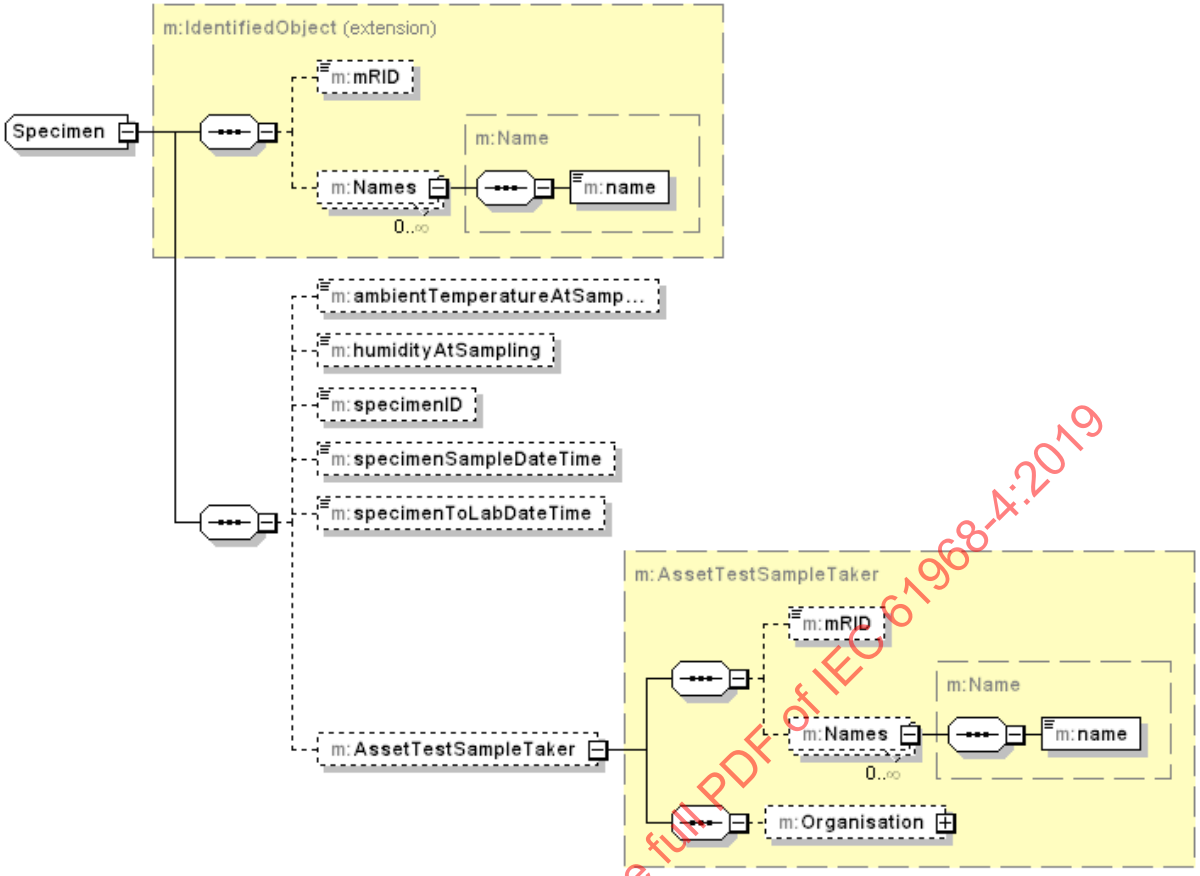


Figure 76 – ProcedureDataSets message format: Specimen element

The following is an XML example for a ProcedureDataSets message payload. This shows a LabTestDataSet with detailed information of the Specimen and identifying information for one AnalogValue. This MeasurementValue child corresponds to the OilAnalysisPaperAnalog of kind degreeOfPolymerization, in particular the one that was identified in the Procedures XML example in 5.11.3.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:ProcedureDataSets xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# ProcedureDataSets.xsd">
      <m:LabTestDataSet>
            <m:mRID>fe37a60e-d8b7-49e5-8c12-93af7c58d223</m:mRID>
            <m:completedDateTime>2015-12-19T09:30:47Z </m:completedDateTime>
            <m:createdDateTime>2015-12-19T09:30:47Z </m:createdDateTime>
            <m:AnalogValue>
                  <m:value>4.1</m:value>
                  <m:OilAnalysisPaperAnalog>
                        <m:mRID>d5f14947-72b7-456b-8695-18577aebcc9e</m:mRID>
                        <m:kind>degreeOfPolymerization</m:kind>
                  </m:OilAnalysisPaperAnalog>
            </m:AnalogValue>
            <m:conclusion>Insulation paper degraded significantly, take asset out of service
immediately.</m:conclusion>
            <m:conclusionConfidence>High</m:conclusionConfidence>
            <m:reasonForTest>routine</m:reasonForTest>
      </m:LabTestDataSet>
</m:ProcedureDataSets>
```

5.13 AssetMeasurements message

5.13.1 General

An AssetMeasurements message can contain the Measurements made on assets. This message enables the retrieval of ongoing measurements directly performed on the assets, such as those that originally came from an Intelligent Electronic Device (IED) performing online monitoring functions. For Measurements that are the result of Procedures performed on an Asset, use Procedures message. Also, the AssetMeasurements message only provides the identifying information of the Measurements; details of the Measurements of interest can be obtained using MeasurementDetails message.

5.13.2 Applications

The AssetMeasurements message is used to obtain various measurements pertaining to one or more Assets. A typical application for this message is for an asset analytic system to query and discover the available Measurement data for the assets it is interested in assessing, as shown in Figure 77. Such data may be indicative of the condition of the asset and therefore of value in management of the assets. In Figure 77, an asset analytic system is querying an asset measurement and monitoring system to discover data pertaining to the asset of interest.

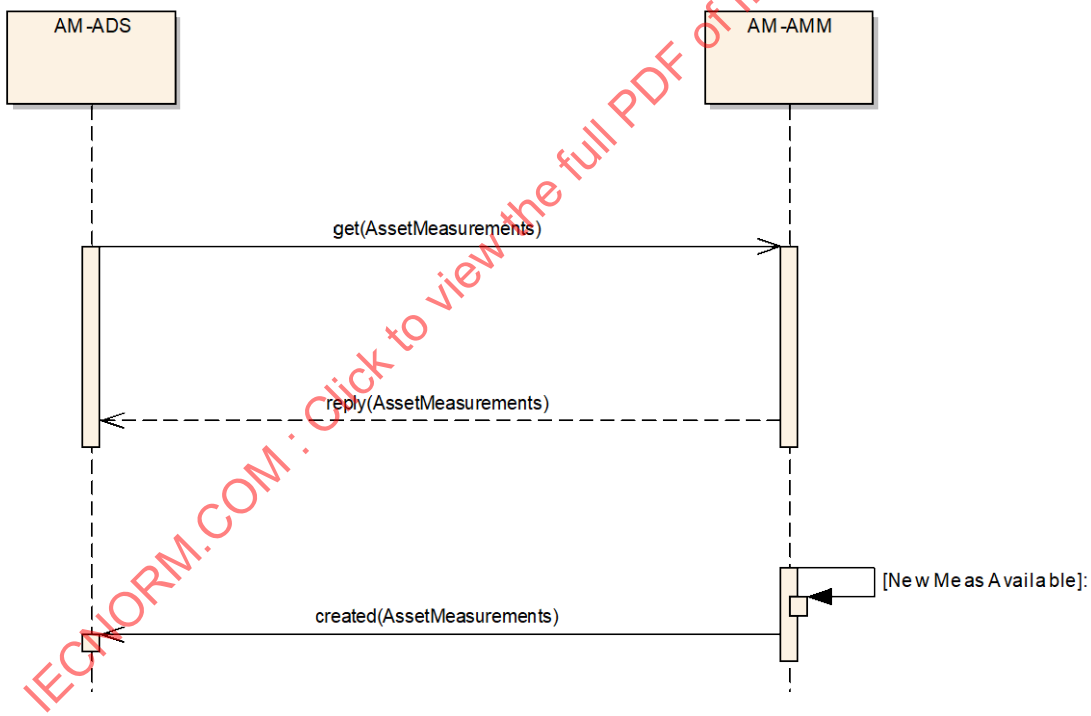


Figure 77 – Asset Measurements message exchange

5.13.3 Message format

Figure 78 shows the AssetMeasurements message format. The message payload shown in the figure consists of several root elements. The root elements are Assets, which can then contain the identifying information for the Measurement objects that pertain to the Asset. The Measurement child classes contain the identifying information for the Measurement child class as well the associated MeasurementValue child class. Additional details on the Measurements of interest can be obtained by using the MeasurementDetails message. The values from the measurement can be obtained using the MeasurementValues message.

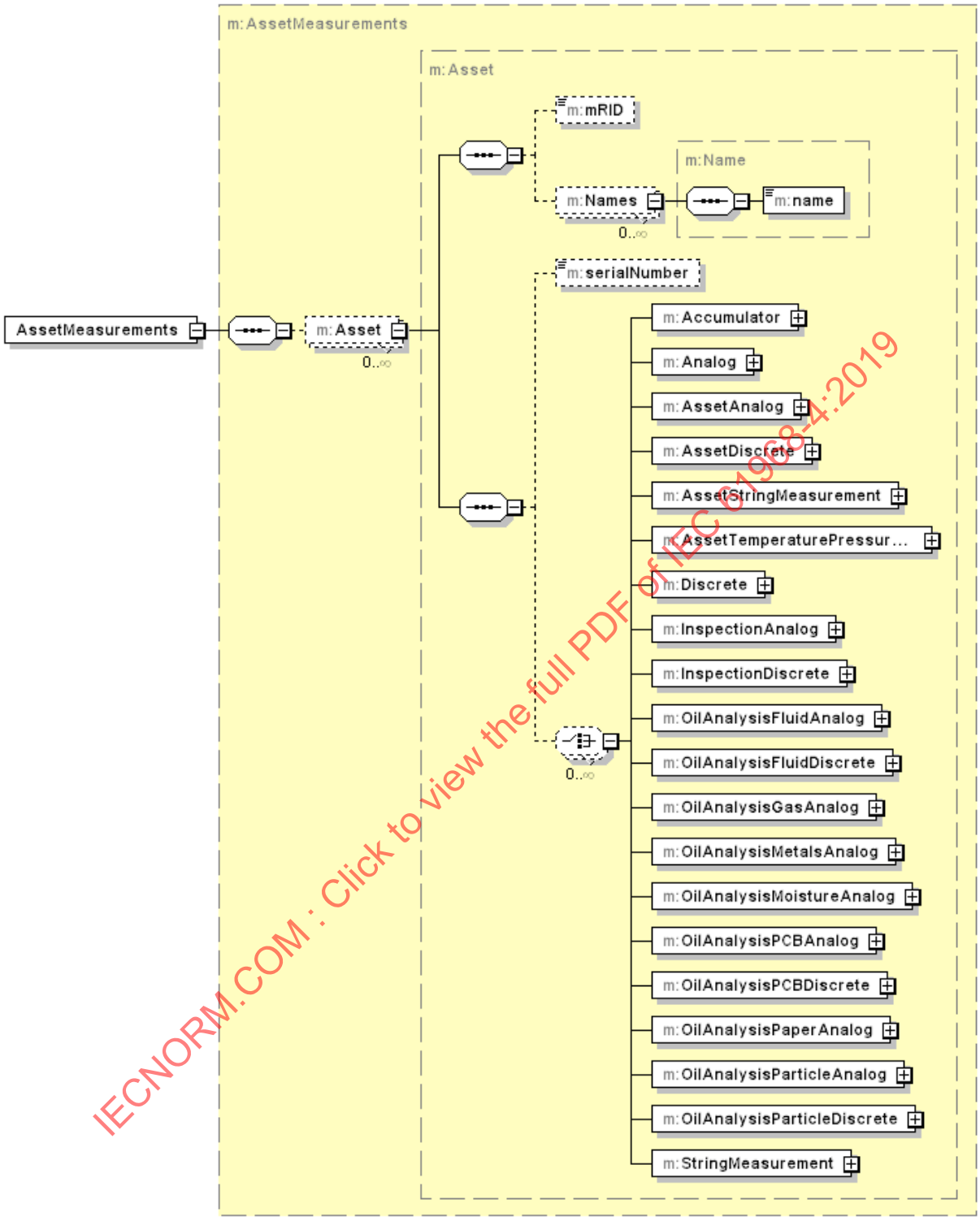


Figure 78 – AssetMeasurements message format

The following is an XML example for an AssetMeasurements message payload. This shows OilAnalysisGasAnalog measurement of total dissolved combustible gases (TDCG) in percentage for the same Asset illustrated in the XML example of 5.10.3. The OilAnalysisGasAnalog object also identifies the MeasurementValue (AnalogValue) that pertains to it.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetMeasurements xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetMeasurements.xsd">
      <m:Asset>
            <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            <m:OilAnalysisGasAnalog>
                  <m:mRID>d2deff03-2b29-4f03-b850-c6823672da61</m:mRID>
                  <m:AnalogValues>
                        <m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
                  </m:AnalogValues>
                  <m:kind>totalDissolvedCombustibleGas</m:kind>
            </m:OilAnalysisGasAnalog>
      </m:Asset>
</m:AssetMeasurements>
```

5.14 MeasurementDetails message

5.14.1 General

A MeasurementDetails message can contain detailed information about Measurements of interest, such as unit, minimum and maximum values, any calculations that were made to obtain the Measurement, and the test standard that was used.

5.14.2 Applications

The MeasurementDetails message is used to obtain detailed information about one or more Measurement child classes. A typical application for this message is for an asset analytic system to query and discover details about Measurement data that it is interested in processing. This exchange is similar to that in Figure 72, with the ProcedureDataSets message replaced by the MeasurementDetails message.

5.14.3 Message format

Figure 79 shows the MeasurementDetails message format. It can contain a multiplicity of elements that are Measurement specializations. Figure 80 shows one such element, Analog, which contains the Measurement attributes such as the unit details and the additional attributes belonging to the specialization such as maxValue and minValue. CalculationMethodHierarchy can be incorporated to provide details of the calculations performed (further illustrated in Figure 81).

Figure 82 shows another example, an element of type AssetTemperaturePressureAnalog. In addition to the attributes of Analog, it also has attributes such as "kind", detectionLimit, and "precision". Moreover, TestStandard element can be incorporated to provide details of test standard that was used in obtaining the measurement (further illustrated in Figure 83).

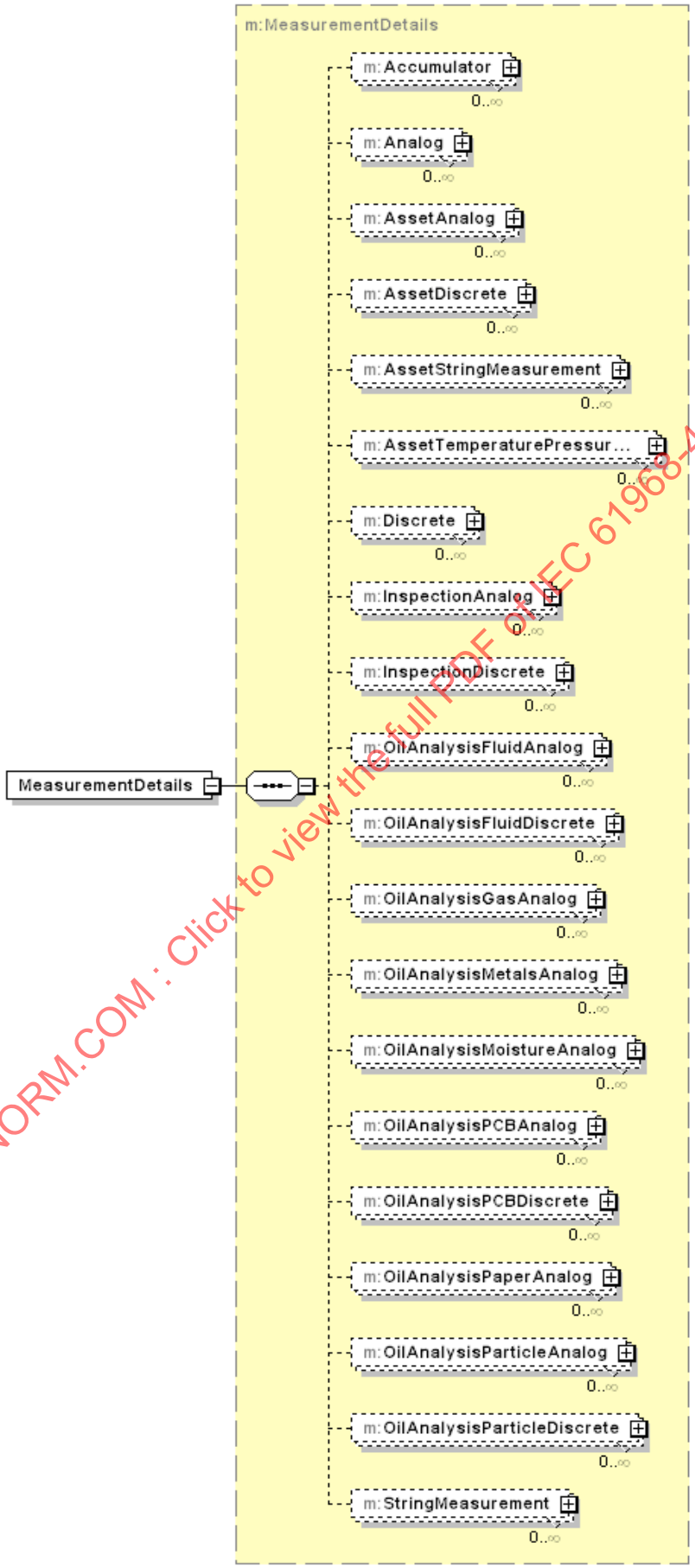


Figure 79 – MeasurementDetails message format

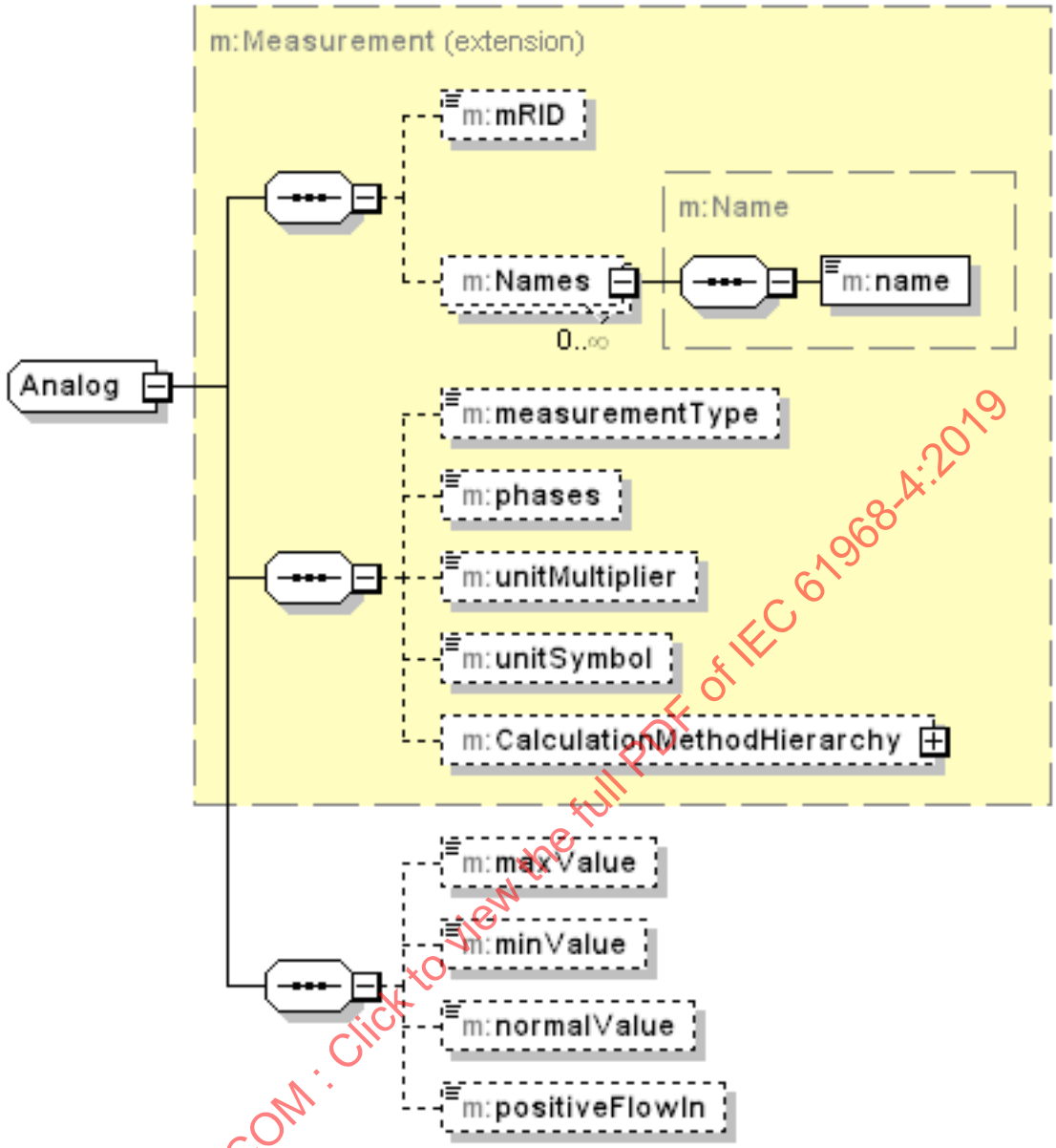


Figure 80 – MeasurementDetails message format: Analog element

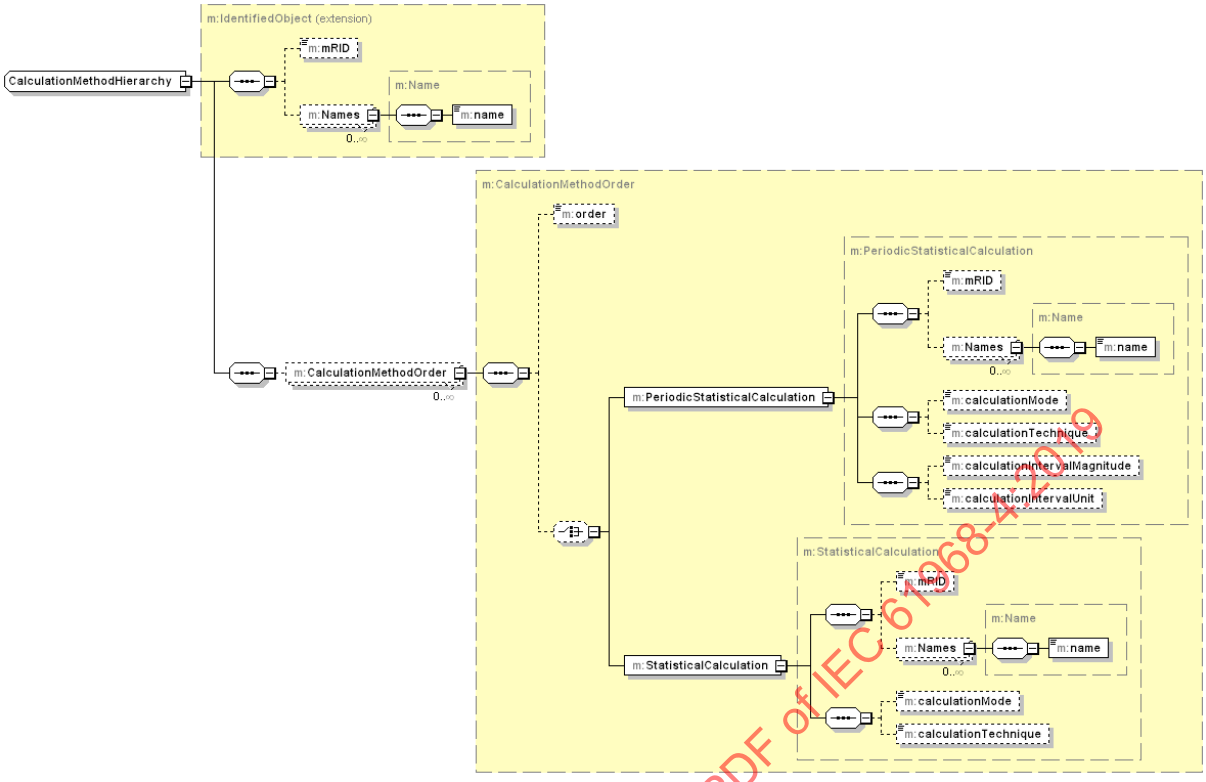


Figure 81 – MeasurementDetails message format: CalculationMethodHierarchy element

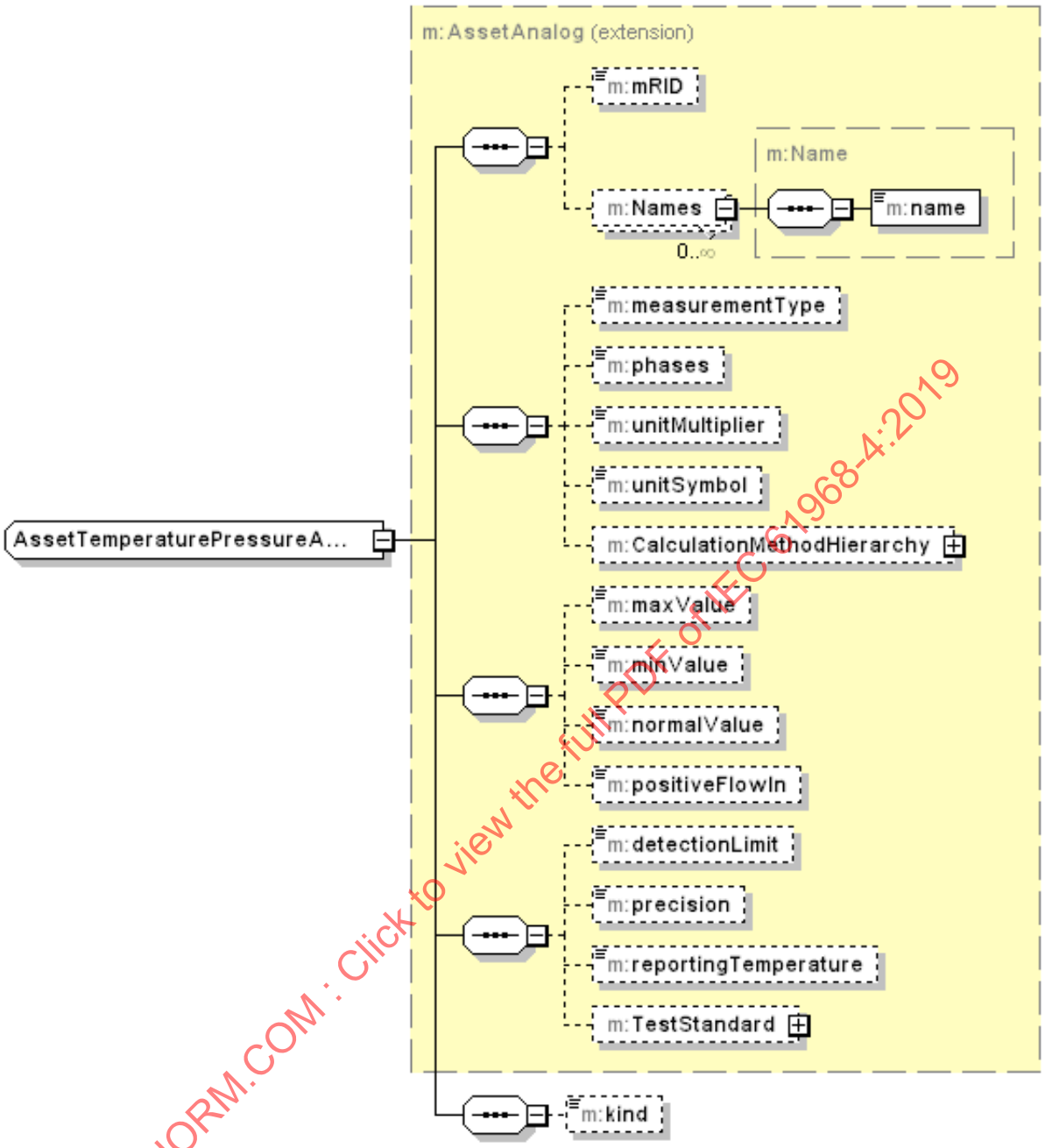


Figure 82 – MeasurementDetails message format: AssetTemperaturePressureAnalog element

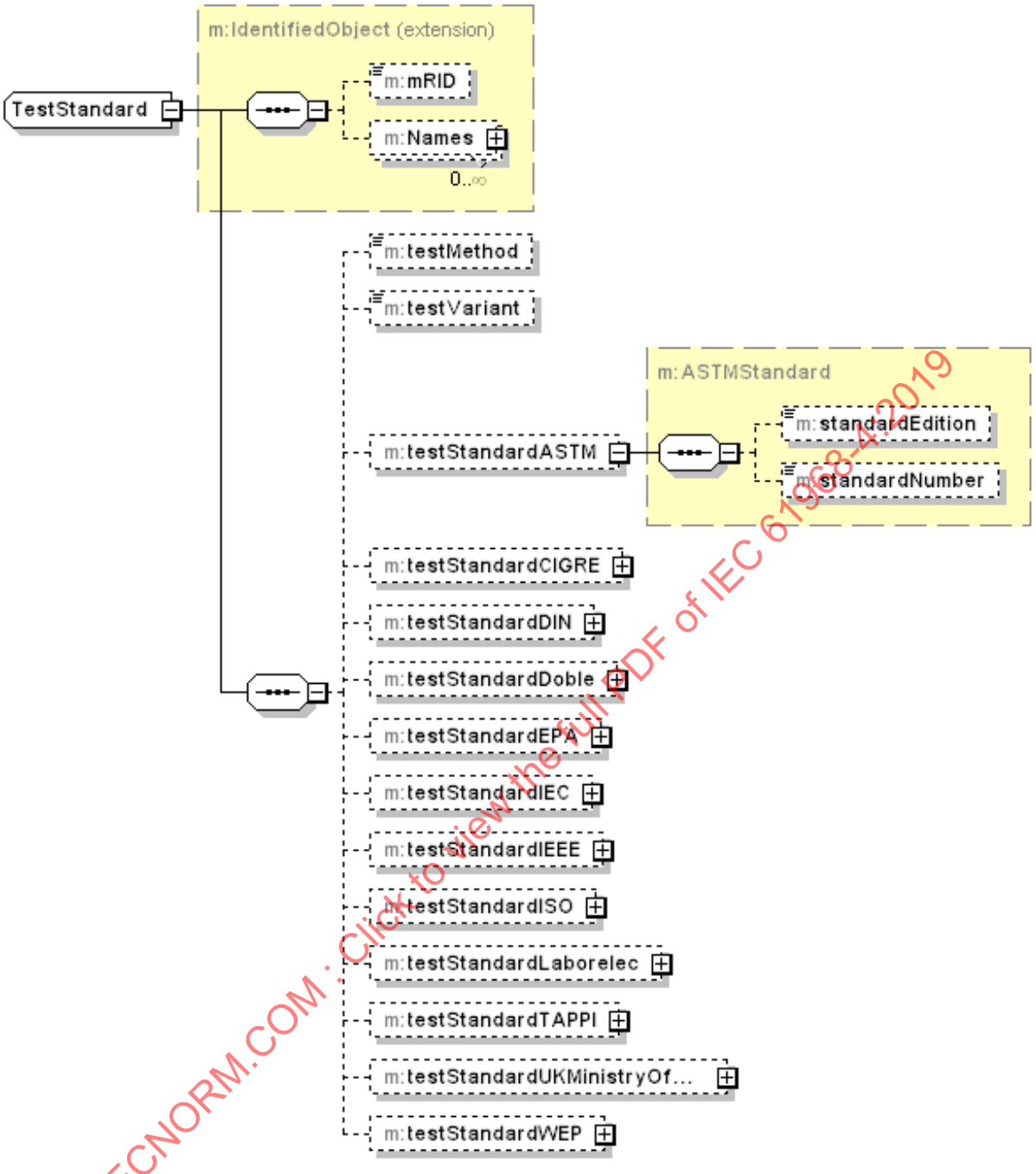


Figure 83 – MeasurementDetails message format: TestStandard element

The following is an XML example for a MeasurementDetails message payload. This contains an OilAnalysisGasAnalog of kind totalCombustibleGasPercent, which was first identified in the XML example in 5.13.3.

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Sample XML file generated by XMLSpy v2016 sp1 (http://www.altova.com)-->
<m:MeasurementDetails xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# MeasurementDetails.xsd">

      <m:OilAnalysisGasAnalog>
            <m:mRID> f5d3fc3d-041e-44c7-bda1-0c75b7c89a05</m:mRID>
            <m:unitMultiplier>none</m:unitMultiplier>
            <m:unitSymbol>none</m:unitSymbol>
            <m:maxValue>100</m:maxValue>
            <m:minValue>0</m:minValue>
            <m:normalValue>1.5</m:normalValue>
            <m:CalculationMethodHierarchy>
                  <m:CalculationMethodOrder>
                        <m:order>0</m:order>
                        <m:PeriodicStatisticalCalculation>
                              <m:calculationMode>period</m:calculationMode>
                              <m:calculationTechnique>average</m:calculationTechnique>

      <m:calculationIntervalMagnitude>1</m:calculationIntervalMagnitude>
                              <m:calculationIntervalUnit>day</m:calculationIntervalUnit>
                        </m:PeriodicStatisticalCalculation>
                  </m:CalculationMethodOrder>
            </m:CalculationMethodHierarchy>
            <m:kind>totalCombustibleGasPercent</m:kind>
      </m:OilAnalysisGasAnalog>

</m:MeasurementDetails>
```

5.15 MeasurementValues message

5.15.1 General

A MeasurementValues message can contain MeasurementValues. Whereas the Procedure and Measurement related messages such as AssetProcedures, Procedures, AssetMeasurements, and MeasurementDetails are used for various details about Asset-related measurable data, the actual value that was measured is obtained using the MeasurementValues message.

5.15.2 Applications

The MeasurementValues message is used to obtain one or more objects that are specializations of MeasurementValue. A typical application for this message is for an asset analytic system to query and obtain the measurement values that it is interested in processing. This exchange is similar to the one illustrated in Figure 72, with ProcedureDataSets message replaced by MeasurementValues message.

5.15.3 Message format

Figure 84 shows the MeasurementValues message format. It can contain a multiplicity of elements that are MeasurementValue specializations, namely AccumulatorValue, AnalogValue, DiscreteValue, or StringValue.

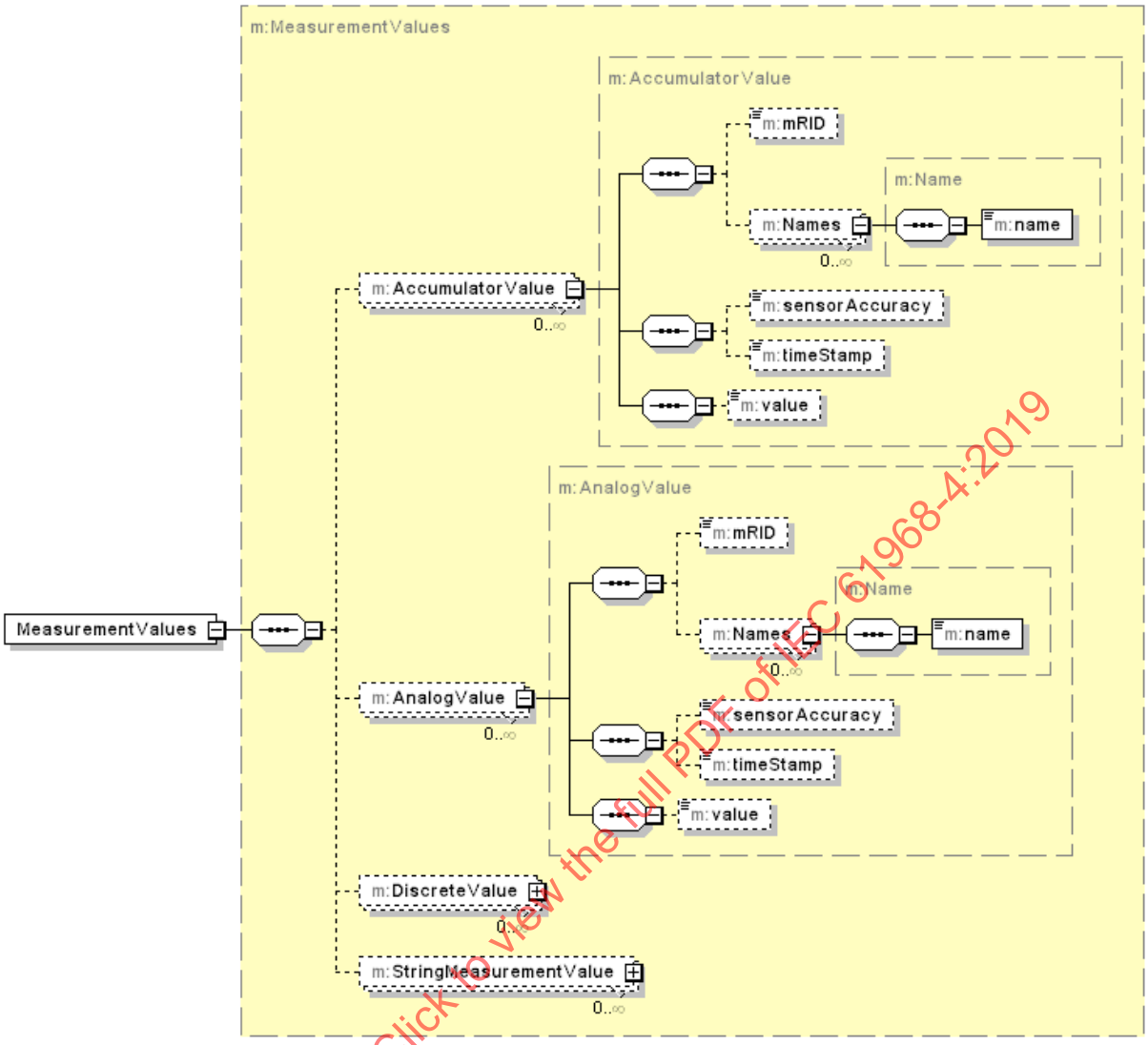


Figure 84 – MeasurementValues message format

The following is an XML example for a MeasurementValues message payload. This contains an AnalogValue at three different timeStamp instances. Note that this AnalogValue was first identified in the XML example in 5.13.3 as the value associated to an OilAnalysisGasAnalog of kind totalCombustibleGasPercent.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:MeasurementValues xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# MeasurementValues.xsd">
      <m:AnalogValue>
            <m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
            <m:timeStamp>2015-12-14T09:00:00Z</m:timeStamp>
            <m:value>3.5</m:value>
      </m:AnalogValue>
            <m:AnalogValue>
            <m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
            <m:timeStamp>2015-12-15T09:00:00Z</m:timeStamp>
            <m:value>3.7</m:value>
      </m:AnalogValue>
            <m:AnalogValue>
            <m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
            <m:timeStamp>2015-12-16T09:00:00Z</m:timeStamp>
            <m:value>4.1</m:value>
      </m:AnalogValue>
</m:MeasurementValues>
```

5.16 Analytics message

5.16.1 General

An Analytics message can contain the details of Analytic, such as the attributes that describe the Analytic, and the Assets and/or AssetGroups to which the Analytic applies. The actual scores from the Analytic are obtained using the AssetAnalytics and AssetGroupAnalytics messages. The health event notifications from Analytic are obtained using the AssetHealthEvents message.

5.16.2 Applications

The Analytics message is used to exchange details of Analytics of interest. An Analytic element in this message can also contain identifying information of the Assets and/or AssetGroups to which the Analytic applies.

A typical application for this message is for an asset analytic system to convey the details of the analytics it performs, as shown in, as shown in Figure 85. In this figure, various systems such as substation inventory systems, maintenance and inspection systems, and network monitoring systems are querying an asset analytics system to discover details of its analytic capabilities.

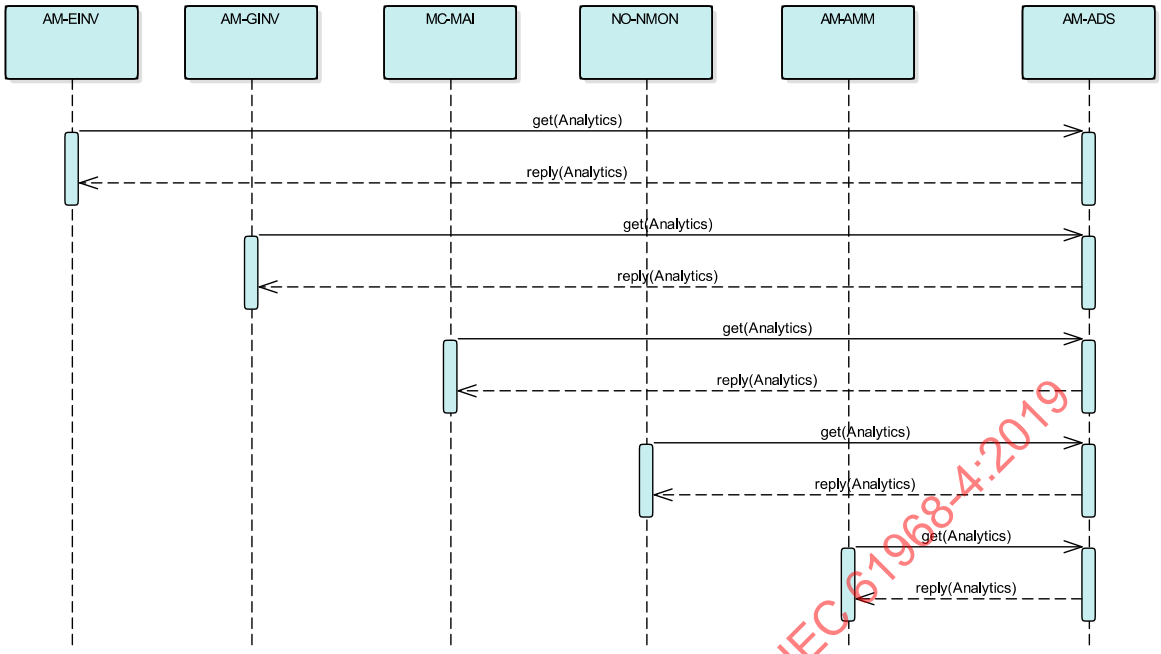


Figure 85 – Analytics message exchanges

5.16.3 Message format

Figure 86 shows the Analytics message format. The message payload shown in the figure consists of one or more Analytics, with its attributes. As shown in the figure, the Analytics element can also contain identifying information for the Assets and/or AssetGroups to which the Analytic applies.

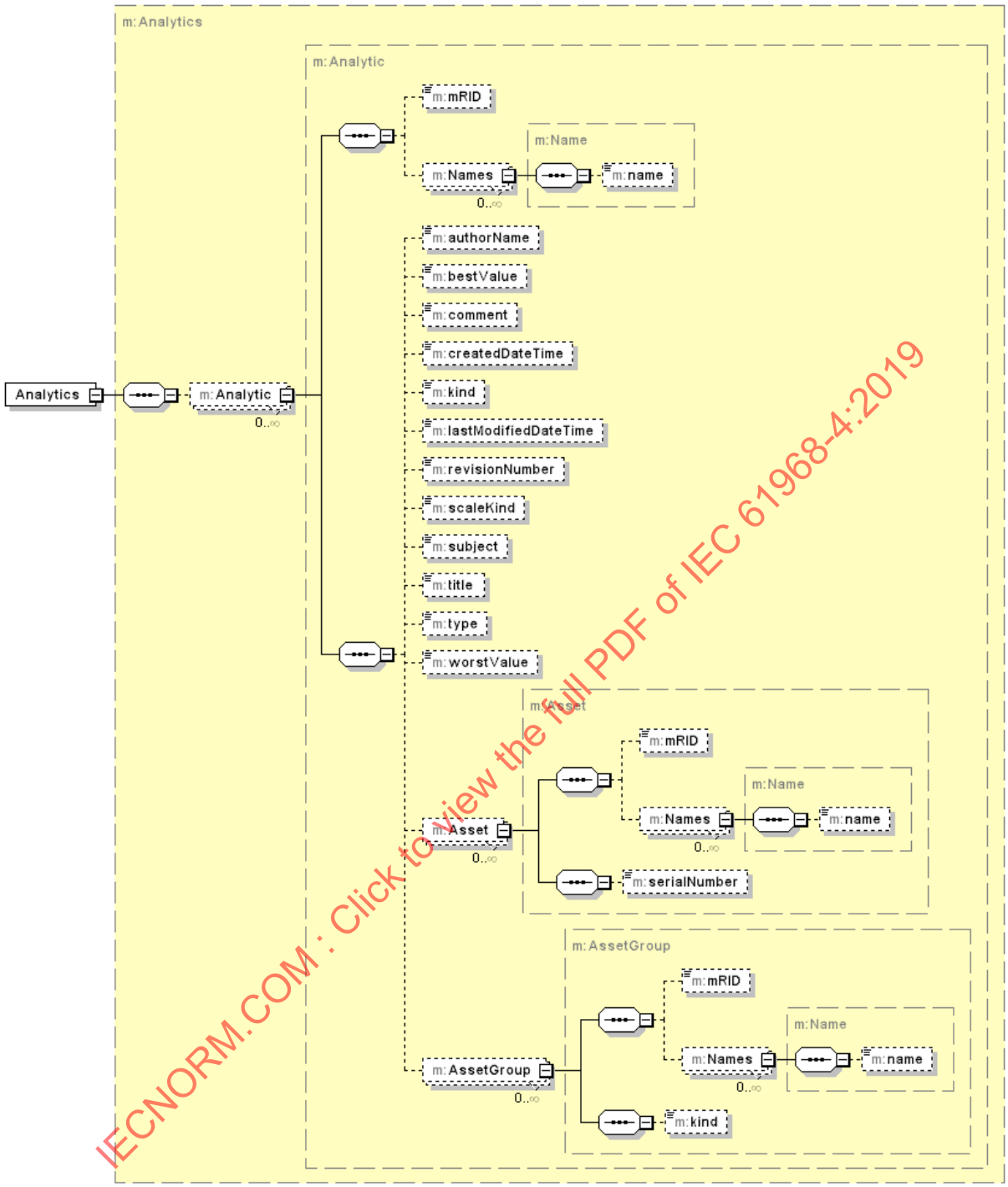


Figure 86 – Analytics message format

The following is an XML example for an Analytics message payload. This describes an Analytic that is a health analytic (Analytic.kind = healthAnalytic), and also includes the list of Assets to which the Analytic applies.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:Analytics xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# Analytics.xsd">
      <m:Analytic>
            <m:mRID> df37a60e-d8b7-49e5-8c12-93af7c58d257</m:mRID>
            <m:createdDateTime>2001-12-17T09:30:47Z</m:createdDateTime>
            <m:kind>healthAnalytic</m:kind>
            <m:lastModifiedDateTime>2010-06-03T10:22:14Z</m:lastModifiedDateTime>
            <m:revisionNumber>2.1</m:revisionNumber>
            <m:title>Dielectric Health</m:title>
            <m:Asset/>
<m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
            </m:Asset>
            <m:Asset/>
<m:mRID>6a9fb099-e67d-4c33-88f4-aa3e479ec1da</m:mRID>
            </m:Asset>
      </m:Analytic>
</m:Analytics>
```

5.17 AssetAnalytics message

5.17.1 General

An AssetAnalytics message can contain the details of various analytics that are applicable to assets and the health and risk scores generated by these analytics.

5.17.2 Applications

The AssetAnalytics message is used to exchange assessments of one or more assets. These assessments could, for instance, be indicators of health/condition of the assets or the risk pertaining to the assets in the form of quantitative scores. These assessments are made by analytics. The AssetAnalytics message can be used to exchange details of the analytics as well.

A typical application for this message is for an asset analytic system to convey its assessment of various assets. This assessment data is indicative of the condition and the risks pertaining to the assets and therefore of value in management of the assets. The exchange pattern for AssetAnalytics is identical to that shown in Figure 85, with the AssetAnalytics message in place of the Analytics message. Various systems such as substation and geographical inventory systems, maintenance and inspection systems, network monitoring systems, and asset measurement and monitoring systems query an asset analytics system to discover assessments pertaining to the assets of interest.

5.17.3 Message format

Figure 87 and Figure 88 illustrate the AssetAnalytics message format. This message can have a multiplicity of Asset objects, which can contain several Analytic objects to describe the analytics applied to the asset, several objects of type AnalyticScore and its children to convey the scores attributed to the asset, and several AssetHealthEvent objects that describe the analytic-detected events pertaining to the asset.

Figure 89 through Figure 91 illustrate the AssetScore, HealthScore, and RiskScore objects. In addition to a quantitative description of the score, these objects can also contain reference to the Analytic that generated that score. Furthermore, a HealthScore object can contain reference to a RiskScore object that depends on it; and the RiskScore object can contain references to a multiplicity of HealthScore objects that were utilized in calculating the RiskScore.

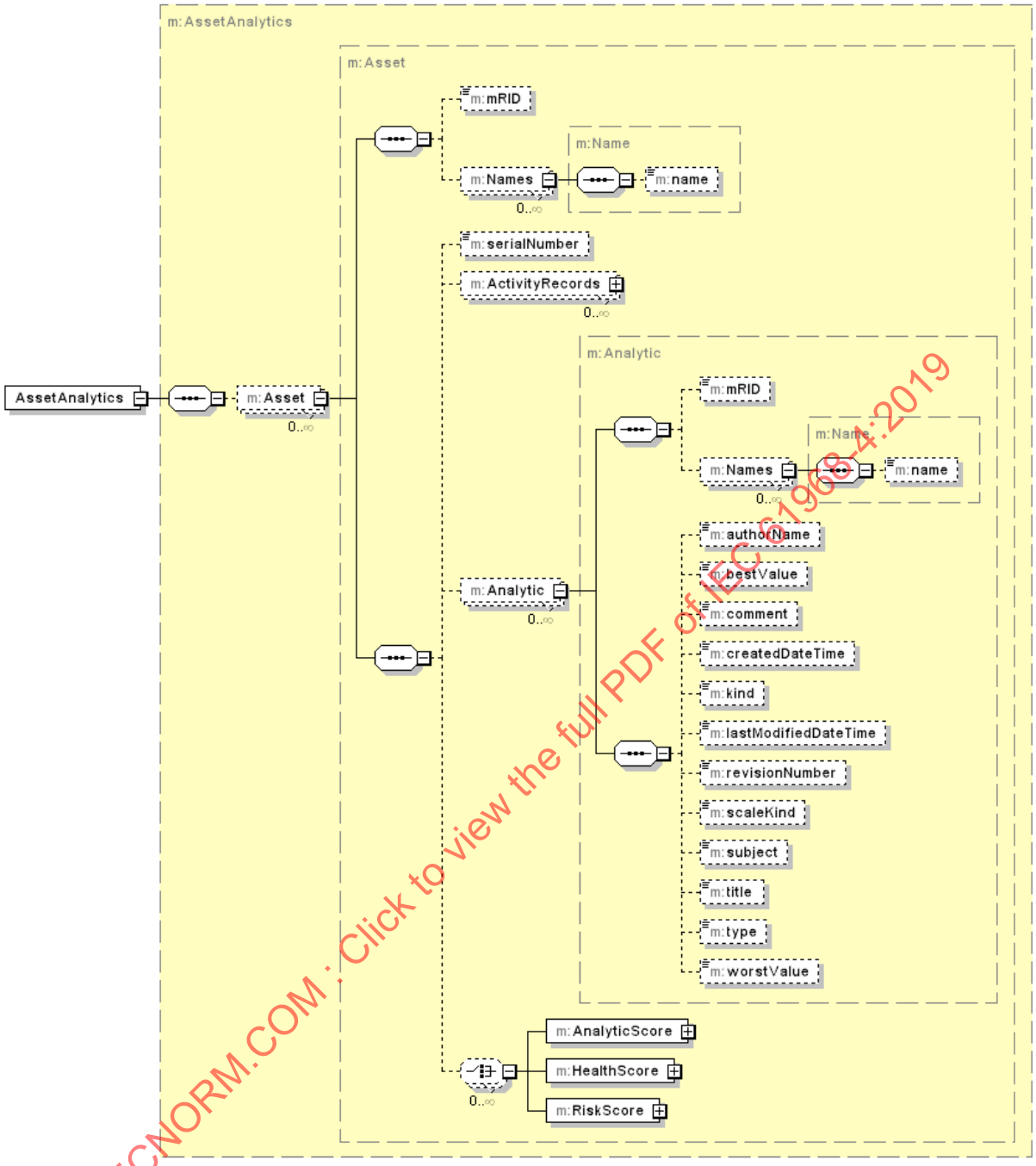


Figure 87 – AssetAnalytics message format 1

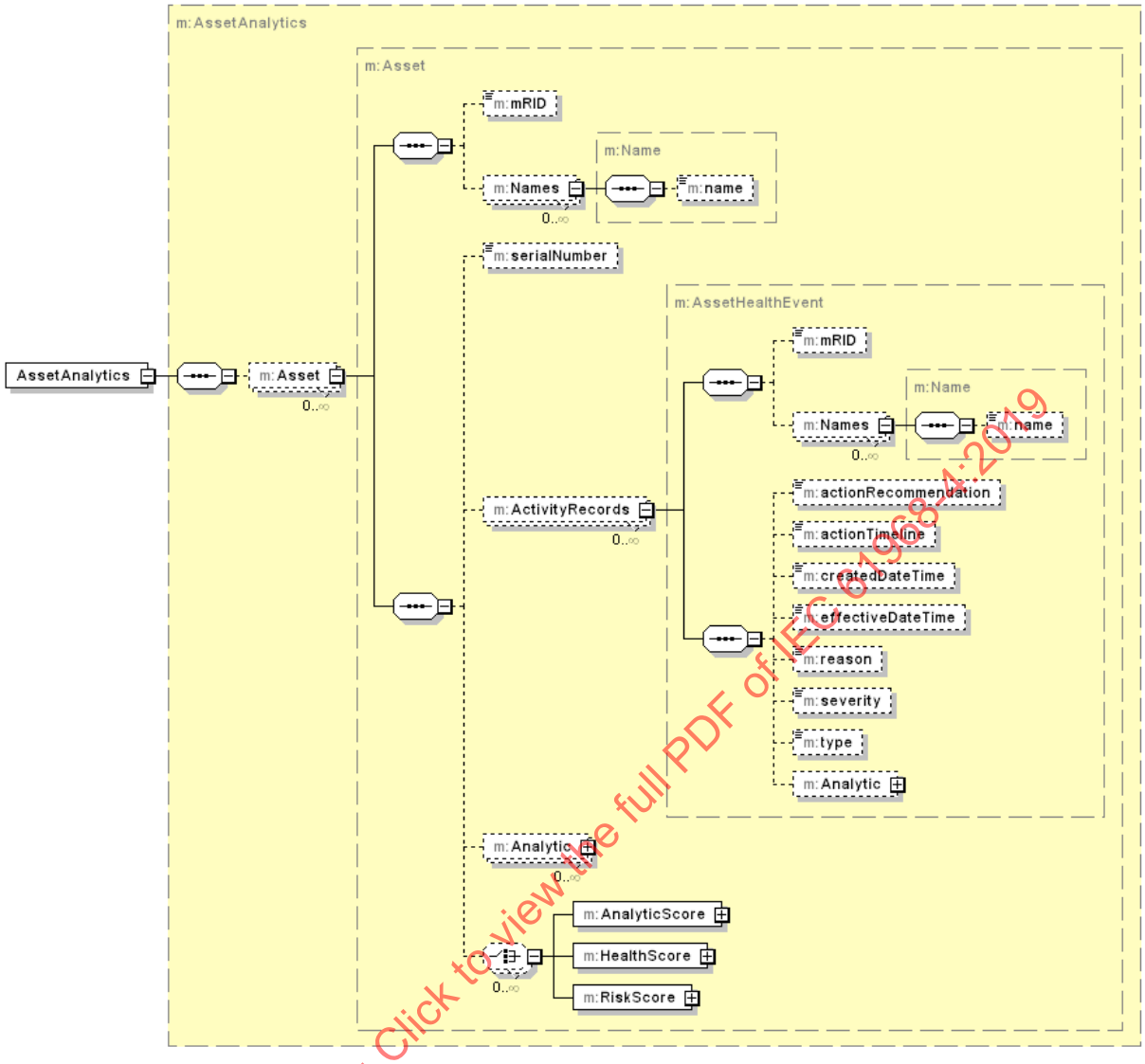


Figure 88 – AssetAnalytics message format 2

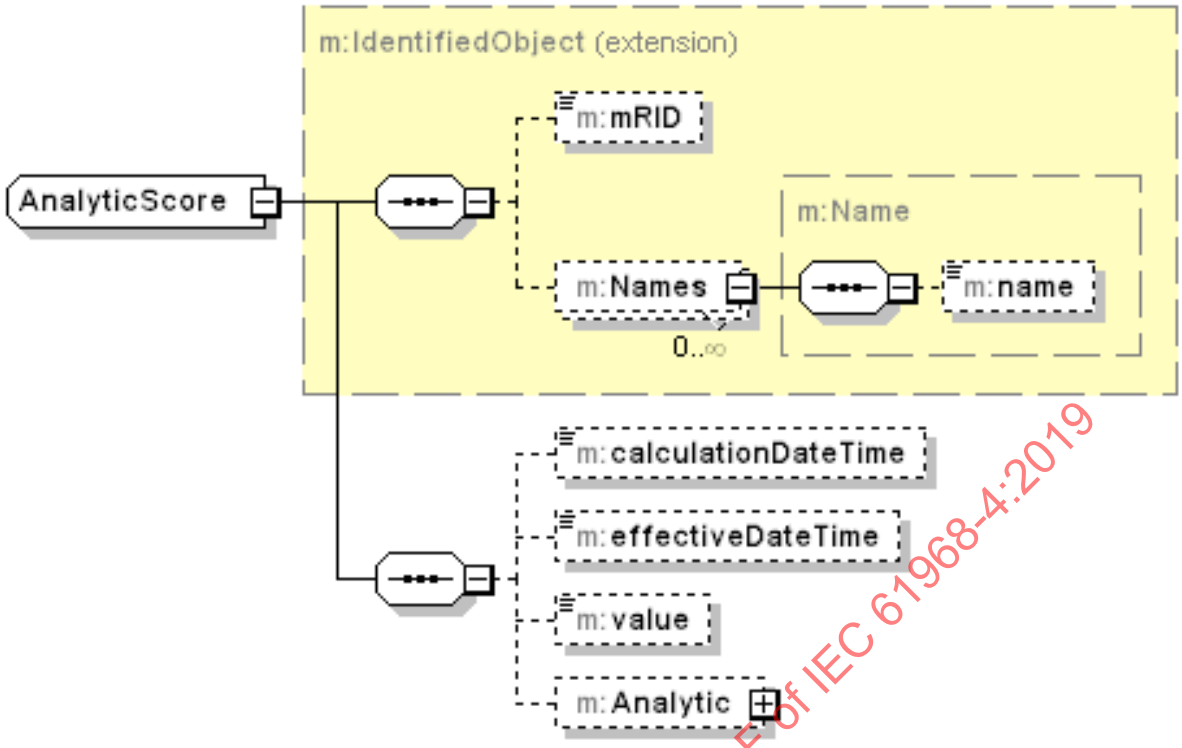


Figure 89 – AssetAnalytics message format: AnalyticScore element

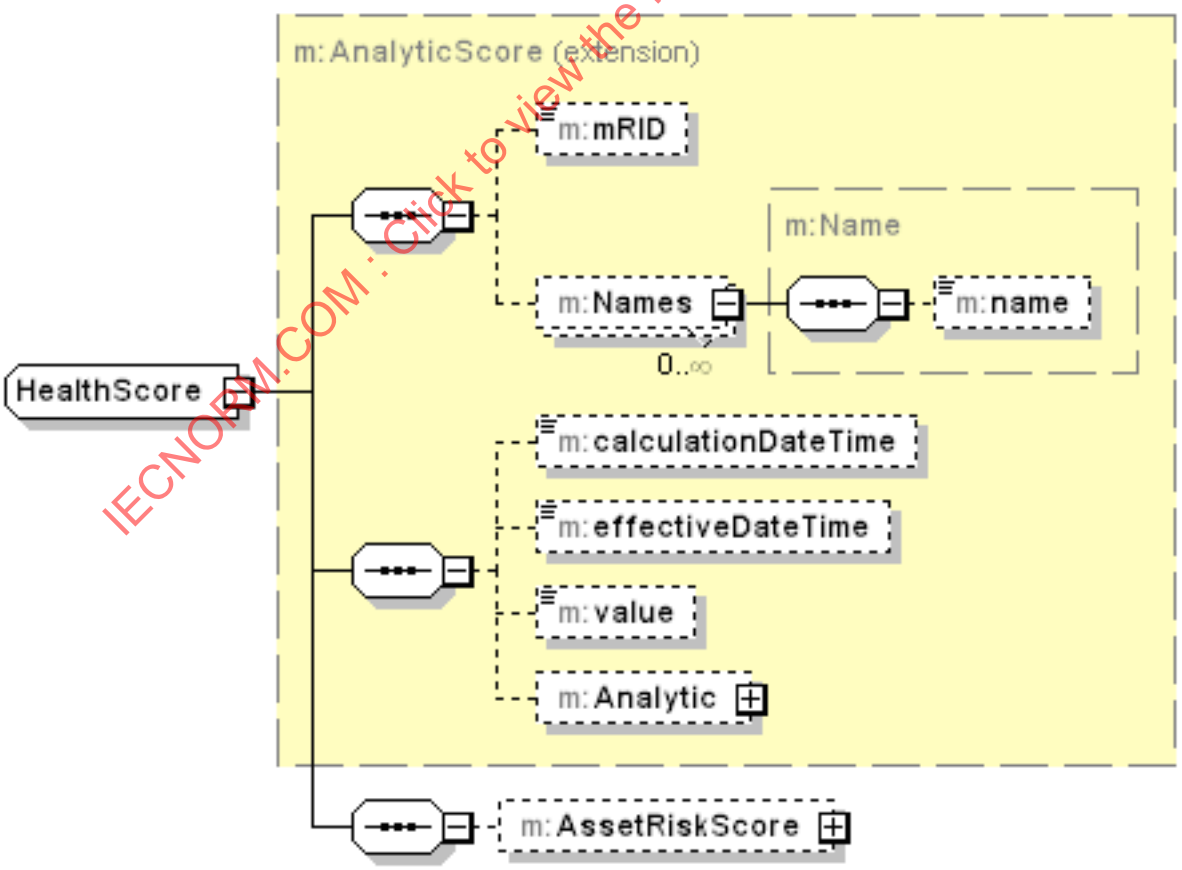


Figure 90 – AssetAnalytics message format: HealthScore element

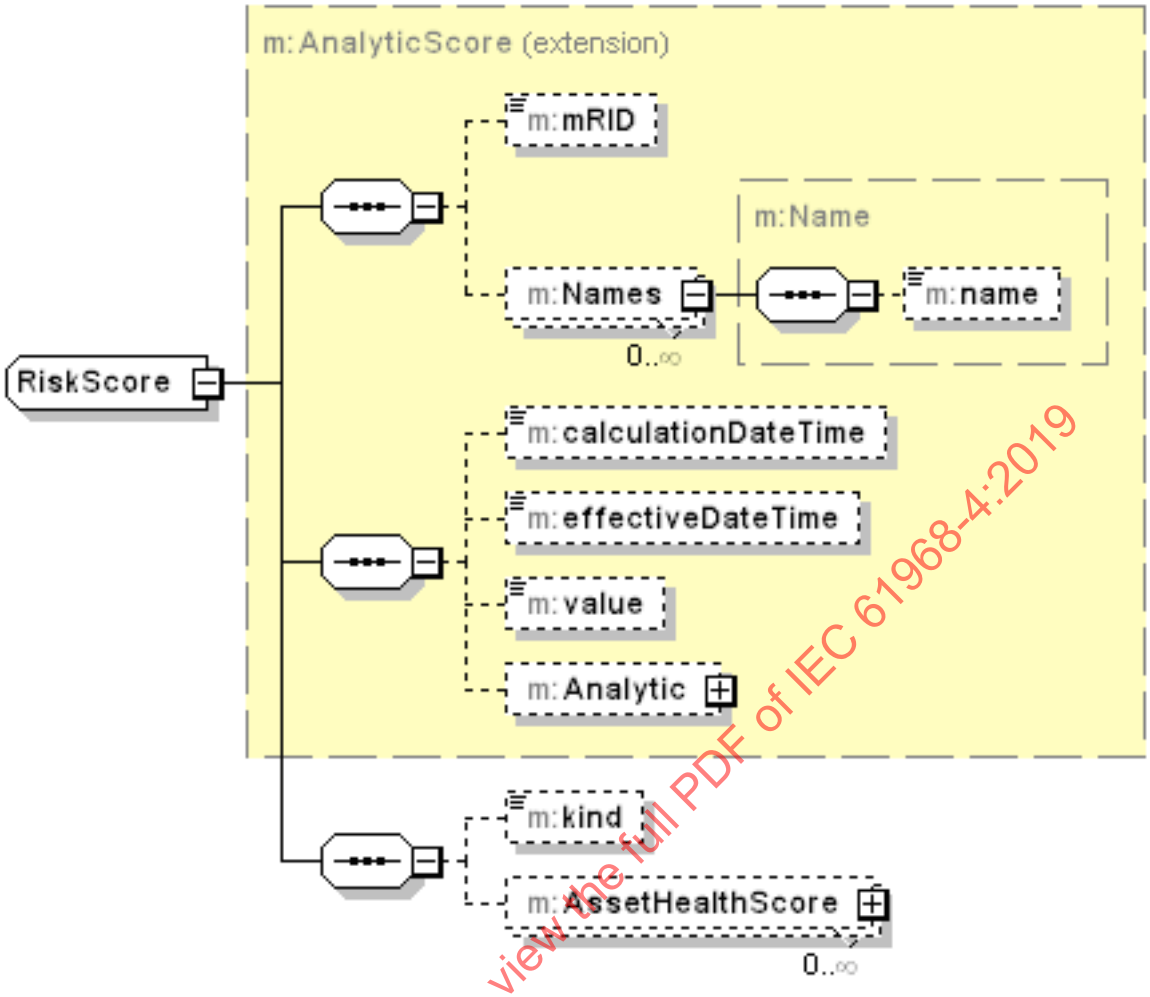


Figure 91 – AssetAnalytics message format: RiskScore element

The following is an XML example for an AssetHealth message payload, which shows the details of an Analytic (Analytic.type of LossOfLife) and three scores generated by this Analytic at one-year intervals. The XML example also shows a second Asset with a HealthScore of 95, which is close to the best value of 100.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetAnalytics xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetAnalytics.xsd">
	<m:Asset>
		<m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
		<m:Analytic>
			<m:mRID>6a9fb099-e67d-4c33-88f4-aa3e479ec1da</m:mRID>
			<m:authorName>IEEE</m:authorName>
			<m:createdDateTime>2010-12-17T09:30:47Z</m:createdDateTime>
			<m:type>LossOfLife</m:type>
		</m:Analytic>
		<m:AnalyticScore>
			<m:bestValue>0</m:bestValue>
			<m:calculationDateTime>2015-01-01T09:00:00Z</m:calculationDateTime>
			<m:scaleKind>String</m:scaleKind>
			<m:value>70</m:value>
			<m:worstValue>100</m:worstValue>
			<m:Analytic ref="6a9fb099-e67d-4c33-88f4-aa3e479ec1da"/>
		</m:AnalyticScore>
		<m:AnalyticScore>
			<m:calculationDateTime>2014-01-01T09:00:00Z</m:calculationDateTime>
			<m:value>65</m:value>
			<m:Analytic ref="6a9fb099-e67d-4c33-88f4-aa3e479ec1da"/>
		</m:AnalyticScore>
		<m:AnalyticScore>
			<m:calculationDateTime>2013-01-01T09:00:00Z</m:calculationDateTime>
			<m:value>62</m:value>
			<m:Analytic ref="6a9fb099-e67d-4c33-88f4-aa3e479ec1da"/>
		</m:AnalyticScore>
	</m:Asset>
	<m:Asset>
		<m:mRID>9ea05e0a-024a-495d-85bd-f2553b89dcaa</m:mRID>
		<m:HealthScore>
			<m:bestValue>100</m:bestValue>
			<m:calculationDateTime>2015-01-01T09:30:00Z</m:calculationDateTime>
			<m:value>95</m:value>
			<m:worstValue>0</m:worstValue>
		</m:HealthScore>
	</m:Asset>
</m:AssetHealth>
```


5.18 AssetGroupAnalytics message

5.18.1 General

An AssetGroupAnalytics message can contain the details of groupings of Assets, as described by the AssetGroup class. This message contains information such as when the AssetGroup was created, for what purpose, and what Assets are in the grouping. In the case of asset groupings made for analytical purposes, the analytic score can be exchanged using the AssetScore message.

5.18.2 Applications

The AssetGroupAnalytics message is used to exchange details of asset groupings of interest that may have been created for analysis (e.g. transformers above a certain rating), functional management (e.g. the assets belonging to a feeder), etc. The exchange pattern for AssetAnalytics is similar to that shown in Figure 85, with the AssetGroupAnalytics message in place of the Analytics message. Various systems such as substation and geographical inventory systems, maintenance and inspection systems, network monitoring systems, and asset measurement and monitoring systems query an asset analytics system to discover assessments pertaining to the asset groups of interest. An additional exchange pattern, not

shown in the figure, consists of an asset analytic system querying a network and substation inventory system to discover the composition of AssetGroup.

5.18.3 Message format

Figure 92 shows the AssetGroupAnalytics message format. The message payload shown in the figure consists of one or more AssetGroup, with its attributes. As shown in the figure, the AssetGroup element can contain identifying information for the Assets that belong to the AssetGroup. Furthermore, the message can also contain the various analytic scores computed on the asset group.

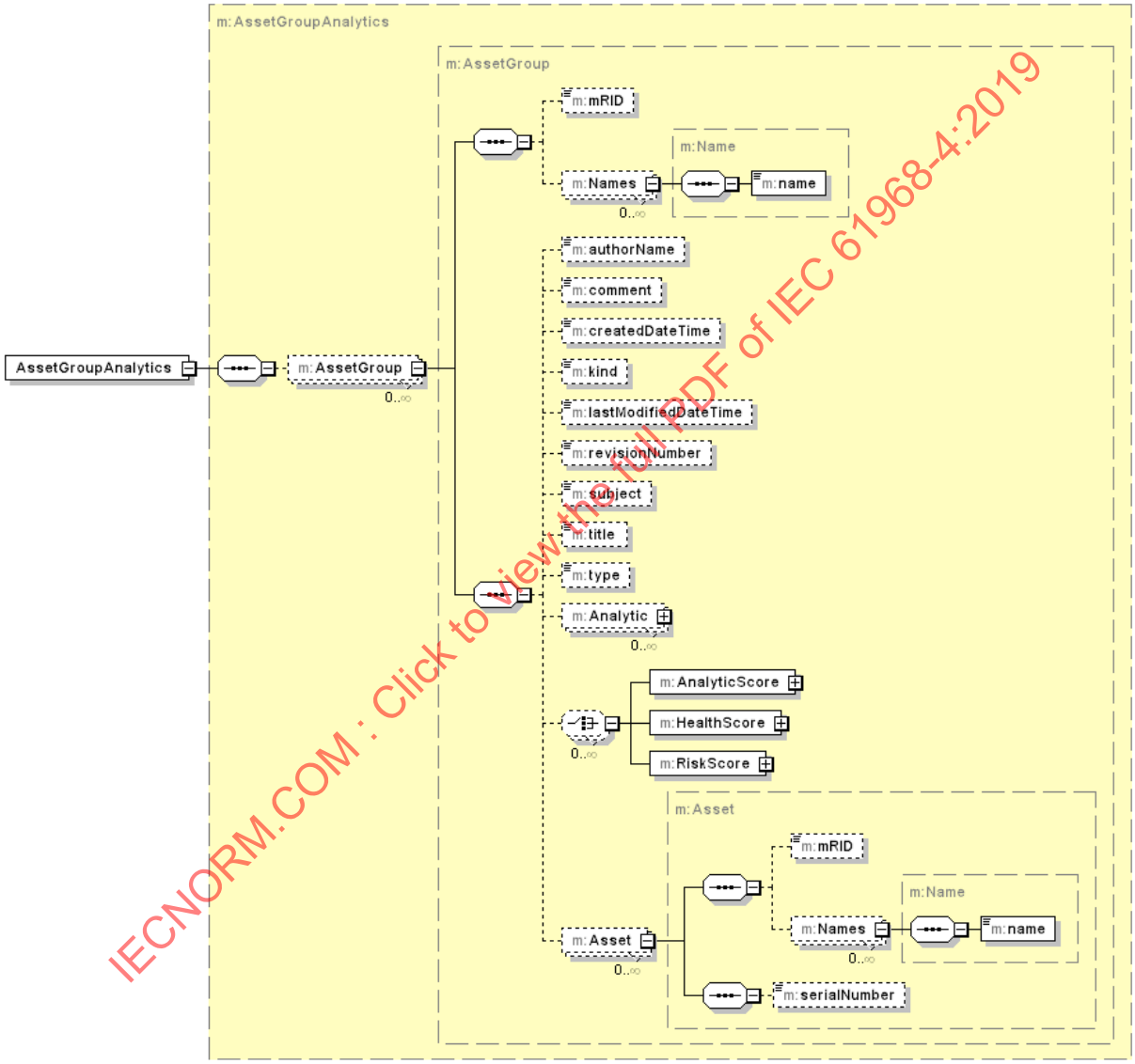


Figure 92 – AssetGroupAnalytics message format

The following is an XML example for an AssetGroupAnalytics message payload. This contains three Assets that belong to a group of kind (AssetGroup.kind) analysisGroup.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetGroups xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetGroupAnalytics.xsd">
      <m:AssetGroup>
            <m:mRID>d2deff03-2b29-4f03-b850-c6823672da61</m:mRID>
            <m:createdDateTime>2014-11-27T16:20:00Z</m:createdDateTime>
            <m:kind>analysisGroup</m:kind>
            <m:lastModifiedDateTime>2016-03-11T13:45:12Z</m:lastModifiedDateTime>
            <m:title>Critical Power Transformers in the Boston Area</m:title>
            <m:Asset/>
<m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
            </m:Asset>
            <m:Asset/>
<m:mRID>6a9fb099-e67d-4c33-88f4-aa3e479ec1da</m:mRID>
            </m:Asset>
            <m:Asset/>
<m:mRID>9ea05e0a-024a-495d-85bd-f2553b89dcaa</m:mRID>
            </m:Asset>
            <m:Names>
                  <m:name>criticalBostonTransformers</m:name>
            </m:Names>
      </m:AssetGroup>
</m:AssetGroups>
```

5.19 AssetHealthEvents message

5.19.1 General

An AssetHealthEvents message can contain health events pertaining to one or more assets. These health events are typically significant indicators of asset condition and are generated by analytics. The AssetHealthEvents can contain the details of the analytics that generated the asset health events as well.

5.19.2 Applications

The AssetHealthEvents message is used to exchange significant asset health-related events and indications. A typical application for this message is for an asset analytic system to notify relevant systems on health issues that may need to be acted upon. As shown in Figure 93, an asset analytic system detects an asset health issue and conveys it to systems such as maintenance and inspection system, which may then trigger maintenance action on the basis of the notification.

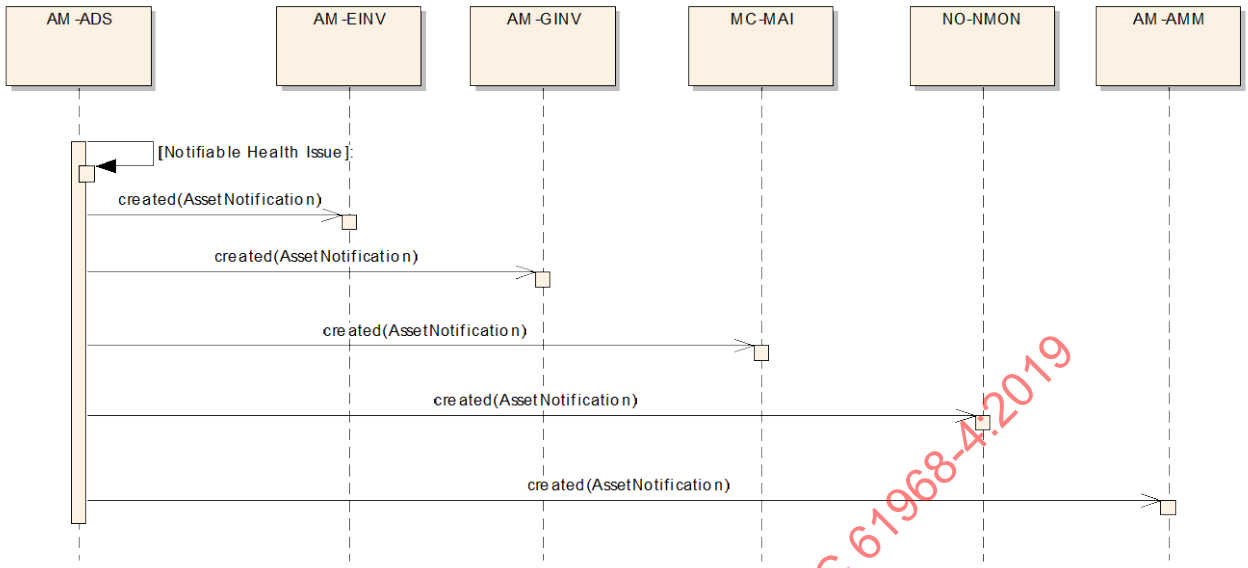


Figure 93 – AssetHealthEvents message exchanges

5.19.3 Message format

Figure 94 is an illustration of the AssetHealthEvents message format. The root element in the message is AssetHealthEvent, which is a record of change in an asset's health and is created by an analytic. The AssetHealthEvent contains details about the event, such as the type of the event, the data/time of its creation, its severity, and recommended action. It also contains identifying information for the assets to which the event pertains and reference to the analytics that created it.

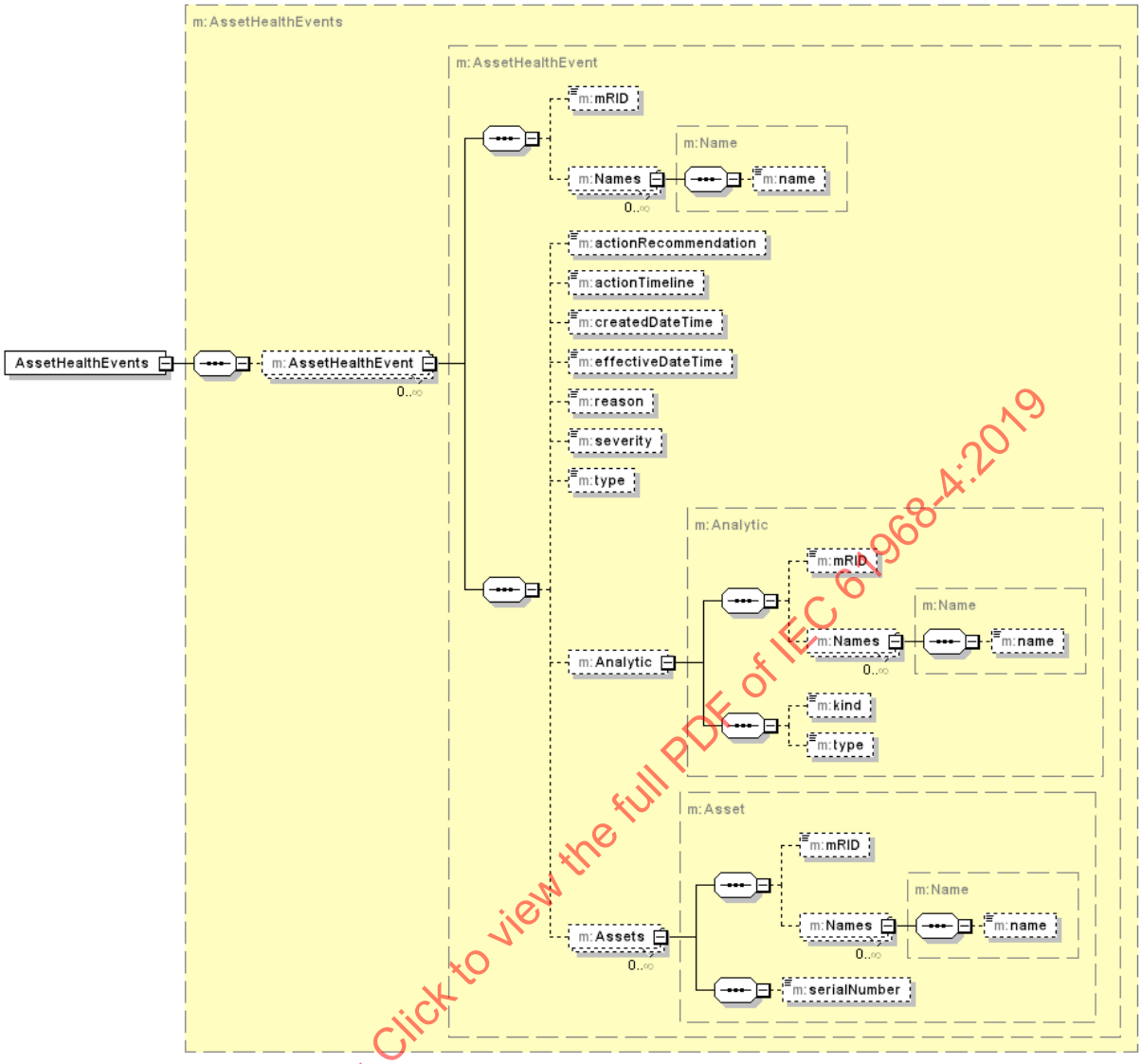


Figure 94 – AssetHealthEvents message format

The following is an XML example for an AssetHealthEvents message payload, which is for an event of type PartialDischarge. The actionRecommendation is to take the asset out of service within 1 day, as specified by actionTimeline.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetHealthEvents xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetNotification.xsd">
      <m:AssetHealthEvent>
            <m:actionRecommendation>Take the asset out of
service</m:actionRecommendation>
            <m:actionTimeline>P0Y0M1DT0H0M</m:actionTimeline>
            <m:createdDateTime>2016-01-05T09:30:47Z</m:createdDateTime>
            <m:type>PartialDischarge</m:type>
            <m:Analytic>
                  <m:mRID>6a9fb099-e67d-4c33-88f4-aa3e479ec1da</m:mRID>
            </m:Analytic>
            <m:Assets>
                  <m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
            </m:Assets>
      </m:AssetHealthEvent>
</m:AssetHealthEvents>
```

6 Document conventions

6.1 UML diagrams

All UML-based sequence diagrams contained herein are to be considered as informative examples of how a message exchange could occur.

One of the strengths of the CIM is its flexibility. As technology advances, and new needs develop, new messages can be created. These new messages might involve additional systems (not pictured.) These new messages may leverage different options than the ones depicted in the example.

All UML-based communication diagrams and message flow diagrams contained herein are to be considered informative.

All UML-based class diagrams contained herein are to be considered informative. The reader is referred to IEC 61968-1 which contains the normative definitions of the classes used in the CIM.

6.2 Message definitions

6.2.1 General

Message format diagrams contained in the body of this document are to be considered as normative.

Use cases and sequence diagrams presented in this document are for informative purposes only, and represent usage examples for the normative message definitions.

6.2.2 Mandatory vs. optional

The messages described within this document were derived from use cases which satisfy an underlying business need for a specific information exchange. Each use case provides a given context for the use of the CIM. Message format diagrams describe the elements which are passed. The elements depicted in dashed-line boxes are to be considered optional in a given context. The elements depicted in solid boxes are to be considered mandatory in a given context. If a diagram should depict an entire class as mandatory or optional, the reader should interpret this to mean that the use of the class is either mandatory or optional, but not that every element within the class is now mandatory or optional. The reader shall refer to the normative definition of the class to determine this.

6.2.3 Verb tense

CIM verbs illustrated in some of the sequence diagrams within this document are shown in UPPER CASE; however, the verbs in the headers of all IEC 61968-4 CIM messages are required to be in lower case.

6.3 Synchronous versus asynchronous messages

The use of asynchronous or synchronous messages in the sequence diagrams in this document is for illustrative purposes only and is not prescriptive.

6.4 Depiction of simple acknowledgment messages

In web services implementations, there is always a synchronous acknowledgement to request messages even if the overall exchange pattern is asynchronous. When using JMS messaging, this simple acknowledgement is also included in the messaging pattern if the AckRequired Boolean is set to "true" in the 61968-100 Header of the request message. However; this simple acknowledgment is suppressed if the AckRequired Boolean is set to "false".

The depiction or lack of depiction of these simple acknowledgment messages in sequence diagrams within this document is intentionally inconsistent as the sequence diagrams are informative and no assumption is made as to whether JMS or web services are being used or whether the AckRequired Boolean is set to "true". Refer to IEC 61968-100 for further information on this subject.

Annex A
(normative)

Description of message type verbs

Table A.1 is copied from Annex B of IEC 61968-100:2013 for convenience purposes only.

Table A.1 – Normative definitions of verbs

Verbs	Meaning	Message Structure
create	The 'create' verb is used to publish a request to the master system to create a new object. The master system may in turn publish the new object as an event using the verb 'created'. The master system may also use the verb 'reply' to respond to the 'create' request, indicating whether the request has been processed successfully or not.	Request message will include HeaderType and Payload structures.
change	The 'change' verb is used to publish a request to the master system to make a change to an object based on the information in the message. The master system may in turn publish the changed object as an event using the verb 'changed' to notify that the object has been changed since last published. The master system may also use the verb 'reply' to respond to the 'change' request, indicating whether the request has been processed successfully or not.	Request message will include HeaderType, RequestType and optionally Payload structures. The requestType structure will potentially identify specific object IDs.
cancel	The'cancel' verb is used to publish a request to the master system to cancel the object, most commonly in the cases where the object represents a business document. The master system may in turn publish the cancelled message as an event using the verb 'canceled' to notify that the document has been cancelled since last published. The master system may also use the verb 'reply' to respond to the 'cancel' request, indicating whether the request has been processed successfully or not. The 'cancel' verb is used when the business content of the document is no longer valid due to error(s).	Request message will include HeaderType, RequestType and optionally Payload structures. The requestType structure will potentially identify specific object IDs.
close	The 'close' verb is used to publish a request to the master system to close the object, most commonly in cases where the object represents a business document. The master system may in turn publish the closed message as an event using the verb 'closed' to notify that the document has been closed since last published. The master system may also use the verb 'reply' to respond to the 'close' request, indicating whether the request has been processed successfully or not. The 'close' verb is used when the business document reaches the end of its life cycle due to successful completion of a business process.	Request message will include HeaderType, RequestType and optionally Payload structures. The requestType structure will potentially identify specific object IDs.
delete	The 'delete' verb is used to publish a request to the master system to delete one or more objects. The master system may in turn publish the closed message as an event using the verb 'deleted' to notify that the object has been deleted since last published. The master system may also use the verb 'reply' to respond to the 'delete' request, indicating whether the request has been processed successfully or not. The 'delete' verb is used when the business object should no longer be kept in the integrated systems either due to error(s) or due to archiving needs. However, the master system will most likely retain a historical record of the object after deletion.	Request message will include HeaderType, RequestType and optionally Payload structures. The requestType structure will potentially identify specific object IDs.
execute	This is used when the message is conveying a complex transaction that involves a variety of create, delete and/or change operations through the use of the Payload.OperationSet element..	See Payload.OperationSet in Message.xsd.
get	The 'get' verb is used to issue a query request to the master system to return a set of zero or more objects that meet a specified criteria. The master system may in turn return zero or more objects using the 'reply' verb in a response message.	Request message will include HeaderType and RequestType structures. The requestType structure will potentially identify specific parameters to qualify the request, such as object IDs.

Verbs	Meaning	Message Structure
created	The ‘created’ verb is used to publish an event that is a notification of the creation of a object as a result of either an external request or an internal action within the master system of that object. This message type is usually subscribed by interested systems and could be used for mass updates. There is no need to reply to this message type.	Event message will include HeaderType and Payload structures.
changed	The ‘changed’ verb is used to publish an event that is a notification of the change of an objectt as a result of either an external request or an internal action within the master system of that object. This could be a generic change in the content of the object or a specific status change such as "approved", "issued" etc. This message type is usually subscribed by interested systems and could be used for mass updates. There is no need to reply to this message type.	Event message will include HeaderType and Payload structures.
closed	The ‘closed’ verb is used to publish an event that is a notification of the normal closure of an objectt as a result of either an external request or an internal action within the master system of that object. This message type is usually subscribed by interested systems and could be used for mass updates. There is no need to reply to this message type.	Event message will include HeaderType and Payload structures.
canceled	The ‘canceled’ verb is used to publish an event that is a notification of the cancellation of an objectt as a result of either an external request or an internal action within the master system of that object. This message type is usually subscribed by interested systems and could be used for mass updates. There is no need to reply to this message type.	Event message will include HeaderType and Payload structures.
deleted	The ‘deleted’ verb is used to publish an event that is a notification of the deletion of an object as a result of either an external request or an internal action within the master system of that object. This message type is usually subscribed by interested systems and could be used for mass updates. There is no need to reply to this message type.	Event message will include HeaderType and Payload structures.
executed	This provides for an event that indicates the execution of a complex transaction that uses the Payload.OperationSet element.	See Payload.OperationSet in Message.xsd.
reply	There are two primary usages of the ‘reply’ verb, but in both cases it is only used in response to request messages, whether the pattern used is synchronous or asynchronous. The first usage is to indicate the success, partial success or failure of a transactional request to the master system to create, change, delete, cancel, or close a document. The second usage is in response to a ‘get’ request, where objects of interest may be returned in the response.	Used only for response messages. For responses to transactional requests, the message will contain HeaderType and ReplyType structures. For responses to get requests, the message will contain HeaderType, ReplyType and potentially Payload structures.

Annex B
(informative)

Use cases

B.1 Business use cases

IEC 62913-1 identifies two types of use cases:

- business use cases describe how Roles of a given system interact to execute a business process. These processes are derived from services, i.e. business transactions, which have previously been identified.
- system use cases describe how Actors of a given system interact to perform a smart grid function required to enable / facilitate the business processes described in business use cases. Their purpose is to detail the execution of those processes from an information system perspective.

IEC 62913-1 further clarifies that since a smart grid function can be used to enable / facilitate more than one business process, a system use case can be linked to more than one business use case.

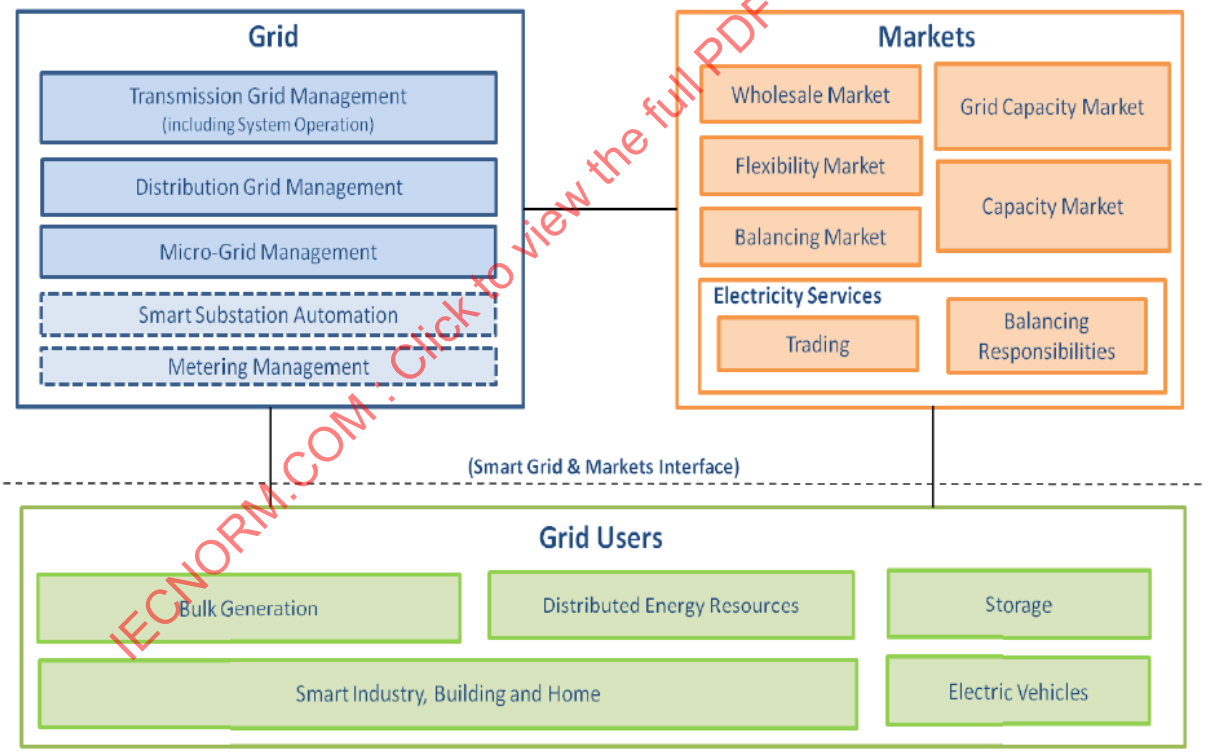


Figure B.1 – IEC 62913 Conceptual model (source: IEC 62913-1)

IEC 62913 breaks down the scope of Smart Grid applications into domains, which are illustrated in Figure B.1. In this context, IEC 62913-2-1 identifies the generic business use cases for grid-related domains. Of the use cases described in early drafts of this standard, two directly pertain to this document (IEC 61968-4):

- decide asset renewal priorities and optimise maintenance programmes (see Figure B.2);
- decide to carry out urgent maintenance operations.

Business Process	*Brief description*	*Smart Grid Functions required to enable/execute the business process*
Decide renewal priorities on network and optimise maintenance programmes	The Generic Business Use Case describes how the Distribution Grid Operator **decides asset renewal priorities and optimises maintenance programmes** in the planning phase, based on the network assets analysis and the development of failure predictive and condition-based maintenance models.	- Store and provide environmental and weather data, - Calculate the health index of a network asset, - Store and provide data about the network.

Figure B.2 – Brief description of the use case on "decide asset renewal priorities and optimise maintenance programmes" (source: IEC 62913-2-1).

Clause B.2 provides the system use cases corresponding to these business use cases. These system use cases are part of the requirements for this document.

B.2 System use cases

B.2.1 General

B.2.2 and B.2.3 provide the two system use cases for this document. Note that the "Information Exchanged" in these use cases directly map to profiles in this document and, in a few cases, IEC 61968-3 and IEC 61968-6.

B.2.2 Analytical evaluation of asset health

B.2.2.1 Description of the use case

B.2.2.1.1 Name of use case

Use case identification		
ID	*Domain(s)*	*Name of use case*
	Asset Management, Asset Planning, Maintenance & Work Management.	Analytical evaluation of asset health and risk

B.2.2.1.2 Version Management

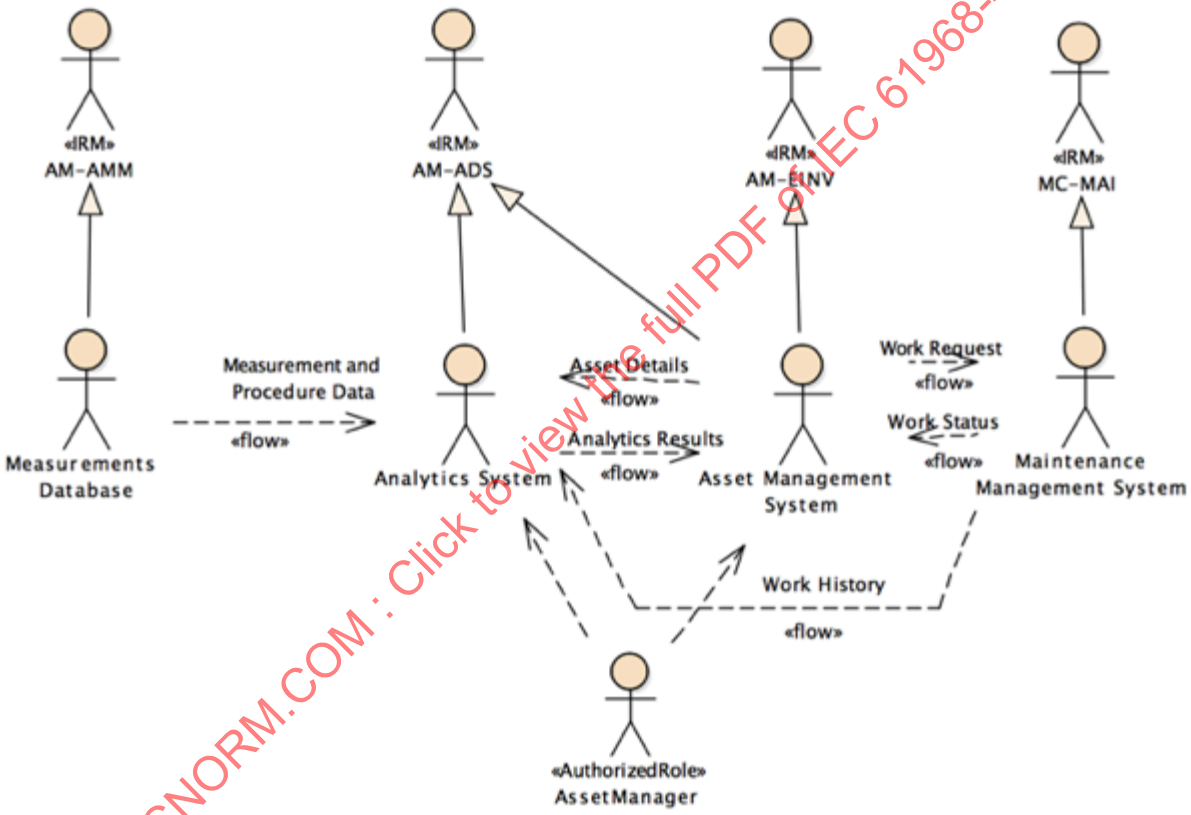
Version management changes / version	*Date*	*Name Author(s) or Committee*	*Area of expertise / domain / role*	*Title*	*Approval status draft, for comments, for voting, final*
1	2016.11.01	IEC TC57 WG14 Part 4 Team	Asset Management	Replace a failed asset	Draft

B.2.2.1.3 Scope and objectives of use case

Scope and objectives of use case	
Related business case	Decide renewal priorities on network and optimise maintenance programmes
Scope	Analytical evaluation of specific grid assets and asset fleets in order to: – Plan long term renewal and replacement strategies – Determine maintenance tasks and schedules on the basis of asset condition.
Objective	– Facilitate Capital Expenses (CapEx) investment decisions on renewal and replacement of grid assets. – Facilitate Operational Expenses (OpEx) spending strategy to best maintain the grid assets.

B.2.2.1.4 Narrative of use case

Narrative of use case
Short description – max 3 sentences
This use case describes analytical evaluation of the health and risk of grid assets by aggregating and processing data available about the assets. The analytical evaluation is used to strategically plan what assets need to be renewed or replaced, and when. The analytical evaluation is also used to determine the maintenance schedule of assets on the basis of their condition.
Complete description
The following use case diagram depicts the analytical evaluation of asset health and risk. The actors at the top are IEC 61968-1 Interface Reference Model (IRM) business sub-functions that describe system functional capabilities. The actors in the middle are commonly known system names that implement the functionality embodied by the IRM actors. For instance, AM-ADS (Records and Asset Management – Asset Decision Support) describes analytical capabilities and AM-EINV (Records and Asset Management – Substation and Network Inventory) describes asset registry, which are typically features implemented by asset management systems. The actor in the bottom row is the human actor who has the authorized role of Asset Manager and uses the Asset Management System in order to accomplish the job function.



The use case consists of an Asset Manager deploying an Analytics System in order to evaluate the health and risk pertaining to an asset type. The Analytics System obtains the necessary asset details from an Asset Management System, work history from a Maintenance Management System, and measurements from Measurement Systems. The Analytics System then performs its analytical evaluation, the results of which are made available to the Asset Manager and to interested systems. The Asset Manager can then decide to act upon the results by, for instance, initiating maintenance work on some of the assets.

B.2.2.1.5 General remarks

General remarks
Data driven analytics is a key component of strategic asset management. This use case establishes the requirements for IEC 61968-4 in order to support data driven analytics.

B.2.2.2 Diagrams of use case

Diagram of use case

B.2.2.3 Technical details

B.2.2.3.1 Actors: people, systems, applications, databases, the power system, and other stakeholders

Actors		
Grouping (Community)		*Group description*
Records and Asset Management (AM)		IEC 61968-1 Interface Reference Model (IRM) Business Function
Actor name see Actor list	*Actor type see Actor list*	*Actor description see Actor list*
Asset Monitoring and Measurement (AM-AMM)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Asset monitoring and measurement involves inspection, testing, measurement, and monitoring of the assets in order to understand, assess and manage their condition and performance.
Asset Decision Support (AM-ADS)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Asset decision support involves strategy definition and prioritisation, maintenance strategy planning, risk management, programme management and decision-making. The central aspect of asset decision support is analytics. It drives the condition, configuration, performance, operating costs, and flexibility of the asset base, with the aim of maximising value.
Substation and Network Inventory (AM-EINV)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	The electrical substation and network assets that a utility owns, or for which has legal responsibility, and will maintain an accurate asset register developed around an asset hierarchy that supports advanced asset management functions.
Geographical Inventory (AM-GINV)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Management of geospatial data, typically by utilizing computer graphics technology to enter, store, and update graphic and non-graphic information. Geographic depictions and related non-graphic data elements for each entity are typically stored in some form of a data store. The graphic representations are referenced using a coordinate system that relates to locations on the surface of the earth. Information in the data store can be queried and displayed based upon either the graphic or non-graphic attributes of the entities.

Actors			
Grouping (Community)		***Group description***	
Maintenance and Construction (MC)		IEC 61968-1 Interface Reference Model (IRM) Business Function	
Actor name ***see Actor list***	***Actor type*** ***see Actor list***	***Actor description*** ***see Actor list***	***Further information specific to this use case***
Maintenance and Inspection (MC-MAI)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Work involving inspection, cleaning, adjustment, or other service of equipment to enable it to perform better or to extend its service life. Examples of maintenance work are routine oil changes and painting. Examples of inspection work are pole inspections, vault inspections, and substation inspections.	
Work Scheduling and Dispatching (MC-SCH)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Work scheduling and dispatching makes it possible, for a defined scope of work, to assign the required resources and keep track of work progress.	

B.2.2.3.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	***Triggering event***	***Pre-conditions***	***Assumption***
Utility Asset Manager	Wants to evaluate the health and risk associated with a particular type of asset (e.g. high voltage power transformers) for purposes of long-term investment planning and short-term maintenance planning	Has acquired an analytics system that is able to evaluate health and risk for the asset type of interest	

B.2.2.3.3 References / Issues

References						
No.	***References type***	***Reference***	***Status***	***Impact on use case***	***Originator / Organisation***	***Link***

B.2.2.3.4 Further information on the use case for classification / mapping

Classification information
Relation to other use cases
The IEC 62913-2-1 business use case on "Decide asset renewal priorities and optimise maintenance programmes" establishes the business justification for this use case.
Level of depth
System-level use case that illustrates and guides system implementation
Prioritisation
Generic, regional or national relation
View
Further keywords for classification

B.2.2.4 Step by step analysis of use case

Scenario conditions					
No.	***Scenario name***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
4.1	Analytics system discovers the assets of interest	AM-ADS			
4.2	Analytics system obtains the details of the assets of interest	AM-ADS			
4.3	Analytics system obtains results from all tests of interest performed on the assets	AM-ADS			
4.4	Analytics system obtains all the measurement data of interest pertaining to the assets	AM-ADS			
4.5	Analytics system provides fleet-level analytics results, which can be used for long term investment planning	AM-ADS			
4.6	Analytics system provides individual asset analytics results, which can be used for maintenance planning	AM-ADS			
4.7	Analytics system identifies asset conditions that require intervention	AM-ADS			

Step 1 – Asset system discovers assets of interest

Scenario					
Scenario Name:					
Step No.	***Event***	***Service***	***Information producer (Actor)***	***Information receiver (Actor)***	***Information exchanged***
1	Analytics system gets the list of available assets	GET	AM-EINV	AM-ADS	AssetList
2	Analytics system gets further details on some of the assets in order to identify those of interest	GET	AM-EINV	AM-ADS	AssetDetails AssetCatalogue TypeAssetCatalogue

Step 2 – Analytics system discovers the information objects available for the assets of interest

Scenario					
Scenario name:					
Step No.	Event	Service	Information producer (Actor)	Information receiver (Actor)	Information exchanged
1	Analytics system identifies the information objects available for the assets of interest	GET	AM-EINV	AM-ADS	AssetTemplate
2	Analytics system obtains details of the asset-related information objects	GET	AM-EINV	AM-ADS	AssetDetails
3	Analytics system obtains the lifecycle history of the assets of interest	GET	AM-EINV	AM-ADS	AssetHistory
4	Analytics system obtains the maintenance and work history for the assets of interest	GET	MC-MAI	AM-ADS	AssetWorkHistory

Step 3 – Analytics system obtains results from all tests of interest performed on the assets

Scenario					
Scenario name:					
Step No.	Event	Service	Information producer (Actor)	Information receiver (Actor)	Information exchanged
1	Analytics system obtains the list of inspection and test results available for the assets	GET	AM-AMM	AM-ADS	AssetProcedures
2	Analytics system obtains the inspection and test results of interest	GET	AM-AMM	AM-ADS	ProcedureDataSets
3	Analytics system obtains the details of the inspections and tests	GET	AM-AMM	AM-ADS	Procedures

Step 4 – Analytics system obtains all the measurement data of interest pertaining to the assets

Scenario					
Scenario name:					
Step No.	Event	Service	Information producer (Actor)	Information receiver (Actor)	Information exchanged
1	Analytics system obtains the list of measurements pertaining to the assets	GET	AM-AMM	AM-ADS	AssetMeasurements
2	Analytics system obtains the measurement values for the measurements of interest	GET	AM-AMM	AM-ADS	MeasurementValues
3	Analytics system obtains the details of the measurements	GET	AM-AMM	AM-ADS	MeasurementDetails

Step 5 – Analytics system provides fleet-level analytics results, which can be used for long term investment planning

Scenario					
Scenario name:					
Step No.	Event	Service	Information producer (Actor)	Information receiver (Actor)	Information exchanged
1	Analytics system advertises the availability of asset fleet analytics	CREATED	AM-ADS	AM-ADS	Analytics
2	Asset management system obtains the asset groups of interest and the analytics scores for the groups	GET	AM-ADS	AM-ADS	AssetGroups

Step 6 – Analytics system provides individual asset analytics results, which can be used for maintenance planning

Scenario					
Scenario name:					
Step No.	Event	Service	Information producer (Actor)	Information receiver (Actor)	Information exchanged
1	Analytics system advertises the availability of asset analytics	CREATED	AM-ADS	AM-ADS	Analytics
2	Asset management system obtains the analytics scores for the assets of interest	GET	AM-ADS	AM-ADS	AssetScores

Step 7 – Analytics system identifies asset conditions that require intervention

Scenario					
Scenario name:					
Step No.	Event	Service	Information producer (Actor)	Information receiver (Actor)	Information exchanged
1	Analytics system sends asset health events to asset management system	CREATED	AM-ADS	AM-ADS	AssetHealthEvents
2	Asset management system send in work request to maintenance management system for assets with health events that require intervention	CREATED	AM-ADS	MC-MAI	WorkRequest

B.2.3 Replacement of asset

B.2.3.1 Description of the use case

B.2.3.1.1 Name of use case

Use case identification		
ID	Domain(s)	Name of use case
	Asset Management, Asset Planning, Maintenance & Work Management.	Replace a failing or failed asset

B.2.3.1.2 Version management

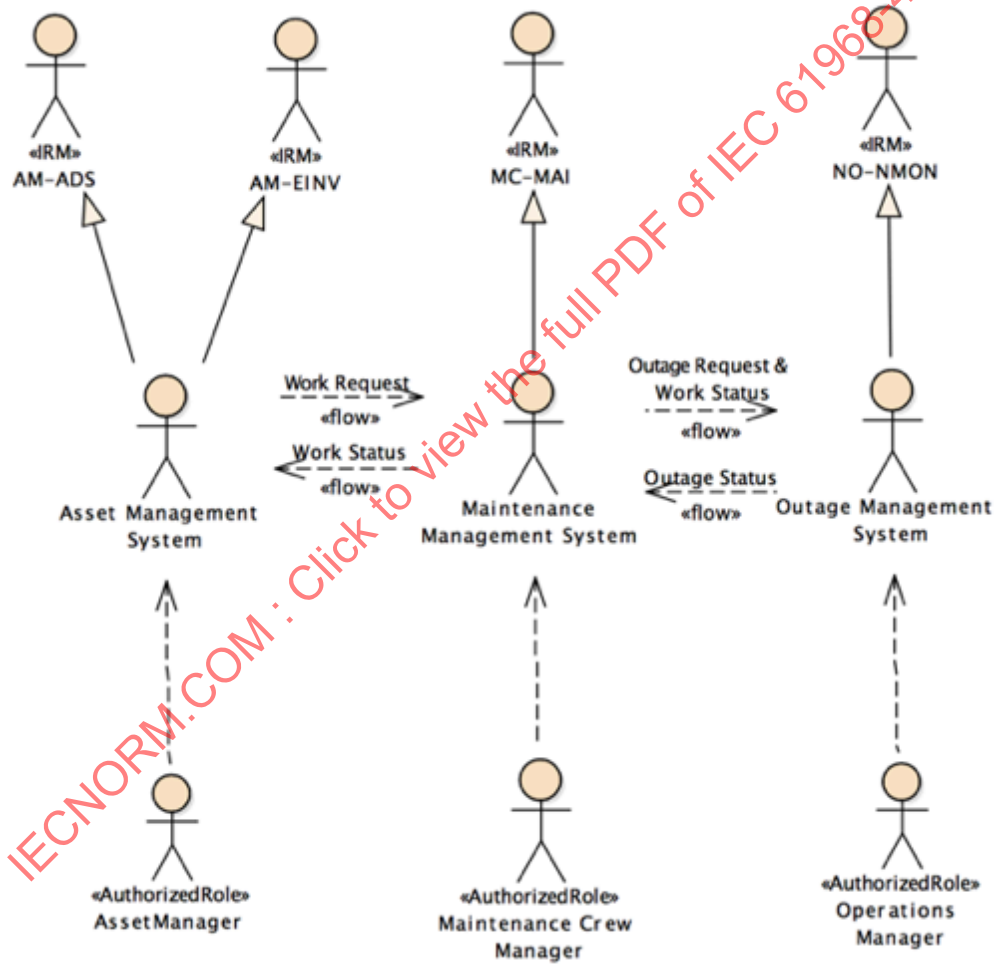
Version management changes / version	Date	Name Author(s) or Committee	Area of expertise / Domain / Role	Title	Approval status draft, for comments, for voting, final
1	2016.11.01	IEC TC57 WG14 Part 4 Team	Asset Management	Replace a failed asset	Draft

B.2.3.1.3 Scope and objectives of use case

Scope and objectives of use case	
Related business case	Decide to carry out urgent maintenance operations
Scope	Replacement of a failed grid asset.
Objective	– Replace a failed asset expeditiously and safely. – Use an in-stock equivalent model if necessary. – Coordinate closely with grid operations so that the work can be done safely and functionality restored quickly.

B.2.3.1.4 Narrative of use case

Narrative of use case
Short description – max 3 sentences
This use case describes replacement of a grid asset due to failure. The replacement could be the same product model as the original asset or a different model with equivalent capability. The replacement work is coordinated with grid operations for safety while the work is in progress and quick restoration of function when the work is completed.
Complete description
The following use case diagram depicts the replacement of failing or failed asset. The actors at the top are IEC 61968-1 Interface Reference Model (IRM) business sub-functions that describe system functional capabilities. The actors in the middle are commonly known system names that implement the functionality embodied by the IRM actors. For instance, AM-ADS (Records and Asset Management – Asset Decision Support) describes analytical capabilities and AM-EINV (Records and Asset Management – Substation and Network Inventory) describes asset registry, which are typically features implemented by asset management systems. The actors in the bottom row are the human actors who have authorized roles such as Asset Manager and use the systems such as the Asset Management System in order to accomplish their job function.



The use case consists of an Asset Manager, having identified a failing or failed asset, wanting to replace it. The Asset Manager initiates a Work Request through an Asset Management system. The Maintenance Crew Manager, who oversees such replacements, receives and processes the Work Request in his Maintenance Management System. The Maintenance Crew Manager then coordinates an outage with the Operations Manager and carries out the replacement work and informs the Asset Manager upon completion of the work.

B.2.3.1.5 General remarks

General remarks
Urgent replacement of failed or failing grid assets is an essential aspect of grid maintenance. This use case establishes the requirements for IEC 61968-4 in order to support expeditious and safe replacement of grid assets.

B.2.3.2 Diagrams of use case

Diagram of use case

B.2.3.3 Technical details

B.2.3.3.1 Actors: people, systems, applications, databases, the power system, and other stakeholders

Actors		
Grouping (community)		*Group description*
Records and Asset Management (AM)		IEC 61968-1 Interface Reference Model (IRM) Business Function
Actor name see Actor list	*Actor type see Actor list*	*Actor description see Actor list*
Asset Monitoring and Measurement (AM-AMM)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Asset monitoring and measurement involves inspection, testing, measurement, and monitoring of the assets in order to understand, assess and manage their condition and performance.
Asset Decision Support (AM-ADS)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Asset decision support involves strategy definition and prioritisation, maintenance strategy planning, risk management, programme management and decision-making. The central aspect of asset decision support is analytics. It drives the condition, configuration, performance, operating costs, and flexibility of the asset base, with the aim of maximising value.
Substation and Network Inventory (AM-EINV)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	The electrical substation and network assets that a utility owns, or for which has legal responsibility, and will maintain an accurate asset register developed around an asset hierarchy that supports advanced asset management functions.
Geographical Inventory (AM-GINV)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Management of geospatial data, typically by utilizing computer graphics technology to enter, store, and update graphic and non-graphic information. Geographic depictions and related non-graphic data elements for each entity are typically stored in some form of a data store. The graphic representations are referenced using a coordinate system that relates to locations on the surface of the earth. Information in the data store can be queried and displayed based upon either the graphic or non-graphic attributes of the entities.

Actors		
Grouping (community)		***Group description***
Maintenance and Construction (MC)		IEC 61968-1 Interface Reference Model (IRM) Business Function
Actor name see Actor list	***Actor type see Actor list***	***Actor description see Actor list***
Maintenance and Inspection (MC-MAI)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Work involving inspection, cleaning, adjustment, or other service of equipment to enable it to perform better or to extend its service life. Examples of maintenance work are routine oil changes and painting. Examples of inspection work are pole inspections, vault inspections, and substation inspections.
Work Scheduling and Dispatching (MC-SCH)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Work scheduling and dispatching makes it possible, for a defined scope of work, to assign the required resources and keep track of work progress.

Actors		
Grouping (community)		***Group description***
Network Operation (NO)		IEC 61968-1 Interface Reference Model (IRM) Business Function
Actor name see Actor list	***Actor type see Actor list***	***Actor description see Actor list***
Network operation monitoring (NO-NMON)	IEC 61968-1 Interface Reference Model (IRM) Business Sub-function	Provides the means for supervising main substation topology (breaker and switch state) and control equipment status. It also provides the utilities for handling network connectivity and loading conditions. It also makes it possible to locate customer telephone complaints and supervise the location of field crews.

B.2.3.3.2 Preconditions, assumptions, post condition, events

Use case conditions		
Actor/System/ Information/Contract	***Triggering event***	***Pre-conditions***
Utility Asset Manager	Wants to replace a failed/failing asset	The asset type is such that it is usually kept in stock, so that a failed/failing asset can be replaced from another of the same model or an equivalent model. Examples are reclosers and pole-top transformers.

B.2.3.3.3 References / Issues

References						
No.	***References type***	***Reference***	***Status***	***Impact on use case***	***Originator / Organisation***	***Link***

B.2.3.3.4 Further Information to the use case for classification / mapping

Classification information
Relation to other use cases
The IEC 62913-2-1 business use case on "Decide to carry out urgent maintenance operations " establishes the business justification for this use case.
Level of depth
System-level use case that illustrates and guides system implementation
Prioritisation
Generic, regional or national relation
View
Further keywords for classification

B.2.3.4 Step by step analysis of use case

Scenario conditions					
No.	***Scenario name***	***Primary actor***	***Triggering event***	***Pre-condition***	***Post-condition***
1	Asset management system checks inventory of the asset being replaced	AM-ADS			
2	Asset management system checks inventory for equivalent models	AM-ADS			
3	Asset management system puts in a work request for asset replacement	AM-ADS			
4	Asset replacement work is scheduled and performed	MC-MAI			
5	Asset replacement work status is updated	MC-MAI			

Step 1 – Asset management system checks inventory for the asset being replaced

Scenario					
Scenario name:		Asset management system checks inventory for the asset being replaced			
Step No.	***Event***	***Service***	***Information producer (Actor)***	***Information receiver (Actor)***	***Information exchanged***
1	Asset management system checks the asset's product model	GET	AM-EINV	AM-ADS	AssetDetails
2	Asset management system checks inventory for that asset model	GET	AM-EINV	AM-ADS	AssetCatalogue

Step 2 – Asset management system checks inventory for equivalent models

Scenario					
Scenario name:		Asset management system checks inventory for equivalent models			
Step No.	**Event**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**
1	Asset management system determines the equivalent product models	GET	AM-EINV	AM-ADS	TypeAssetCatalogue
2	Asset management system checks inventory for the equivalent product models	GET	AM-EINV	AM-ADS	AssetCatalogue

Step 3 – Asset management system puts in a work request for asset replacement

Scenario					
Scenario name:		Asset management system puts in a work request for asset replacement			
Step No.	**Event**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**
1	Asset management system creates a work request for asset replacement	CREATE	AM-ADS	MC-MAI	WorkRequest

Step 4 – Asset replacement work is scheduled and performed

Scenario					
Scenario name:		Asset replacement work is scheduled and performed			
Step No.	**Event**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**
1	Maintenance management system schedules work	CREATED	MC-MAI	MC-SCHD	WorkRequest
2	Maintenance management system schedules an outage	CREATE	MC-MAI	OP-SSC	OutageSchedules
3	Maintenance management system gets the equipment state at the time of performing replacement work	GET	MC-MAI	NO-NMON	AssetPSRDetails

Step 5 – Asset replacement work status is updated

Scenario					
Scenario name:		Asset replacement work status is updated			
Step No.	***Event***	***Service***	***Information producer (Actor)***	***Information receiver (Actor)***	***Information exchanged***
1	Work management system reports work status upon a change	CREATED	MC-SCHD	NO-NMON AM-ADS MC-MAI	MaintenanceOrder
2	Asset management system requests work status	GET	AM-ADS	MC-MAI	AssetWork

Annex C
(informative)

Asset management

C.1 General

The key objective of this document is to enable the data exchanges needed for asset management in electric power utilities. Asset management is a domain that spans the utility enterprise, stretching from customer premise meters to substation assets to lines and poles and involving disparate functional areas of planning and procurement, maintenance, and operation. Condition-based Maintenance (CBM) is an increasingly popular subset of asset management that focuses on maintaining the health of in-service assets. Asset management builds on this and considers the whole lifecycle of the assets in the context of the organizational objectives.

This annex is intended to be a starting point for using CIM and this document in implementing CBM or more comprehensive asset management programs. In Clause C.2, we describe CBM and point out some of the concepts in this document that enable the practice of CBM. In Clause C.3, we discuss asset management and a particular embodiment standardized by ISO 55000/1/2. We also describe some of the concepts of this document that enable key ISO 55000 clauses.

C.2 Condition-based maintenance (CBM)

There is a tremendous amount of data available within the enterprise that is indicative of asset condition. Some examples are SCADA Historian, Geographic Information System (GIS), Intelligent Electronic Devices (IEDs), Work and Asset Management Systems (WAMS), Laboratory Information Management System (LIMS), and databases that store results of diagnostic test. In order to get a complete picture of the asset condition, and therefore implement efficient and effective CBM, this distributed data needs to be gathered and analysed, as shown in Figure C.1.

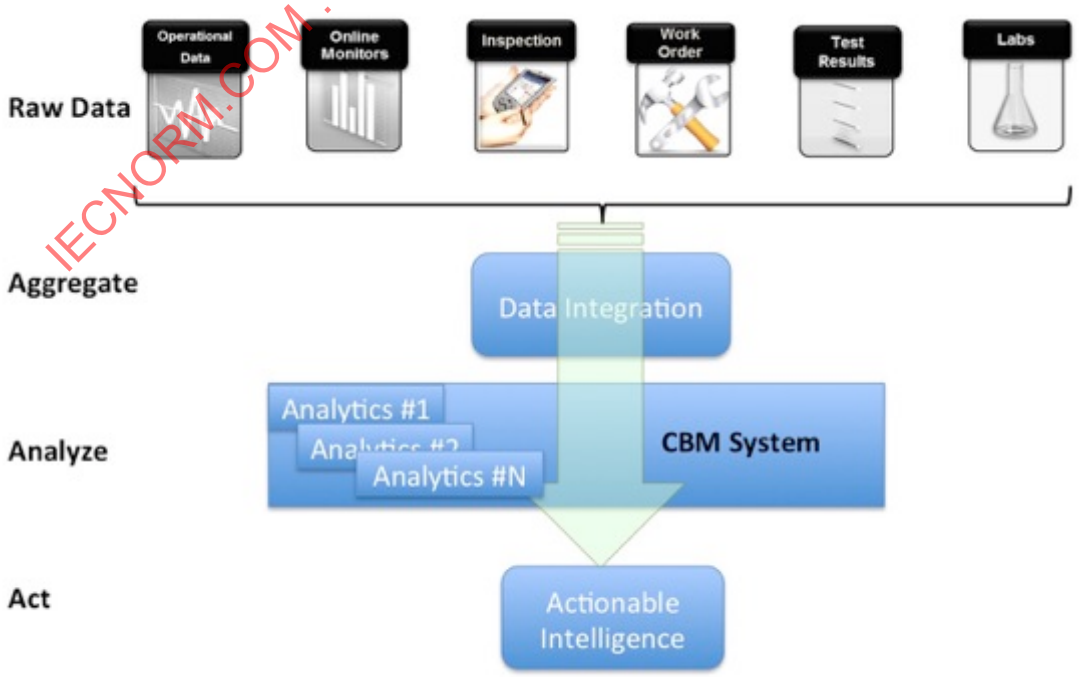


Figure C.1 – Illustration of condition-based maintenance (CBM)

A specific realization of CBM focused on substation assets may include online condition monitoring devices for power transformers, circuit breakers, and batteries that stream data to a historian; diagnostic test results and inspection results that are stored in database systems; and an analytic suite that assesses the data to determine asset condition. For instance, dissolved gases in transformer oil, obtained from online monitoring and laboratory oil test results, could be analyzed for the presence of any fault condition indicators. If the assessment predicts a health event, such as a high risk of bubble formation, an actionable intelligence alert is provided to designated systems and/or persons in order to initiate appropriate action before failure.

In general, CBM programs have some or more of the following elements:

1) Aggregate data from multiple sources.
   a) The data sources pertain to different aspects of an asset – electrical and non-electrical.
   b) The data is indicative of the current and future asset condition and performance.
   c) Multiple data sources may exist for any particular aspect of the asset – e.g., dissolved gases may be measured by online field monitors as well as lab analysis of oil samples.
   d) The multiple data sources have different time-based and data resolution characteristics that arise from different sampling and data storage approaches.
   e) In many cases, the history of data (pattern or trend over time) is the needed input, not just the current value.
2) Generate asset health and risk assessments based on the data.
   a) Asset health assessment is characterized by a score, commonly known as health score or health index.
   b) Many factors that could contribute to the health of the asset are assessed and scored independently.
   c) These scores are combined to produce an overall health score for the asset.
   d) Assets in the same "family" (collection of similar assets) may be compared and ranked.
   e) Risk assessment is done by considering both impact of failure (cost, grid location, replacement availability, etc.) and asset health score.
   f) Asset health and risk assessment are approached using a multitude of different methodologies and there could be multiple metrics used for different purposes.
3) Generate asset health events when assessment indicates significant change in health conditions has occurred.
   a) Recognition that results of assessment represent a situation that merits annunciation.
   b) Asset health events could include:
      i) User notifications and alarms.
      ii) Work order requests – e.g., for additional testing or preventive maintenance.
      iii) Triggers and operational limits for desired health behaviour.
4) Make data available to other systems/tools as needed/requested.

In this context, data exchange occurs while aggregating data from multiple sources (Item 1 above). Raw or unprocessed data is collected from multiple field devices, systems, or databases to be used as input to asset health and risk assessments. Data exchange also occurs while generating asset health events / enabling data consumption (Items 3 and 4). The results or outputs of asset health and risk assessments are shared with and subsequently acted upon by other applications.

The message definitions in IEC 61968-4 enable these data exchanges. Annex E and Annex F describe the IEC 61968-4 messages and exchanges that enable Item 1, namely aggregation of data from multiple sources. Annex G describes the IEC 61968-4 messages and exchanges

that enable Item 3, namely generating asset health events, and Item 4, namely making asset scoring data, available to other systems as needed.

C.3 Asset management and ISO 55000

Asset management takes into account the asset's entire lifecycle and considers how it contributes to the organizational objectives. Just as in the case of CBM, the crux of this approach is analytics, but the analytics goes beyond CBM to do what-if type projections in order to determine, for instance, the operational strategy to maintain the risk associated with the asset fleet at an acceptable level and the long-term replacement strategy. The data processing aspect of such an asset management program is shown in Figure C.2. The central system component here is a system that, in addition to the data processed by CBM systems, also uses financial information and makes assessments that help implement a Strategic Asset Management Plan (SAMP).

Complex asset management decisions in an enterprise are best made on the basis of a dispassionate analysis of relevant data. High-value assets such as power transformers are routinely kept in service beyond their nominal lifetime. From a planning and procurement perspective, the analysis for the repair vs. replace decisions for such assets is driven by risk-management calculations. From a maintenance perspective, optimising the maintenance program requires an accurate assessment of the asset condition, which is made on the basis of asset health analytics. From an operational perspective, balancing of use-related deterioration against revenue is a key aspect of maximizing efficiency of the distribution system. These are some considerations in what constitutes a multi-dimensional problem.

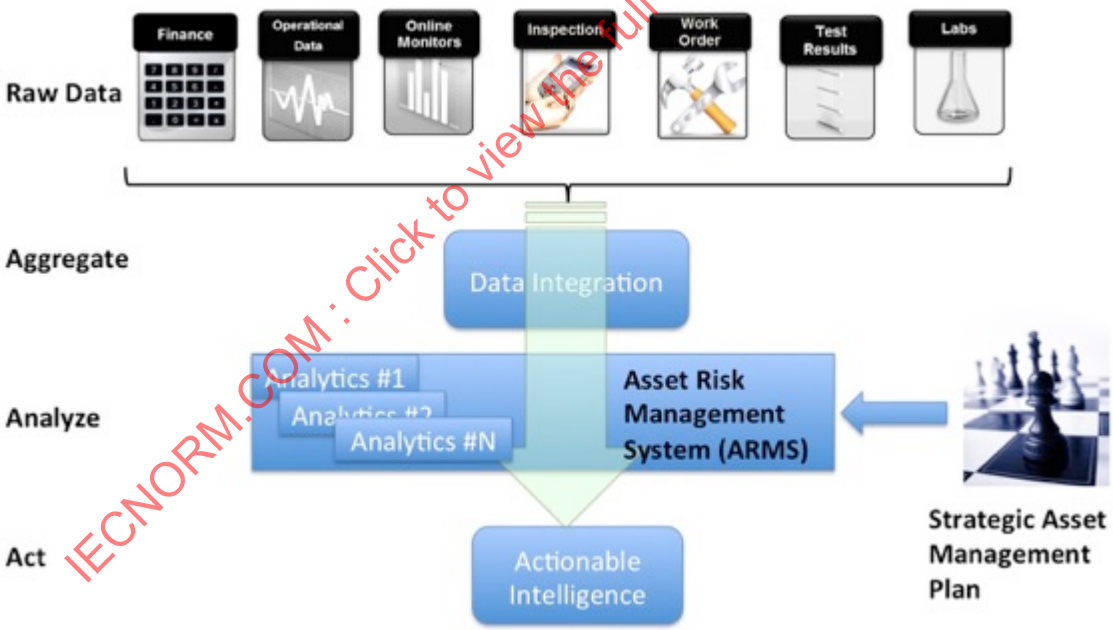


Figure C.2 – Illustration of asset management

There is growing realization of the value of addressing such complex problems strategically. Relevant standards for this are the British standard PAS-55 and ISO 55000. As shown in Figure C.3, ISO 55000 specifies asset management that is iterative and arises from the organizational objectives, is embodied in a strategic asset management plan, and incorporates performance evaluation so that its ongoing contributions to the organizational objectives can be affirmed. This enables the use of best practices in asset management and provides for consistent outcomes.

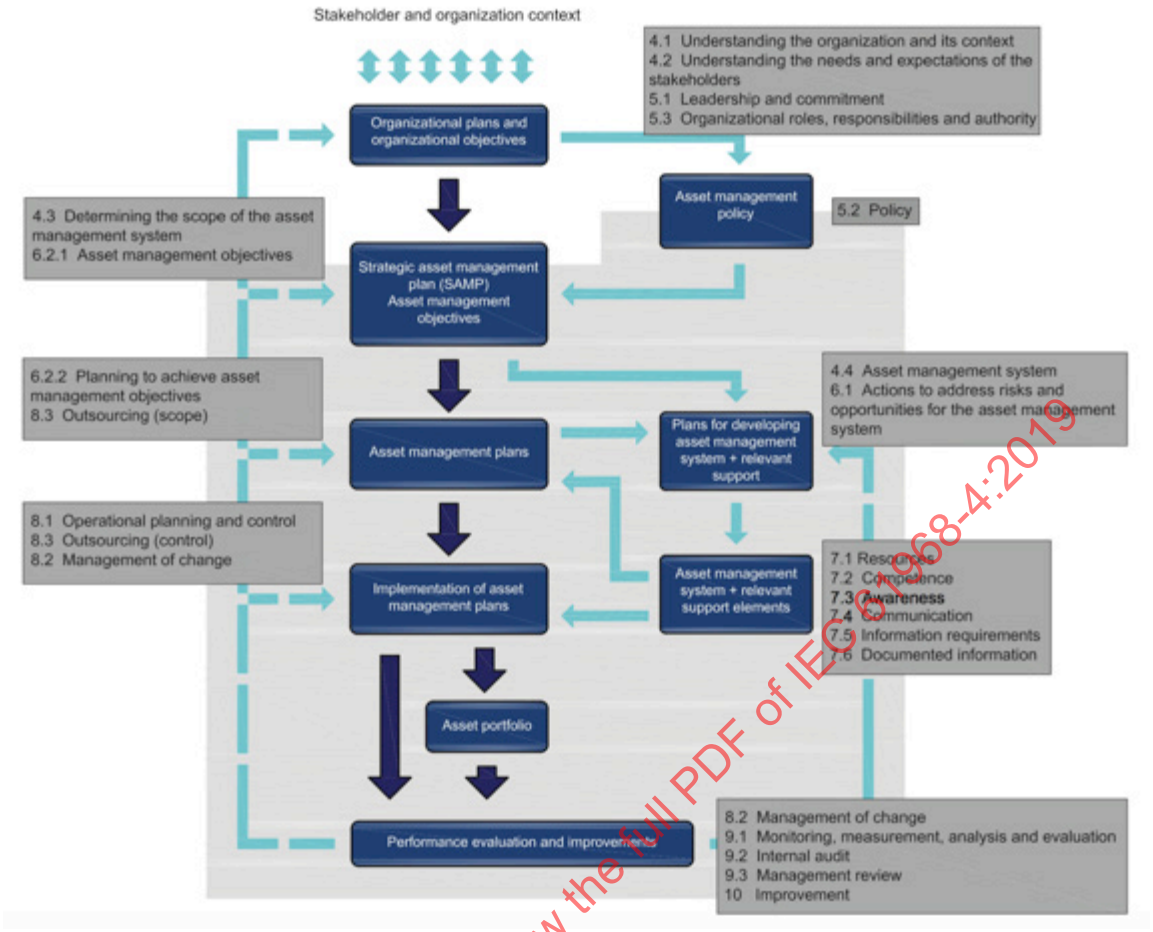


Figure C.3 – ISO 55000/1/2 asset management concept and clauses.

This document provides for the data exchange needs of the strategic asset management discipline, including as described in the ISO 55000/1/2 standards. Of particular relevance are the asset management elements in the lower half of the following figure, which involve data aggregation and processing of the kind depicted in Figure C.2.

Subclause 6.1 of ISO 55002:2014 on "Asset management objectives" describes objectives at the portfolio, asset system, and individual asset levels. Progress towards these objectives then need to be measured and tracked. As described in Subclause 6.2.2 of ISO 55002:2014 on "Planning to achieve asset management objectives," a risk ranking process is necessary to identify critical assets. In addition, Subclause 9.1 of ISO 55002:2014 on "Performance evaluation" specifies systematic measurement, monitoring, analysis and evaluation.

Some of the message exchanges described in this document provide for a possible means to realize these clauses. For instance, AssetGroupAnalytics in 5.18 can be utilized to share information about grouping of assets into asset systems and portfolio. These groups can have Analytic performed on them, resulting in AnalyticScore and RiskScore. An analytic-centric asset management system such as depicted in Figure C.2 could use these concepts for performance evaluation against asset management objectives. The results of such an endeavor can be easily communicated to other systems using IEC 61968-4 messages for further action.

The use case, titled "Analytical evaluation of asset health and risk," described in B.2.2 provides a more detailed illustration of some of the key tenets of asset management and the data exchanges required for them. Most of the data exchanges described in this use case are standardized herein. Some of the data exchanges involve Work Management messages that are standardized in IEC 61968-6. An organization implementing an asset management system

may start out by determining the asset and asset measurement data needed. Annex D and Annex E, which describe the asset related concepts in this document, and Annex F, which describes the asset measurement related concepts in this document, are good resources for this data aggregation design and subsequent implementation. Such an organization might also want to determine the assessments needed to meet its asset management objectives; Annex G provides the framework for this.

Annex D
(informative)

Asset models and information exchange – The case for formal instance templates

D.1 CIM asset containment

The Asset and AssetContainer classes of the CIM provide a very powerful tool for accurately and flexibly modelling assets and their components, supporting an infinite variety of nested combinations of components, an illustration of which is shown in the Figure D.1 object diagram.

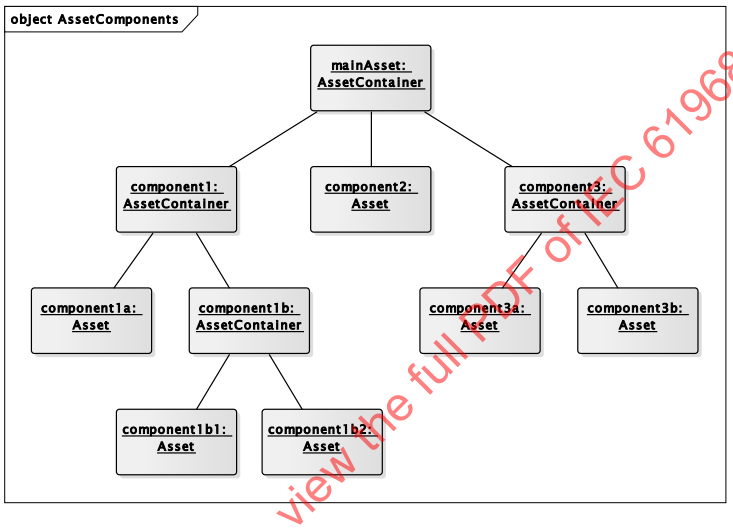


Figure D.1 – Asset component flexibility provided by CIM

The downside of this flexibility is that it makes interoperability more challenging. If one application models a given asset with one combination of components and another models the same asset with a different combination their ability to easily exchange information is compromised.

D.2 Common instance templates for interoperability

D.2.1 General

The concept of common instance templates is presented in this Annex as a method of facilitating the simple and unambiguous exchange of asset information. The approach calls for the creation of a common instance template for each typical kind of electric asset about which asset information is to be shared. The common instance template is composed of component instances representing "parts" of the asset that have relevance from an asset health perspective. The intent is to define just enough component detail to fully support the accurate association of asset health information to the asset (or asset component). For example, if testing is done per bushing or per tank, then bushings and tanks deserve their own component instances. If maintenance is done per interrupter, then interrupters should have component instances.

The following "rule of thumb" questions can be used to guide the definition of common instance templates, assisting in the determination of what components of an asset merit individual modelling and what components should be viewed as simply a part of a larger assembly:

- Can a component be replaced independently of the assembly to which it belongs? If so, is there need for information about how the new component differs from the old component?
- Is there any testing or inspection done that relates specifically to the component and not to the assembly to which the component belongs?
- Can a component be put "in service" (connected to the grid) independently of other components?
- Does any characteristic of the component (manufacturer, model, in-service date) matter in analysing asset health?

This annex presents common instance templates for transmission breakers, which are informative, not normative, in nature. Future editions of this document will expand the collection of informative instance templates to include Distribution breakers, transformers (of many voltage ranges), batteries, current transformers and other commonly deployed electric utility assets. The applicability and usefulness of a common instance template approach for describing 'linear' assets (conductors, poles, insulators, towers, etc.) has yet to be explored.

It is the goal of this document that, over time, asset-related software products implement interfaces based on these common instance templates, eventually allowing utilities to deploy asset analytics easily and quickly, without the need to define local conventions to enable data sharing. Utility use of CIM-based instance templates in local implementations, whether they conform precisely to the common instance templates or are simply inspired by them, will provide the insight necessary to move toward the envisioned level of interoperability, if utilities implementing such local solutions submit their instance templates to the next edition of this document.

D.2.2 Instance template documentation

The main skeleton of an instance template is provided by Asset child instances. Some of the instances will be of a specific Asset child class, others will be Asset or AssetContainer class instances whose asset type is identified by the Asset.kind attribute. Asset.kind is a key mechanism for identifying not only the type of the whole asset but also for distinguishing between various Asset child component instances "inside" an asset. The scope of classes utilized by common instance templates includes the Asset and Asset child classes, as well as Medium, ProductAssetModel, and applicable AssetInfo child classes. These classes are reproduced in Figure D.2 for convenience (please see IEC 61968-11 and IEC 61970-301 for the normative definitions of these classes).

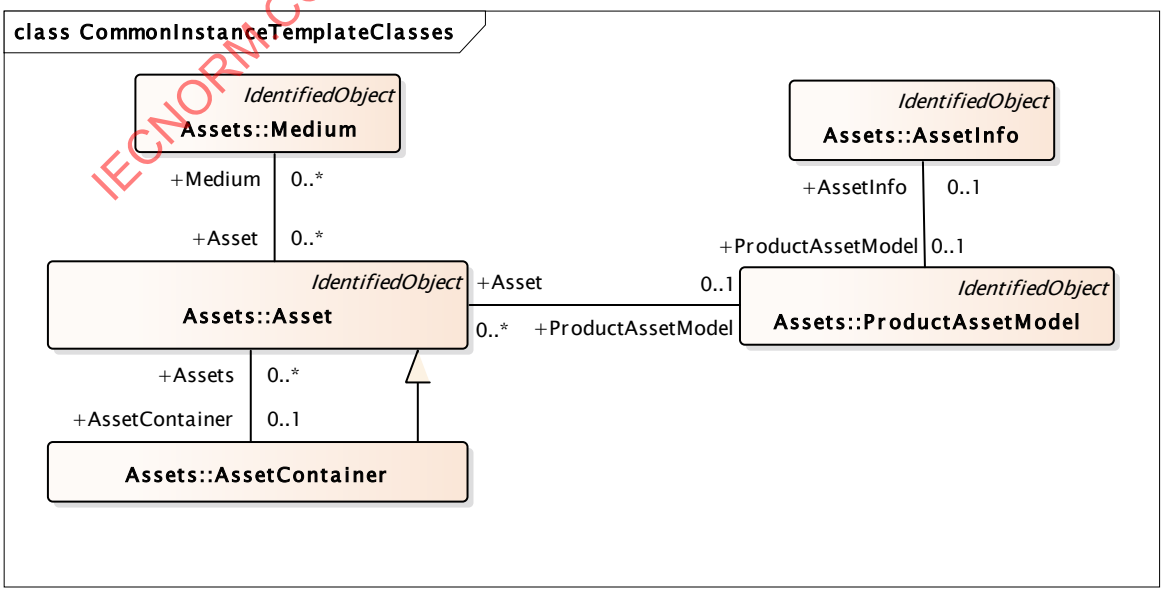


Figure D.2 – Classes utilized in common instance templates

The current approach to documenting common instance templates utilizes a truth table of possible variants for each kind of common electric industry asset augmented with example instance template diagrams of select variants. The diagrams illustrate the configuration of component instances for the kind of asset, showing the class types and required associations. An explicit instance (object) is shown for every component expected to be present. Attribute values appear when a specific value is required for the kind of asset. The common instance template reflects expectations related to public objects. In an interoperable, CIM-based integration solution, if an asset is being shared as a public object, it is assumed that it will have all the component instances, attributes, and associations which are specified in its common instance template.

D.2.3 Instance templates for breakers

Five major families of transmission breakers have been identified, based primarily on unique combinations of insulating and extinguishing medium. They are:

- SF_6 dead tank, where SF_6 gas is used for both insulation and arc extinguishment. These breakers have SF_6-filled insulated (grounded) tanks containing interrupter(s) with connections made via bushings.
- SF_6 live tank, where Insulator stacks provide electrical isolation and SF_6 provides arc-extinguishment. SF_6-filled interrupter chamber(s) are located on top of insulator columns, with the number of insulator columns ranging from one to four per pole.
- Bulk oil, where mineral oil is used for both insulation and arc extinguishment. These breakers have mineral oil-filled insulated (grounded) tanks containing interrupter(s) with connections made via bushings.
- Minimum oil, where insulator stacks provide electrical isolation and mineral oil provides arc extinguishment. Oil-filled interrupter chamber(s) are located on top of insulator columns, with the number of insulator columns ranging from one to two per pole.
- Air blast, where insulator stacks provide electrical isolation and pressurized air provides arc extinguishment. These breakers have air-filled interrupter chamber(s) located on top of insulator columns, with the number of insulator columns ranging from one to ten per pole.

For each family of breakers, there are specific characteristics which govern the components present in the family's common instance templates. These are summarized in Table D.1.

Table D.1 – Salient characteristics for each transmission breaker family

Transmission breaker family	*Salient characteristics*
SF_6 dead tank	Poles / tank Poles / mechanism Number of interrupters in series ("breaks") / pole
SF_6 live tank, Minimum oil, Air blast	Poles / base Stacks / pole Poles / mechanism Number of interrupters in series ("breaks") / pole
Bulk oil	Poles / tank Poles / mechanism

D.2.3.1 SF_6 dead tank breakers

The possible variants for SF_6 dead tank breakers are shown in Figure D.3. Variants with grey, strike-through text are combinations of characteristics not known to exist and therefore not valid in data exchanges.

3 Poles/Tank			1 Pole/Tank (w/ Shared or Separate SF_6)						
3 Poles/ Mechanism		~~1 Pole/ Mechanism~~	3 Poles/ Mechanism		1 Pole/Mechanism				
Single Break	~~Double Break~~		Single Break	~~Double Break~~	Single Break	Double Break	3 Break	•••	n Break

Common instance templates provided

Figure D.3 – SF_6 dead tank breaker variants

Common instance templates are provided for three variants of SF_6 dead tank breakers to illustrate the pattern of objects, associations and required attributes used to describe SF_6 dead tank breakers in a consistent way. The templates are presented in Figure D.4, Figure D.5, and Figure D.6 with two of the variants illustrated by a picture of an actual breaker. In the template diagrams, Asset child class instances are shown in grey, Medium class instances in green, ProductAssetModel class instances in purple and AssetInfo child class instances in blue.

The breaker illustrated in the object diagram of Figure D.4 is an SF_6 breaker with one tank for all three poles, a single break per pole and a single mechanism for all three poles.

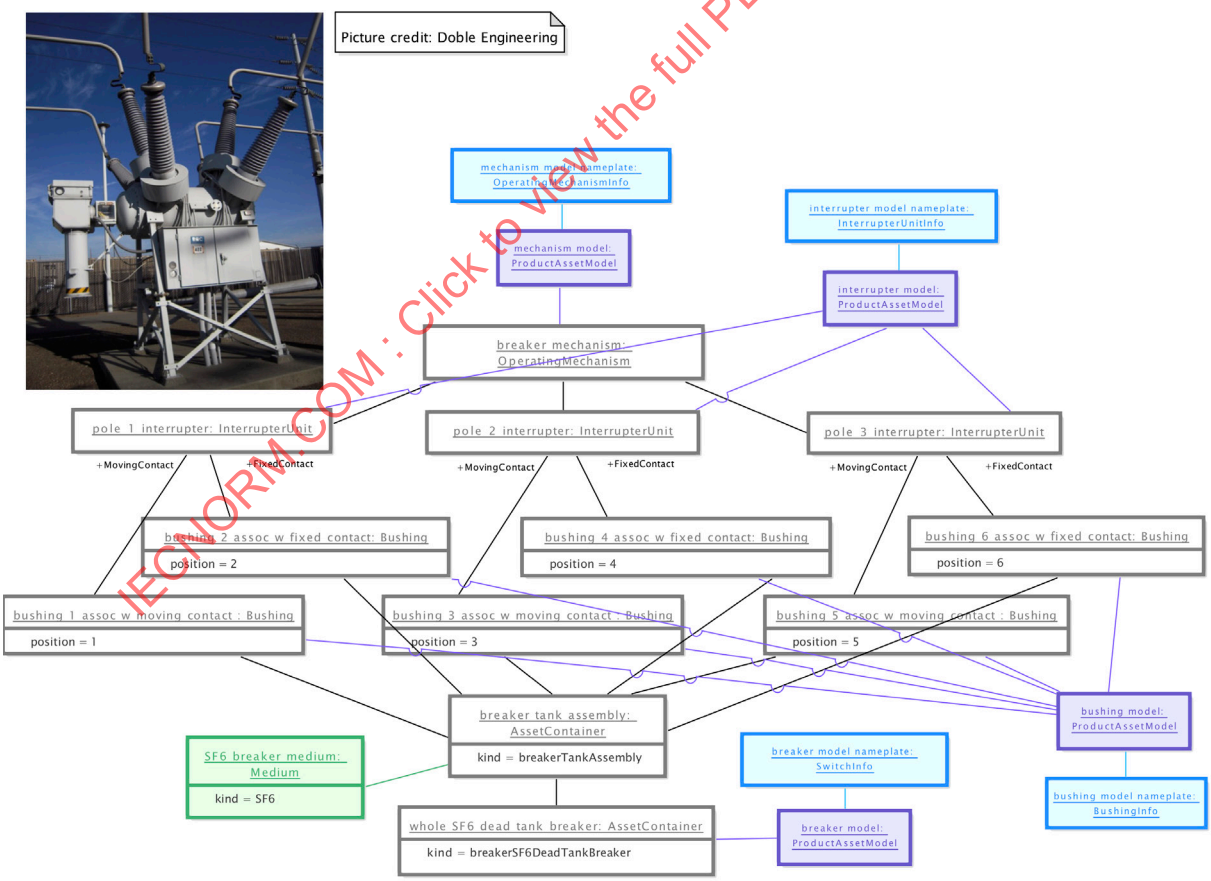


Figure D.4 – Common instance template for SF_6 dead tank breaker with 1 tank, 1 mechanism, single breaks

The breaker illustrated in the object diagram of Figure D.5 is an SF_6 breaker with a tank for each pole, a single break per pole and a single mechanism for all three poles.

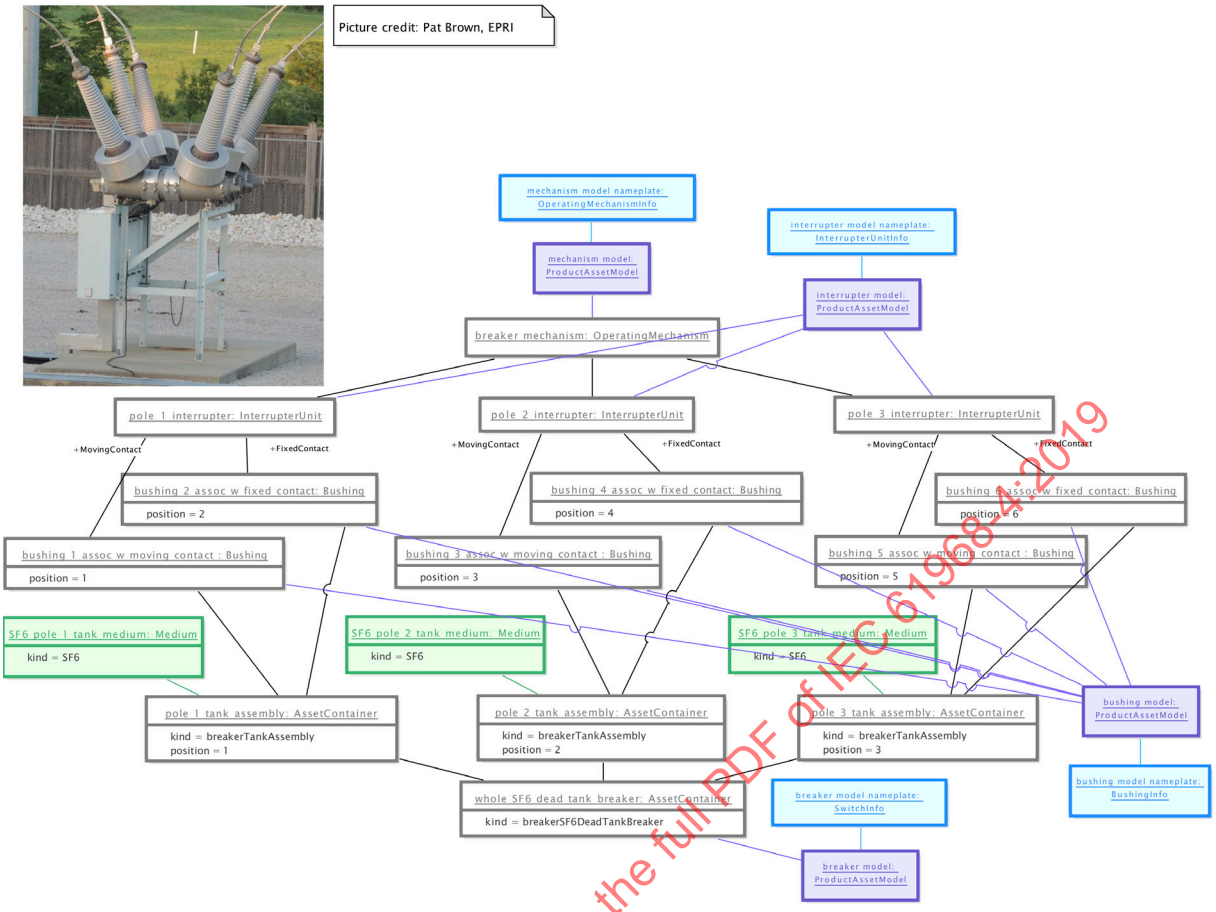


Figure D.5 – Common instance template for SF_6 dead tank breaker with 3 tanks, 1 mechanism, single breaks

The breaker illustrated in the object diagram of Figure D.6 is an SF_6 breaker with a tank for each pole, a double break per pole and a mechanism for each pole.

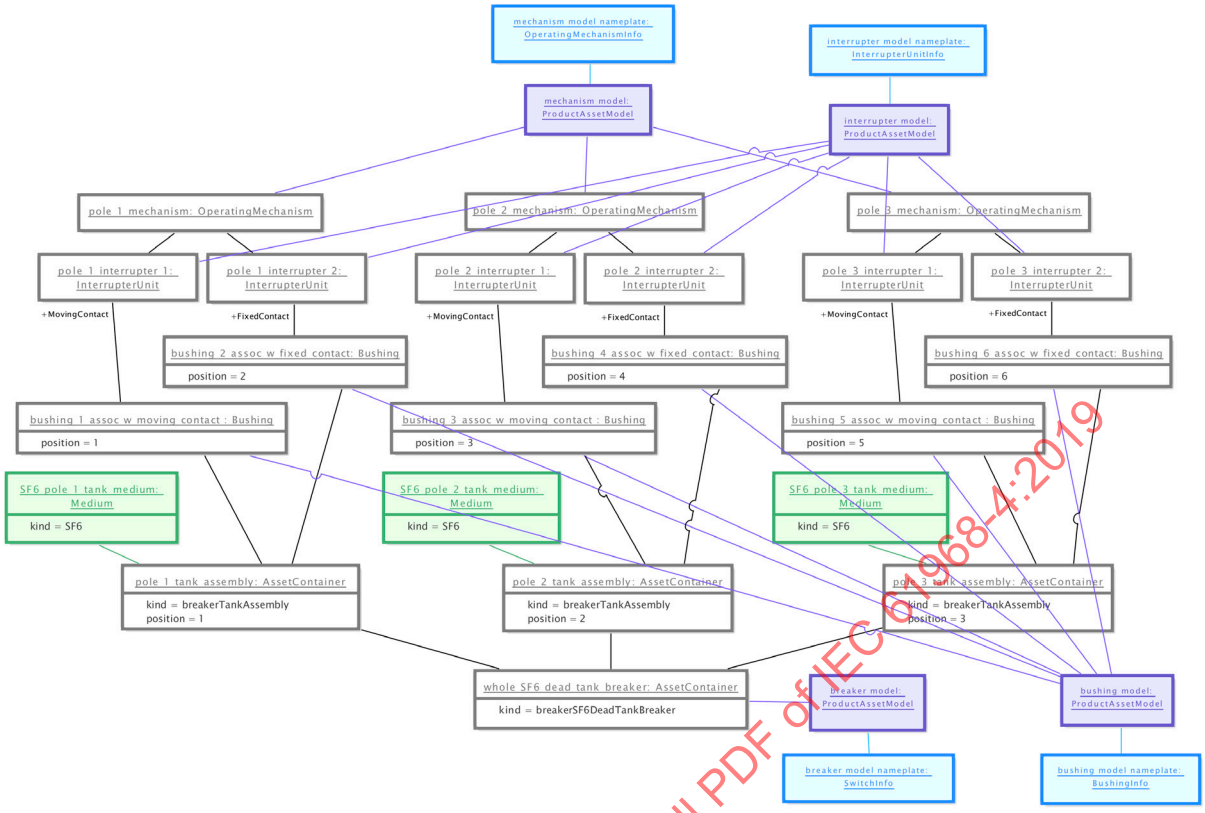


Figure D.6 – Common instance template for SF_6 dead tank breaker with 3 tanks, 3 mechanisms, double breaks

D.2.3.2 SF_6 live tank breakers

The possible variants for SF_6 live tank breakers are shown in Figure D.7. Variants with grey, strike-through text are combinations of characteristics not known to exist and therefore not valid in data exchanges.

<table>
<tr><td colspan="4">3 Poles/Base</td></tr>
<tr><td colspan="3">1 Stack/Pole</td><td>~~2+ Stacks/Pole~~</td></tr>
<tr><td colspan="2">3 Poles/ Mechanism</td><td colspan="2">1 Pole/ Mechanism</td></tr>
<tr><td>Single Break</td><td>Double Break</td><td>Single Break</td><td>Double Break</td></tr>
</table>

<table>
<tr><td colspan="6">1 Pole/Base</td></tr>
<tr><td colspan="3">1 Stack/Pole</td><td colspan="2">2 Stacks/Pole</td><td>~~3+ Stacks/Pole~~</td></tr>
<tr><td>~~3 Poles/ Mechanism~~</td><td colspan="2">1 Pole/ Mechanism</td><td>~~3 Poles/ Mechanism~~</td><td colspan="2">1 Pole/Mechanism</td></tr>
<tr><td></td><td>Single Break</td><td>Double Break</td><td></td><td>2 Break (1 Break/ Stack)</td><td>3 Break (1 Break/ Stack for one Stack 2 Breaks/ Stack other Stack)</td><td>4 Break (2 Breaks/ Stack)</td></tr>
</table>

Common instance templates provided

Figure D.7 – SF_6 live tank breaker variants

Common instance templates are provided for two variants of SF_6 live tank breakers to illustrate the pattern of objects, associations and required attributes used to describe SF_6 live tank breakers in a consistent way. The templates are presented in Figure D.8 and Figure D.9.

The breaker illustrated in the object diagram of Figure D.8 is a SF_6 live tank breaker with three insulating stacks on one base, a single mechanism for all three poles and single break interrupters.

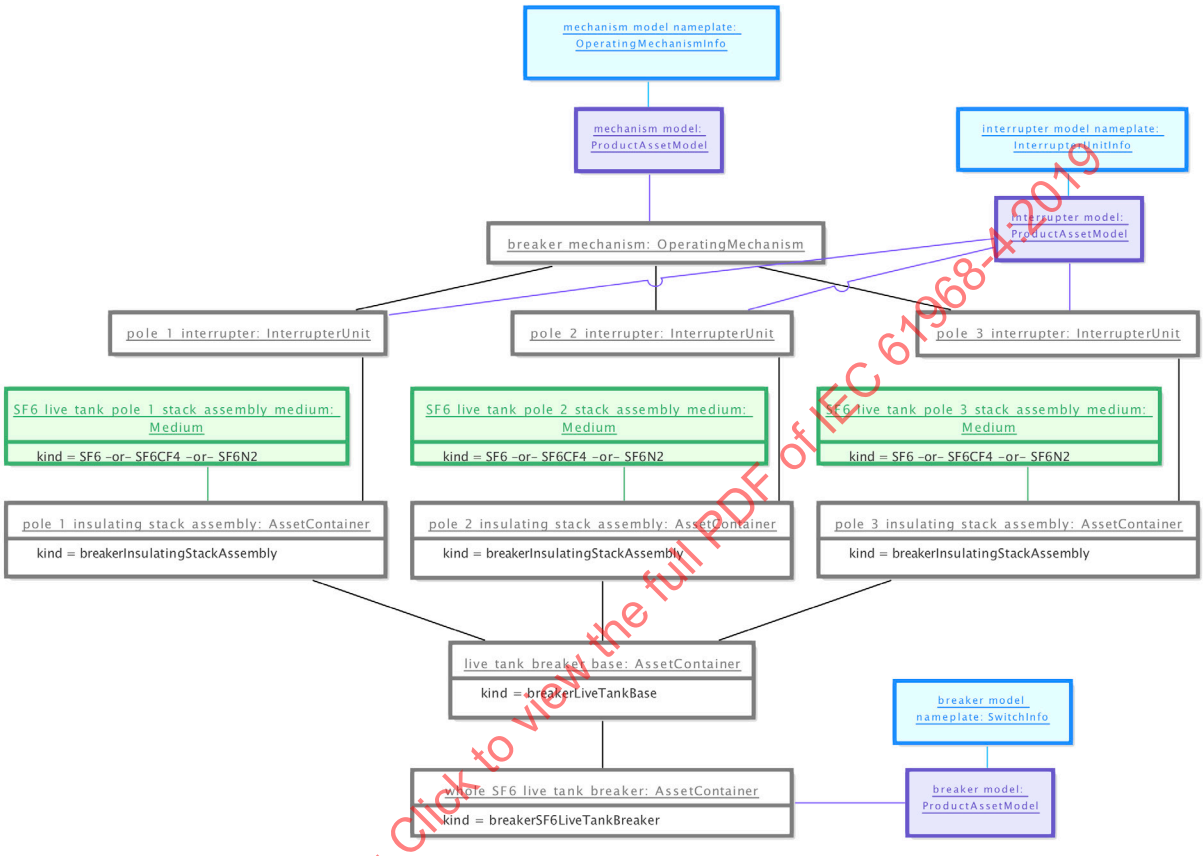


Figure D.8 – Common instance template for SF_6 live tank breaker with 3 insulating stacks on one base, 1 mechanism, single breaks

The breaker illustrated in the object diagram of Figure D.9 is a SF_6 live tank breaker with two insulating stacks on each of three bases (one base per pole), a mechanism for each pole and 4-break interrupters.

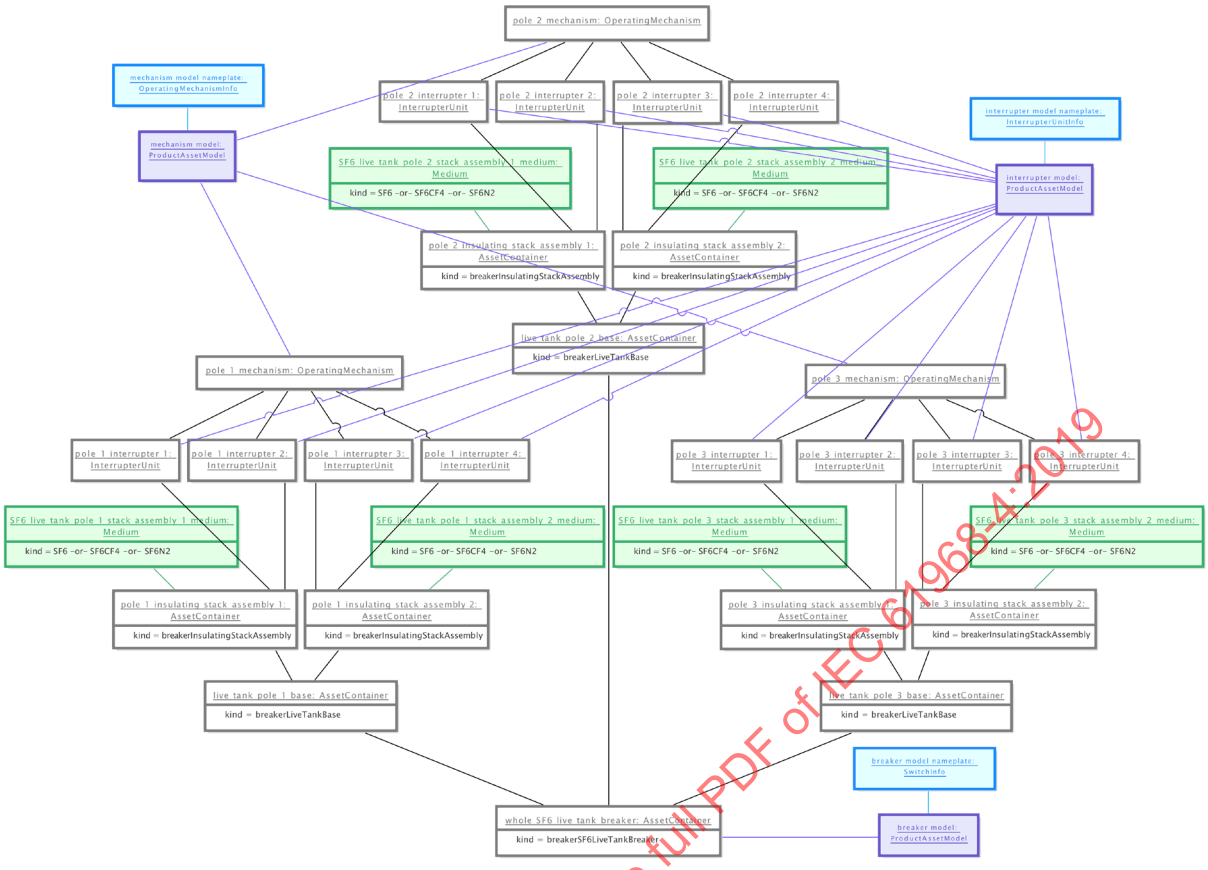


Figure D.9 – Common instance template for SF_6 live tank breaker with 6 insulating stacks on 3 bases, 3 mechanisms, 4 breaks

D.2.3.3 Bulk oil breakers

The possible variants for bulk oil breakers are shown in Figure D.10. Variants with grey, strike-through text are combinations of characteristics not known to exist and therefore not valid in data exchanges.

3 Poles/Tank		1 Pole/Tank	
3 Poles/ Mechanism	~~1 Pole/ Mechanism~~	3 Poles/ Mechanism	1 Pole/ Mechanism

Common instance templates provided

Figure D.10 – Bulk oil breaker variants

Common instance templates are provided for two variants of bulk oil breakers to illustrate the pattern of objects, associations and required attributes used to describe bulk oil breakers in a consistent way. The templates are presented in Figure D.11 and Figure D.12 with one of the variants illustrated by a picture of an actual breaker.

The breaker illustrated in the object diagram of Figure D.11 is a bulk oil breaker with one tank and a single mechanism for all three poles.

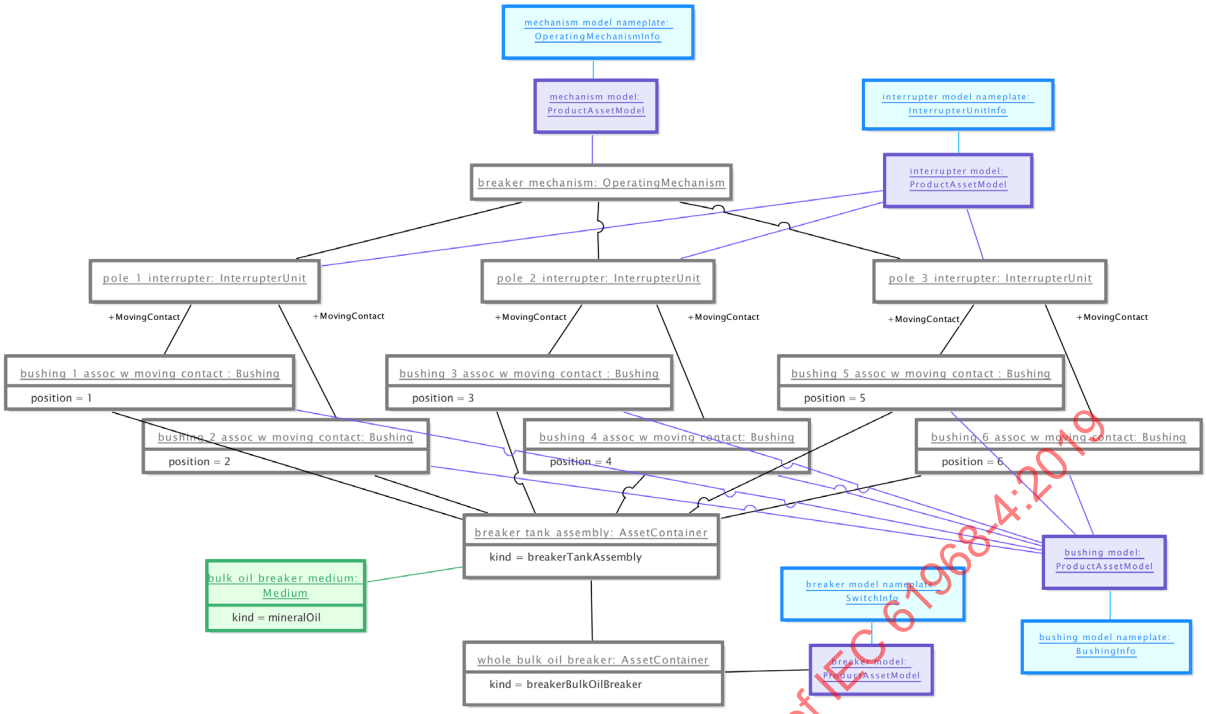


Figure D.11 – Common instance template for bulk oil breaker with 1 tank, 1 mechanism

The breaker illustrated in the object diagram of Figure D.12 is a bulk oil breaker with a tank for each pole and a single mechanism for all three poles.

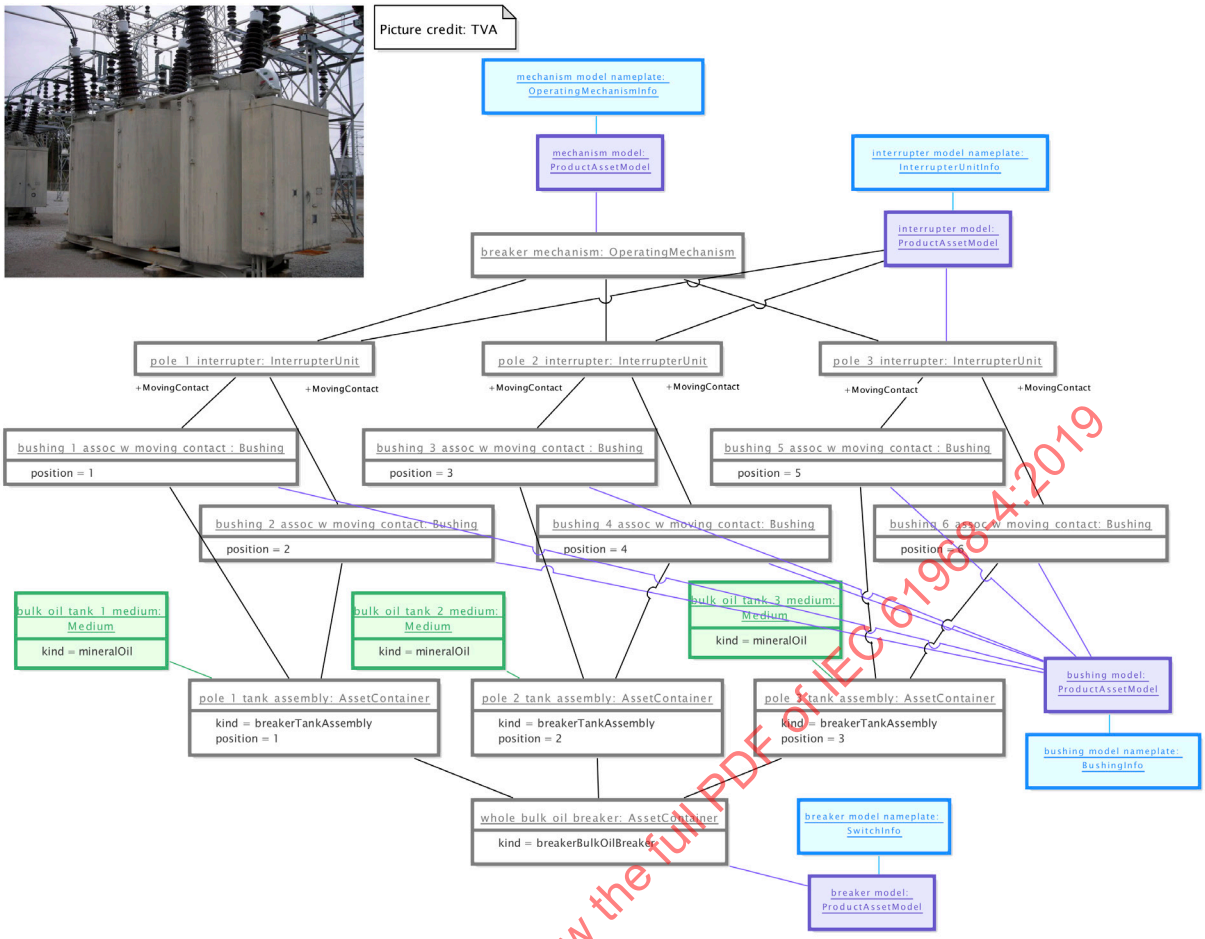


Figure D.12 – Common instance template for bulk oil breaker with 3 tanks, 1 mechanism

D.2.3.4 Minimum oil breakers

The possible variants for minimum oil breakers are shown in Figure D.13. Variants with grey, strike-through text are combinations of characteristics not known to exist and therefore not valid in data exchanges.

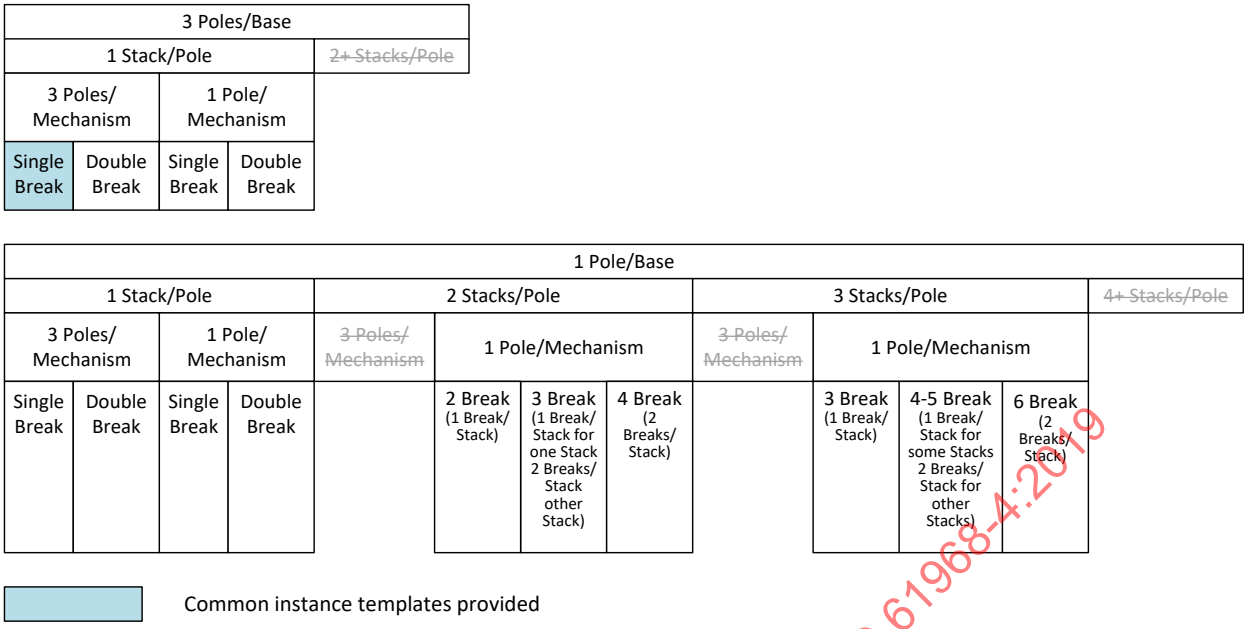


Figure D.13 – Minimum oil breaker variants

Common instance templates are provided for one variant of minimum oil breakers to illustrate the pattern of objects, associations and required attributes used to describe minimum oil breakers in a consistent way. The template is presented in Figure D.14.

The breaker illustrated in the object diagram of Figure D.14 is a minimum oil breaker with a single base, one insulating stack per pole, a single mechanism for all three poles and single break interrupters.

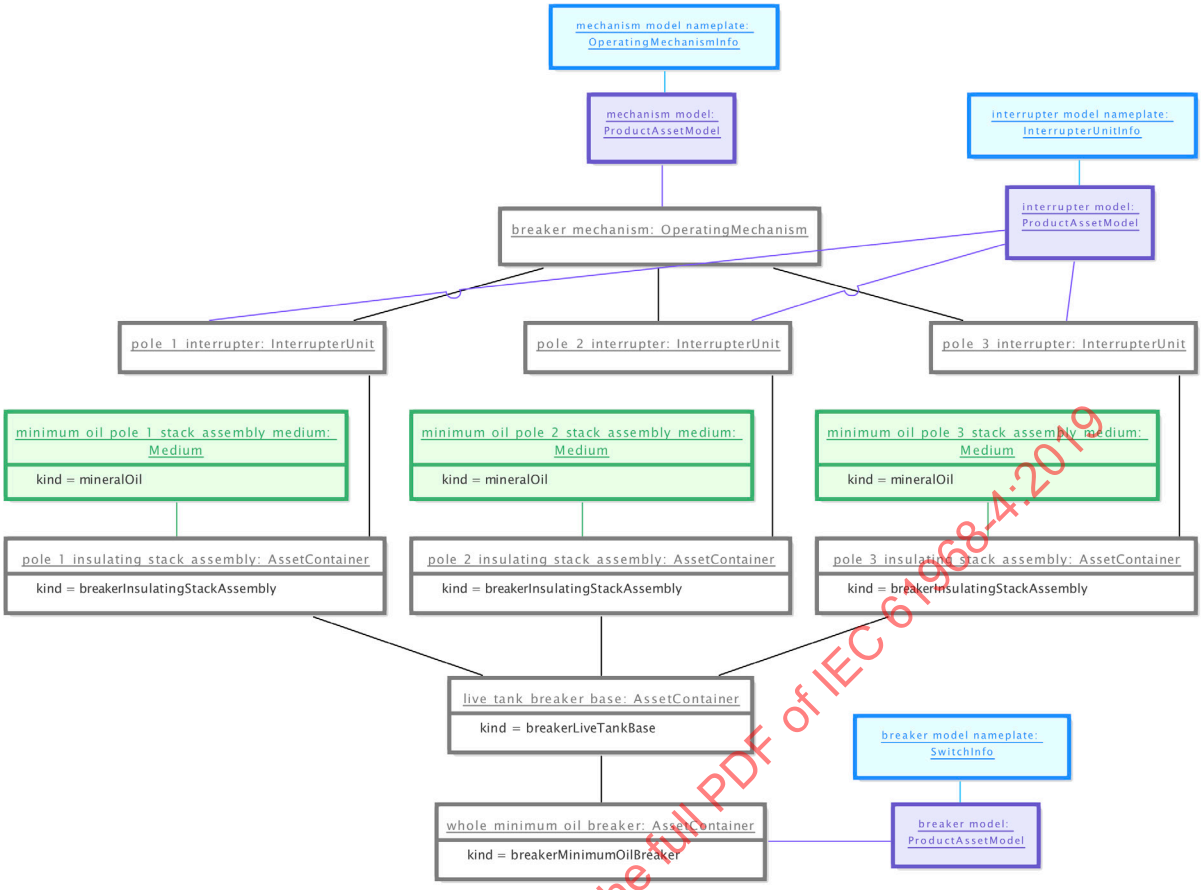


Figure D.14 – Common instance template for minimum oil breaker with 3 insulating stacks on one base, 1 mechanism, single break

D.2.3.5 Air blast circuit breakers

The possible variants for air blast circuit breakers are shown in Figure D.15. Variants with grey, strike-through text are combinations of characteristics not known to exist and therefore not valid in data exchanges.

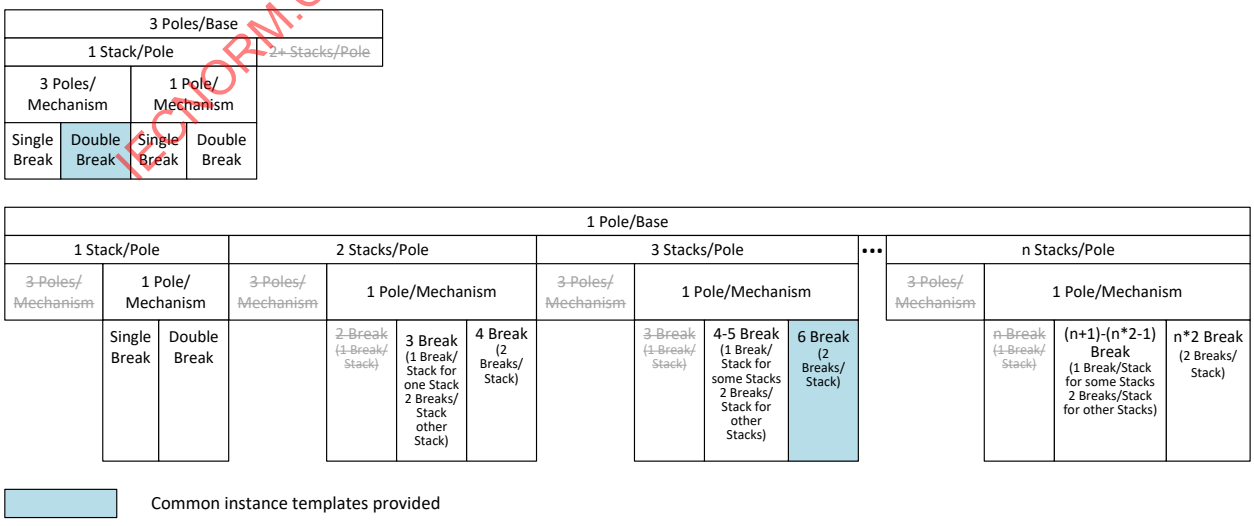


Figure D.15 – Air blast breaker variants

Common instance templates are provided for two variants of air blast circuit breakers to illustrate the pattern of objects, associations and required attributes used to describe air blast circuit breakers in a consistent way. The templates are presented in Figure D.16 and D.17 with each of the variants illustrated by a picture of an actual breaker.

The breaker illustrated in the object diagram of Figure D.16 is an air blast circuit breaker with a single base, one insulating stack per pole, a single mechanism for all three poles and double break interrupters.

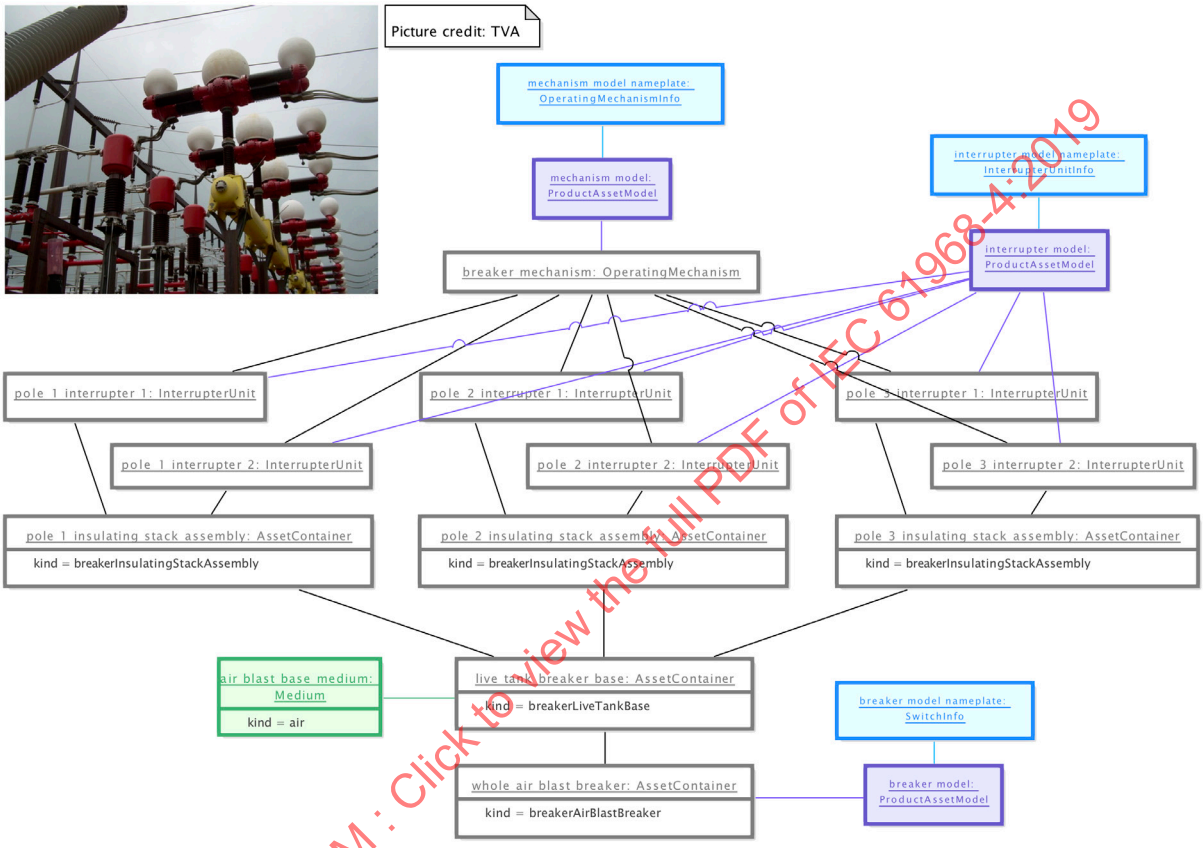


Figure D.16 – Common instance template for air blast breaker with 3 insulating stacks on one base, 1 mechanism, double breaks

The breaker illustrated in the object diagram of Figure D.17 is an air blast circuit breaker with three insulating stacks on each of three bases (one base per pole), a mechanism for each pole and 6-break interrupters.

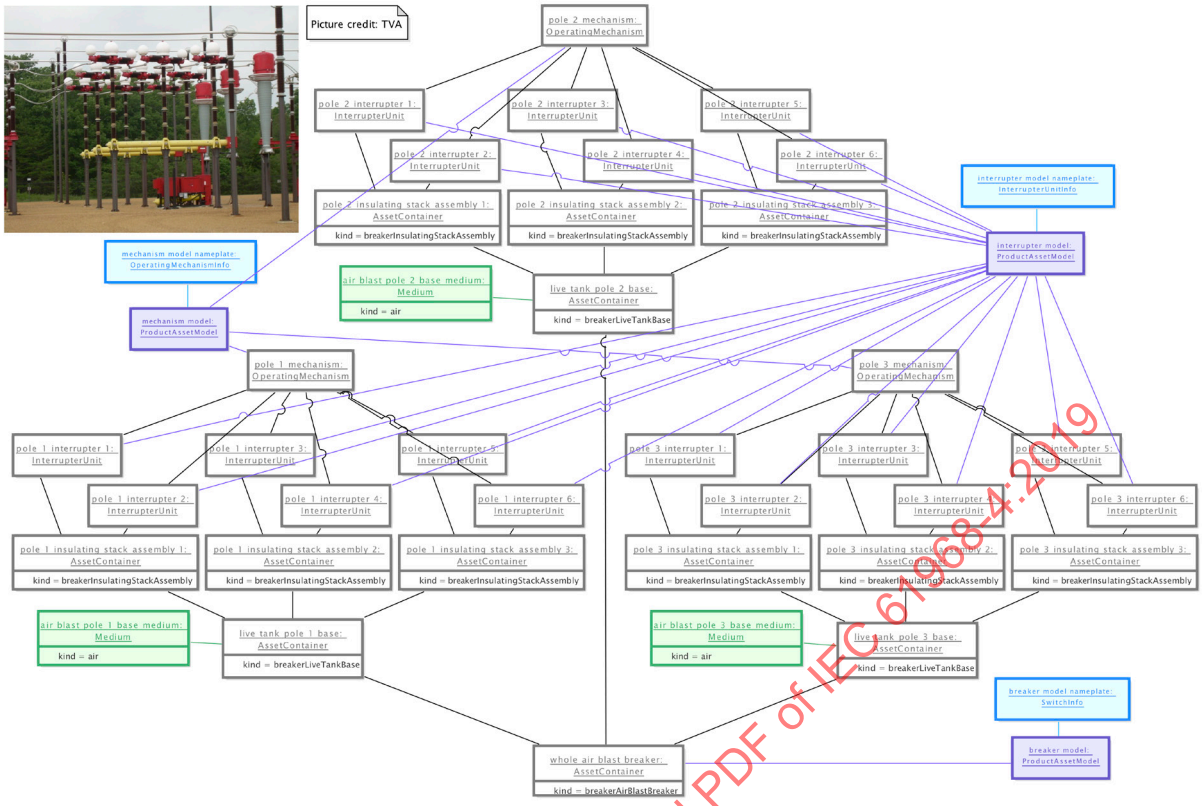


Figure D.17 – Common instance template for air blast breaker with 9 insulating stacks on 3 bases, 3 mechanisms, 6 breaks

Annex E
(informative)

Asset models and information exchange

E.1 General

The exchange of asset information is the central aspect of this document. The asset-related information that are available in the utility enterprise include:

- asset model and category information;
- asset identification and classification information such as serial number, type, and lifecycle stage;
- asset nameplate information;
- the components that comprise the asset;
- history of past events pertaining to the asset;
- information pertaining to the power system role performed by the asset.

In particular (please see IEC 61968-11 and IEC 61970-301 for the normative definitions of these classes):

- Classes that describe an Asset in its characteristics:
  - Asset has information pertaining to the asset instance, such as serial number and type.
  - AssetContainer is an Asset that is comprised of other Assets – e.g. a power transformer is an asset that is comprised of other assets such as bushings and tanks.
  - AssetDeployment has information pertaining to the asset's deployment scenario.
  - AssetInfo has the ratings information.
- Classes pertaining to asset models:
  - ProductAssetModel has information pertaining to a particular manufacturer's model.
  - CatalogAssetType has generic information pertaining to a particular asset type, for which there may be several ProductAssetModels corresponding to the versions provided by various manufacturers.
- Classes pertaining to various asset organizational roles:
  - Manufacturer has information pertaining to a product manufacturer.
  - AssetOwner has ownership information.
  - AssetUser has user information.
  - Maintainer has information about the organization performing maintenance on the asset.
- Classes pertaining to Asset events:
  - ActivityRecord is a record of any asset-related activity that needs to be documented.
  - ConfigurationEvent is a record of configuration activities on an asset.
- Classes pertaining to asset work:
  - WorkTask, RepairWorkTask, and MaintenanceWorkTask describe various asset work tasks.
  - RepairItem identify the specific component of the asset being working on.
- Classes pertaining to asset network role:
  - PowerSystemResource and its child classes describe the network role of an asset.

– Measurements that are aggregated by PowerSystemResource are those that are made on the network role. These may be useful for certain analytical purposes. Contrast this with the asset condition Measurements that associate with the Asset class, which are described in Annex F.

– OperationalLimitSet that provides the set of limits associated with equipment.

The information provided by instances of these classes is useful for asset management analytical purposes. This information can be exchanged by using the messages defined in this document. In order to illustrate the exchange of this information, we consider a few common scenarios:

- Find equivalent assets for field replacement.
- Obtain asset detail and history data for asset condition analytics.
- Obtain details pertaining to the asset's network role for operational analytics.

E.2 Asset replacement

While installing assets, a maintenance person may query the catalogue for a replacement asset. Figure E.1 is an illustrative information exchange for this scenario. The Maintenance and Inspection (MAI) sub-function, which may be incorporated in a work management system or a field tablet, queries the relevant Asset Decision Support (ADS) sub-function, which may be an asset management system component that returns replacement assets available. The ADS queries the Substation and Network Inventory (EINV) sub-function, which may be the asset database of an asset management system, to get the product model information pertaining to the asset being replaced. The AssetCatalogue message is used for this. The ADS sub-function then looks up equivalent product models, using the TypeAssetCatalogue message. Finally, ADS uses the AssetCatalogue message for all the equivalent product models to retrieve the in-stock assets. This list is then returned to the MAI sub-function.

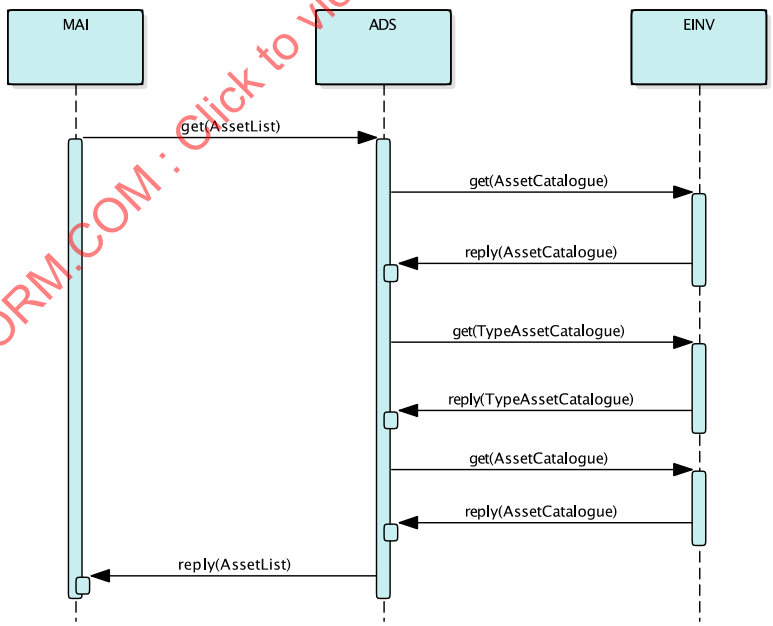


Figure E.1 – Information exchange for asset replacement

E.3 Data for asset condition analytics

Asset condition analytics applications need data pertaining to the assets of interest in order to perform their analysis. Figure E.2 is an illustrative information exchange for obtaining this data. In this figure, the ADS sub-function, which could be an analytic system, queries the

EINV sub-function, which could be the asset database in an asset management system, using the AssetList message. This would provide ADS the list of assets for which the EINV has information. The ADS may only be interested in a sub-set of the available assets – for instance, the analytic package may be capable of assessing only power transformers. The ADS discovers the asset component information objects available for the assets of interest using the AssetTemplate message. It then uses the AssetDetail message to obtain additional details pertaining to the asset components. Finally, it uses the AssetHistory message to obtain historical data pertaining to the asset components.

The ADS sub-function also queries a MAI sub-function, which could be incorporated in a work management system, to obtain the history of work performed on the assets of interest. Analytics systems require measurement data for assets as well. The exchange of asset measurement information is described in Annex F.

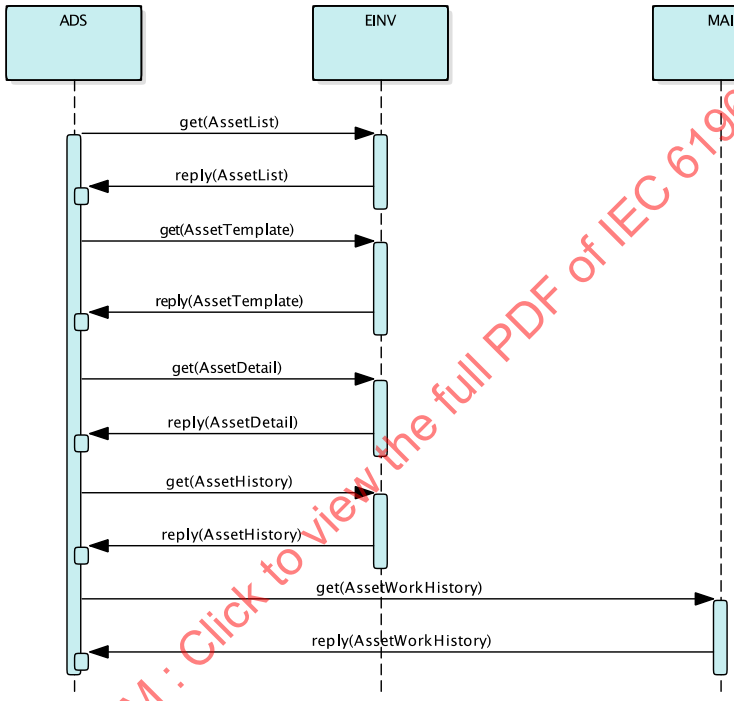


Figure E.2 – Information exchange for asset condition data

E.4 Data for operational analytics

Operational analytics need data pertaining to the network role of the asset. Figure E.3 shows an illustrative exchange to obtain this data. The ADS obtains the list of assets from EINV and identifies the ones of interest. For these, it then queries the Network Monitoring (NMON) sub-function using the AssetPSRDetails message to obtain the electrical network role details.

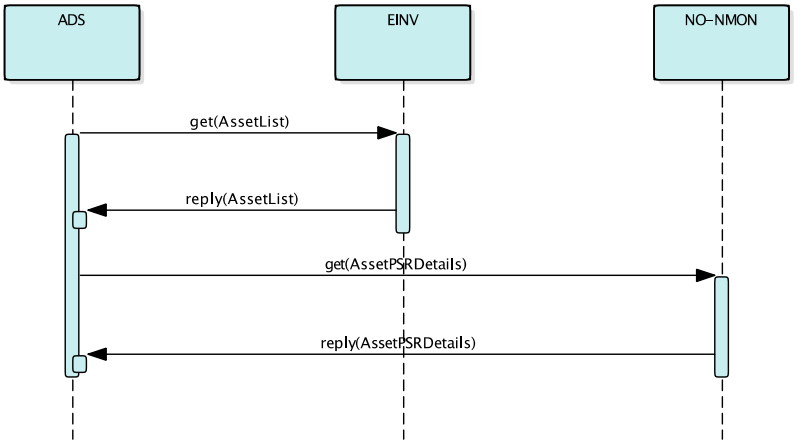


Figure E.3 – Information exchange for operational analytics

Annex F
(informative)

Asset measurement models and information exchange

F.1 General

Measurements made on the assets are the underpinning of condition assessment. Measurements can come in many forms and from disparate sources, such as:

- tests, such as power factor tests on transformers;
- surveys, such as infrared thermography and partial discharge survey;
- laboratory tests, such as testing of insulation oil;
- inspections, such as periodic inspections of substations;
- online monitors, such as dissolved gas analysis (DGA) monitors.

For accurate assessments, it is important to capture the measurement data as well as the metadata pertaining to the measurement, such as details of the data source and the conditions under which the measurement was made. In general, there are two modeling patterns for measurement data, depending on the provenance:

1) Ad Hoc Measurements: The data is produced in a scheduled or on demand manner by ad hoc procedures. Tests, surveys, and inspections fall in this category. These procedures could be performed at regular time intervals, which typically range from weeks to years, or on demand when the need arises.
2) Online Measurements: The data is produced in an ongoing manner from an online monitor. Such measurements can be periodic or event-driven. These measurements could be communicated in real time with strict time constraints.

For ad hoc measurements, a procedure is performed on an asset, such inspection or offline testing or lab testing. For this use case, the following classes are relevant (please see IEC 61968-11 and IEC 61970-301 for the normative definitions of these classes):

– Procedure can represent the details of the procedure;
– a multiplicity of Measurement instances can describe the details of the measurements that can be made as part of the Procedure;
– ProcedureDataSet can represent the dataset from a *single application* of the Procedure, so that there are as many instances of ProcedureDataSet as the number of applications of the said Procedure;
– MeasurementValue instances represent the actual measurement values in the dataset.

For online monitoring of an asset, the following classes are relevant (please see IEC 61968-11 and IEC 61970-301 for the normative definitions of these classes):

– Measurement instances describe the measurements provided by the monitor.
– MeasurementValue instances are the actual measurement values.

As we examine each type of measurement activity, we discover that a different set of information objects need to be instantiated in order to capture the details of the activity. In the rest of this section, we illustrate the instance models for the measurement activities and the typical interactions and messages involved in exchanging the information objects produced by the measurement activities.

F.2 Ad hoc measurements

Lab tests, field tests, inspections, and surveys are examples of ad hoc measurements. Lab test is most commonly performed on oil samples, which may be tested for dissolved gases, oil quality, and contaminants. The tests are intended to evaluate the condition of the oil and its ability to perform its function. Considerable contextual data is also generated for these tests: for instance, when was the sample collected and when it was brought to the lab, the ambient conditions during the sample collection, the standard according to which a particular test was conducted, the equipment that was used in the test, the temperature at which the test was conducted, the lab that conducted the test, etc.

Figure F.1 is an object diagram that shows some of the information objects that could be instantiated for lab testing. It depicts the results of an oil test for dissolved gas.

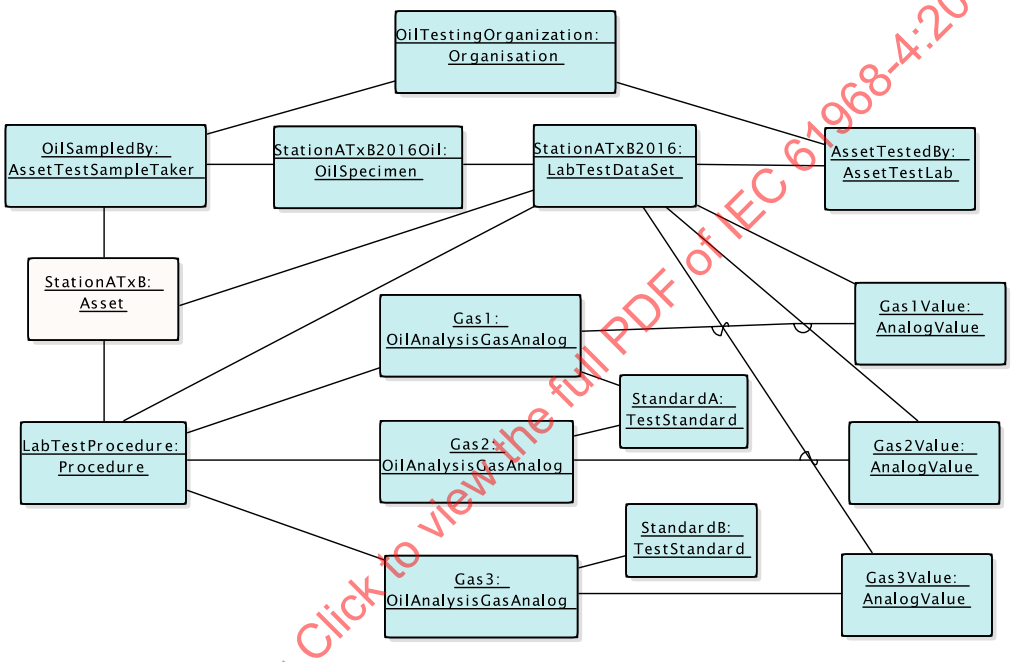


Figure F.1 – Diagram illustrating objects instantiated for lab testing

Figure F.1 shows the following information objects:

- as instance of the Asset class to describe the transformer asset, StationATxB, that is the subject of this test;
- an instance of the Procedure class, named LabTestProcedure, to describe the lab oil testing procedure;
- an instance of the OilSpecimen class, named StationATxB2016Oil, to describe the details of the specimen under test;
- an instance of the AssetTestSampleTaker class, named OilSampledBy, to identify the oil sampler;
- an instance of the AssetTestLab class, named AssetTestLab, to identify the asset testing lab;
- an instance of the Organization class, named OilTestingOrganization, to provide the details of the organization performing oil test. In this example, this same organization is performing both oil sampling and lab testing roles;
- as instance of the LabTestDataSet class, named StationATxB2016, to describe the details of results from testing the oil specimen;

- several instances of OilAnalysisGasAnalog, named Gas1, Gas2, etc., one for each gas measurement made on the oil specimen;
- several instance of AnalogValue, named Gas1Value, Gas2Value, etc., one for each gas measurement made on the oil specimen;
- several instances of TestStandard, named StandardA, StandardB, etc., one for each standardized test that was performed.

Figure F.2 shows typical message exchanges for an analytic system to obtain these information objects. The figure shows three business sub-functions:

- ADS (Asset Decision Support), a business sub-function typically implemented by analytics systems;
- MAI (Maintenance and Inspection), a business sub-function typically implemented by work management systems;
- AMM (Asset Measurement and Monitoring), a business sub-function typically implemented by measurement data systems such as data historian and test result databases.

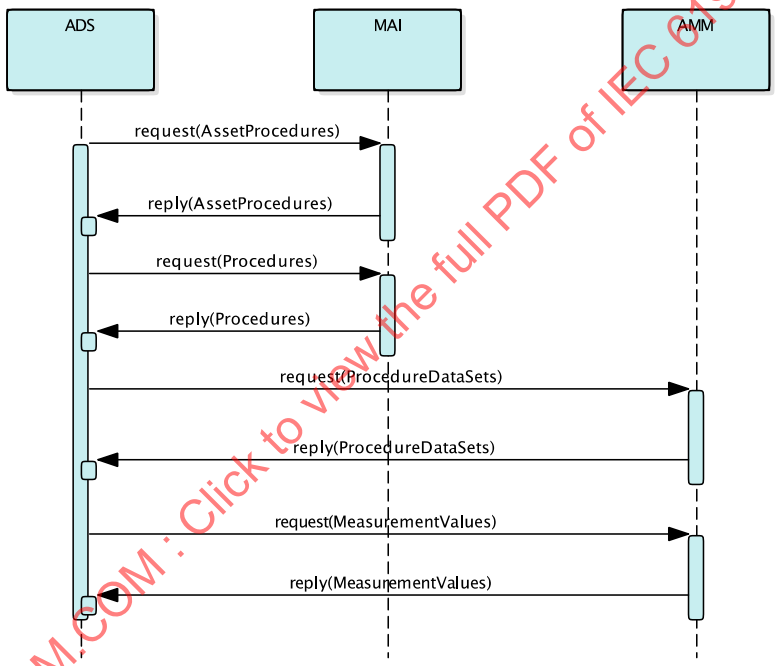


Figure F.2 – Typical message exchanges for ad-hoc measurements

First, ADS obtains the list of procedures applicable to the asset of interest from MAI, using the AssetProcedures message. From this, ADS identifies the procedure of interest, for which it obtains the details from MAI, using the Procedures message.

The Procedures message contains details about the measurements, namely the OilAnalysisGasAnalog instances in this case. ADS uses this reference information to obtain details of the measurements from AMM, using Measurements message, which also contains details of the test standards used.

The AssetProcedures message also has the LabTestDataSet information. ADS identifies the LabTestDataSet corresponding to the procedure of interest and obtain the details of these LabTestDataSets from AMM, using the ProcedureDataSets message. The information in this message includes oil specimen information, sample taker information, test lab information, and reference to MeasurementValue instances. ADS obtains these measurement values from AMM, using the MeasurementValues message. The MeasurementValues message contains the actual measured values.

This particular set of information objects, their naming, and their exchange pattern are only illustrative. Information objects instantiated in real world cases may vary on the basis of the specifics of the test, the process involved in collecting specimen, etc. Likewise, the message exchanges may vary on the basis of the specific use case. But the general pattern with Procedure, ProcedureDataSet, Measurement, and MeasurementValue classes, as well as the messages involved in exchanging the information objects associated with this pattern remains the same. This also holds for other ad hoc measurement approaches such as field tests, inspections, and surveys.

Examples of field tests are dielectric loss/power factor tests on transformers. For such tests, there are test plans describing, for instance, between what points measurements are to be taken: high winding to low winding, high winding to ground, low winding to ground, etc. The outcome of the tests includes the measurements as well as the conditions under which the measurements were taken.

Inspection data typically involves the filling out of a form. Examples are substation inspections with a handheld. The data captured could include numerals such as readings from dials, boolean such as switch status, and free form text such as the description of animal activity.

Examples of surveys are aerial LiDAR surveys of transmission corridors, IR thermography of substation assets, and partial discharge surveys of insulation systems. The measurements from such surveys are typically held in self-contained systems such as the LiDAR data in a GIS, and these systems may have some data processing and exploration capabilities built in. But in a strategic asset management setting, such data should be made accessible, either through an API or by storing in a filestore, for wider range of analytics.

F.3 Online measurements

Examples of online monitors are dissolved gas analyzers (DGAs) and IEC 61850 intelligent electronic devices (IEDs). In addition to the measurements, such devices also may provide quality indications. Furthermore, the device characteristics such as the sensor accuracy are helpful information as well in terms of assessing measurements from such devices. The object diagram in Figure F.3 shows the information objects instantiated for an illustrative DGA monitoring scenario.

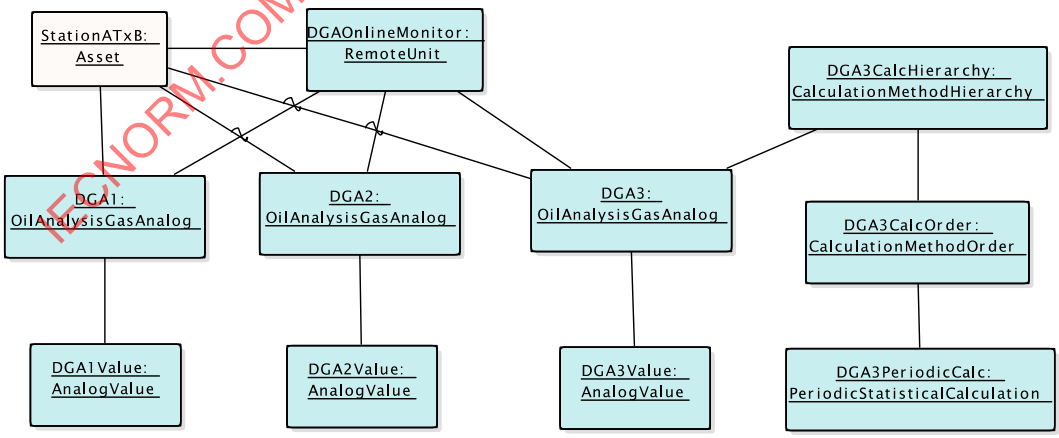


Figure F.3 – Objects instantiated for DGA monitoring

Figure F.3 shows the following information objects:

- an instance of Asset, named StationATxB, to describe the details of the transformer asset that is being monitored;

- an instance of RemoteUnit, named DGAOnlineMonitor, to describe the details of the DGA online monitoring device that's on this transformer;
- several instances of OilAnalysisGasAnalog, named DGA1, DGA2, etc., one for each type of DGA measurement made by the monitor;
- several instances of AnalogValue, named DGA1Value, DGA2Value, etc., one for each DGA measurement made by the monitor;
- if any of the measurements are calculated, instances of CalculationMethodHierarchy, CalculationMethodOrder, and StatisticalCalculation, to describe the details of the calculation.

A few notable aspects of this pattern, in contrast with that for ad hoc measurements, are:

- The Asset-Measurement association is used, since there are no ad hoc procedures executed. The ad hoc measurements pattern used Procedure-Measurement and ProcedureDataSet-MeasurementValue associations.
- In this pattern, the Measurement instances would have unique MeasurementValue counterparts. The same Measurement instance is not typically repeated for multiple installations of the same online monitor, since the configuration of the online monitors could differ at some point in their lifespan.

Figure F.4 shows typical messages involved in exchanging the information objects pertaining to online monitoring. ADS (analytic system) gets the measurements associated with an asset of interest from AMM (measurement data system), using the AssetMeasurements message. From this it identifies the measurements of interest, details of which are obtained using the MeasurementDetails message. This message also provides any calculations involved in the measurement and identifying information of the associated MeasurementValue instances. ADS then uses the MeasurementValues message to obtain the actual measurement values.

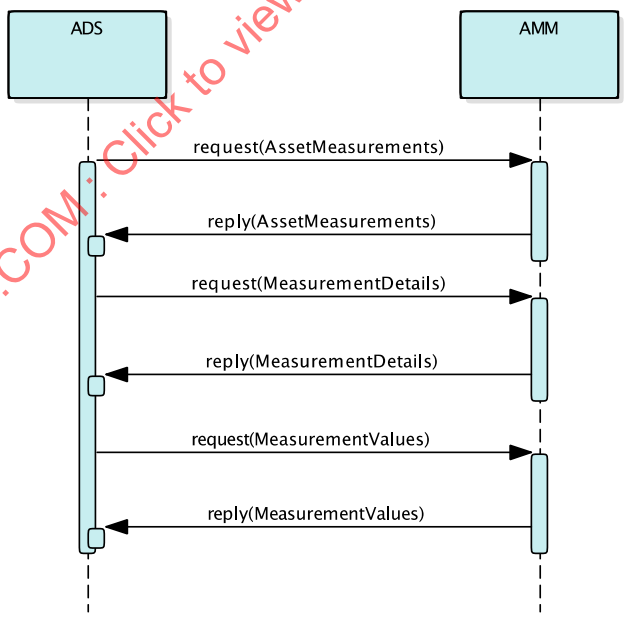


Figure F.4 – Message exchanges for online measurements

Annex G
(informative)

Analytics models and information exchange

Annex E and Annex F described some of the messages used to obtain asset and measurement data that analytics need. This annex describes the analytics information that is provided by the analytics to other systems. There are four key analytics concepts in the messages supported by this standard, namely:

- analytics: the Analytic class describes the analytic – its kind, scoring methodology, and the Document instance that details the analytic;
- scores computed by analytics: the AnalyticScore and its child classes model the score produced from the execution of an analytic;
- health events identified by analytics: the AssetHealthEvent class provides the details of a health event identified by the execution of an analytic;
- asset grouping: the AssetGroup class provides the means to group assets upon which analytic could be executed. This is useful for fleet analytic or feeder analytic.

(Please see IEC 61968-11 and IEC 61970-301 for the normative definitions of the classes mentioned above.)

Figure G.1 shows an illustrative analytics information exchange. In this scenario, a Maintenance and Inspection (MAI) sub-function, which could be part of a work management system, is interested in analytic assessment of individual assets. The MAI queries the relevant Asset Decision Support (ADS) sub-function, which could be part of an analytic package, to first discover the available analytic capabilities using the Analytics message, and then obtain analytic assessment of specific assets using the AssetAnalytics message.

Figure G.1 also depicts a second ADS sub-function, ADS1, which could be part of a planning application, interested in analytics of groups of assets – for instance, fleet analytics. In this case, ADS1 queries ADS to first discover the available group analytics, using the Analytics message, and then obtain the group assessments, using the AssetGroupAnalytics message.

Finally, upon the detection of a significant asset health event, the analytic package may create an AssetHealthEvent, which is communicated using the AssetHealthEvent message to interested systems – in Figure G.1, MAI receives this message, which may be used to take preventive or corrective action.

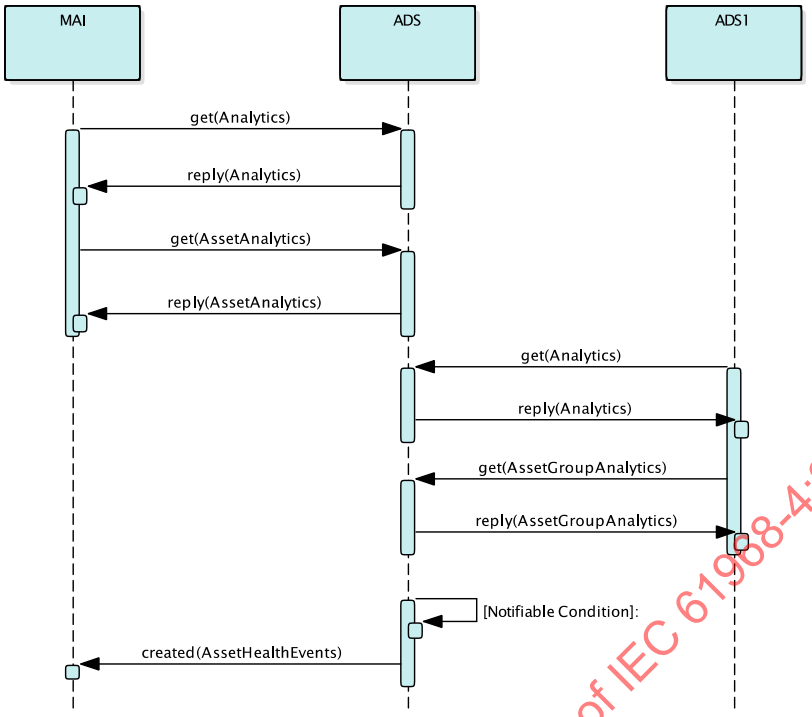


Figure G.1 – Illustrative analytics information exchange

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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INTÉGRATION D'APPLICATIONS POUR LES SERVICES ÉLECTRIQUES – INTERFACES SYSTÈME POUR LA GESTION DE LA DISTRIBUTION –

Partie 4: Interfaces pour la gestion des dossiers et des actifs

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La Norme internationale IEC 61968 a été établie par le comité d'études 57 de l'IEC: Gestion des systèmes de puissance et échanges d'informations associés.

Cette deuxième édition annule et remplace la première édition parue en 2007. Cette édition constitue une révision technique.

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

a) suppression des profils de l'édition 1, dont la fonctionnalité a été remplacée par d'autres parties des normes IEC 61970 et IEC 61968. En particulier, NetworkDataSet et ChangeSet ont été remplacés par des normes telles que CDPSM (IEC 61968-13) et par d'autres actions en cours, telles que la modélisation des modifications. Le profil Presentation a été remplacé par Diagram Layout Profile (profil de présentations de schémas) (IEC 61970-453);

b) révision des profils AssetList, AssetCatalogue et TypeAssetCatalogue de l'édition 1, pour les remettre en harmonie avec les cas d'utilisation courants et la dernière version UML du CIM. Ces profils se basent sur une ancienne version UML du CIM et de nombreuses classes dans ces profils ne font plus partie des récents modèles UML du CIM;

c) ajout de plusieurs nouveaux profils pour permettre d'échanger des données d'état des actifs, de résultats analytiques et alertes, d'informations physiques, fonctionnelles et sur le cycle de vie des actifs, ainsi que du fonctionnement des actifs;

d) annexes informatives sur la manière dont le présent document peut être utilisé pour permettre une gestion stratégique des actifs;

e) annexes informatives avec des exemples d'illustrations pour l'application du présent document;

f) domaine d'application coordonné avec l'IEC 61968-13, le cas échéant;

g) cas d'utilisation dans le modèle de cas d'utilisation de l'IEC 62559-2;

h) traçabilité des cas d'utilisation par rapport aux cas d'utilisation de l'IEC 62913-2-1.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
57/2059/FDIS	57/2074/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 internationale.

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INTRODUCTION

La série de normes IEC 61968, prise en compte dans son ensemble, définit des interfaces pour les principaux éléments d'une architecture d'interface pour les systèmes de gestion de distribution (DMS – Distribution Management Systems). L'IEC 61968-1, *Architecture des interfaces et recommandations générales*, identifie et établit des exigences relatives aux interfaces normalisées basées sur un Modèle d'Interface de Référence (IRM – Interface Reference Model). Les parties 3 à 9 de l'IEC 61968 définissent des interfaces relatives à chacune des principales fonctions métier décrites par le Modèle d'Interface de Référence.

Au sens de l'IEC 61968, un DMS (Distribution Management System, système de gestion de distribution) est composé de différentes applications distribuées, permettant à l'entreprise de distribution de gérer des réseaux électriques. Ces fonctions incluent la surveillance et la commande des équipements de fourniture d'énergie, les processus de gestion qui assurent la fiabilité du système, la gestion de la tension, la maîtrise de la demande d'énergie, la gestion des interruptions de service, la gestion des travaux, la mise en relation automatisée et la gestion des équipements.

Cette série de normes se limite à la définition d'interfaces et ne dépend pas de la mise en œuvre. Il assure l'interopérabilité entre différents systèmes, plateformes et langages informatiques. Les méthodes et les technologies utilisées pour réaliser la fonctionnalité conformément à ces interfaces sont jugées comme ne relevant pas du domaine d'application de ces normes. Seule l'interface elle-même est spécifiée dans ces normes.

Cette partie de l'IEC 61968 a pour but de définir une norme pour l'intégration de la gestion des dossiers et des actifs comprenant des systèmes d'informations géographiques et des systèmes de gestion des risques liés aux actifs, ainsi que d'autres systèmes et fonctions métier relevant du domaine d'application de l'IEC 61968. Le domaine d'application du présent document est l'échange d'informations entre les systèmes de gestion des dossiers et des actifs et d'autres systèmes au sein de l'entreprise de distribution d'électricité. Les descriptions spécifiques des protocoles de communication employés par ces systèmes ne relèvent pas du domaine d'application du présent document. Bien au contraire, le présent document reconnaît et modélise les capacités générales susceptibles d'être assurées par des systèmes de gestion des dossiers et des actifs, y compris la gestion des risques liés aux actifs, la planification des actifs et la gestion des actifs en fonction de leur état. De cette manière, le présent document ne sera pas influencé par la spécification, le développement et/ou le déploiement des systèmes de gestion des dossiers et des actifs de la génération suivante, que ce soit en utilisant les normes ou par des moyens propriétaires.

La série des normes IEC 61968 est prévue pour faciliter l'intégration interapplications, par opposition à l'intégration intra-applications. L'intégration intra-application est destinée aux programmes d'un même système, communiquant habituellement les uns avec les autres en utilisant des intergiciels qui sont intégrés dans leur environnement d'exécution sous-jacent et tendent à être optimisés pour des connexions proches, en temps réel et synchrones, et des interrogations/réponses interactives ou des modèles de communication conversationnels. L'IEC 61968, en revanche, est prévue pour supporter l'intégration interapplications d'une entreprise de distribution qui a besoin de relier des systèmes disparates existants ou futurs (applications héritées ou achetées), chacun supporté par des environnements d'exécution différents. Par conséquent, ces normes d'interface sont appropriées pour les applications faiblement couplées avec une plus grande hétérogénéité dans le langage, les logiciels d'exploitation, les protocoles et les outils de gestion. Cette série de normes est prévue pour supporter des applications qui nécessitent l'échange de données environ toutes les secondes, minutes ou heures, plutôt que d'attendre un traitement de nuit par lot. Cette série de normes, qui est destinée à être mise en œuvre avec des services d'intergiciel, qui échangent des messages parmi des applications, complétera mais ne remplacera pas les entrepôts de données de l'entreprise de distribution, les passerelles de base de données, et les archives opérationnelles.

Au sens de l'IEC 61968, un système de gestion de distribution (DMS – Distribution Management System) se compose de différents composants d'application distribués permettant à l'entreprise de distribution de gérer les réseaux de distribution électriques. Ces fonctions incluent la surveillance et la commande des équipements de fourniture d'énergie, les processus de gestion qui assurent la fiabilité du système, la gestion de la tension, la maîtrise de la demande d'énergie, la gestion des interruptions de service, la gestion des travaux, la mise en relation automatisée et la gestion des équipements. Des interfaces normalisées sont définies pour chaque classe d'applications identifiée dans le Modèle d'Interface de Référence (IRM – interface reference model), qui est décrit dans l'IEC 61968-1.

Cette partie de l'IEC 61968 comporte les articles présentés dans le Tableau 1.

Tableau 1 – Vue d'ensemble de l'IEC 61968-4

Article	Titre	Objet
1	Domaine d'application	Le domaine d'application et l'objet du document sont décrits.
2	Références normatives	Documents qui contiennent des stipulations qui, par référence dans le texte, constituent des dispositions pour la présente Norme internationale.
3	Termes et définitions	Description de concepts et de termes importants pour la gestion des dossiers et des actifs.
4	Modèles de référence et d'informations	Description de l'approche générale des systèmes de gestion des dossiers et des actifs, du modèle de référence, des cas d'utilisation, du modèle d'interface de référence, des fonctions et des composants de la gestion des dossiers et des actifs, des termes de types de messages et du modèle d'informations statiques.
5	Types de messages pour la gestion des dossiers et des actifs	Types de messages liés à l'échange d'informations pour les documents liés à la gestion des dossiers et des actifs.
Annexe A	Description des verbes des types de messages	Description des verbes utilisés pour les types de messages.
Annexe B	Cas d'utilisation	Description des cas d'utilisation relevant de la présente norme.
Annexe C	Gestion d'actifs	Description d'un exemple de cadre de gestion d'actifs s'appuyant sur la présente norme.
Annexe D	Modèles d'actifs et échange d'informations – Le cas des modèles d'instance formels	Description de l'utilisation du CIM pour modéliser les actifs représentatifs du service de distribution électrique.
Annexe E	Modèles d'actifs et échange d'informations	Exemples de messages liés aux actifs et d'échanges d'informations usuels.
Annexe F	Modèles de mesures d'actifs et échange d'informations	Exemples de messages liés aux mesures d'actifs et d'échanges d'informations usuels.
Annexe G	Modèles d'analyse d'actifs et échange d'informations	Exemples de messages liés à l'analyse d'actifs et d'échanges d'informations usuels.

INTÉGRATION D'APPLICATIONS POUR LES SERVICES ÉLECTRIQUES – INTERFACES SYSTÈME POUR LA GESTION DE LA DISTRIBUTION –

Partie 4: Interfaces pour la gestion des dossiers et des actifs

1 Domaine d'application

Cette partie de l'IEC 61968 spécifie le contenu informationnel d'un ensemble de types de messages pouvant être utilisés afin de prendre en charge de nombreuses activités fonctionnelles liées à la gestion des dossiers et des actifs. La planification d'extension du réseau, la copie des données de départ ou d'autres données du réseau entre les systèmes, les éditions de réseau ou de diagramme et l'inspection des actifs sont des applications représentatives des types de messages définis dans le présent document. Les types de messages définis dans les autres parties de l'IEC 61968 peuvent également s'avérer pertinents dans ces cas d'utilisation.

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 61968-1:2012, *Intégration d'applications pour les services électriques – Interfaces système pour la gestion de distribution – Partie 1: Architecture des interfaces et recommandations générales*

IEC 61968-3:2017, *Intégration d'applications pour les services électriques – Interfaces système pour la gestion de la distribution – Partie 3: Interface pour l'exploitation du réseau*

IEC 61968-6:2015, *Intégration d'applications pour les services électriques – Interfaces système pour la gestion de distribution – Partie 6: Interfaces pour la maintenance et la construction*

IEC 61968-9:2013, *Intégration d'applications pour les services électriques – Interfaces système pour la gestion de distribution – Partie 9: Interface pour le relevé et la commande des compteurs*

IEC 61968-11:2018, *Intégration d'applications pour les services électriques – Interfaces système pour la gestion de distribution – Partie 11: Extensions du modèle d'information commun (CIM) pour la distribution*

IEC 61968-100:2013, *Intégration d'applications pour les services électriques – Interfaces système pour la gestion de distribution – Partie 100: Profils de mise en œuvre*

IEC 61970-301:2016, *Interface de programmation d'application pour système de gestion d'énergie (EMS-API) – Partie 301: Base de modèle d'information commun (CIM)*

IEC 62361-100:2016, *Gestion des systèmes de puissance et échanges d'informations associés – Interopérabilité à long terme – Partie 100: Mapping des profils CIM avec le plan XML*

IEC TR 62361-103:2018 *Power systems management and associated information exchange – Part 103: Standard profiling* (disponible en anglais seulement).

ISO 55000:2014, *Gestion d'actifs – Aperçu général, principes et terminologie*

ISO 55001:2014, *Gestion d'actifs – Systèmes de management – Exigences*

ISO 55002:2014, *Gestion d'actifs – Systèmes de management – Lignes directrices pour l'application de l'ISO 55001*

3 Termes et définitions

Aucun terme n'est défini dans le présent document.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

4 Modèles de référence et d'informations

4.1 Généralités

Les types de messages définis dans le présent document reposent sur un découpage logique des activités fonctionnelles et des composants du DMS appelé Modèle d'Interface de Référence de l'IEC 61968. Le contenu des types de messages repose sur un modèle d'informations statiques afin de garantir la cohérence des noms de champs et des types de données. Chaque type de message est défini comme un ensemble de champs copiés à partir des classes du modèle d'informations de l'IEC 61968-11 et de l'IEC 61970-301. Cette définition des messages est conforme à l'IEC 62361-100 et à l'IEC 62361-103. En particulier, le modèle contextuel est élaboré à partir du modèle canonique présenté par l'IEC 61968-11 et l'IEC 61970-301, et le modèle syntaxique/de profil est généré sous la forme d'un plan XSD.

Les types de messages définis dans le présent document sont destinés à satisfaire à une majorité d'applications usuelles. Dans certaines mises en œuvre particulières de projet, il peut s'avérer souhaitable de modifier l'ensemble des champs à l'aide d'une méthodologie, telle que celle décrite dans l'IEC 61968-1.

4.2 Modèle de référence

4.2.1 Généralités

Les schémas représentés de la Figure 1 à la Figure 3 servent de modèle de référence et donnent un exemple des composants logiques et des flux de données relatifs à la présente Norme internationale. Ces schémas décrivent les flux entre les composants du modèle de référence. Les nombres entre parenthèses donnent les liens vers les définitions des flux. L'architecture de référence reflète plusieurs composants logiques (potentiellement réalisés en tant que systèmes ou sous-systèmes) qui font partie de la gestion des dossiers et des actifs ou qui y sont liés par le besoin d'échanger des informations. Les composants logiques présentés sont les suivants:

a) surveillance de l'exploitation du réseau (NMON – Network Operation Monitoring);

b) surveillance et mesure des actifs (AMM – Asset Monitoring and Measurement);

c) assistance à la décision en matière d'actifs (ADS – Asset Decision Support);

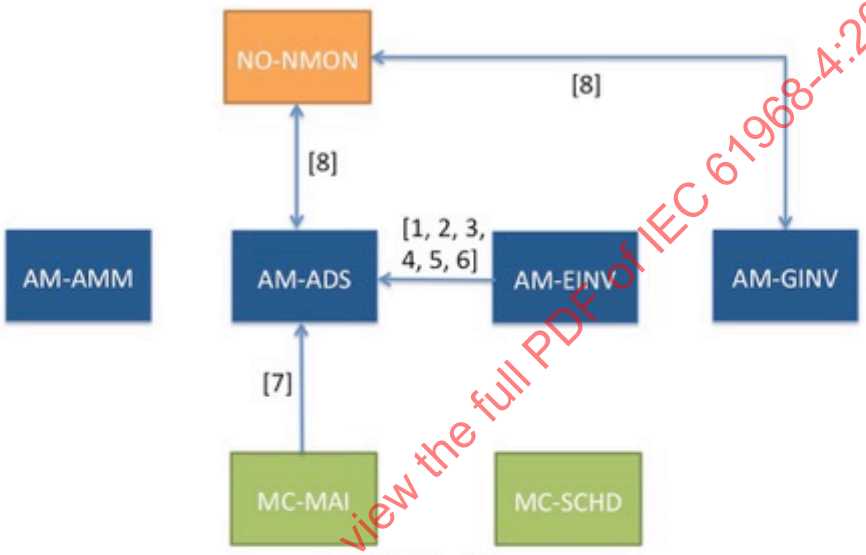
d) inventaire du réseau et des postes (EINV – Substation and Network Inventory);

e) inventaire géographique (GINV – Geographical Inventory);

f) maintenance et inspection (MAI – Maintenance and Inspection);

g) programmation et répartition du travail (SCHD – Work Scheduling and Dispatching).

Les flux de données sont découpés en trois schémas, chacun d'eux décrivant le flux de données relevant d'un domaine important de la présente norme. La Figure 1 représente les flux de données relevant des Actifs, tels que les informations relatives à leur cycle de vie, leur emplacement, leur propriétaire, les informations de la plaque signalétique et les informations sur le modèle. La Figure 2 représente les flux de données relevant des Mesures, tels que les procédures portant sur des actifs ou des mesures effectuées sur ces derniers, ainsi que les valeurs correspondantes des jeux de données et des mesures. La Figure 3 représente les flux de données relevant des Analyses, tels que les descriptions d'une analyse et les résultats obtenus par une analyse.

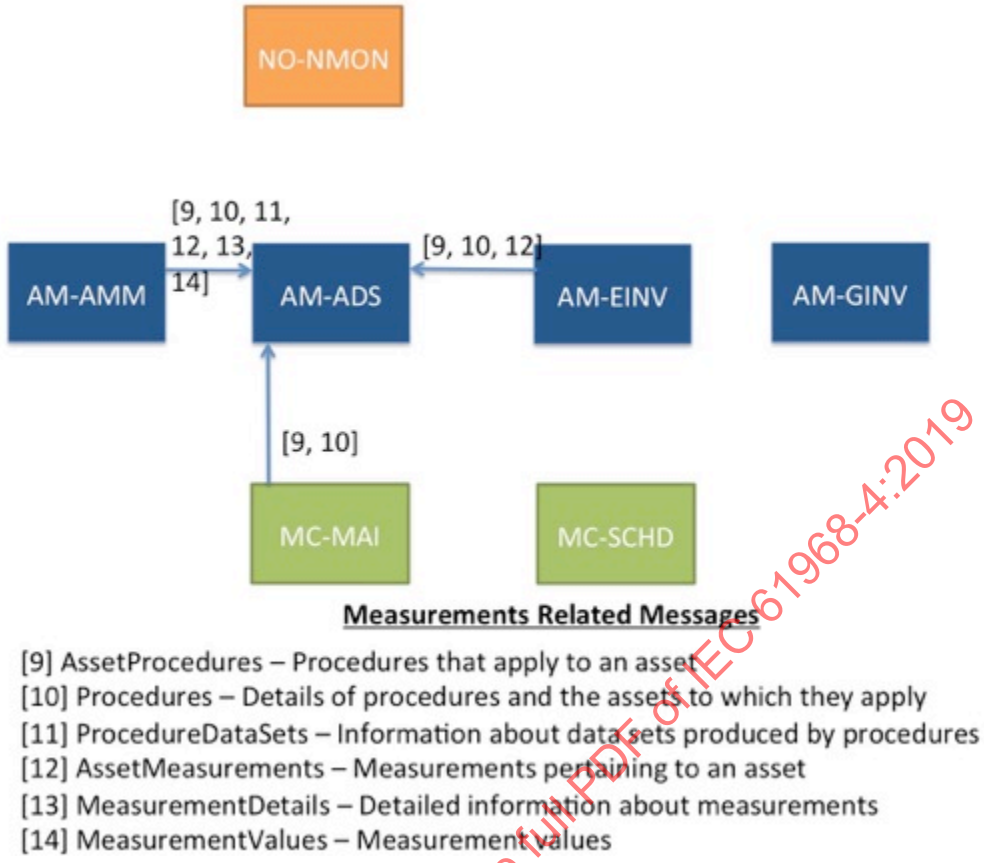


Asset Related Messages

[1] AssetList – List of available assets
[2] AssetCatalogue – Information about a manufacturer's model
[3] TypeAssetCatalogue – Information about a type of asset
[4] AssetTemplate – Composition of an asset in terms of its components
[5] AssetDetail – Detailed information about specific assets
[6] AssetHistory – Asset change history log
[7] AssetWorkHistory - Work history information for an asset
[8] AssetPSRDetails - Information about the network state of an asset

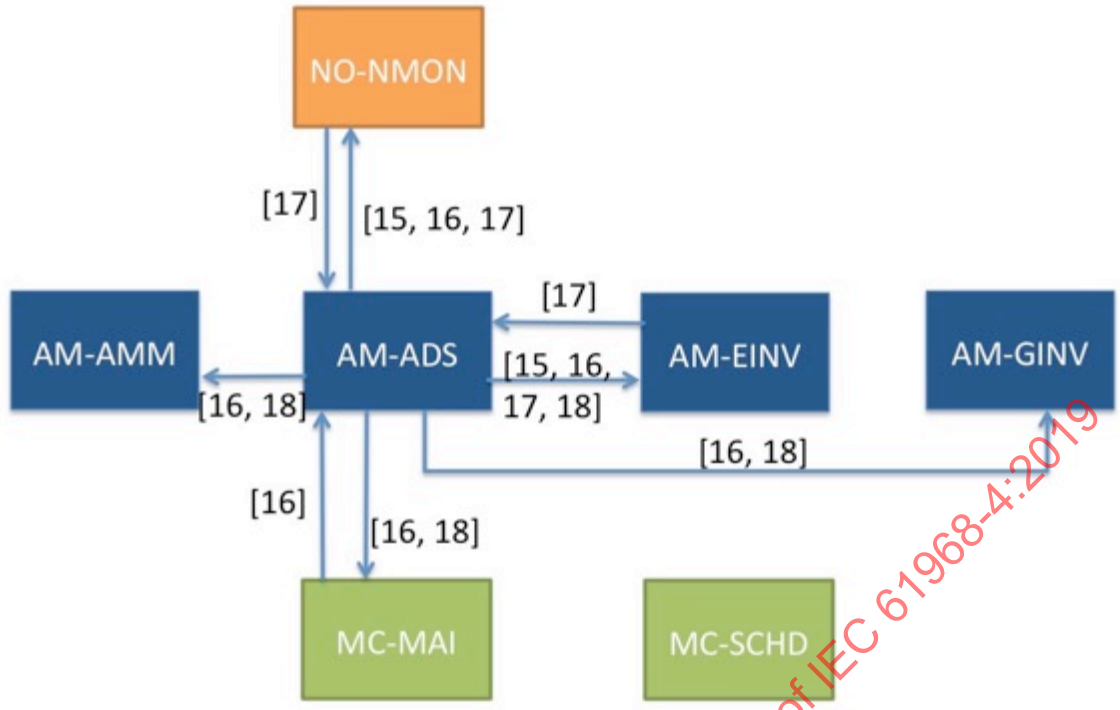
Anglais	Français
Asset Related Messages	Messages liés aux actifs
[1] AssetList – List of available assets	[1] AssetList – Liste des actifs disponibles
[2] AssetCatalogue – Information about a manufacturer's model	[2] AssetCatalogue – Informations sur le modèle d'un constructeur
[3] TypeAssetCatalogue – Information about a type of asset	[3] TypeAssetCatalogue – Informations sur un type d'actif
[4] AssetTemplate – Composition of an asset in terms of its components	[4] AssetTemplate – Composition d'un actif en composants constitutifs
[5] AssetDetail – Detailed information about specific assets	[5] AssetDetail – Informations détaillées sur des actifs spécifiques
[6] AssetHistory – Asset change history log	[6] AssetHistory – Journal historique des modifications d'un actif
[7] AssetWorkHistory – Work history information for an asset	[7] AssetWorkHistory – Informations sur l'historique de fonctionnement d'un actif
[8] AssetPSRDetails – Information about the network state of an asset	[8] AssetPSRDetails – Informations sur l'état d'un actif au sein du réseau

Figure 1 – Présentation de flux de messages liés à un Actif



Anglais	Français
Measurements Related Messages	Messages liés à des mesures
[9] AssetProcedures – Procedures that apply to an asset	[9] AssetProcedures – Procédures qui s'appliquent à un actif
[10] Procedures – Details of procedures and the assets to which they apply	[10] Procédures – Détails de procédures et les actifs auxquels elles s'appliquent
[11] ProcedureDataSets – Information about data sets produced by procedures	[11] ProcedureDataSets – Informations sur des jeux de données produits par des procédures
[12] AssetMeasurements – Measurements pertaining to an asset	[12] AssetMeasurements – Mesures concernant un actif
[13] MeasurementDetails – Detailed information about measurements	[13] MeasurementDetails – Informations détaillées sur des mesures
[14] MeasurementValues – Measurement values	[14] MeasurementValues – Valeurs de mesure

Figure 2 – Présentation de flux de messages liés à des mesures



Anglais	Français
Analytics Related Messages	Messages liés à des analyses
[15] Analytics – Information about an analytic	[15] Analyses – Informations sur une analyse
[16] AssetAnalytics – The various analytic scores for assets	[16] AssetAnalytics – Les différents résultats d'évaluation analytique pour des actifs
[17] AssetGroupAnalytics – Information about assets groupings and their scores	[17] AssetGroupAnalytics – Informations sur des regroupements d'actifs et leurs résultats d'évaluations quantitatives
[18] AssetHealthEvents – Analytic-identified health events for an asset	[18] AssetHealthEvents – Evénements concernant l'état de santé d'un actif et identifiés par des analyses

Figure 3 – Présentation de flux de messages liés à des analyses

Les 4.2.2 à 4.2.8 décrivent les composants logiques qui participent aux flux de données présentés.

4.2.2 Surveillance de l'exploitation du réseau (NMON – Network Operation Monitoring)

Donne les moyens de superviser la topologie d'un poste principal (état du disjoncteur et de l'interrupteur) et le statut des appareils de commande. Fournit également aux services électriques le moyen de gérer la connectivité de réseau et les conditions de charge. Permet également de localiser les réclamations téléphoniques des clients et de superviser l'emplacement des équipes de terrain.

4.2.3 Surveillance et mesure des actifs (AMM – Asset Monitoring and Measurement)

La surveillance et la mesure des actifs comprennent l'inspection, les essais, la mesure et la surveillance des actifs afin de comprendre, d'évaluer et de gérer leur état et leurs performances.

4.2.4 Assistance à la décision en matière d'actifs (ADS – Asset Decision Support)

L'assistance à la décision en matière d'actifs comprend la définition de la stratégie et des priorités, la planification de la stratégie de maintenance, la gestion des risques, la gestion des programmes et la prise de décisions. L'aspect central de l'assistance à la décision en matière d'actifs repose sur des analyses. Elle pilote l'état, la configuration, les performances, les coûts de fonctionnement et la flexibilité de la base installée, dans le but d'une valorisation maximale.

4.2.5 Inventaire du réseau et des postes (EINV – Substation and Network Inventory)

Les postes électriques et les actifs de réseau qu'une entreprise de distribution possède, ou dont elle a la responsabilité légale, et dont elle tient un registre précis articulé autour d'une hiérarchie d'actifs prenant en charge des fonctions de gestion d'actifs avancées.

4.2.6 Inventaire géographique (GINV – Geographical Inventory)

Gestion de données géospatiales, qui fait généralement appel à une technologie informatique graphique pour la saisie, la sauvegarde et la mise à jour des informations graphiques et non graphiques. Les descriptions géographiques et les éléments de données non graphiques associés pour chacune des entités sont généralement sauvegardés sous une forme ou une autre d'entrepôt de données. Les représentations graphiques sont référencées à l'aide d'un système de coordonnées relatif aux emplacements situés à la surface de la Terre. Les informations de l'entrepôt de données peuvent faire l'objet de requêtes et s'afficher sur la base des attributs graphiques ou non graphiques des entités.

4.2.7 Maintenance et inspection (MAI – Maintenance and Inspection)

Intervention comprenant des activités d'inspection, de nettoyage, de réglage, ou d'autres services des équipements pour leur permettre d'améliorer leurs performances ou d'étendre leur durée de vie utile. La vidange d'huile régulière et la réfection de la peinture sont des exemples types de travaux de maintenance. Les examens des poteaux, des tranchées ou des postes sont des exemples d'inspection.

4.2.8 Programmation et répartition du travail (SCHD – Work Scheduling and Dispatching)

La programmation et répartition du travail permet, pour une étendue de travaux définie, d'affecter les ressources nécessaires et de garder la trace de l'avancement du travail.

4.3 Modèle d'Interface de Référence

L'objet de cette norme n'est pas de définir les applications et les systèmes qu'il convient que les fournisseurs proposent. Il est prévu qu'une application concrète (physique) offre la fonctionnalité d'un ou plusieurs composants abstraits (logiques) énumérés dans cette norme. Ces composants abstraits sont regroupés par les fonctions métier du Modèle d'Interface de Référence.

Dans le présent document, le terme "composant abstrait" fait référence à la partie d'un système logiciel qui prend en charge une ou plusieurs des interfaces définies dans les normes IEC 61968-3 à -9. Cela ne signifie pas forcément qu'un logiciel compatible soit fourni sous forme de modules séparés ou sous forme de système unique.

L'IEC 61968-1 décrit des services d'infrastructure communs à tous les composants abstraits, alors que les IEC 61968-3 à -9 définissent les détails des informations échangées pour des types de composants abstraits spécifiques.

L'IEC 61968 définit ce qui suit:

a) une infrastructure interapplications est compatible si elle fournit des services définis dans l'IEC 61968-1 pour prendre en charge au moins deux applications ayant des interfaces compatibles avec l'IEC 61968-3 à -9;

b) une interface d'application est compatible si elle prend en charge les normes d'interface définies dans les IEC 61968-3 à -9 pour les composants abstraits correspondants définis dans le Modèle d'Interface de Référence.

Il est seulement demandé à une application de prendre en charge les normes d'interface des composants applicables énumérés sous les composants abstraits. Il n'est pas demandé à une application de prendre en charge des interfaces demandées par d'autres composants abstraits de la même sous-fonction métier ou de la même fonction métier. Alors que le présent document définit essentiellement les informations échangées entre des composants de fonctions métier différentes, elle définit parfois également des informations échangées entre des composants d'une fonction métier unique lorsqu'une forte demande du marché pour cette aptitude a été constatée.

4.4 Gestion des dossiers et des actifs

Il convient de noter que les types de messages définis dans le présent document peuvent être émis et reçus par tout type de composant au sein d'un système de gestion de distribution (DMS). Le Tableau 2 présente ces fonctions et des composants abstraits types, dont il est prévu qu'ils soient des producteurs d'informations pour ces types de messages. Les utilisateurs types de ces informations comprennent notamment les autres composants énumérés dans l'IEC 61968-1.

Tableau 2 – Fonctions métier et composants abstraits

Fonctions métier	Sous-fonctions métier	Composants abstraits
Gestion des dossiers et des actifs (AM)	Inventaire du réseau et des postes (EINV)	Caractéristiques des équipements
		Modèle de connectivité
		Ecran de poste
		Base de données de télécommande
	Inventaire géographique (GINV)	Représentations de réseau
		Cartes géographiques
	Gestion de l'inventaire général (CIM)	Inventaire des actifs non électriques
		Inventaire des matériels
		Inventaire des véhicules
	Assistance à la décision en matière d'actifs (ADS)	Stratégie de maintenance
		Planification du cycle de vie
		Analyse centrée sur la fiabilité
		Normes d'ingénierie et de conception
		Normes de conformité et gestion des réglementations
		Mesures de performances
		Gestion des risques
		Gestion environnementale
		Systèmes d'aide à la décision
		Valeurs nominales de courant thermique des équipements de réseau et des lignes
		Eléments déclenchant des interventions de maintenance
		Groupes de maintenance des actifs (listes)
		Historique des défaillances d'actifs
		Performances financières des actifs
		Allocation budgétaire
	Surveillance et mesure des actifs (AMM)	Gestion des données des séries temporelles et des séries d'événements
		Gestion des informations de laboratoire
		Gestion des informations d'essai des actifs
		Configuration de sécurité et journaux des événements
		Visualisation des informations destinées aux équipes de terrain
		Gestion de conformité et rapports

5 Types de messages pour la gestion des dossiers et des actifs

5.1 Généralités

Un certain nombre de conventions générales relatives aux définitions de messages données dans le présent document sont présentées ci-après:

- Les objets sont identifiés par mRID et une multiplicité de membres Name.name est héritée d'IdentifiedObject. Les systèmes en transaction peuvent faire appel à l'un des attributs ou aux deux pour identifier de manière unique les objets échangés.
- Plusieurs classes de CIM ont un membre appelé "type" qui fournit une description en chaîne de caractères d'une instance de la classe. Certaines classes de CIM (comme Asset) ont également un membre énuméré appelé "kind". Il s'agit d'un ajout récent destiné à améliorer l'interopérabilité. Les messages du présent document qui intègrent de telles classes comprennent à la fois les membres "type" et "kind". En cas d'indisponibilité d'une valeur appropriée pour "kind", les systèmes en transaction peuvent faire appel à la valeur "autre" pour "kind", afin d'indiquer qu'il convient d'utiliser la description en chaîne de caractères dans l'attribut "type".
- Les attributs des charges utiles des messages sont tous facultatifs. Il appartient aux systèmes en transaction de mettre en œuvre la logique nécessaire aux champs exigés.

Un certain nombre de réflexions générales relatives aux définitions de messages données dans le présent document sont présentées ci-après:

- les plans XML sont conformes à l'IEC 62361-100 et à l'IEC 62361-103, et ont été élaborés avec CIMTool[1];
- la description schématisée des plans, représentée à la Figure 5, à la Figure 7, etc., a été réalisée sous XMLSpy[2] à partir du plan XML;
- les exemples d'occurrence XML, comme ceux décrits aux Articles 5.2.3, 5.3.3, etc., ont été générés sous XMLSpy à partir du plan XML.

5.2 Messages AssetList

5.2.1 Généralités

Un message AssetList peut contenir la liste des actifs assurant un service de distribution. Les objets Asset récupérés ne contiennent que des informations d'identification, comme mRID, nom et type. Il convient que le message AssetDetail soit utilisé pour obtenir des informations précises sur des objets Asset présentant un intérêt spécifique.

5.2.2 Applications

Le message AssetList a pour but d'obtenir une liste de tous les actifs disponibles dans un système. Par exemple, un système inventaire des postes peut disposer d'informations sur des actifs de type poste. Les fonctions de planification et d'analyses qui s'intéressent à un sous-ensemble spécifique des actifs, comme les transformateurs de puissance, peuvent utiliser ce message pour obtenir la liste de tous les objets Asset dans le système inventaire des postes. Les fonctions de planification et d'analyse peuvent alors employer d'autres messages, tels qu'AssetTemplate et AssetDetail pour obtenir plus d'informations sur les objets Asset qui sont identifiés en tant que transformateurs de puissance. Pour résumer, ce message est destiné à être une simple requête visant à obtenir la liste des actifs disponibles, de sorte que le système récepteur puisse identifier un sous-ensemble des actifs disponibles en vue d'autres investigations. Un exemple d'échange AssetList est représenté à la Figure 4, où AM-ADS demande et obtient une AssetList provenant de AM-EINV.

---

1 CIMTool est l'appellation commerciale d'un produit distribué par Langdale Consultants. Cette information est donnée à l'intention des utilisateurs du présent document et ne signifie nullement que l'IEC approuve ou recommande l'emploi exclusif du produit ainsi désigné. Des produits équivalents peuvent être utilisés s'il est démontré qu'ils conduisent aux mêmes résultats.

2 XMLSpy est l'appellation commerciale d'un produit distribué par Altova. Cette information est donnée à l'intention des utilisateurs du présent document et ne signifie nullement que l'IEC approuve ou recommande l'emploi exclusif du produit ainsi désigné. Des produits équivalents peuvent être utilisés s'il est démontré qu'ils conduisent aux mêmes résultats.

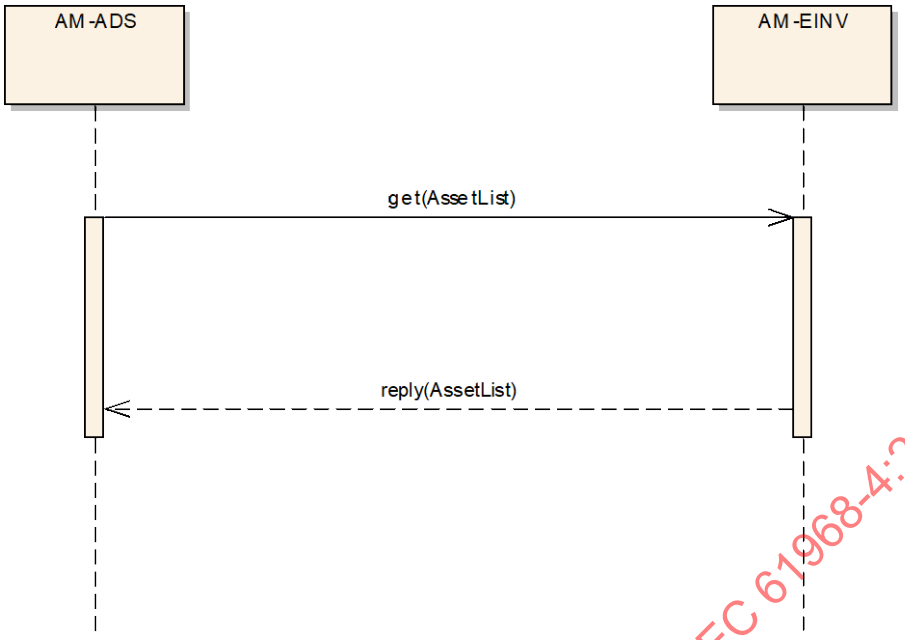


Figure 4 – Échange de messages AssetList

5.2.3 Format du message

La Figure 5 représente le format de message utilisé pour obtenir une AssetList d'un système qui dispose d'une base de données d'objets Asset. Le système qui répond retourne la liste d'objets Asset, identifiés par leur mRID et/ou leur nom. De plus, l'attribut "kind" (qui est un choix dans une énumération d'actifs) ou l'attribut "type" (qui est une description en chaîne de caractères de ce qu'est l'actif) de l'actif peuvent être inclus. En cas d'indisponibilité d'une classification de l'actif (comme PowerTransformer) dans l'énumération, une valeur "autre" est généralement utilisée pour l'attribut "kind", afin d'indiquer qu'il convient d'utiliser à la place la description contenue dans l'attribut "type".

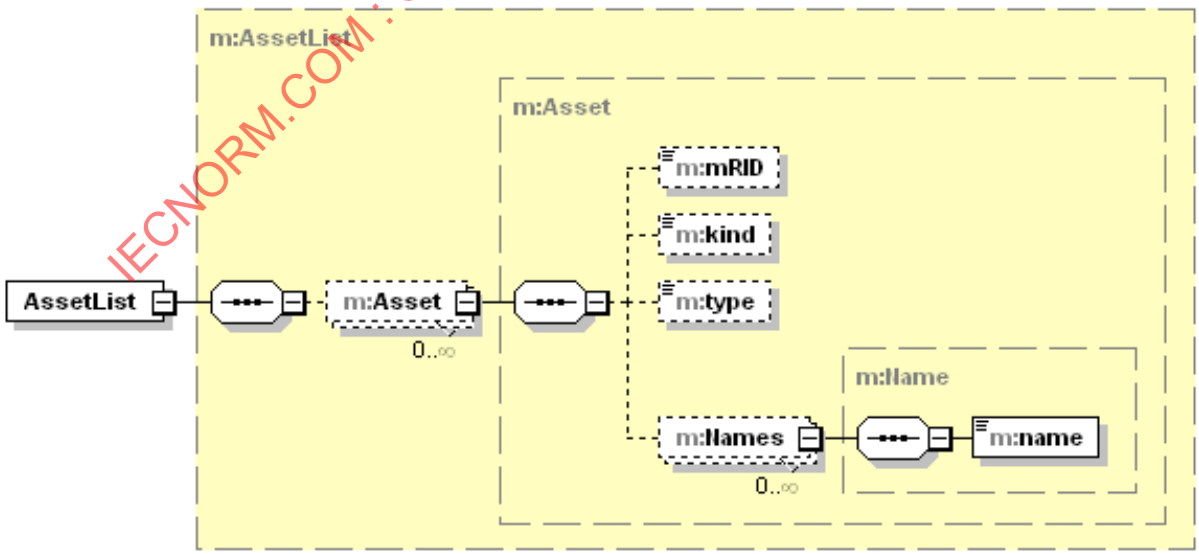


Figure 5 – Format de message AssetList

L'exemple qui suit est un exemple XML pour un AssetList.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetList xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetList.xsd">
	<m:Asset>
		<m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
		<m:kind>breakerSF6DeadTankBreaker</m:kind>
	</m:Asset>
	<m:Asset>
		<m:mRID>9ea05e0a-024a-495d-85bd-f2553b89dcaa</m:mRID>
		<m:kind>other</m:kind>
		<m:type>twoWindingTransformer</m:type>
	</m:Asset>
	<m:Asset>
		<m:mRID>6a9fb099-e67d-4c33-88f4-aa3e479ec1da</m:mRID>
	</m:Asset>
</m:AssetList>
```

5.3 Messages AssetCatalogue

5.3.1 Généralités

Un AssetCatalogue est une collection d'informations concernant des types de produits et de matériels disponibles, qui servent à construire ou à installer des actifs, à les maintenir ou à les exploiter. Chaque article de catalogue concerne un produit spécifique disponible auprès d'un constructeur spécifique. Un message AssetCatalogue peut contenir des informations de référence telles que drawingNumber et modelNumber, sur un ProductAssetModel spécifique, ainsi que les informations signalétiques AssetInfo qui le concernent.

5.3.2 Applications

Le message AssetCatalogue sert à échanger des informations sur le catalogue des actifs. Les applications contiennent, par exemple, le remplacement d'actifs génériques et la planification à long terme. Alors qu'elle est en train d'installer des actifs, une personne chargée de la maintenance peut interroger le catalogue pour trouver un modèle de produit spécifique concerné. Dans une planification à long terme, un projet peut avoir un ensemble d'exigences et le catalogue des modèles de produit approuvés de l'organisation sert de base à la prise de décisions. Un ingénieur ou un analyste interroge le catalogue et applique les règles relatives au choix afin d'identifier les articles du catalogue qui ont des spécifications satisfaisant aux exigences du projet. L'interrogation et l'obtention par un système d'analyse des actifs des informations de catalogue souhaitées, comme le montre la Figure 6, sont des applications courantes de ce message.

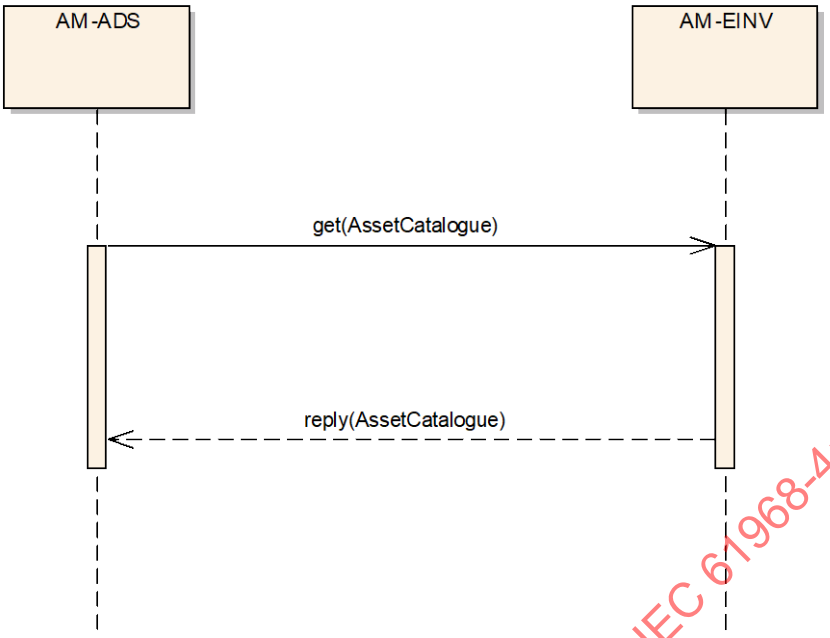


Figure 6 – Échange de messages AssetCatalogue

5.3.3 Format du message

La Figure 7 montre le format de la charge utile du message, utilisé pour obtenir des informations AssetCatalogue. La charge utile du message est constituée d'une multiplicité d'objets ProductAssetModel. En plus des attributs de ProductAssetModel, le message peut également contenir la liste des objets Asset qui correspondent au modèle de produit. La Figure 8 représente l'élément Asset. En plus d'identifier les informations, des informations d'état telles qu'inUseState et lifecycleState peuvent être fournies, de manière qu'un système de requêtes puisse identifier si, par exemple, l'actif est un article d'inventaire disponible pour l'installation.

La charge utile du message peut également contenir des informations signalétiques d'une classe fille d'AssetInfo à laquelle le ProductAssetModel est associé. La Figure 9 représente les informations signalétiques relatives à une section de barre omnibus. La Figure 10 représente l'élément PowerTransferInfo. Alors que les autres éléments fils AssetInfo contiennent les attributs de l'élément, PowerTransformerInfo a une structure unique en ce qu'il contient une multiplicité d'éléments TransformerTankInfo, qui à leur tour peuvent comprendre une multiplicité d'éléments TransformerEndInfo.

Le message ProductAssetModel peut également contenir le CatalogAssetType relatif au ProductAssetModel. La Figure 11 représente l'élément CatalogueAssetType. Ce CatalogueAssetType est le type de produit générique correspondant aux objets ProductAssetModel fonctionnellement équivalents. Ces informations peuvent servir à trouver des modèles de produit équivalents, en utilisant le message TypeAssetCatalogue décrit au 5.4.

De plus, le message ProductAssetModel peut contenir des informations sur le constructeur (Manufacturer), qui sont représentées plus précisément à la Figure 12.

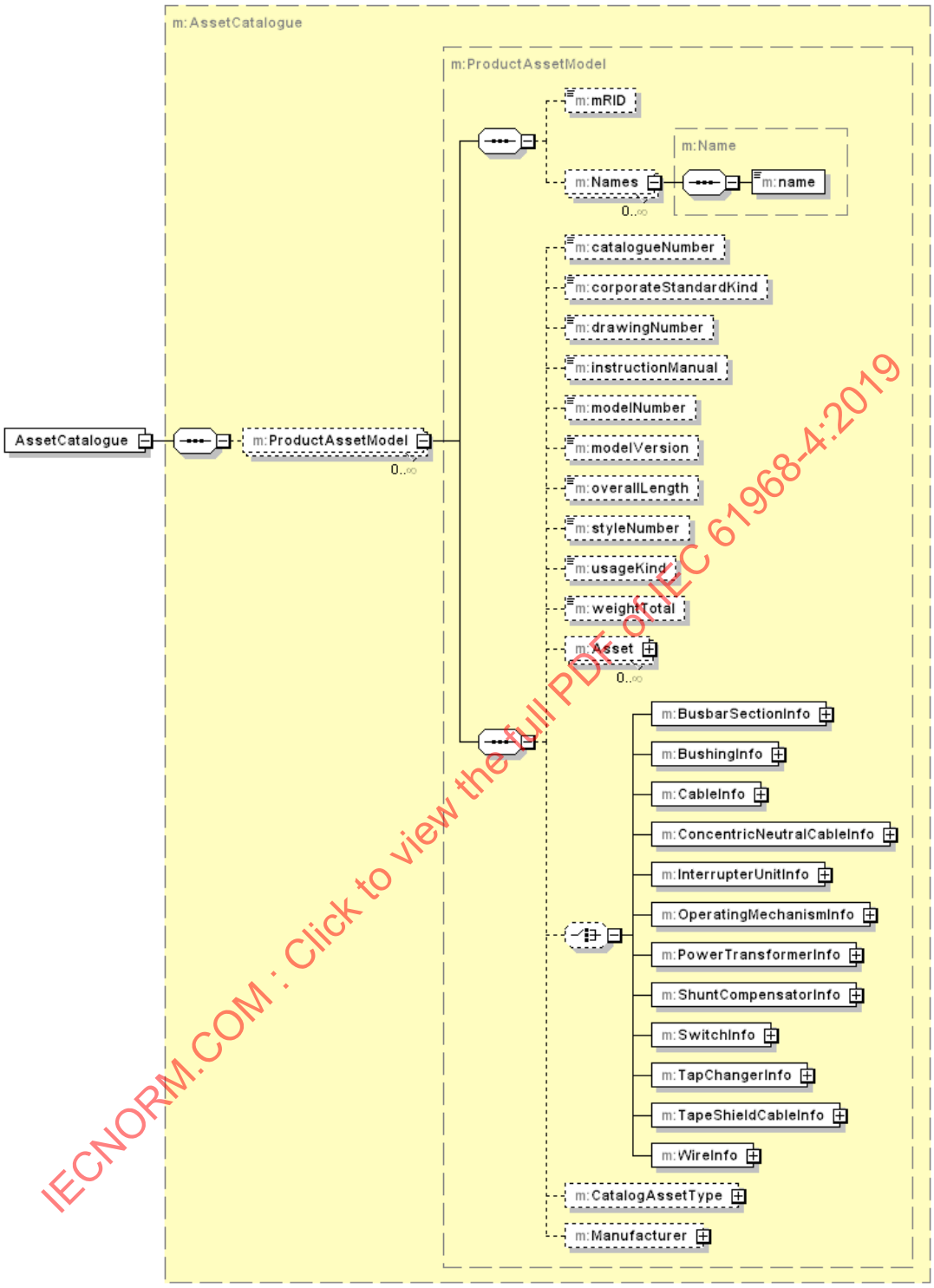


Figure 7 – Format de message AssetCatalogue

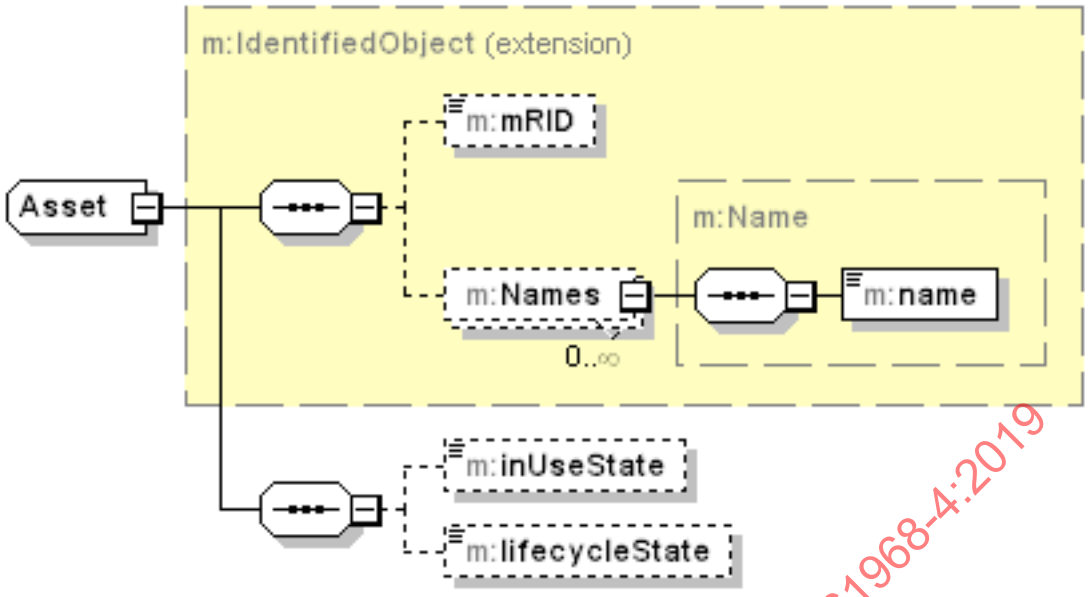


Figure 8 – Message AssetCatalogue: élément Asset

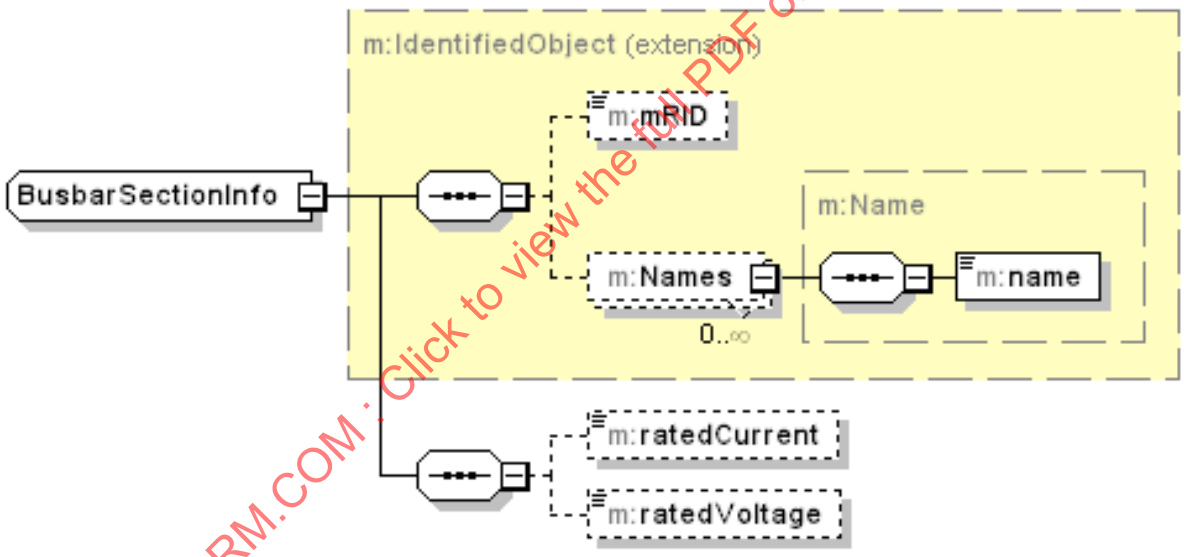


Figure 9 – Message AssetCatalogue: élément BusbarSectionInfo

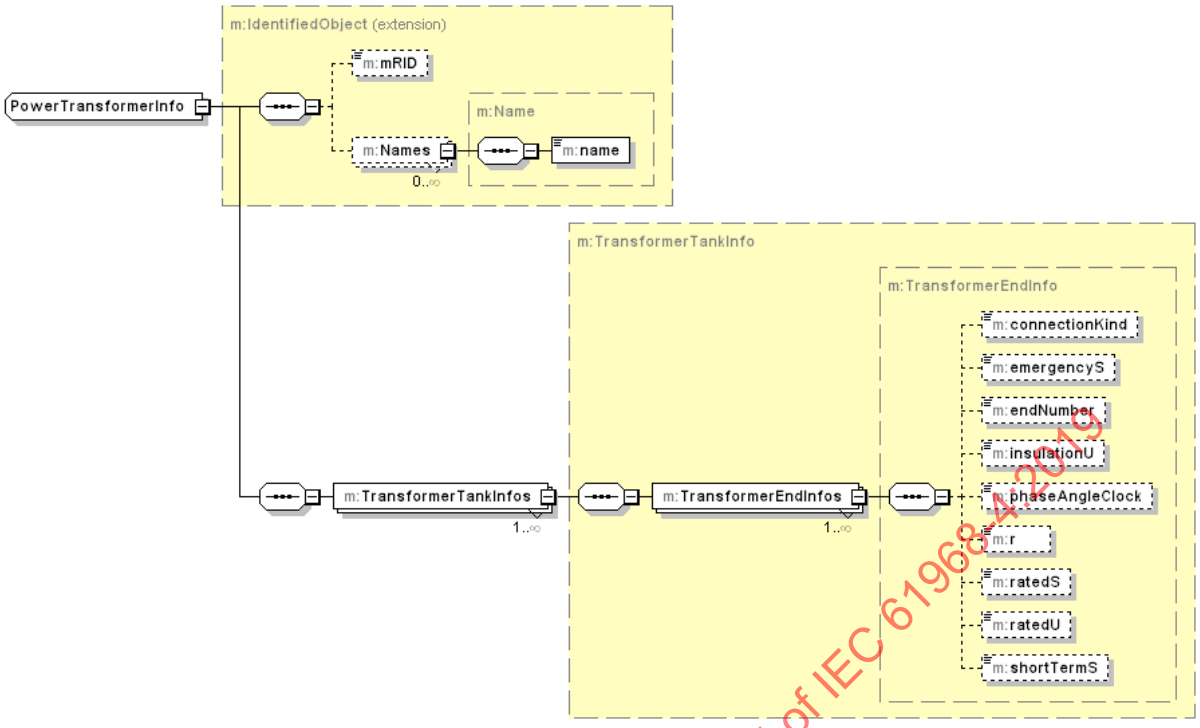


Figure 10 – Message AssetCatalogue: élément PowerTransformerInfo

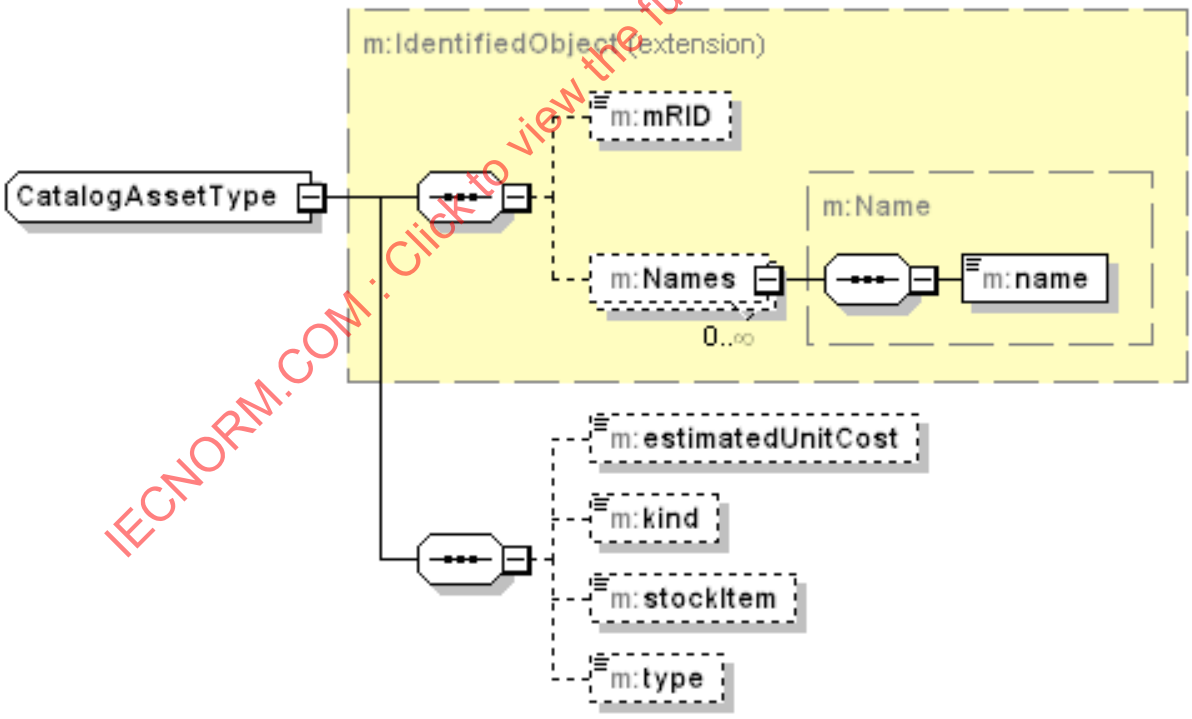


Figure 11 – Message AssetCatalogue: élément CatalogAssetType

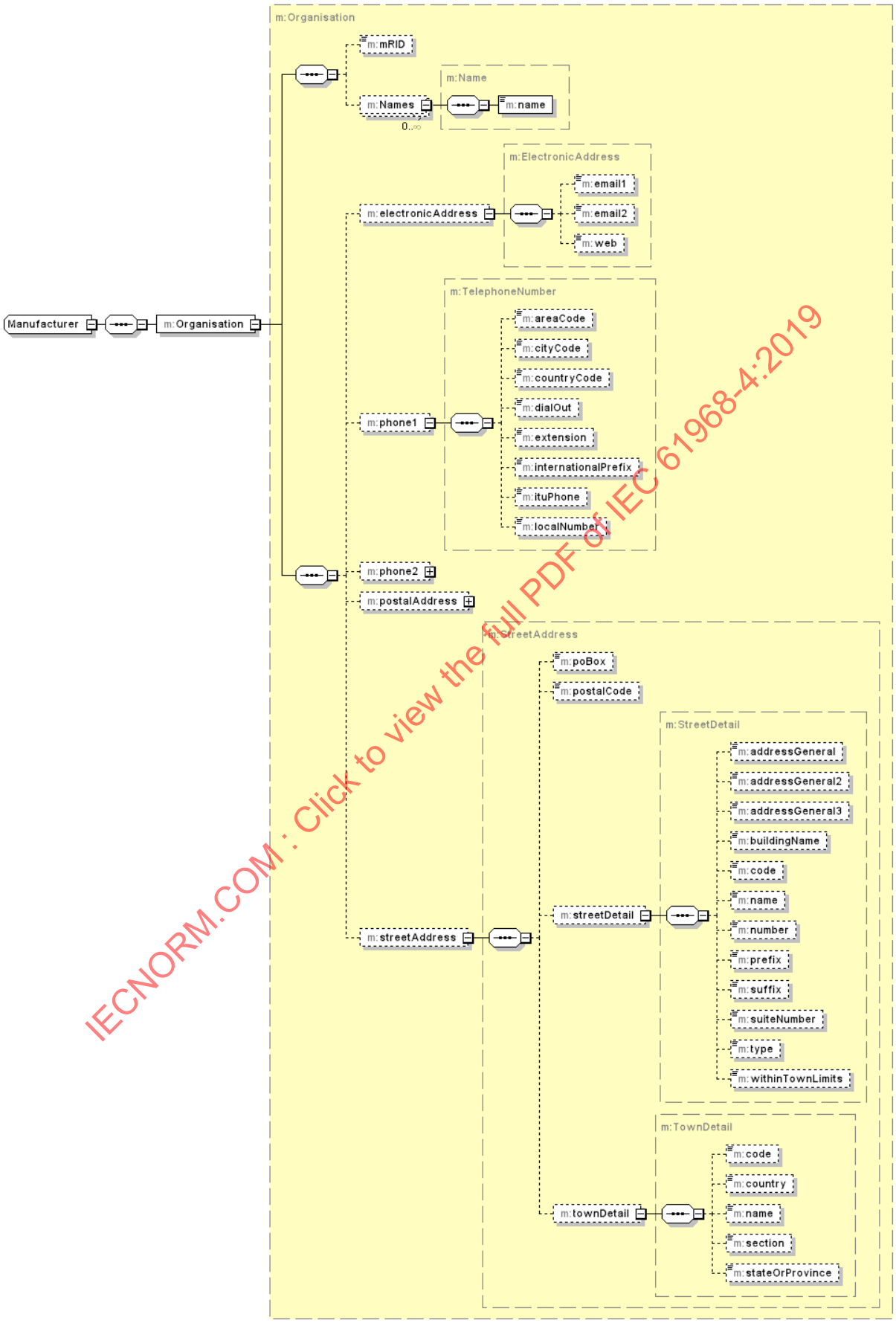


Figure 12 – Message AssetCatalogue: élément Manufacturer

L'exemple qui suit est un exemple XML pour un AssetCatalogue. Il comprend le modèle et les informations sur les caractéristiques assignées d'un disjoncteur.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetCatalogue xmlns:m="http://iec.ch/TC57/2007/AssetCatalogue#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/AssetCatalogue# AssetCatalogue.xsd">
      <m:ProductAssetModel>
            <m:mRID>25fc985e-b658-11e5-9f22-ba0be0483c18</m:mRID>
            <m:modelNumber>UN45D3000</m:modelNumber>
            <m:modelVersion>2</m:modelVersion>
            <m:SwitchInfo>
                  <m:breakingCapacity>50000</m:breakingCapacity>
                  <m:ratedCurrent>3150</m:ratedCurrent>
                  <m:ratedFrequency>60</m:ratedFrequency>

      <m:ratedImpulseWithstandVoltage>1050000</m:ratedImpulseWithstandVoltage>
                  <m:ratedInterruptingTime>3</m:ratedInterruptingTime>
                  <m:ratedVoltage>253000</m:ratedVoltage>
            </m:SwitchInfo>
      </m:ProductAssetModel>
</m:AssetCatalogue>
```

5.4 Messages TypeAssetCatalogue

5.4.1 Généralités

Un message TypeAssetCatalogue peut obtenir des données pour un ensemble de types d'actifs assurant un service de distribution. Il s'agit d'un ensemble d'informations relatives aux types génériques d'actifs pouvant être utilisés pour la conception, l'analyse, etc. Le CatalogAssetType dans un message TypeAssetCatalogue n'est pas associé à un constructeur particulier, mais le message peut comporter des références à des ProductAssetModels qui décrivent des versions spécifiques d'un constructeur donné et associées au CatalogueAssetType.

5.4.2 Applications

Le message TypeAssetCatalogue sert à échanger des modèles d'actifs génériques. Des applications possibles sont, par exemple, la conception et l'analyse. En phase de conception exploratoire, un modèle d'actif générique peut être utilisé au départ, pour être ensuite remplacé par des informations de modèle spécifiques du produit à mesure que la conception progresse. En phase d'analyse, un modèle d'actif générique peut être utilisé pour une ébauche d'analyse exploratoire. Dans ces deux cas, le modèle générique pour l'actif concerné peut être obtenu à partir d'un système gardien. L'interrogation et l'obtention par un système d'analyse des actifs des informations de TypeAssetCatalogue souhaitées, comme le montre la Figure 13, sont des applications courantes de ce message.

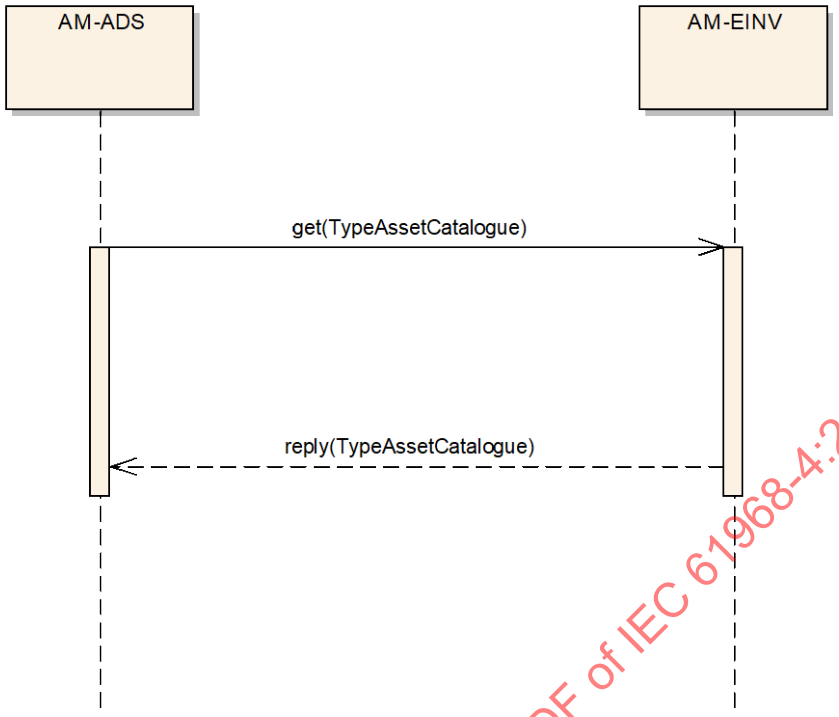


Figure 13 – Échange de messages TypeAssetCatalogue

5.4.3 Format du message

La Figure 14 montre le format de message pour obtenir des informations TypeAssetCatalogue. La charge utile du message est constituée d'une multiplicité d'objets CatalogueAssetType. En plus des attributs de CatalogueAssetType, la charge utile peut également contenir des informations signalétiques pour le CatalogueAssetType sous la forme de classes filles AssetInfo telles que BusbarSectionInfo et BushingInfo. De plus, le message peut contenir une référence aux ProductAssetModels auxquels le CatalogueAssetType est associé.

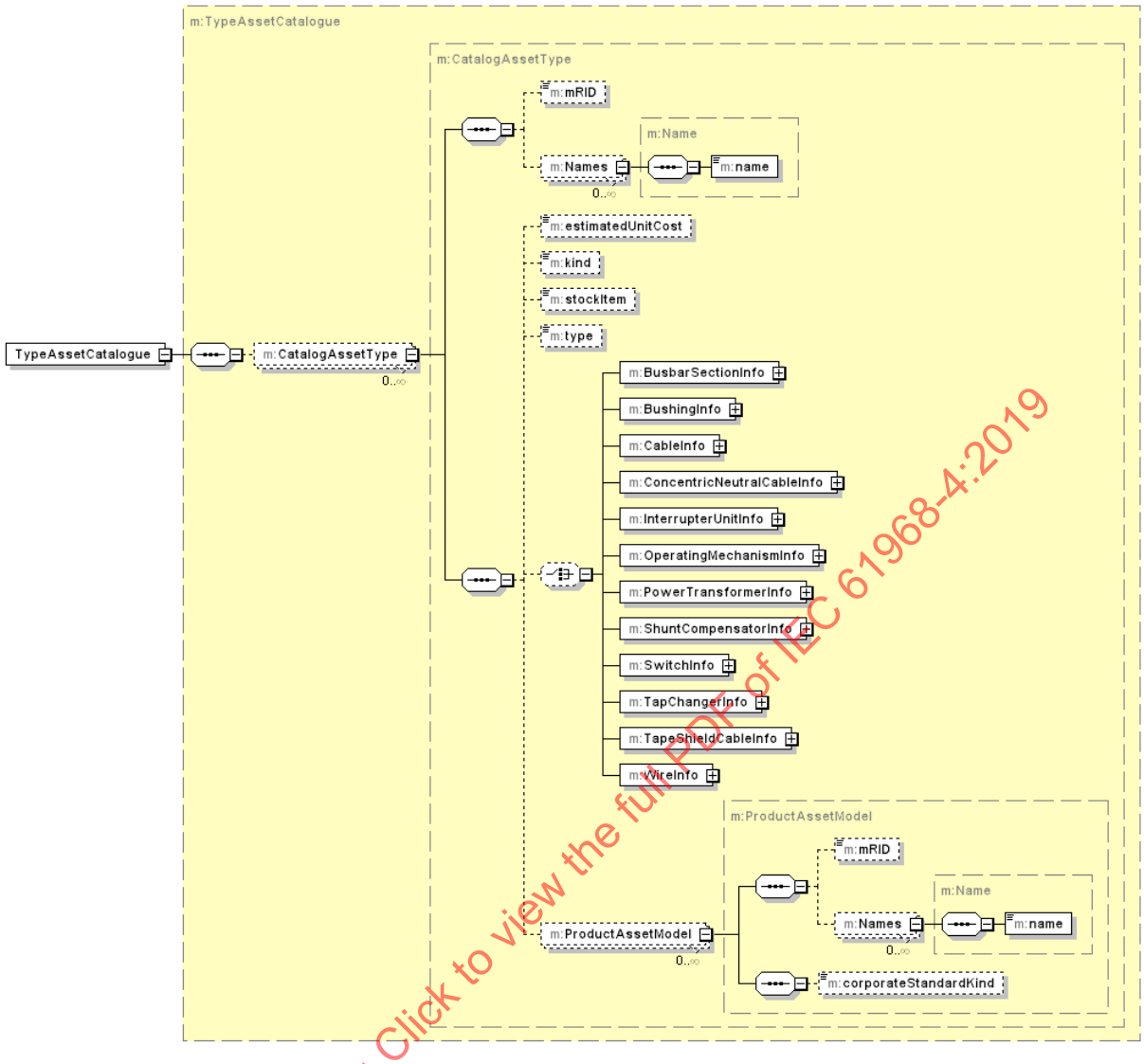


Figure 14 – Format de message TypeAssetCatalogue

L'exemple qui suit est un exemple XML pour un TypeAssetCatalogue.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:TypeAssetCatalogue xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:m="http://iec.ch/TC57/2007/TypeAssetCatalogue#"
xsi:schemaLocation="http://iec.ch/TC57/2007/TypeAssetCatalogue#
TypeAssetCatalogue.xsd">
        <m:CatalogAssetType>
                <m:mRID>b4ca7c94-ca02-4f9a-b405-31209ccbe1d1</m:mRID>
                <m:estimatedUnitCost>10000</m:estimatedUnitCost>
                <m:stockItem>true</m:stockItem>
                <m:ProductAssetModels >
                        <m:mRID>cfc68fef-ae54-408f-baa7-aaf04bdb3c92</m:mRID>
                </m:ProductAssetModels >
                <m:ProductAssetModels>
                        <m:mRID>25fc985e-b658-11e5-9f22-ba0be0483c18</m:mRID>
                </m:ProductAssetModels>
        </m:CatalogAssetType>
</m:TypeAssetCatalogue>
```

5.5 Messages AssetTemplate

5.5.1 Généralités

Un message AssetTemplate contient des données relatives à la composition logique et informative d'un type (kind) d'actifs particulier. Ce message contient les objets d'informations qui comprennent l'actif et les relations des objets d'informations les uns avec les autres. Ce message a pour but de décrire la façon spécifique dont les classes AssetContainer-Asset imbriquées indéfiniment ont été utilisées pour décrire un bien assurant un service de distribution spécifique. Cela révèle au système demandeur, par exemple une analyse qui évalue l'état du bien en question, la hiérarchie des objets pour ce bien, c'est-à-dire les objets d'informations qui peuvent être disponibles pour les différents composants du bien et comment ils sont en relation les uns avec les autres.

5.5.2 Applications

Le message AssetTemplate sert à trouver les composants formant le modèle d'informations d'un type (kind) d'actifs. Généralement, il est prévu que ce modèle d'informations reflète la composition logique d'un bien. Par exemple, un disjoncteur au SF6 à cuve mise à la terre peut comprendre une cuve, six traversées, trois interrupteurs et un mécanisme de manœuvre. Chacun de ces composants peut être modélisé sous forme de classe Asset ou de classe fille Asset. Le message AssetTemplate pour ce type (kind) d'actif renvoie alors les objets Asset relevant de ces composants et indique comment ils s'associent les uns aux autres, c'est-à-dire lesquelles des classes Asset/classes filles Asset s'associent avec quelles autres classes Asset/classes filles Asset, et à quel objet le Medium est associé, le cas échéant.

L'interrogation et l'obtention par un système d'analyse des actifs de la composition et de la hiérarchie des objets du type d'actifs en cours d'évaluation sont des applications courantes de ce message. Comme le montre la Figure 15, un système d'analyse des actifs interroge un système d'inventaire du réseau et des postes afin d'obtenir les objets d'informations comprenant un type d'actif particulier et la relation qui existe entre ces actifs.

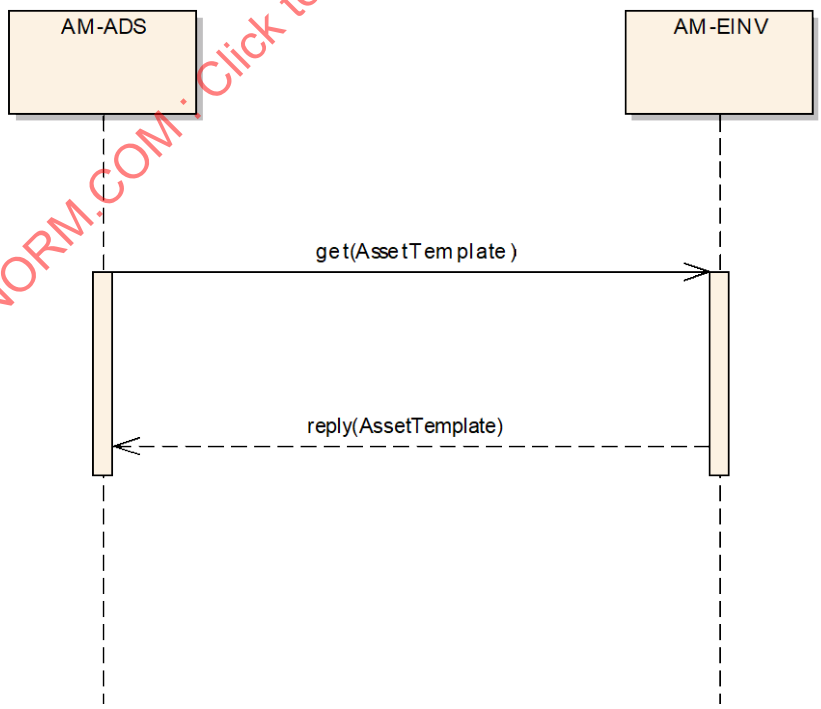


Figure 15 – Échange de requêtes AssetTemplate

Une autre application pour ce message est la création par un système d'analyse des actifs de la composition et de la hiérarchie des objets d'un type d'actif. Comme le montre la Figure 16,

un système d'analyse des actifs, qui peut être incorporé à un logiciel de conception, donne à un système d'inventaire du réseau et des postes les objets d'informations comprenant un type d'actif particulier et la relation qui existe entre ces actifs.

Des hiérarchies d'objets sont données à titre d'information à l'Annexe D pour un certain nombre d'actifs usuels.

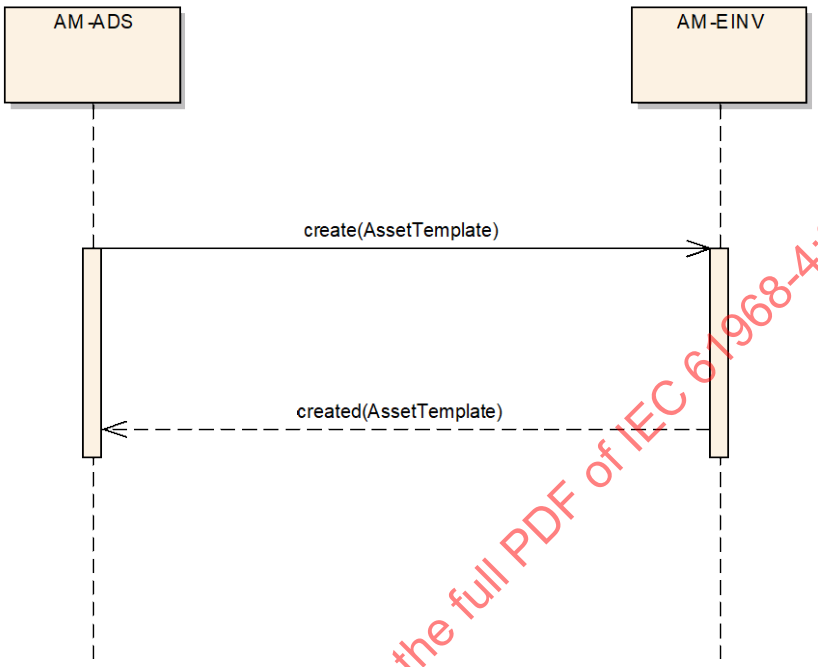


Figure 16 – Échange de création de modèles d'actifs

5.5.3 Format du message

Les Figure 17, Figure 18 et Figure 19 représentent le format de message AssetTemplate. Un objet AssetContainer de niveau racine, comme l'indique la Figure 17, peut obtenir d'autres objets AssetContainer de manière imbriquée, avec la description hiérarchique aboutissant aux objets Asset. La Figure 18 représente les éléments Asset et Medium du message AssetTemplate. La Figure 18 représente les éléments de disjoncteur avec les associations uniques telles que les extrémités Bushing connectées aux extrémités FixedContact et MovingContact d'une InterrupterUnit.

Le message AssetTemplate peut servir à décrire le modèle d'objets d'informations pour des actifs de complexité variée:

- actifs complexes tels que les transformateurs de puissance principaux d'un poste ayant de multiples niveaux imbriqués d'AssetContainer;
- actifs plus simples tels que les transformateurs montés en haut de poteau pouvant être d'un niveau imbriqué d'un AssetContainer avec ses actifs composants tels que Bushing;
- actifs composants tels que Bushing.

Le message AssetTemplate a deux réalisations possibles:

1) il ne comprend que l'attribut "kind" et/ou "type" des classes Asset, des classes filles Asset (AssetContainer, Bushing, etc.) et Medium. Cette réalisation permet la description de la hiérarchie d'objets d'un actif général;
2) il contient les informations d'identification telles que mRID ou un nom unique d'instances des classes Asset, des classes filles Asset (AssetContainer, Bushing, etc.) et Medium. Cette réalisation permet la description de la hiérarchie d'objets d'un actif spécifique.

Dans le cas de la deuxième réalisation, c'est-à-dire de la hiérarchie des objets d'un actif spécifique, le message AssetDetail peut être utilisé pour obtenir les propriétés des objets composants de l'actif en question.

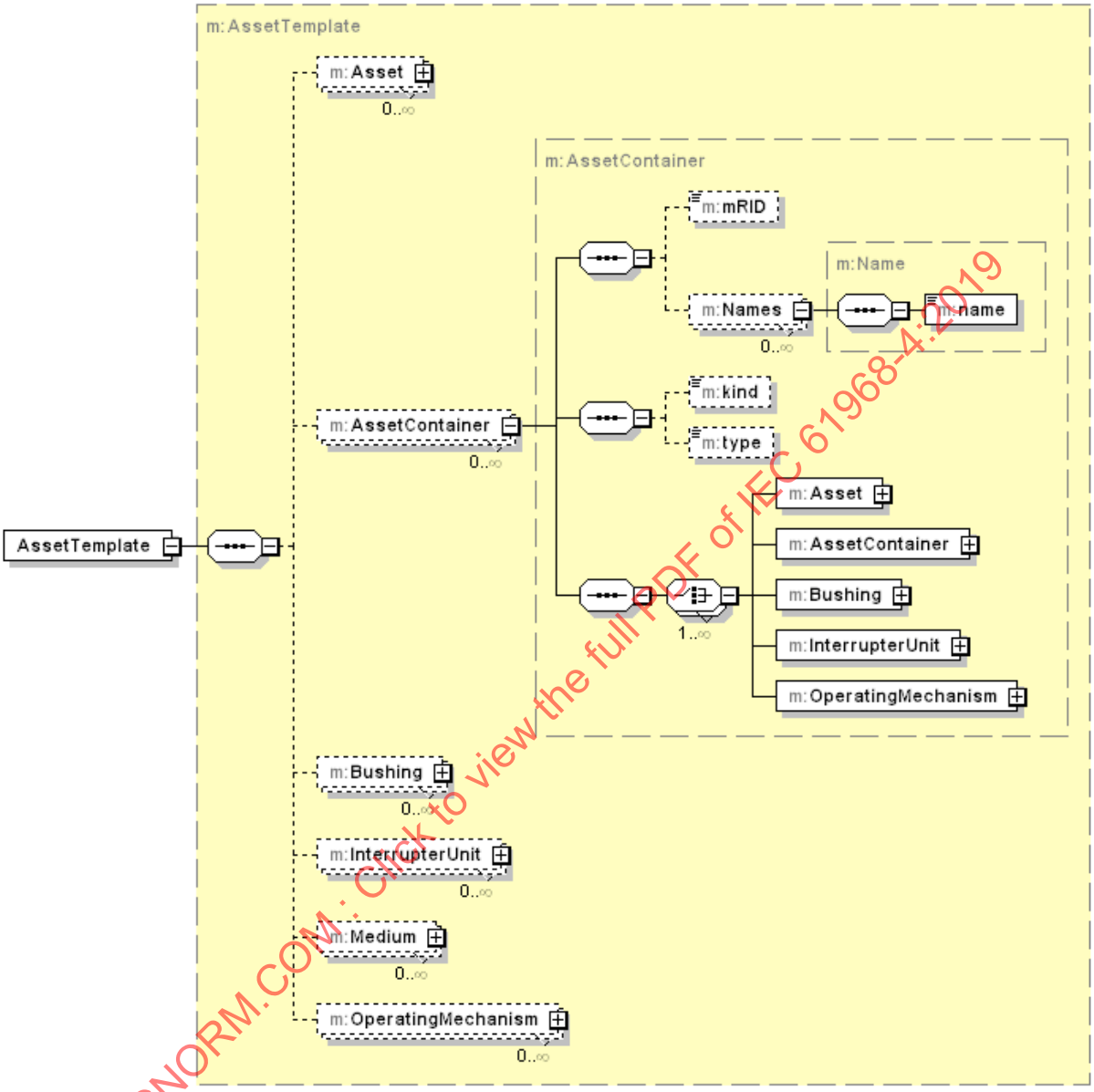


Figure 17 – Message AssetTemplate présentant l'élément AssetContainer

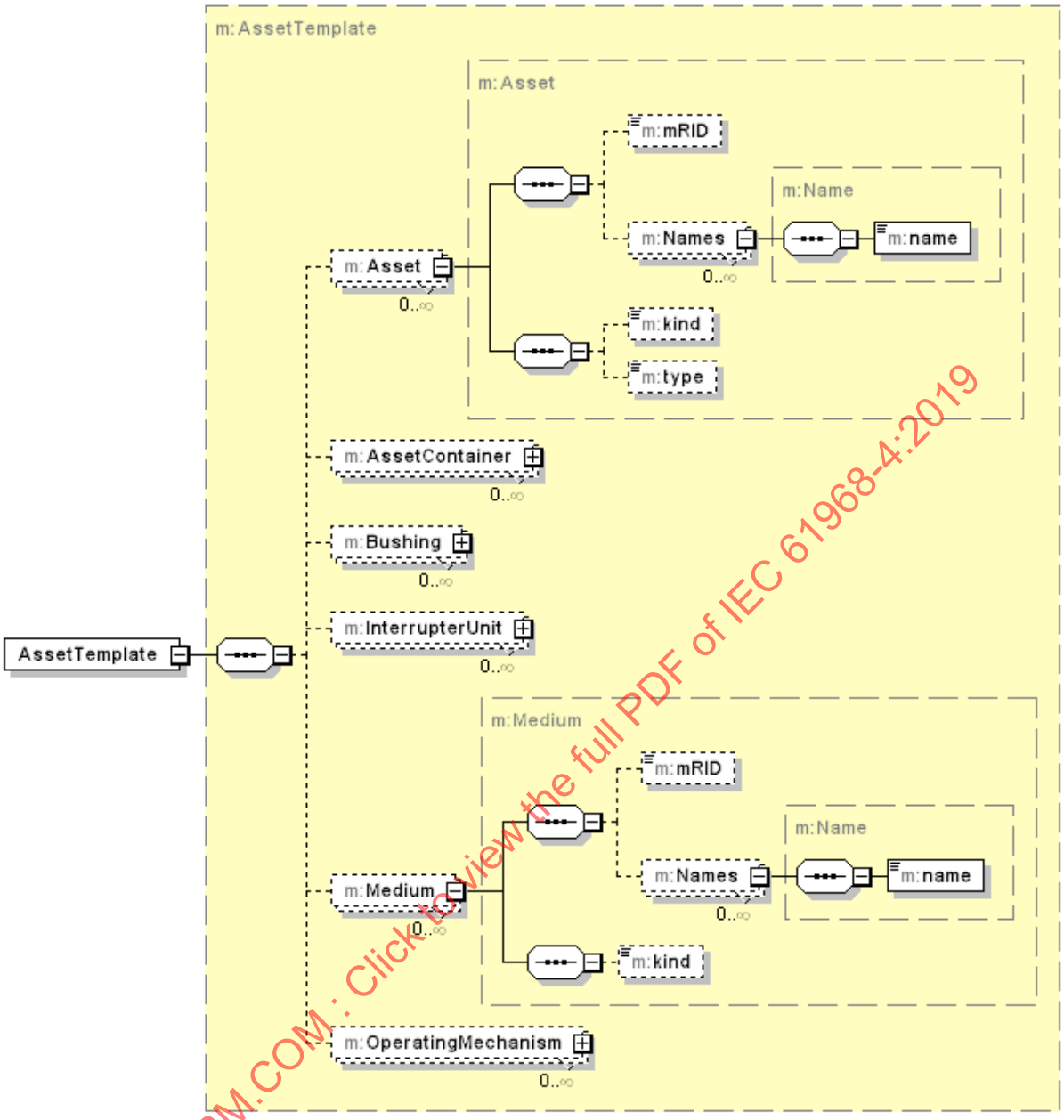


Figure 18 – Message AssetTemplate présentant les éléments Asset et Medium

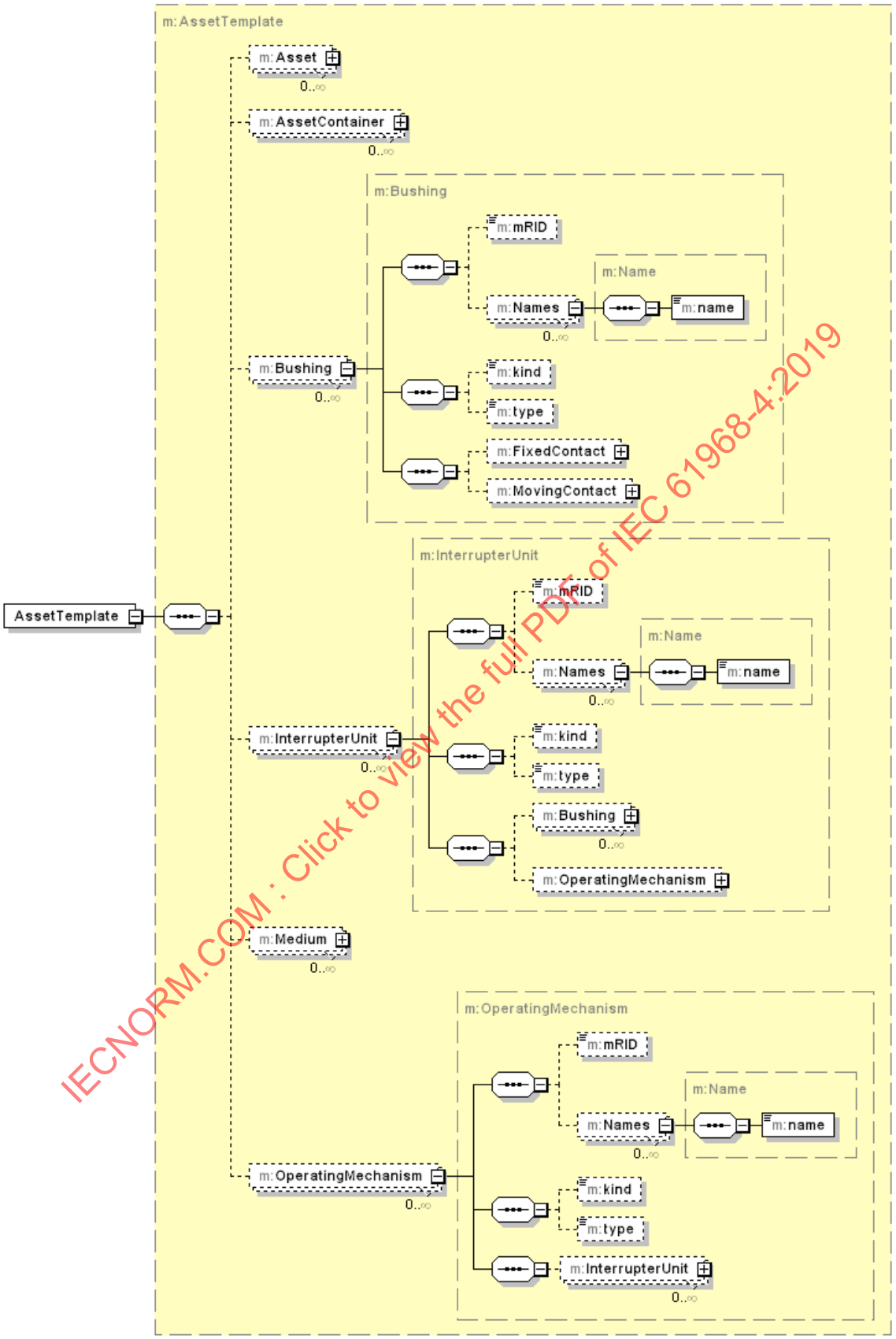


Figure 19 – Message AssetTemplate présentant les éléments Bushing, InterrupterUnit et operatingMechanism

L'exemple qui suit est un exemple XML pour un AssetTemplate qui décrit un disjoncteur au SF6 à cuve mise à la terre.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetTemplate xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetTemplate.xsd">
	<m:AssetContainer>
		<m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
		<m:kind>breakerSF6DeadTankBreaker</m:kind>
		<m:AssetContainer ref="a49bd9e3-abba-4140-a202-200af5e134f8"/>
	</m:AssetContainer>
	<m:AssetContainer>
		<m:mRID>a49bd9e3-abba-4140-a202-200af5e134f8</m:mRID>
		<m:kind>breakerTankAssembly</m:kind>
		<m:Mediums ref="f5d3fc3d-041e-44c7-bda1-0c75b7c89a05"/>
		<m:Bushing ref="9343e63b-fcb1-4fb3-9e9a-e9b519754c13"/>
		<m:Bushing ref="fe37a60e-d8b7-49e5-8c12-93af7c58d223"/>
		<m:Bushing ref="c278ccba-3c18-4634-a54a-6d42379407a2"/>
		<m:Bushing ref="d5f14947-72b7-456b-8695-18577aebcc9e"/>
		<m:Bushing ref="0b2407fb-cd83-45f4-ba06-3cafc68f1f6d"/>
		<m:Bushing ref="1e98268b-411a-407a-813b-9a13abeab21e"/>
		<m:InterrupterUnit ref="397e055a-b6e1-469f-86bc-46235a67d638"/>
		<m:InterrupterUnit ref="5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc"/>
		<m:InterrupterUnit ref="312f340c-d430-4e52-8fef-7f4ead013493"/>
		<m:OperatingMechanism ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
	</m:AssetContainer>
	<m:Bushing>
		<m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:FixedContact ref="397e055a-b6e1-469f-86bc-46235a67d638"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>fe37a60e-d8b7-49e5-8c12-93af7c58d223</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:MovingContact ref="397e055a-b6e1-469f-86bc-46235a67d638"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>c278ccba-3c18-4634-a54a-6d42379407a2</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:FixedContact ref="5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>d5f14947-72b7-456b-8695-18577aebcc9e</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:MovingContact ref="5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>0b2407fb-cd83-45f4-ba06-3cafc68f1f6d</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:FixedContact ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
	</m:Bushing>
	<m:Bushing>
		<m:mRID>1e98268b-411a-407a-813b-9a13abeab21e</m:mRID>
		<m:insulationKind>oilImpregnatedPaper</m:insulationKind>
		<m:MovingContact ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
	</m:Bushing>
	<m:InterrupterUnit>
		<m:mRID>397e055a-b6e1-469f-86bc-46235a67d638</m:mRID>
		<m:OperatingMechanism ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
		<m:Bushing ref="9343e63b-fcb1-4fb3-9e9a-e9b519754c13"/>
		<m:Bushing ref="fe37a60e-d8b7-49e5-8c12-93af7c58d223"/>
```

```
        </m:InterrupterUnit>
        <m:InterrupterUnit>
            <m:mRID>5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc</m:mRID>
            <m:OperatingMechanism ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
            <m:Bushing ref="c278ccba-3c18-4634-a54a-6d42379407a2"/>
            <m:Bushing ref="d5f14947-72b7-456b-8695-18577aebcc9e"/>
        </m:InterrupterUnit>
        <m:InterrupterUnit>
            <m:mRID>312f340c-d430-4e52-8fef-7f4ead013493</m:mRID>
            <m:OperatingMechanism ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
            <m:Bushing ref="0b2407fb-cd83-45f4-ba06-3cafc68f1f6d"/>
            <m:Bushing ref="1e98268b-411a-407a-813b-9a13abeab21e"/>
        </m:InterrupterUnit>
        <m:Medium>
            <m:mRID>f5d3fc3d-041e-44c7-bda1-0c75b7c89a05</m:mRID>
            <m:kind>sF6</m:kind>
        </m:Medium>
        <m:OperatingMechanism>
            <m:mRID>e643467f-7c72-4384-9da2-b61956524cd5</m:mRID>
            <m:InterrupterUnit ref="397e055a-b6e1-469f-86bc-46235a67d638"/>
            <m:InterrupterUnit ref="5d4df34b-88d2-4d06-9116-c7bd3d6a9cfc"/>
            <m:InterrupterUnit ref="e643467f-7c72-4384-9da2-b61956524cd5"/>
        </m:OperatingMechanism>
</m:AssetTemplate>
```

5.6 Messages AssetDetail

5.6.1 Généralités

Un message AssetDetail peut comporter les propriétés d'un Asset ainsi que d'autres objets liés qui décrivent ses caractéristiques, comme des informations signalétiques, l'identité du propriétaire et l'emplacement. Ce message est le principal moyen d'échange d'informations précises sur les caractéristiques des actifs, dont l'identité unique peut avoir été obtenue en utilisant des messages comme AssetList et AssetTemplate. Noter que ce message ne concerne que les informations caractéristiques de l'actif en question. Pour les échanges de données d'essais et de mesures d'un actif, utiliser les messages AssetProcedures et AssetMeasurements.

5.6.2 Applications

Le message AssetDetail sert à obtenir les informations concernant un ou plusieurs actifs. Ces informations contiennent les attributs de la classe Asset, ainsi que ceux des classes associées telles qu'AssetInfo, Location et Ownership.

L'interrogation et l'obtention par un système d'analyse des actifs des informations sur les actifs qu'il souhaite évaluer, comme le montre la Figure 20, sont des applications courantes de ce message. Sur cette figure, un système d'analyse des actifs demande à un système d'inventaire du réseau et des postes de trouver les informations précises relatives aux actifs concernés.

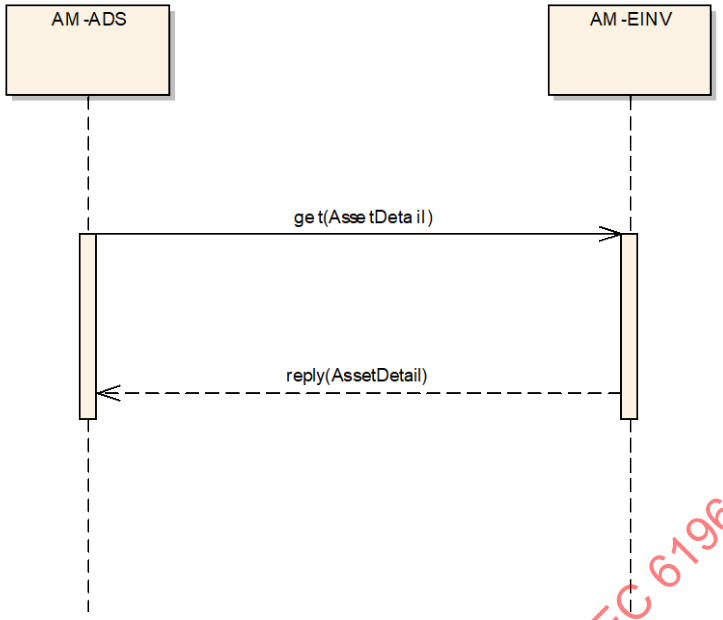


Figure 20 – Échange de messages AssetDetail

5.6.3 Format du message

Le format de message AssetDetail est représenté de la Figure 21 à la Figure 30. La charge utile du message indiquée sur la figure consiste en une multiplicité d'objets Asset ou d'objets fils Asset. L'objet Asset peut comporter des attributs de la classe Asset, des informations signalétiques sous la forme de classes filles AssetInfo, des informations Location et une multiplicité d'informations Ownership (pour tenir compte des actifs qui sont la copropriété de plusieurs entités). Dans le cas de l'élément Asset représenté à la Figure 22, des informations AssetDeployment peuvent également être fournies (Figure 23). Si cet actif est un disjoncteur, il est également possible d'y incorporer un SwitchOperationSummary (Figure 24).

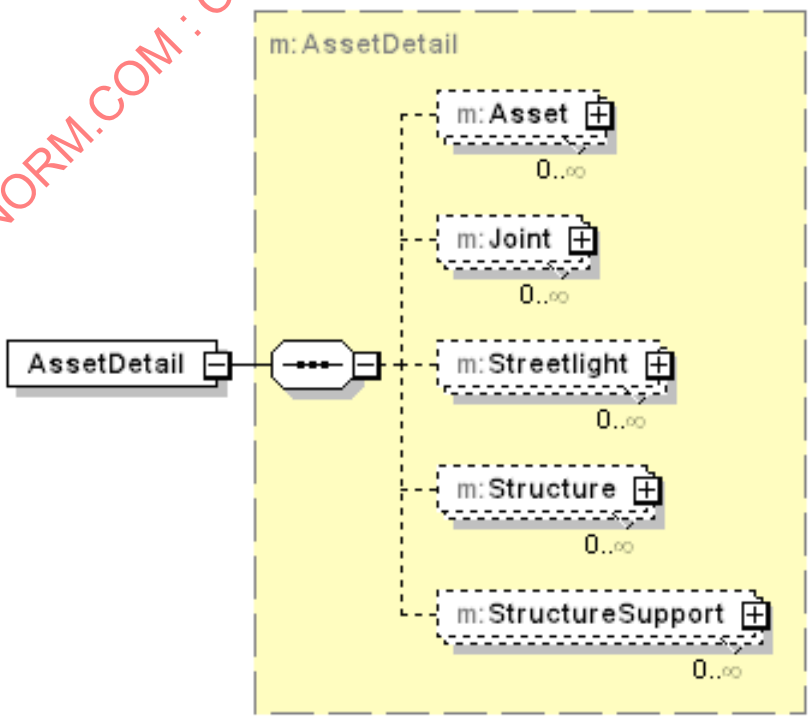


Figure 21 – Format de message AssetDetail

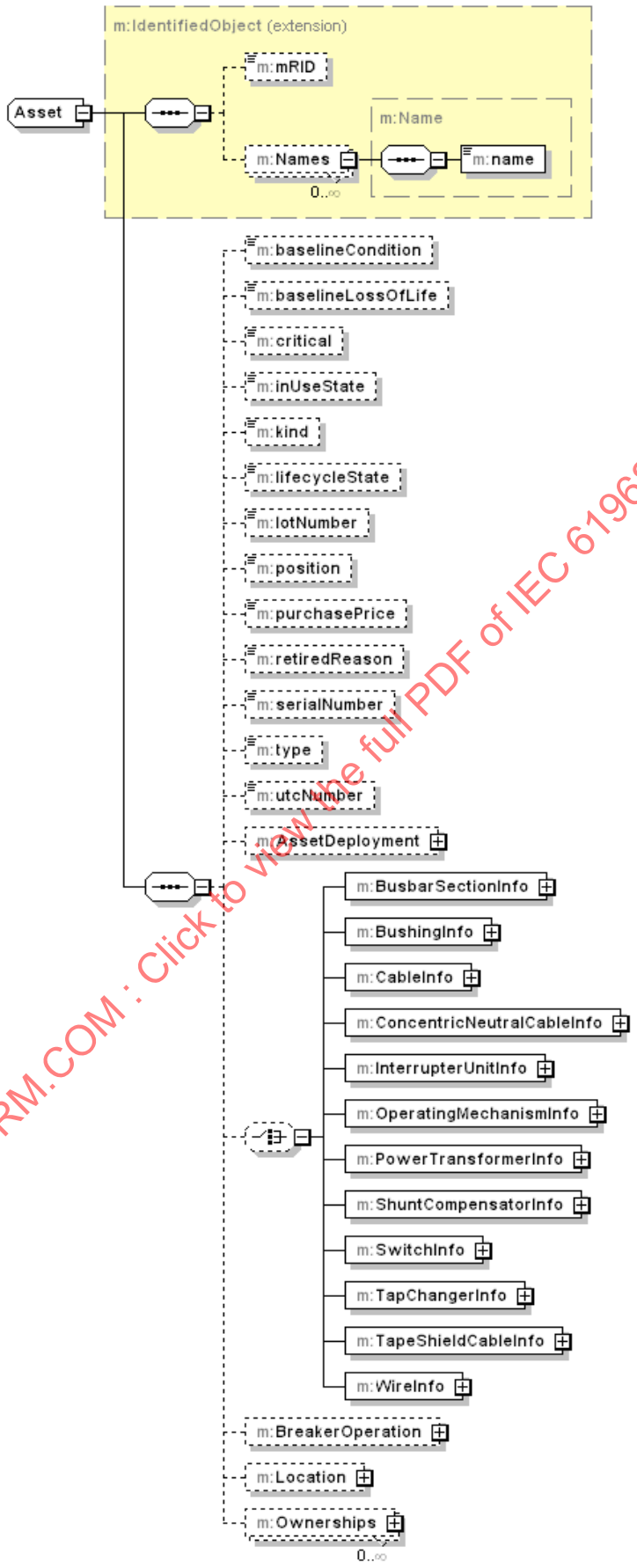


Figure 22 – Message AssetDetail: élément Asset

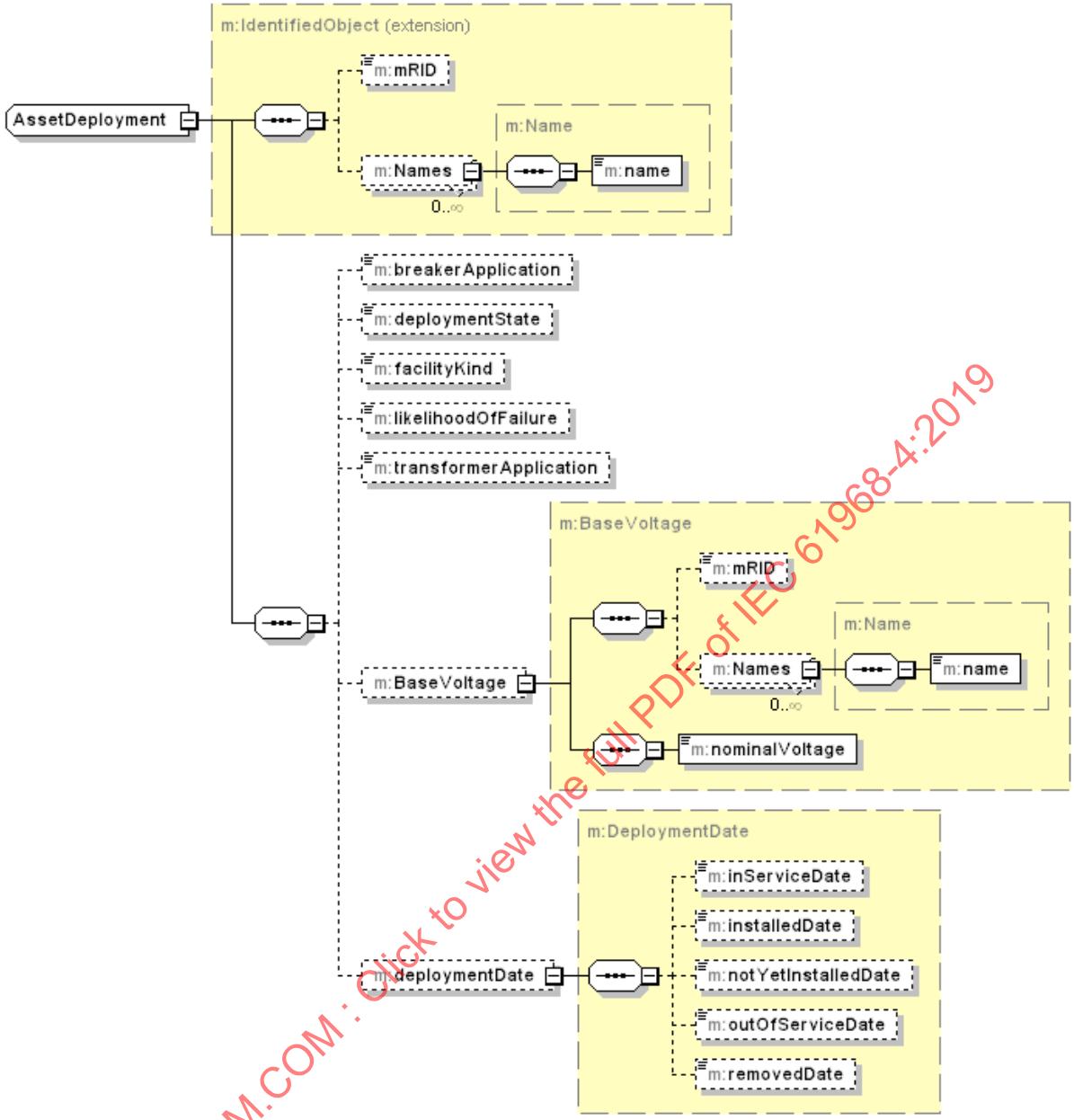


Figure 23 – Message AssetDetail: élément AssetDeployment (compris dans l'élément Asset représenté à la Figure 22)

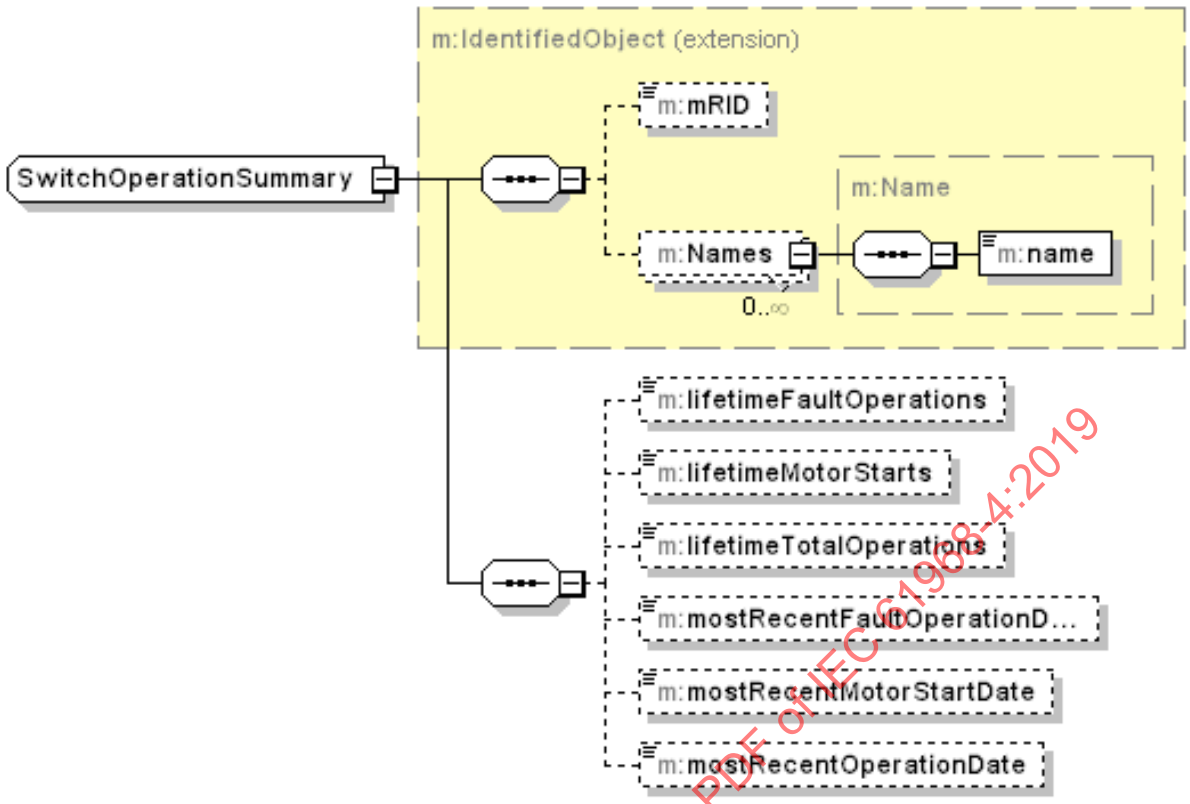


Figure 24 – Message AssetDetail: élément SwitchOperationSummary (compris dans l'élément Asset représenté à la Figure 22, en tant qu'association BreakerOperation)

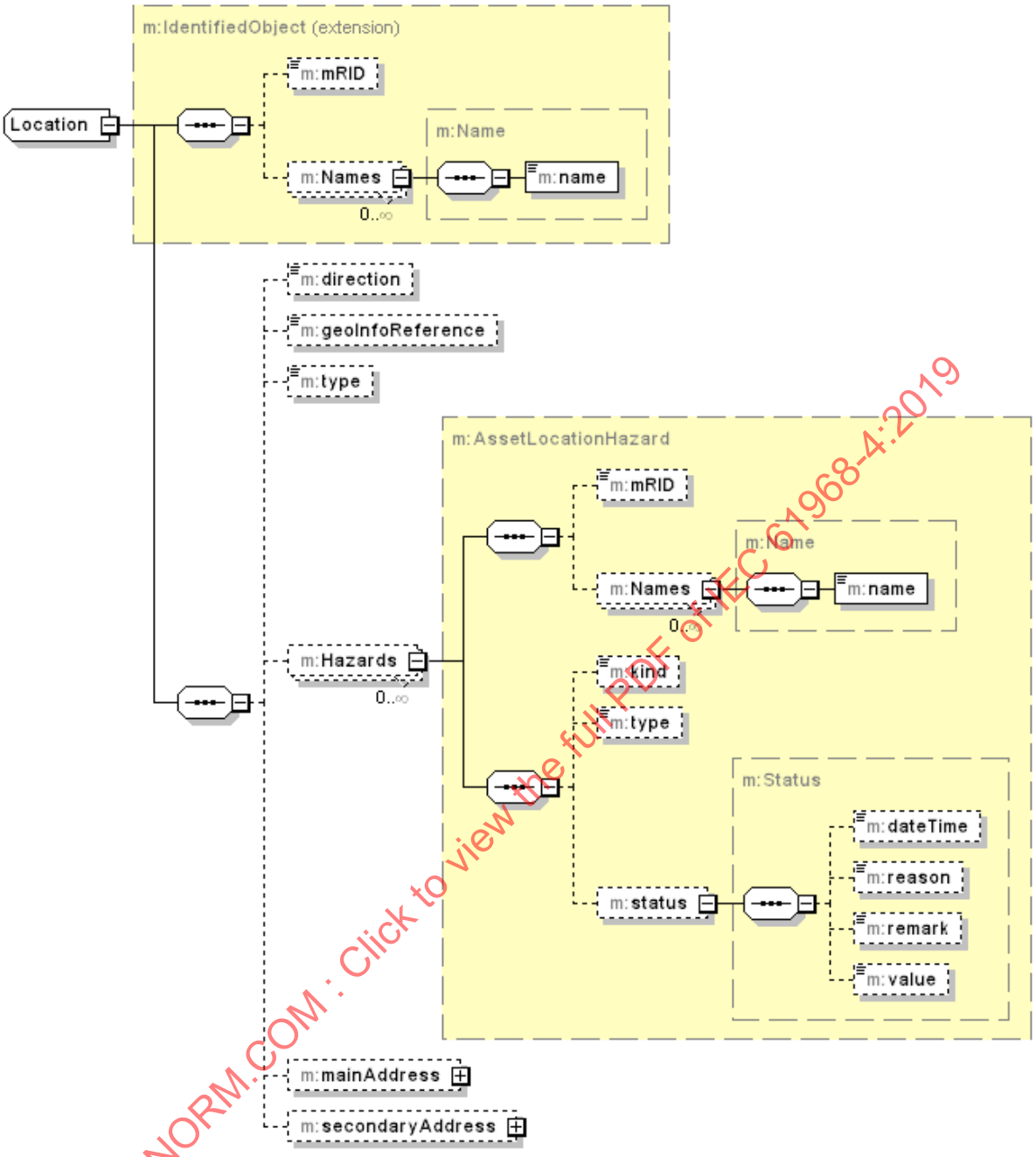


Figure 25 – Message AssetDetail: élément Location

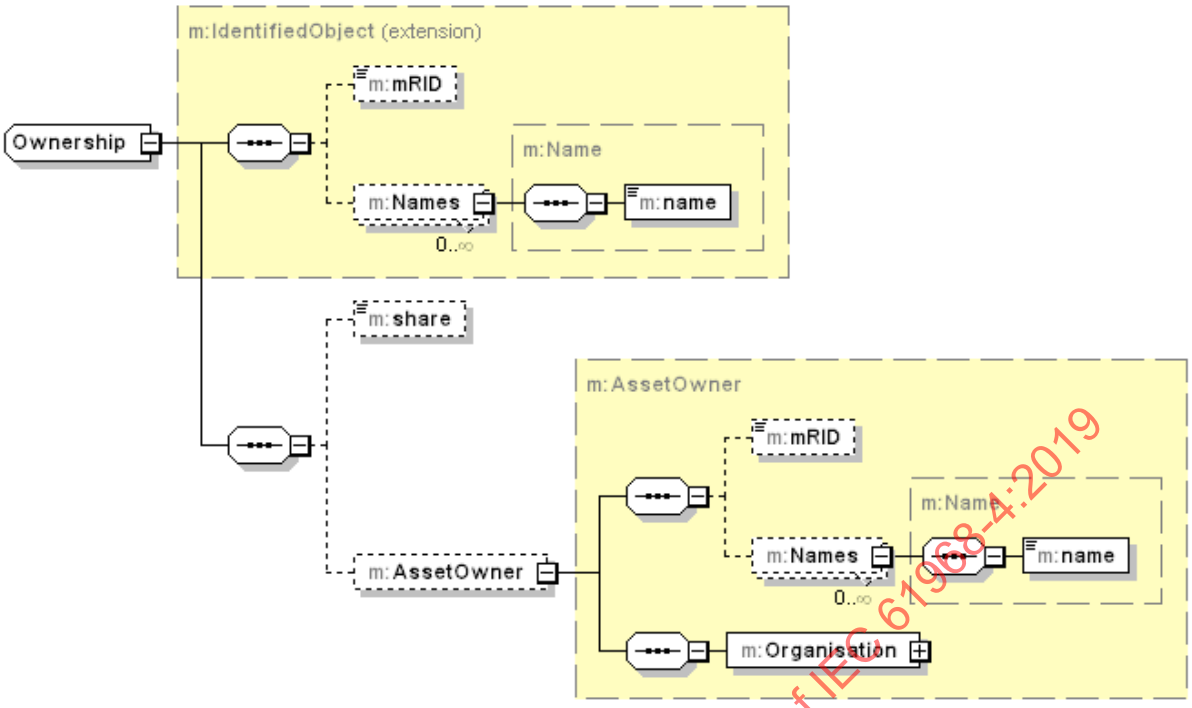


Figure 26 – Message AssetDetail: élément Ownership

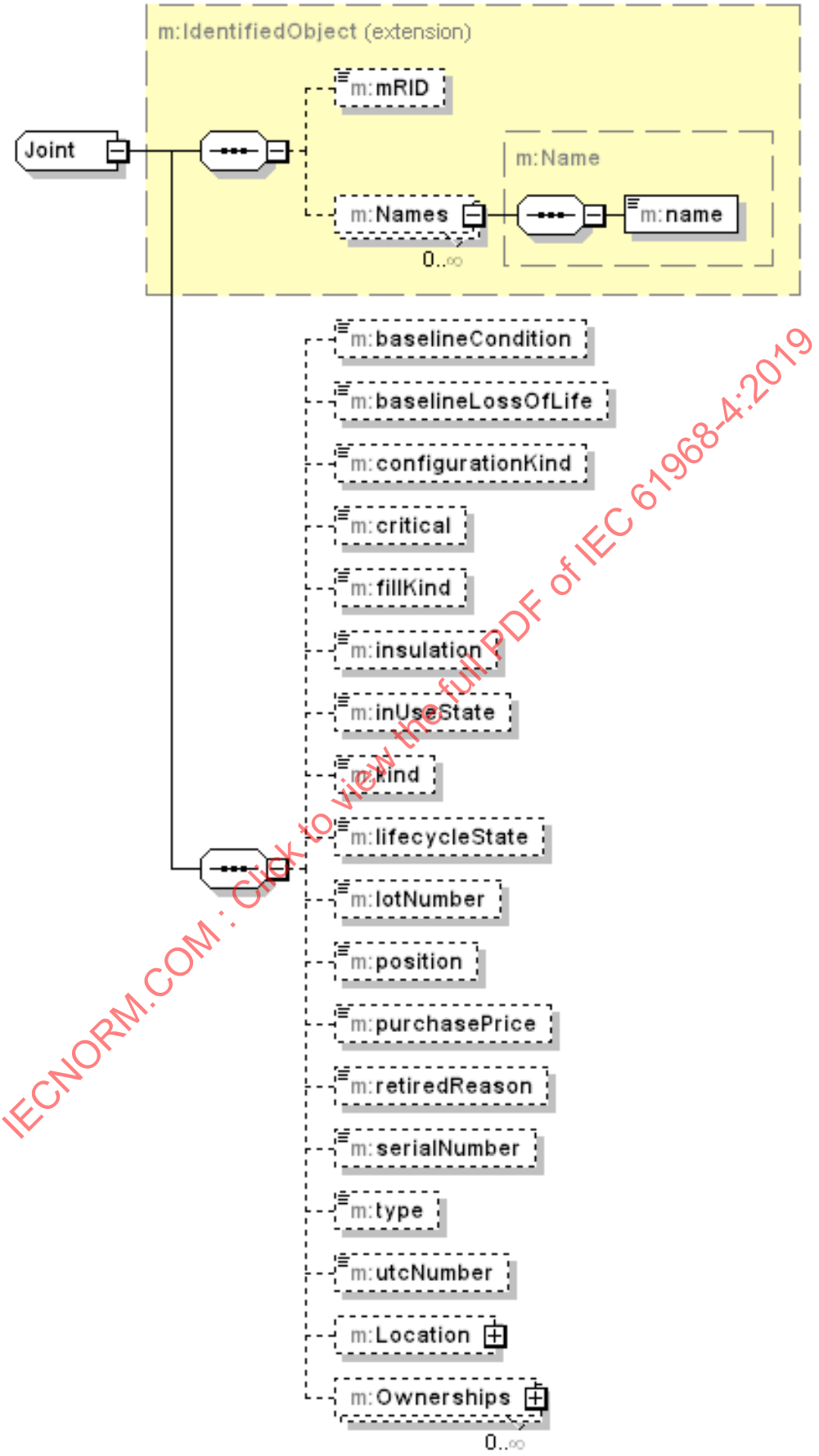


Figure 27 – Message AssetDetail: élément Joint

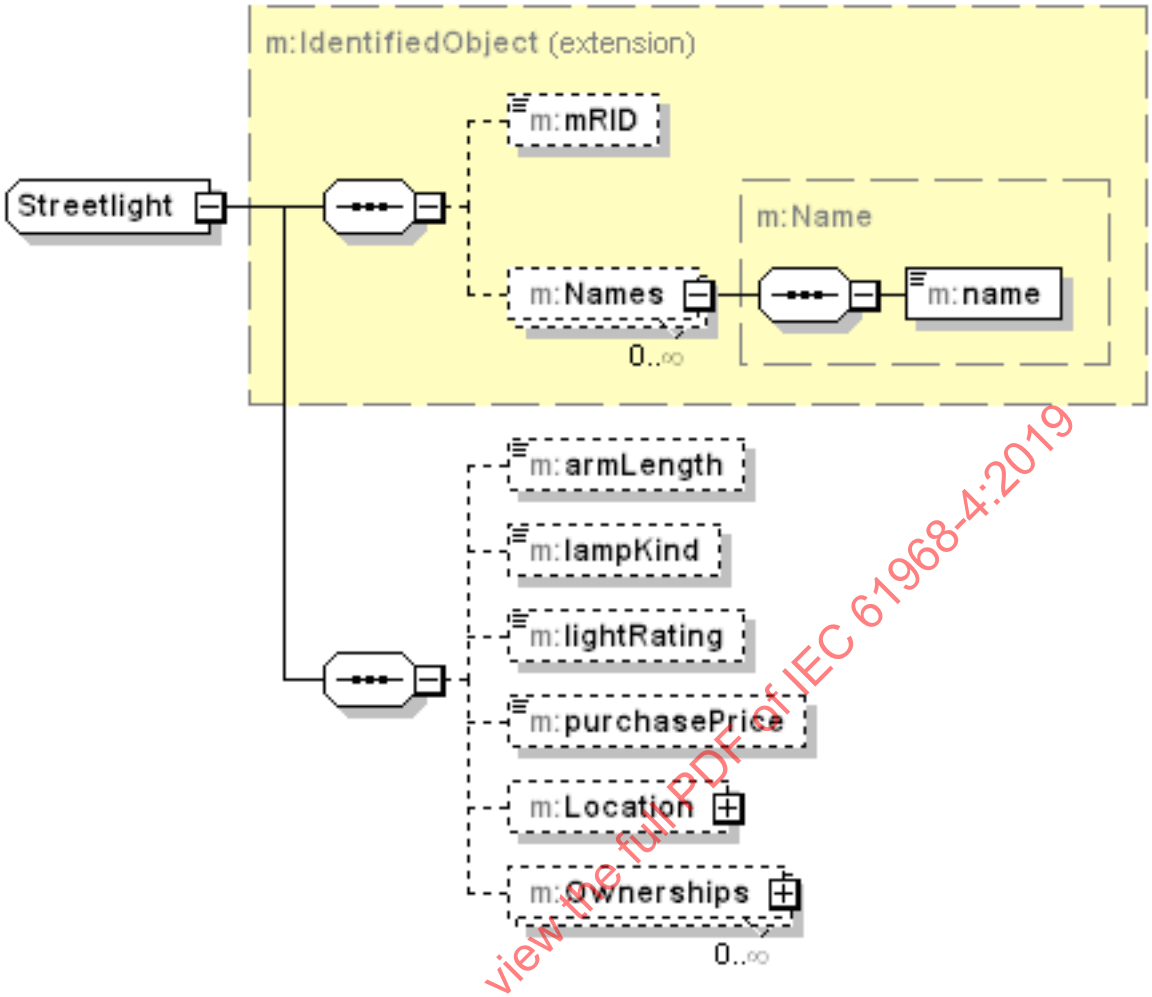


Figure 28 – Message AssetDetail: élément Streetlight

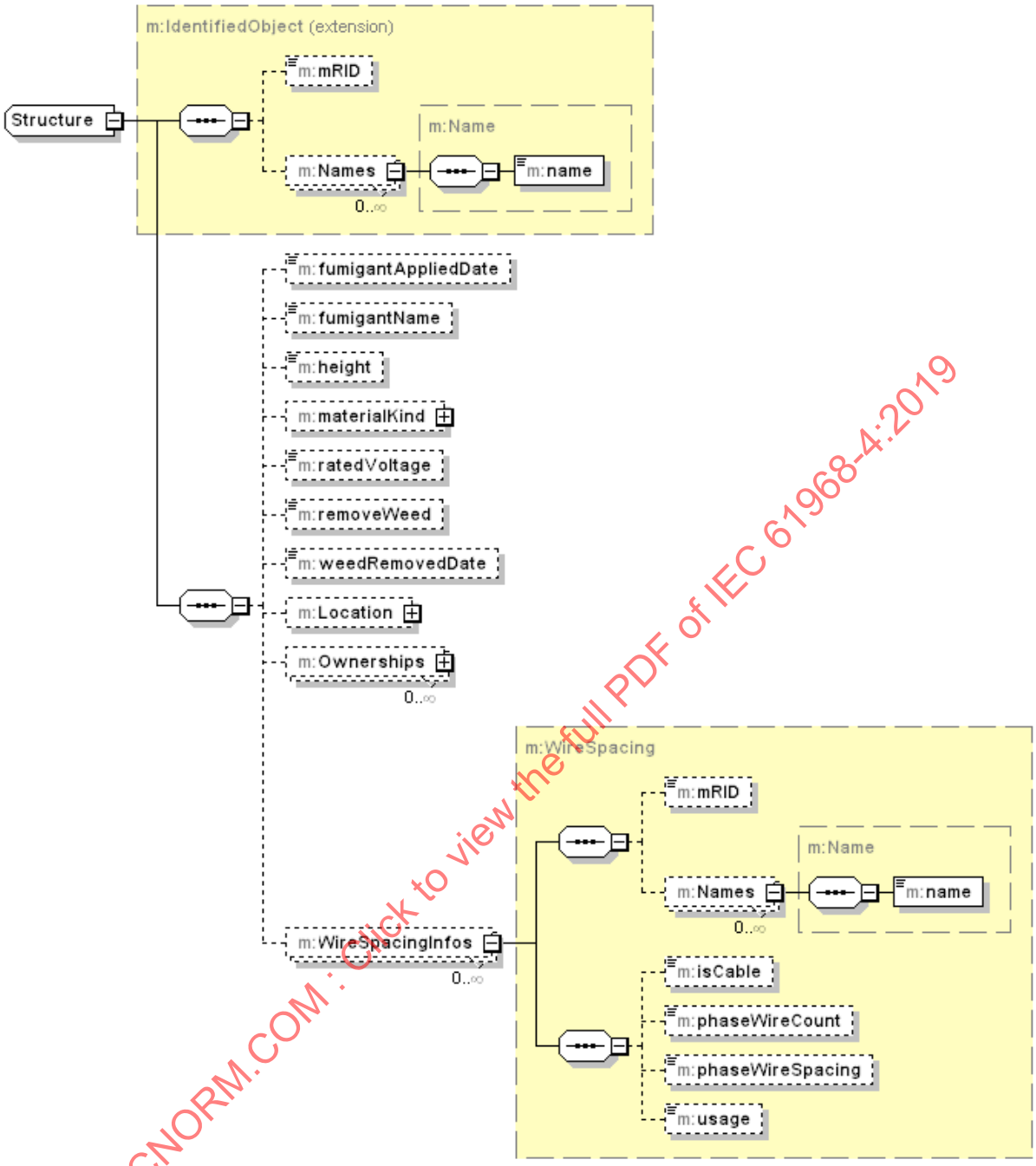


Figure 29 – Message AssetDetail: élément Structure

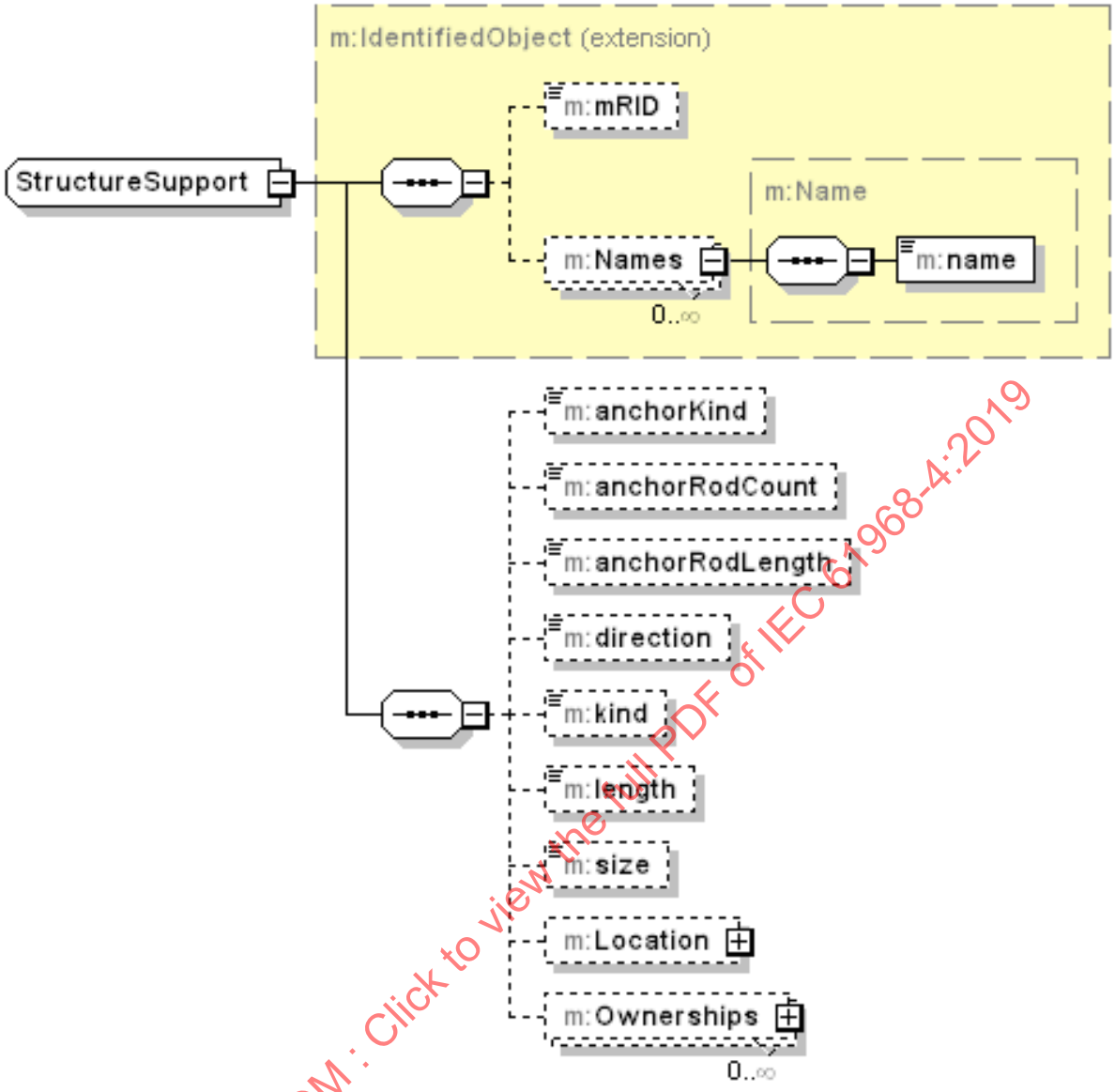


Figure 30 – Message AssetDetail: élément StructureSupport

L'exemple qui suit est un exemple XML pour un AssetDetail, qui contient les informations pour un disjoncteur au SF6 à cuve sous une tension de 550 kV.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetDetail xmlns:m="http://iec.ch/TC57/2007/AssetDetail#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/AssetDetail# AssetDetail.xsd">
      <m:Asset>
            <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            <m:baselineLossOfLife>50</m:baselineLossOfLife>
            <m:critical>true</m:critical>
            <m:kind>breakerSF6LiveTankBreaker</m:kind>
            <m:lifecycleState>inService</m:lifecycleState>
            <m:name>ElectricSomervilleCB8</m:name>
            <m:SwitchInfo>
                  <m:breakingCapacity>63000</m:breakingCapacity>
                  <m:isSinglePhase>true</m:isSinglePhase>
                  <m:isUnganged>true</m:isUnganged>
                  <m:ratedCurrent>5000</m:ratedCurrent>
                  <m:ratedFrequency>60</m:ratedFrequency>
```

```
            <m:ratedImpulseWithstandVoltage>1175000</m:ratedImpulseWithstandVolt
        age>
            <m:ratedInterruptingTime>0,033333</m:ratedInterruptingTime>
            <m:ratedVoltage>550000</m:ratedVoltage>
        </m:SwitchInfo>
        <m:Location>
            <m:mainAddress>
                <m:streetDetail>
                    <m:name>Electric</m:name>
                    <m:number>88</m:number>
                    <m:type>Avenue</m:type>
                    <m:withinTownLimits>true</m:withinTownLimits>
                </m:streetDetail>
                <m:townDetail>
                    <m:code>02144</m:code>
                    <m:country>USA</m:country>
                    <m:name>Somerville</m:name>
                    <m:stateOrProvince>Massachusetts</m:stateOrProvince>
                </m:townDetail>
            </m:mainAddress>
        </m:Location>
        <m:Ownerships>
            <m:share>100</m:share>
            <m:AssetOwner>
                <m:mRID>f5d3fc3d-041e-44c7-bda1-0c75b7c89a05</m:mRID>
                <m:Names>
                    <m:name>Grid Corporation</m:name>
                </m:Names>
            </m:AssetOwner>
        </m:Ownerships>
    </m:Asset>
</m:AssetDetail>
```

5.7 Message AssetHistory

5.7.1 Généralités

Un message AssetHistory peut contenir l'historique d'un actif, à savoir les entrées de fichier journal sur les modifications intervenues dans l'état de l'actif (Asset), ainsi que sur l'emplacement (Location) et la propriété (Ownership) d'un actif particulier. Tandis que le message AssetDetail permet d'échanger les informations usuelles sur les actifs, le message AssetHistory permet, quant à lui, d'échanger l'historique des actifs.

5.7.2 Applications

Le message AssetHistory sert à obtenir les informations historiques relatives aux actifs. Ces informations contiennent les modifications apportées aux attributs de la classe Asset, ainsi que ceux des classes associées Location et Ownership.

L'interrogation et l'obtention par un système d'analyse des actifs des informations historiques de l'actif qu'il souhaite évaluer, comme le montre la Figure 31, sont des applications courantes de ce message. Sur cette figure, un système d'analyse des actifs demande à un système d'inventaire du réseau et des postes de trouver les informations historiques relatives au bien concerné.

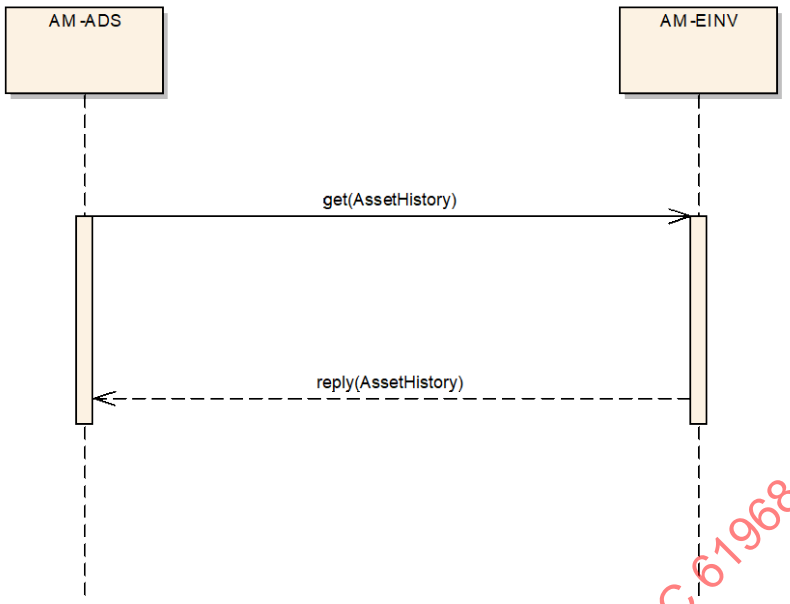


Figure 31 – Échange de messages AssetHistory

5.7.3 Format du message

La Figure 32 représente le format de message AssetHistory. La charge utile du message indiquée sur la figure consiste en un Asset identifié de manière unique par mRID. Les objets ConfigurationEvent au sein de l'Asset sont des enregistrements de fichier journal dans une information concernant l'Asset. La chronologie des informations référencées est donnée par le ConfigurationEvent qui y fait référence, par exemple ConfigurationEvent.effectiveDateTime désigne l'information de date et d'heure DateTime qui commence lorsque les informations contenues étaient valides.

Les objets ActivityRecord (Figure 33) et FailureEvent (Figure 34) peuvent aussi être donnés au sein de l'Asset afin d'acheminer les activités et échecs pertinents. L'objet Author (Figure 35) donne des informations relatives à la personne ayant relevé l'événement.

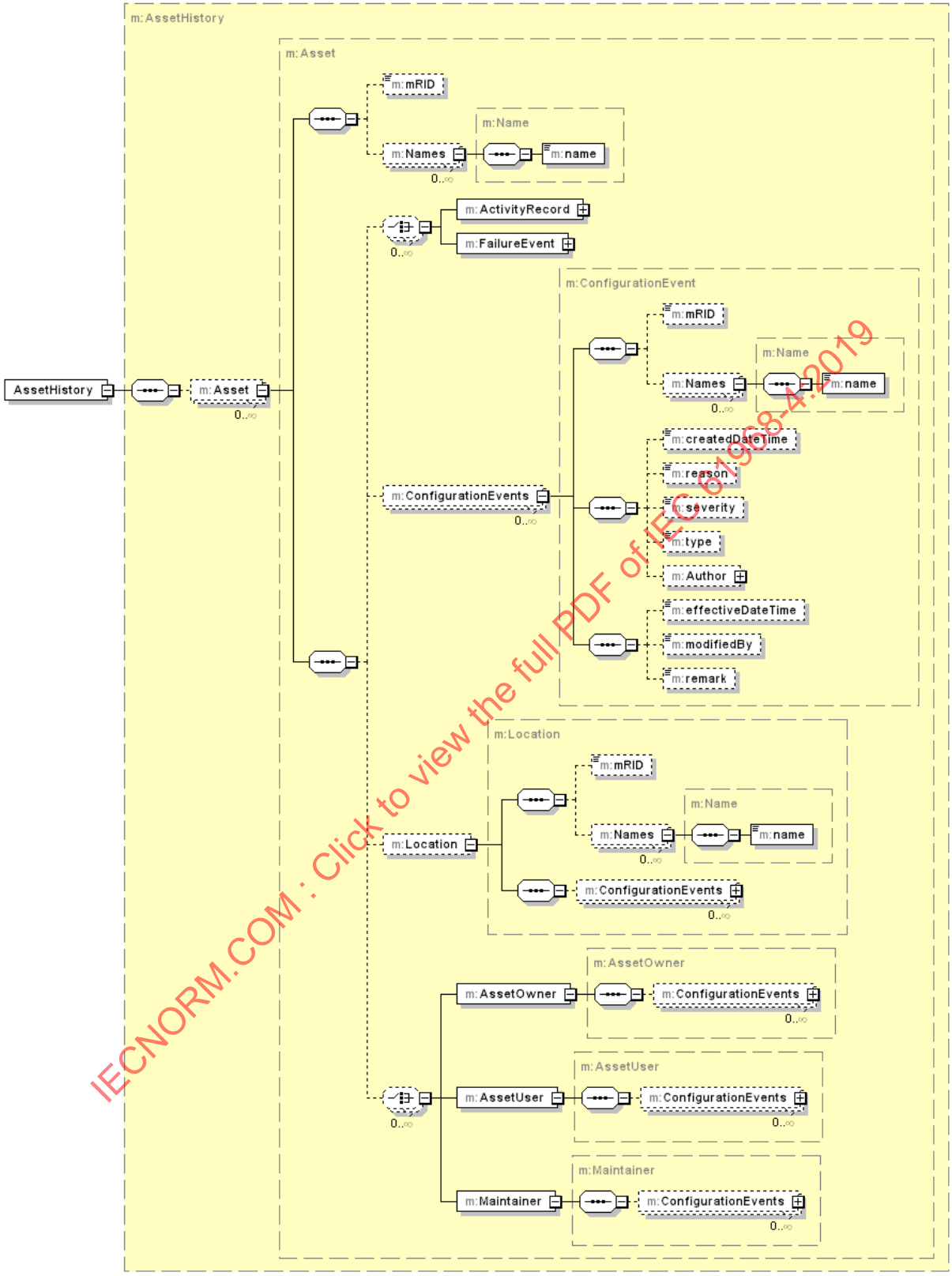


Figure 32 – Format de message AssetHistory

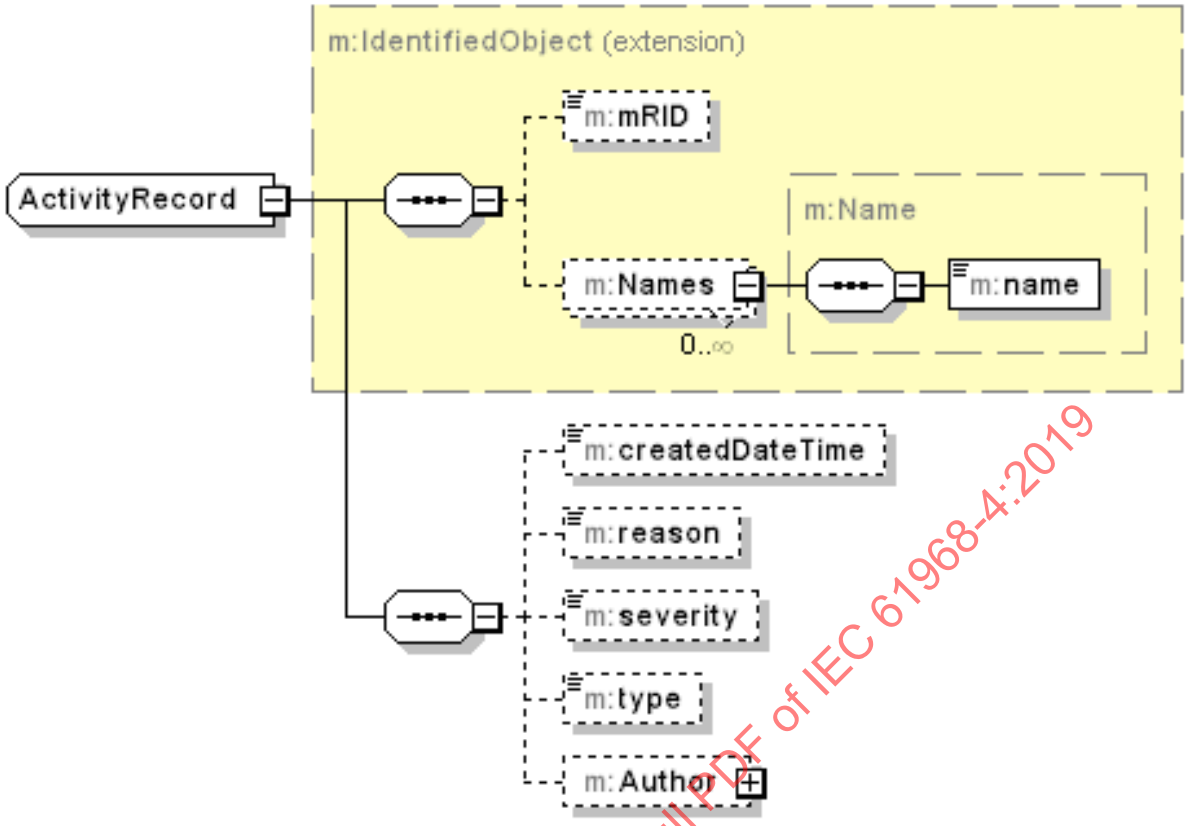


Figure 33 – Message AssetHistory: élément ActivityRecord

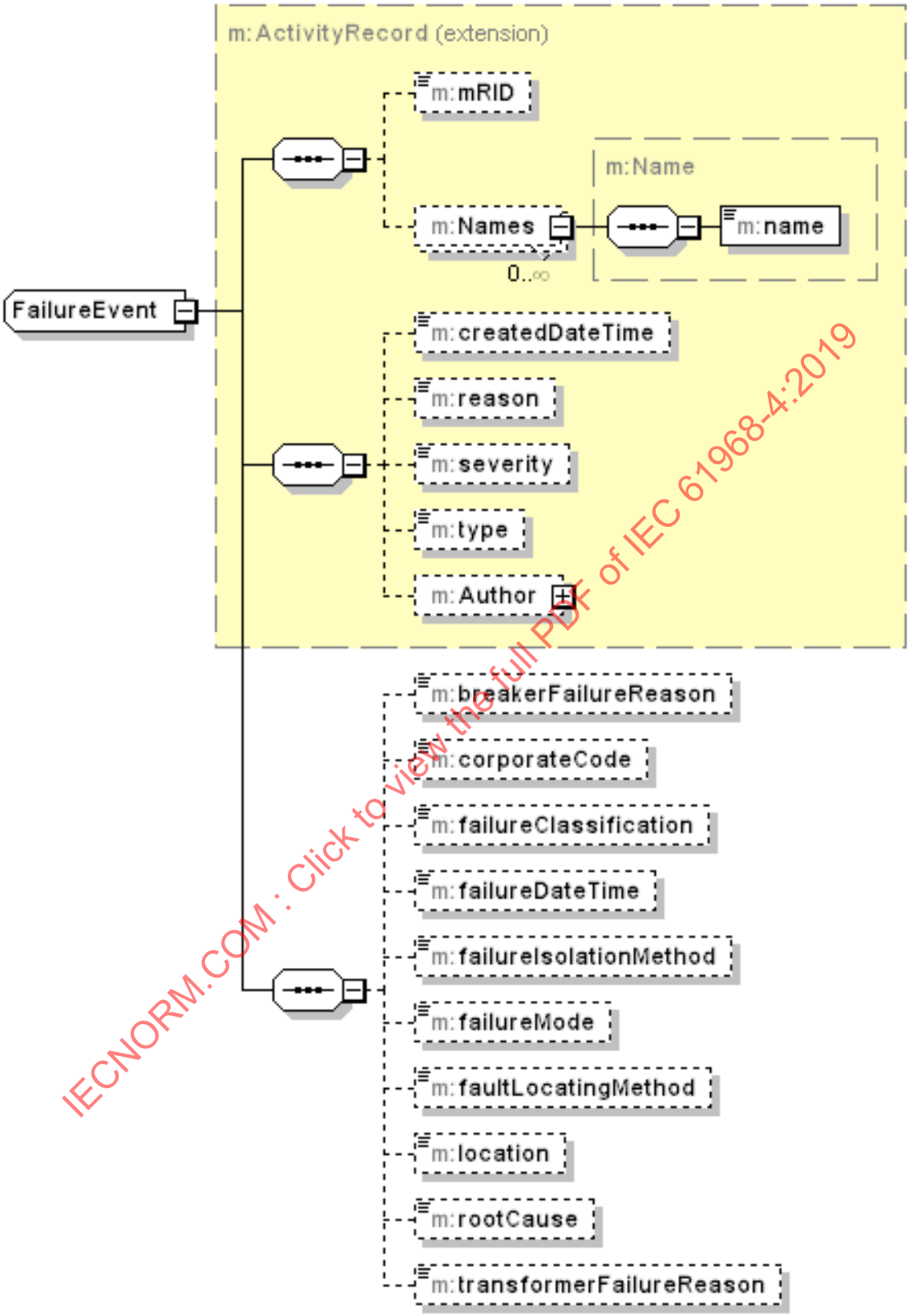


Figure 34 – Message AssetHistory: élément FailureEvent

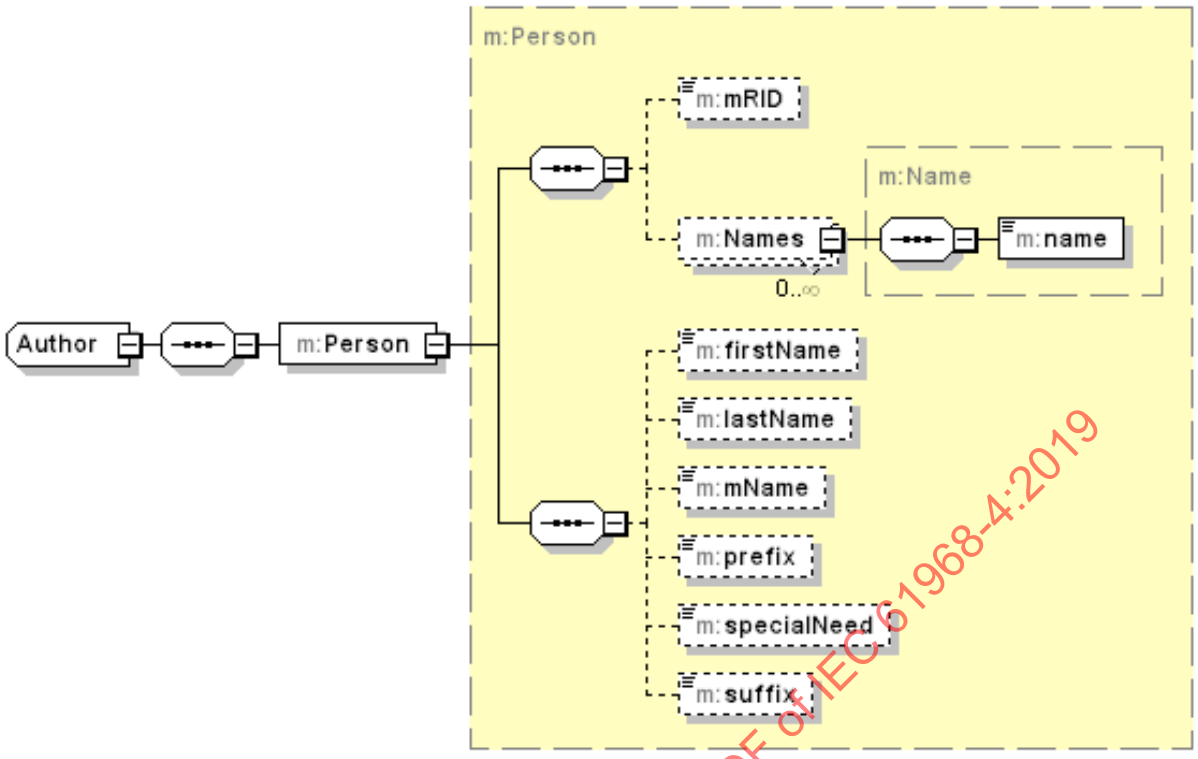


Figure 35 – Message AssetHistory: élément Author

L'exemple qui suit est un exemple XML pour un AssetHistoryLog, qui présente l'Asset modifié pour devenir important en 2004 à l'initiative du responsable de la protection des infrastructures importantes (CIP, Critical Infrastructure Protection) et le baselineLossOfLife passant à 28 % et à 40 % en 2007 et 2011, respectivement, à l'initiative du gestionnaire des actifs (Asset Manager). Les rôles de CIP Manager et d'Asset Manager sont donnés à titre d'example afin d'illustrer l'emploi de ce message.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetHistory xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetHistory.xsd">
      <m:Asset>
            <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            <m:ConfigurationEvents>
                  <m:createdDateTime>2004-12-17T09:30:47Z</m:createdDateTime>
                  <m:effectiveDateTime>2004-12-17T09:30:47Z</m:effectiveDateTime>
                  <m:modifiedBy>CIP Manager</m:modifiedBy>
                  <m:reason>critical changed from false to true</m:reason>
            </m:ConfigurationEvents>
            <m:ConfigurationEvents>
                  <m:createdDateTime>2007-02-15T11:21:07Z</m:createdDateTime>
                  <m:effectiveDateTime>2007-02-15T11:21:07Z</m:effectiveDateTime>
                  <m:modifiedBy>Asset Manager</m:modifiedBy>
                        <m:reason>baselineLossOfLife changed from 10 to 28</m:reason>
            </m:ConfigurationEvents>
            <m:ConfigurationEvents>
                  <m:createdDateTime>2011-02-10T08:32:40Z</m:createdDateTime>
                  <m:effectiveDateTime>20011-02-10T08:32:40Z</m:effectiveDateTime>
                  <m:modifiedBy>Asset Manager</m:modifiedBy>
                  <m:reason>baselineLossOfLife changed from 28 to 40</m:reason>
            </m:ConfigurationEvents>
      </m:Asset>
</m:AssetHistory>
```

5.8 AssetWorkHistory

5.8.1 Généralités

Un message AssetWorkHistory peut contenir l'historique du fonctionnement des actifs concernés. Ces informations sont précieuses, par exemple pour estimer l'état d'un actif ou pour générer des rapports de conformité.

5.8.2 Applications

Le message AssetWorkHistory sert à échanger le fonctionnement ayant été constaté préalablement sur un ou plusieurs actifs. L'interrogation et l'obtention par un système d'analyse des actifs de l'historique de fonctionnement disponible des actifs qu'il souhaite évaluer, comme le montre la Figure 36, sont des applications courantes de ce message. De telles données peuvent indiquer l'état de l'actif et, par conséquent, elles sont précieuses pour la gestion des actifs. Sur la Figure 36, un système d'analyse des actifs demande à un système de maintenance et d'inspection de trouver l'historique de fonctionnement relatif aux actifs concernés.

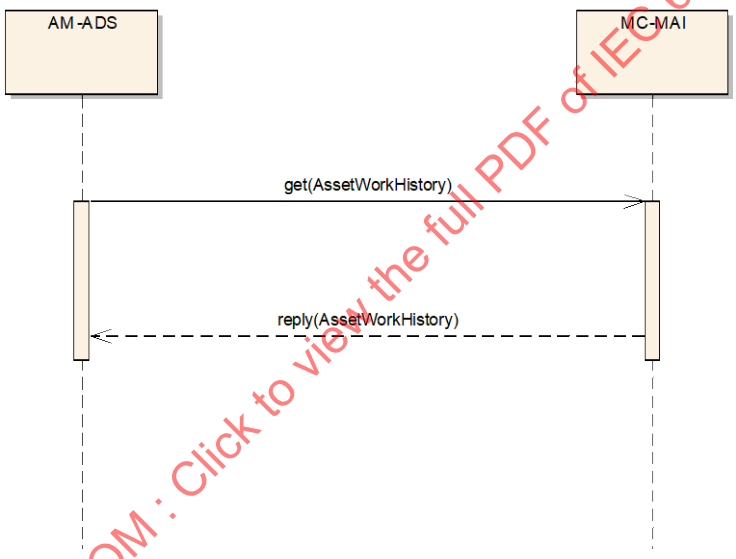


Figure 36 – Échange de messages AssetWorkHistory

5.8.3 Format du message

La Figure 37 représente le format du message AssetWorkHistory. L'élément racine de ce message est Asset. Il peut y avoir une multiplicité d'objets Asset, qui peuvent contenir une multiplicité de WorkTasks relatives à cet Asset particulier. Les détails du WorkTask pertinent sont donnés à la Figure 38, ceux du MaintenanceWorkTask sont donnés à la Figure 39, et ceux du RepairWorkTask sont donnés à la Figure 40.

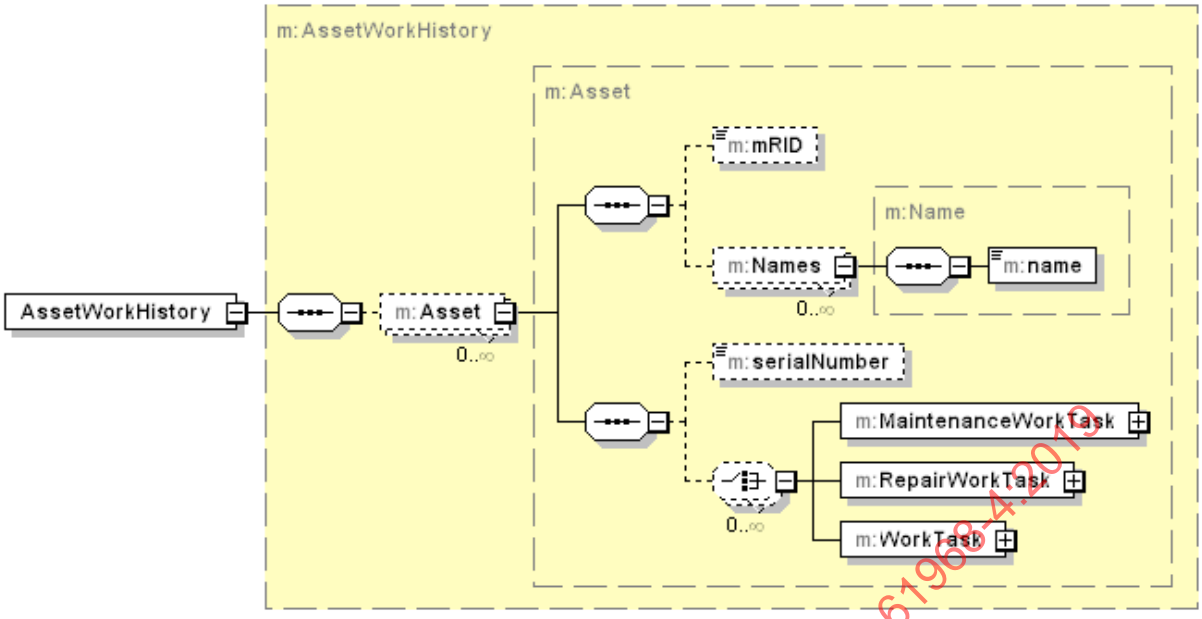


Figure 37 – Format de message AssetWorkHistory

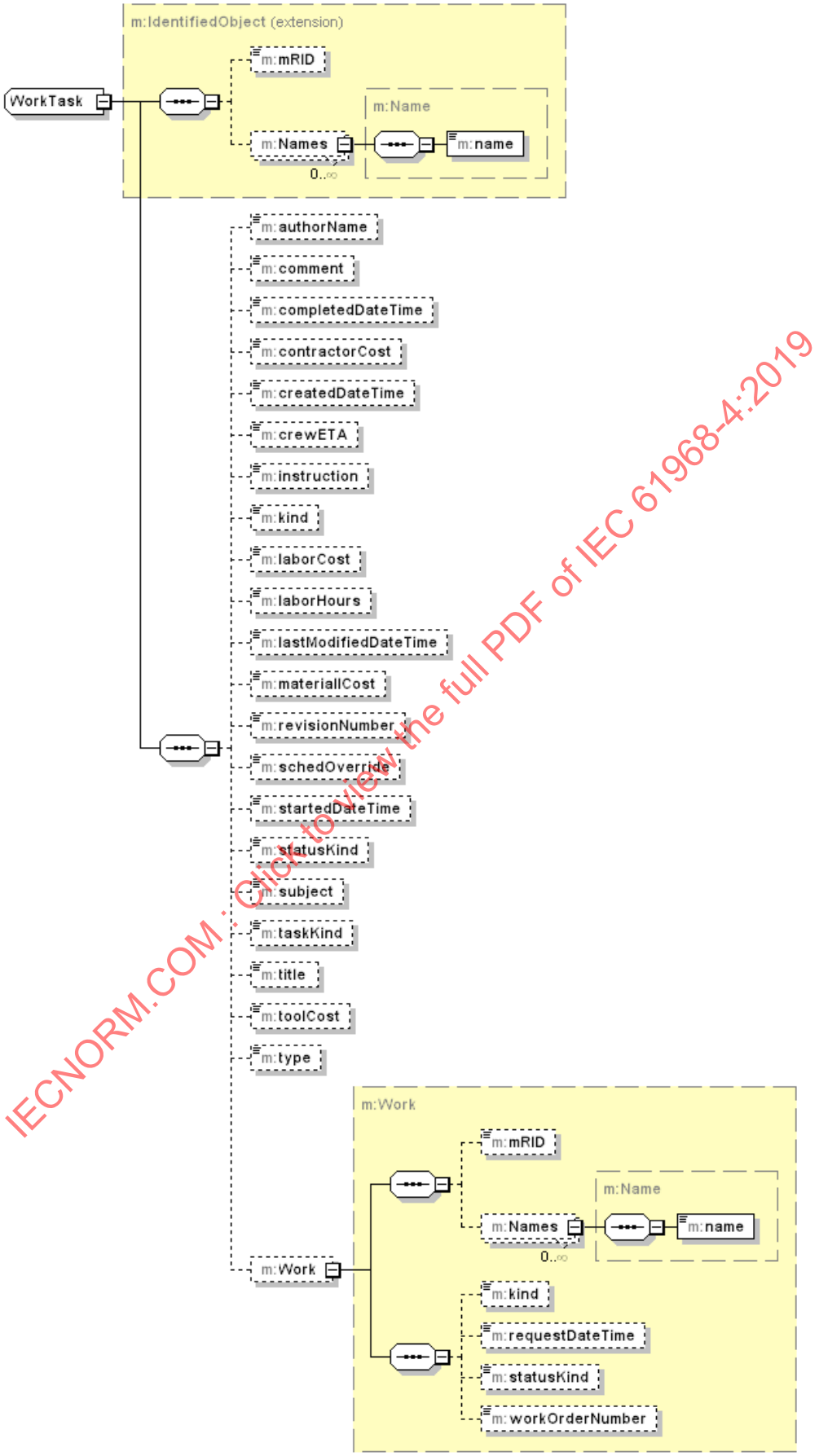


Figure 38 – Message AssetWorkHistory: élément WorkTask

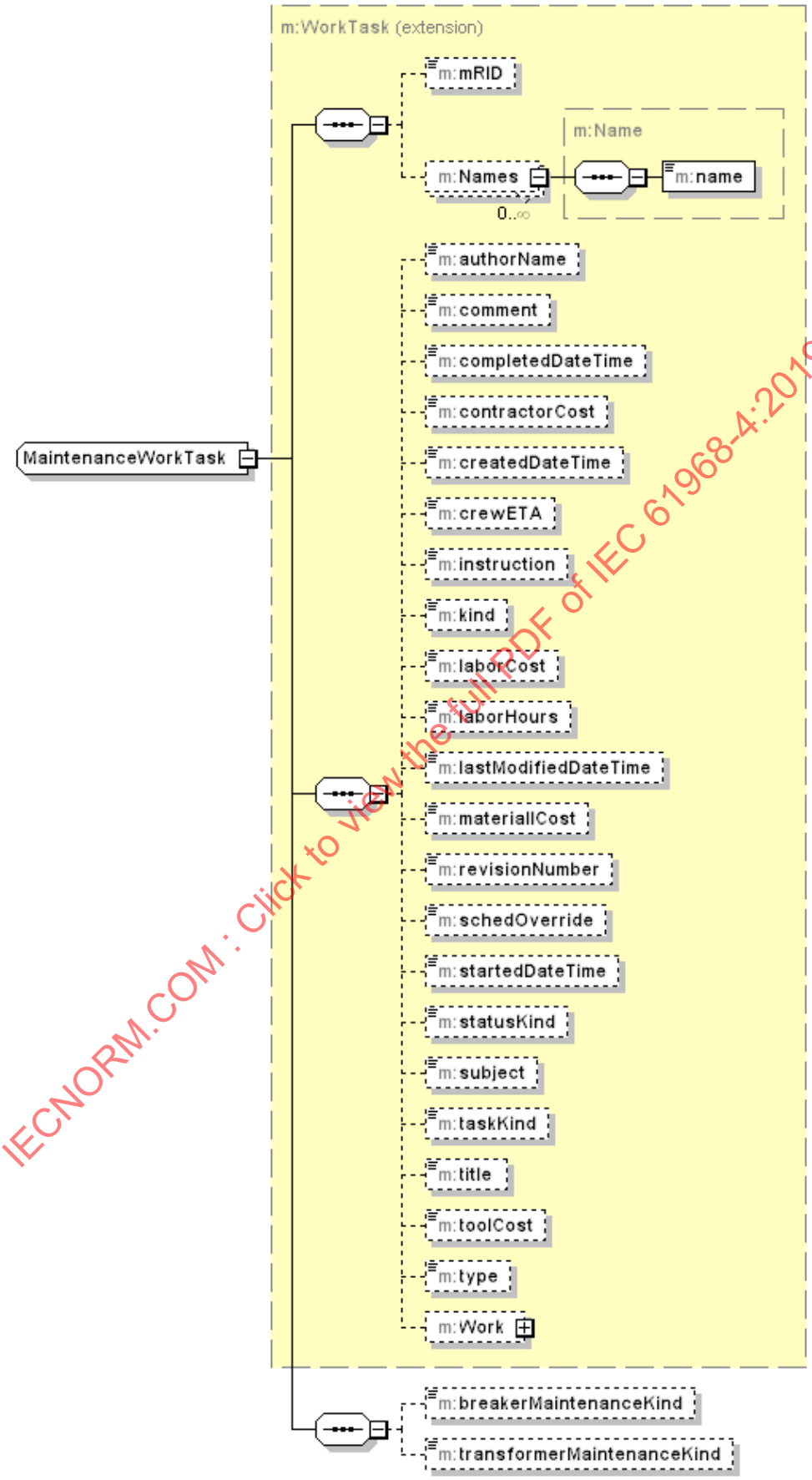


Figure 39 – Message AssetWorkHistory: élément MaintenanceWorkTask

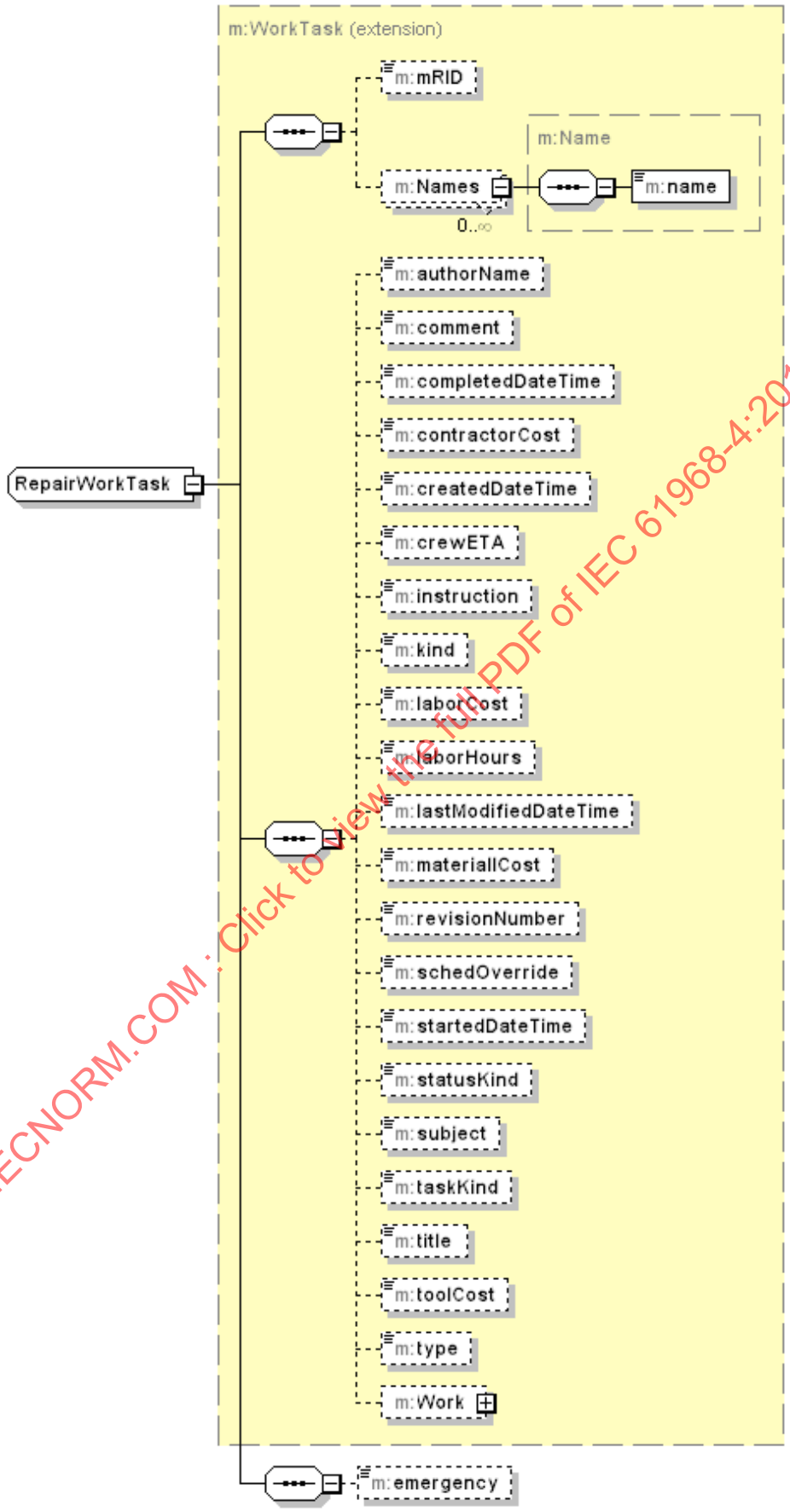


Figure 40 – Message AssetWorkHistory: élément RepairWorkTask

Un plan XML précis est donné en Annexe B. L'exemple qui suit est un exemple XML pour une charge utile de message AssetWorkHistory.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetWorkHistory xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetWorkHistory.xsd">
      <m:Asset>
            <m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
            <m:WorkTasks>
                  <m:createdDateTime>2015-12-17T09:30:47Z</m:createdDateTime>
                  <m:instruction>Check the warning alert from bushing
monitor</m:instruction>
                  <m:taskKind>investigate</m:taskKind>
            </m:WorkTasks>
            <m:WorkTasks>
                  <m:createdDateTime>2015-11-15T11:05:00Z</m:createdDateTime>
                  <m:instruction>Replace the main oil tank temperature transducer that is
acting unreliable</m:instruction>
                  <m:taskKind>exchange</m:taskKind>
            </m:WorkTasks>
      </m:Asset>
</m:AssetWorkHistory>
```

5.9 Message AssetPSRDetails

5.9.1 Généralités

Un message AssetPSRDetails peut contenir les informations relatives à l'état d'un actif, dans l'état dans lequel il est sur le terrain. Ces informations sont précieuses pour échanger l'état actuel des actifs dans un but de sensibilisation en fonction des situations, par exemple pour récupérer l'état conforme de l'actif afin de le comparer et d'apporter des corrections à son état à la conception.

5.9.2 Applications

Le message AssetPSRDetails sert à échanger des informations relatives à l'état actuel d'un ou plusieurs actifs. L'interrogation par un système d'inventaire géographique du système de surveillance du réseau, en vue d'obtenir des informations sur l'état actuel de l'actif, comme le montre la Figure 41, de manière qu'il puisse être mis à la disposition du personnel de gestion des actifs, est une application courante de ce message. Dans cette application, le système de surveillance du réseau peut également acheminer toutes les modifications de l'état de l'actif, telles que le fait de changer un interrupteur de l'état normalement ouvert à l'état normalement fermé en raison de commutations saisonnières, dans la mesure où de telles modifications se produisent. Comme le montre la Figure 42, une autre application de ce message est l'acheminement par le système d'inventaire géographique de l'état conforme du bien vers un système de surveillance du réseau, étant donné que cet état conforme peut être différent de sa description à la conception dans le système de surveillance du réseau.

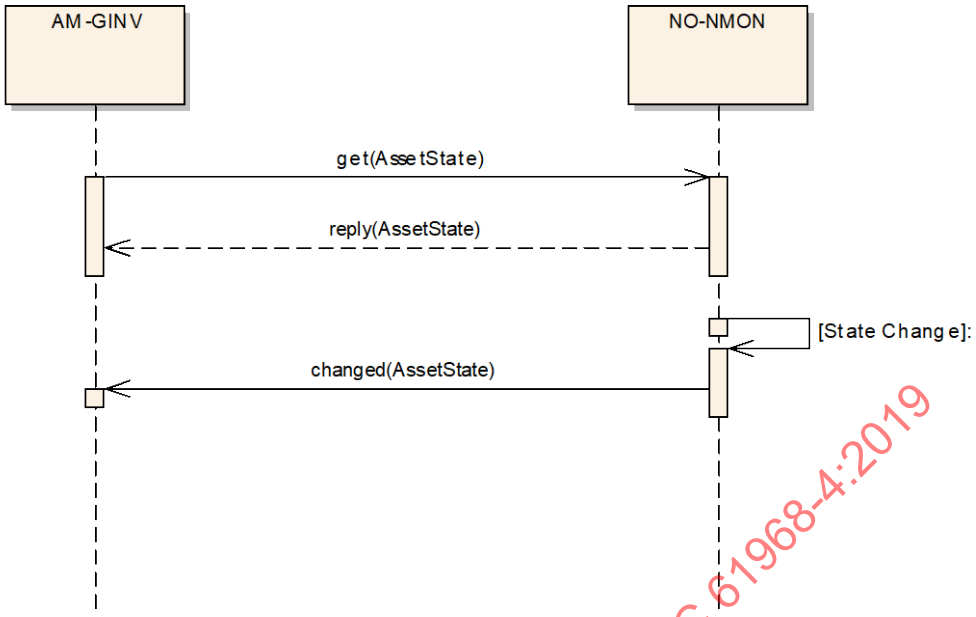


Figure 41 – Échange 1 de messages AssetPSRDetails

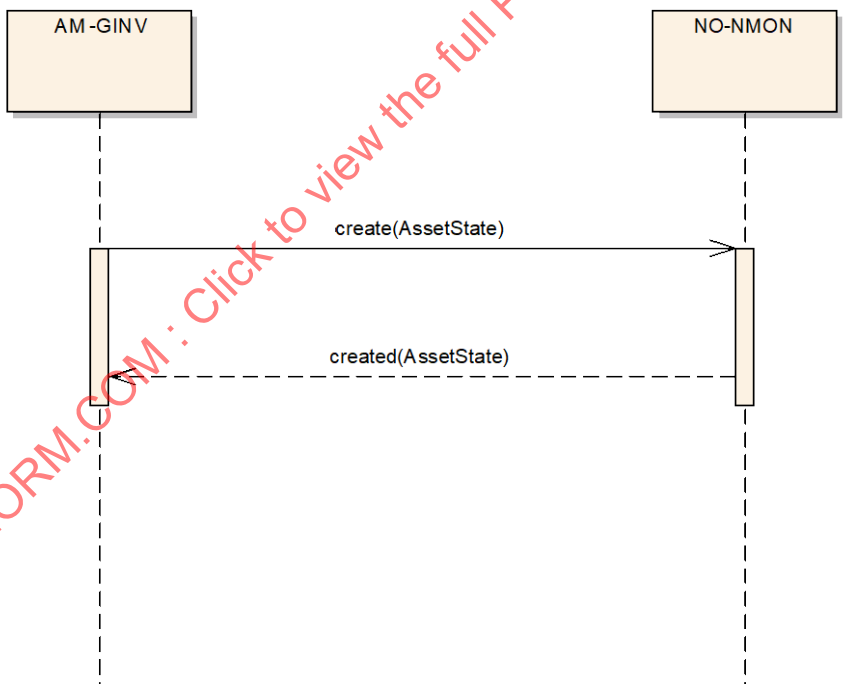


Figure 42 – Échange 2 de messages AssetPSRDetails

5.9.3 Format du message

La Figure 43 représente le format de message AssetState. L'élément racine de ce message est Asset. Il peut y avoir une multiplicité d'objets Asset, ceux-ci pouvant contenir un ou plusieurs objets de type PowerSystemResource (Conductor, EnergyConsumer, etc.). Ces objets contenus donnent des informations sur l'état du réseau relatives à l'Asset. Les éléments du type PowerSystemResource qui peuvent être contenus par l'élément Asset du message AssetState sont représentés de la Figure 44 à la Figure 67.

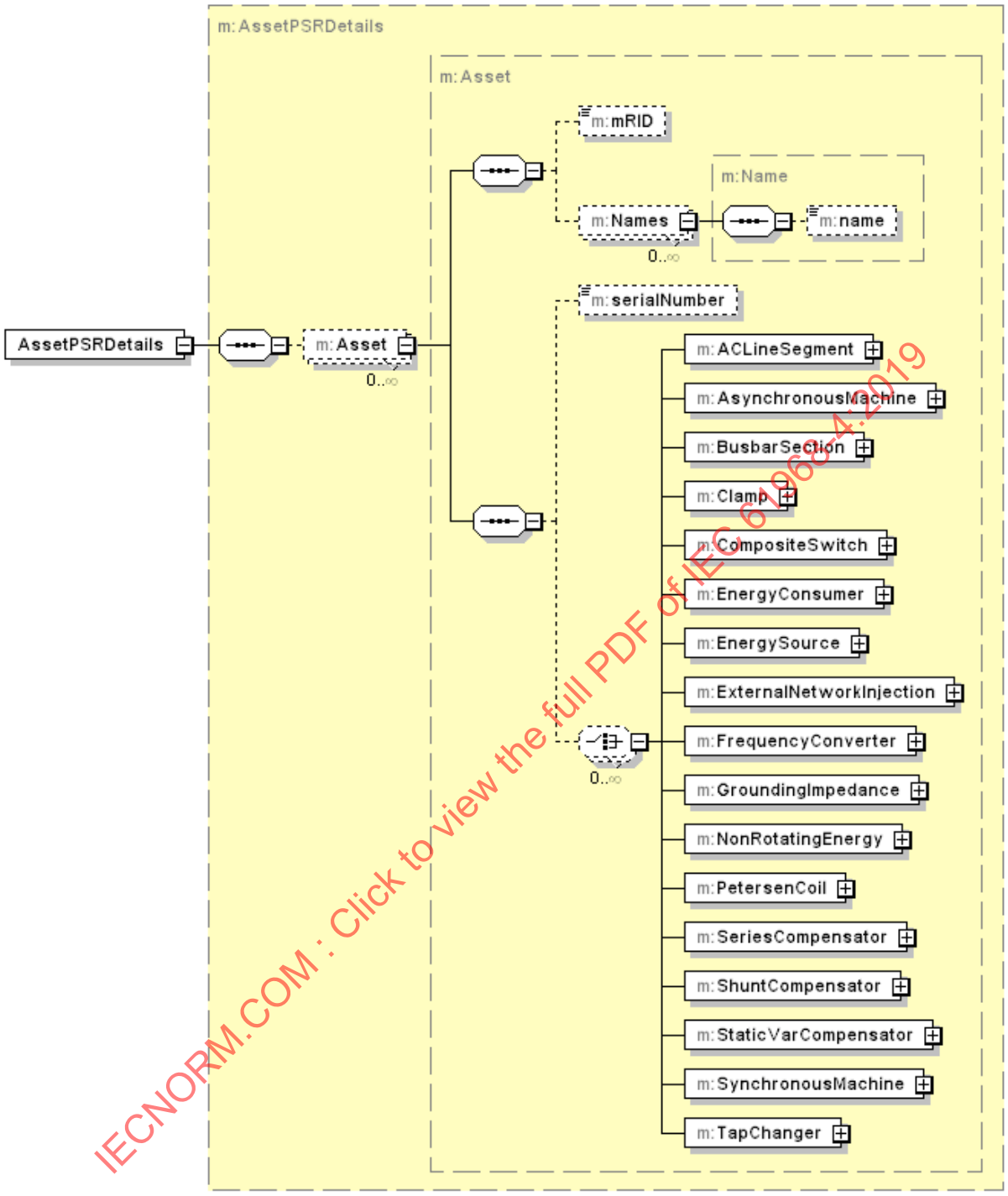


Figure 43 – Format de message AssetPSRDetails

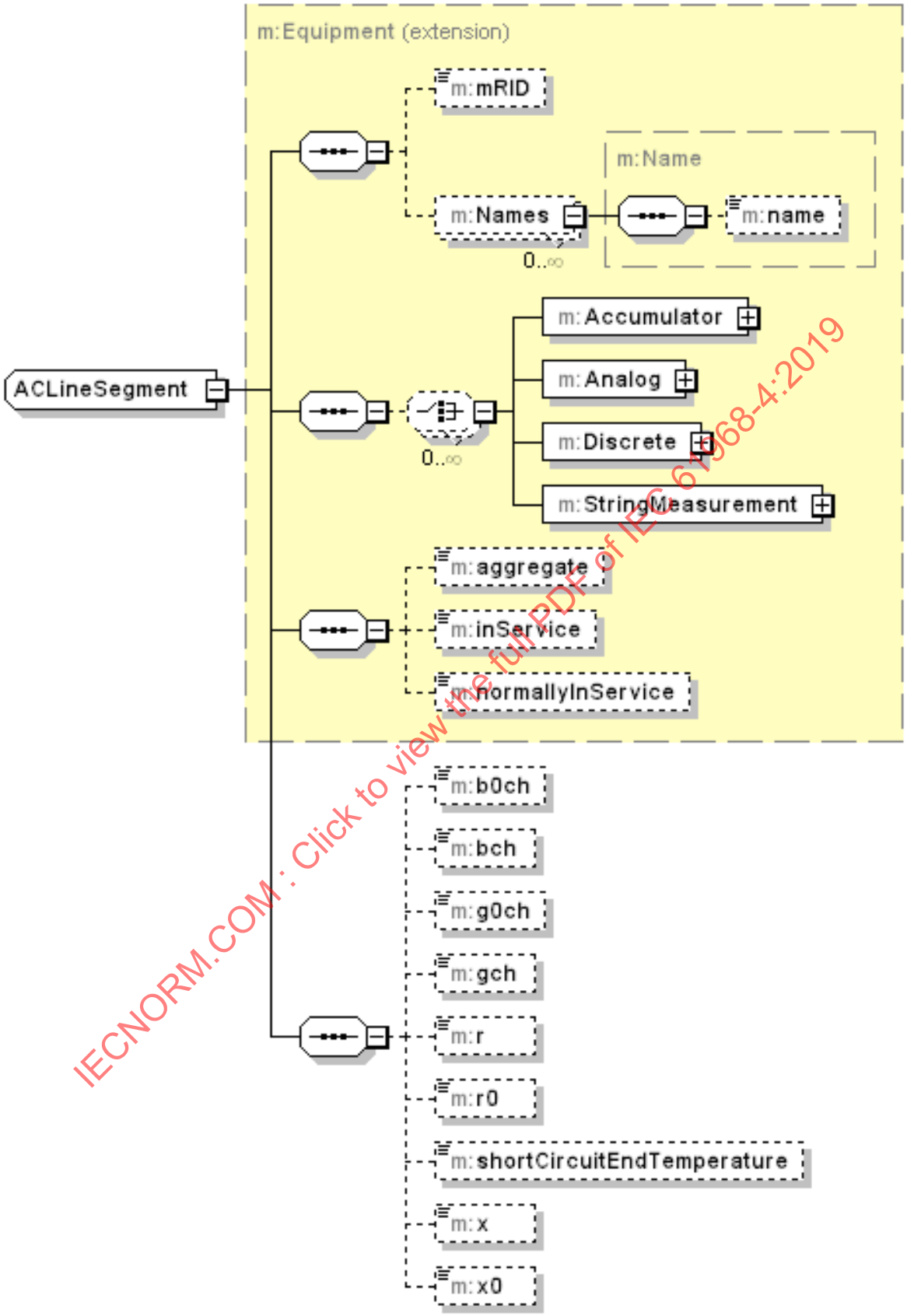


Figure 44 – Message AssetPSRDetails: élément ACLineSegment

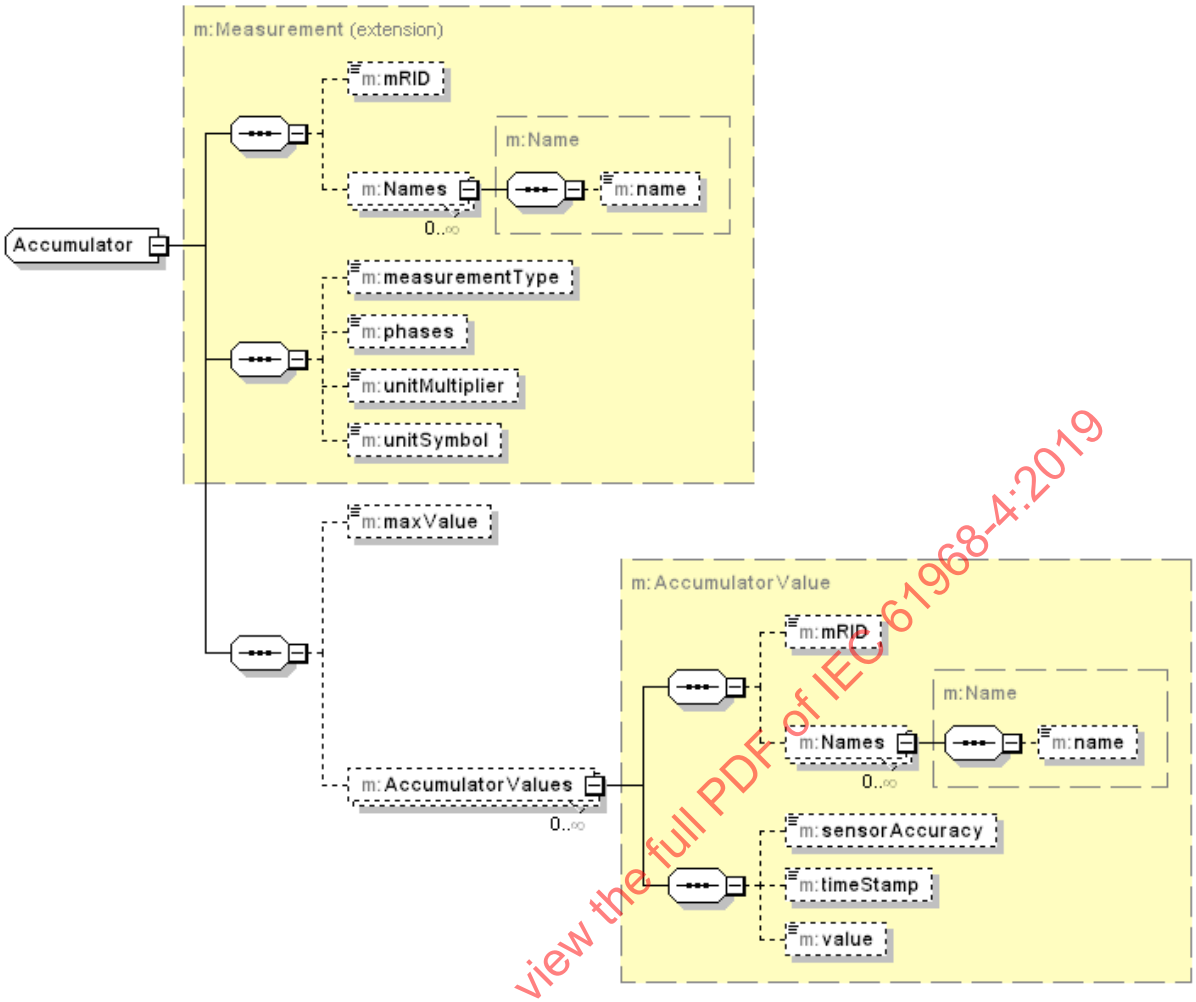


Figure 45 – Message AssetPSRDetails: élément Accumulator

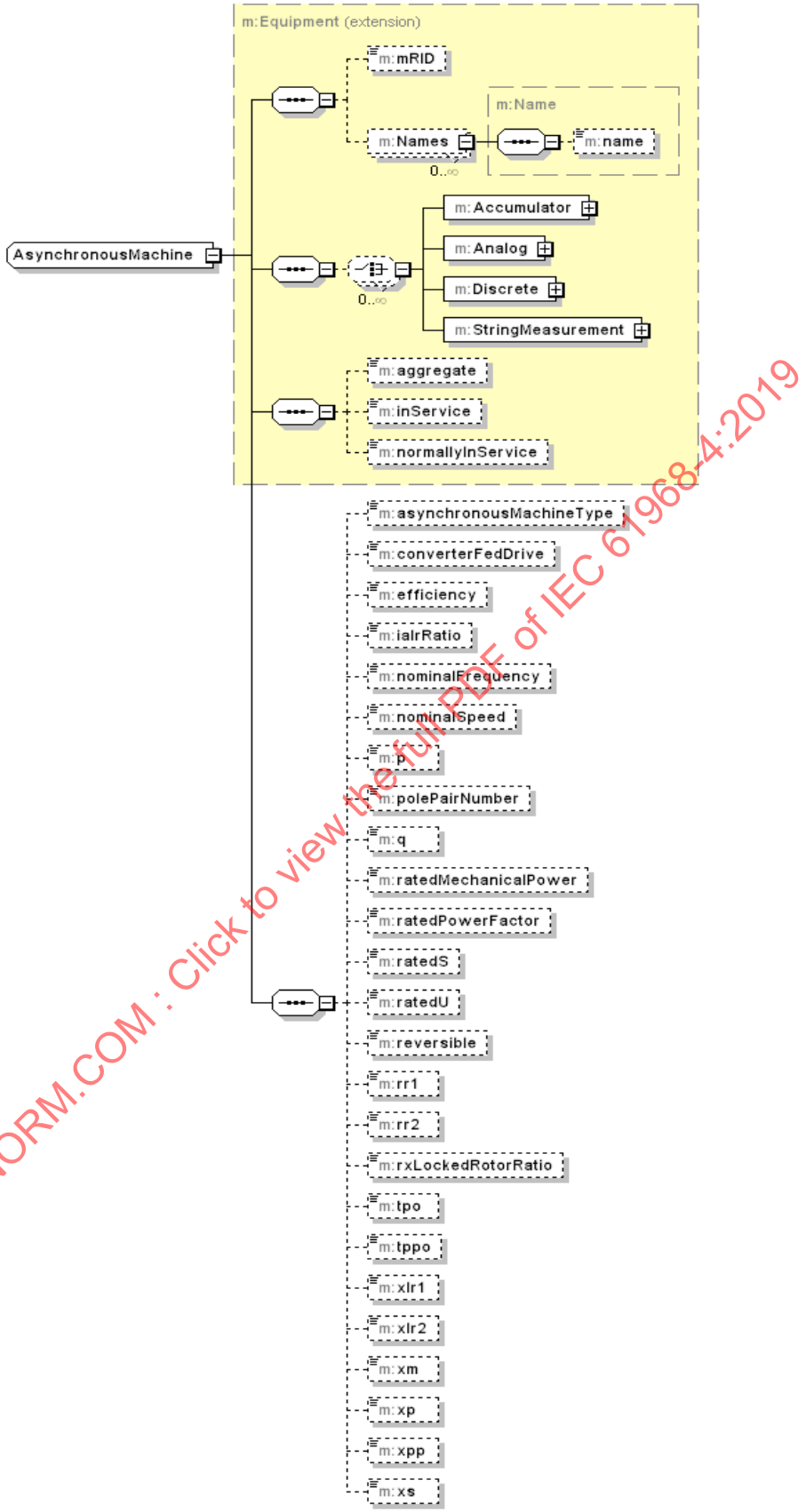


Figure 46 – Message AssetPSRDetails: élément AsynchronousMachine

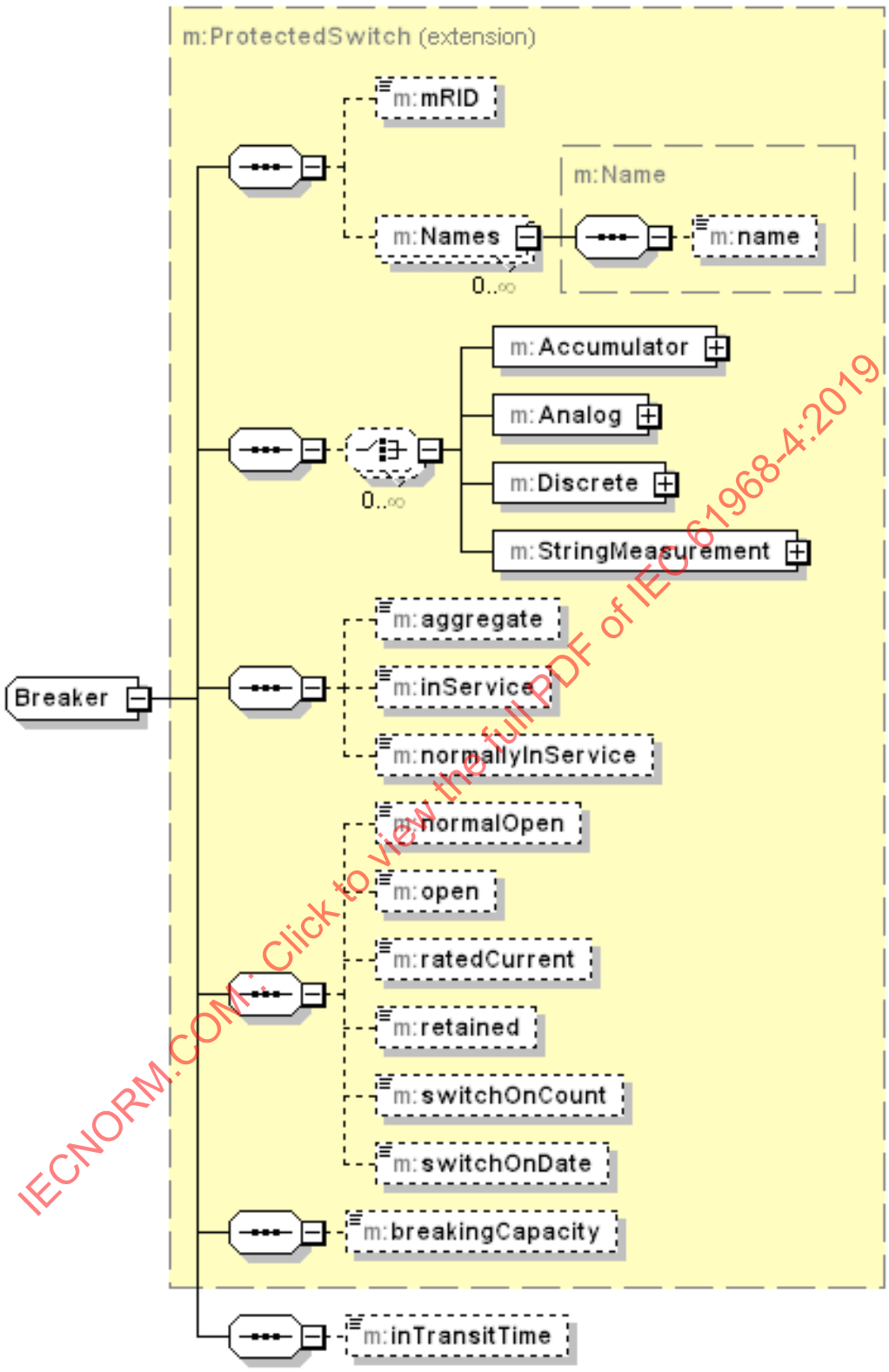


Figure 47 – Message AssetPSRDetails: élément Breaker

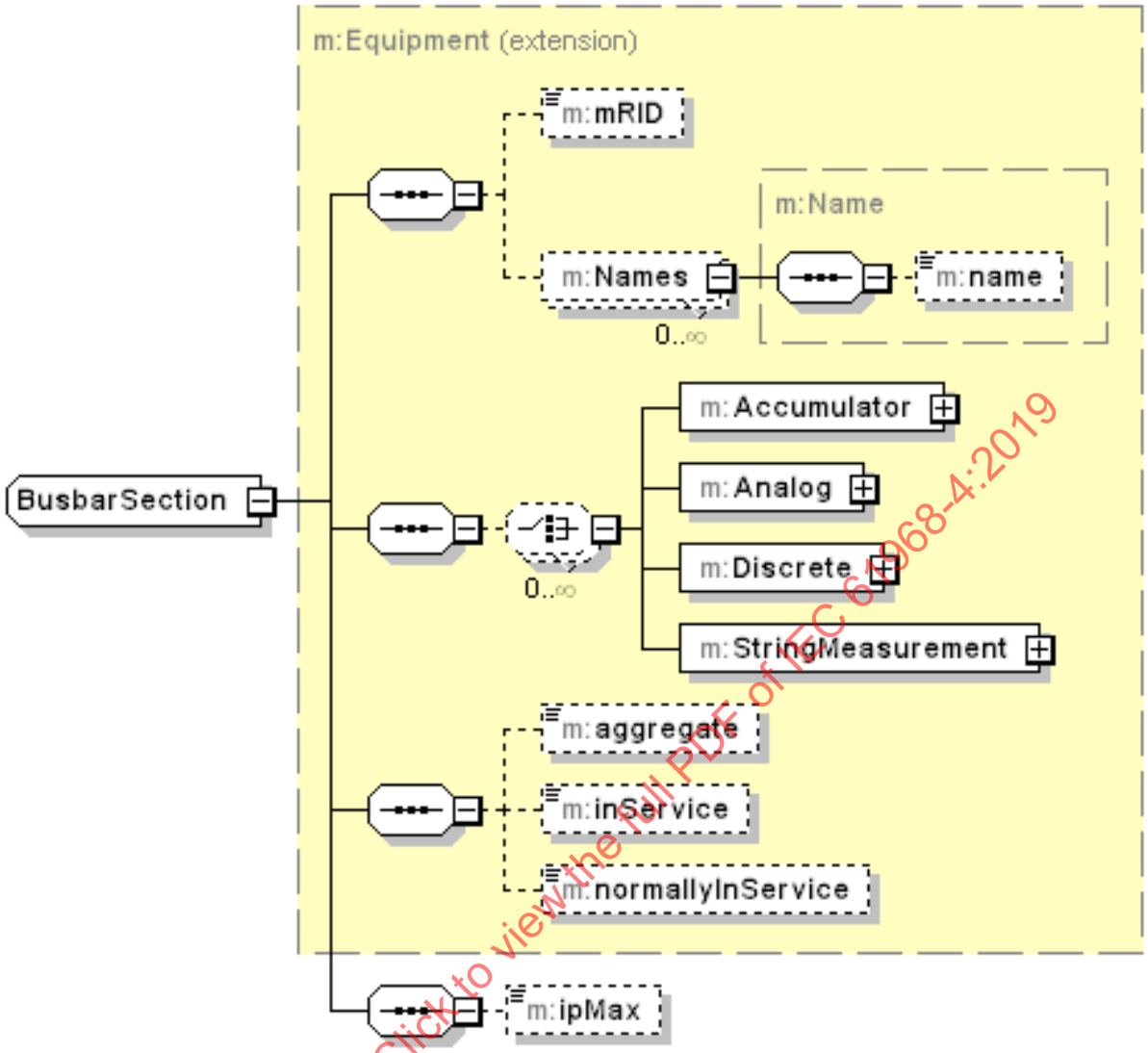


Figure 48 – Message AssetPSRDetails: élément BusbarSection

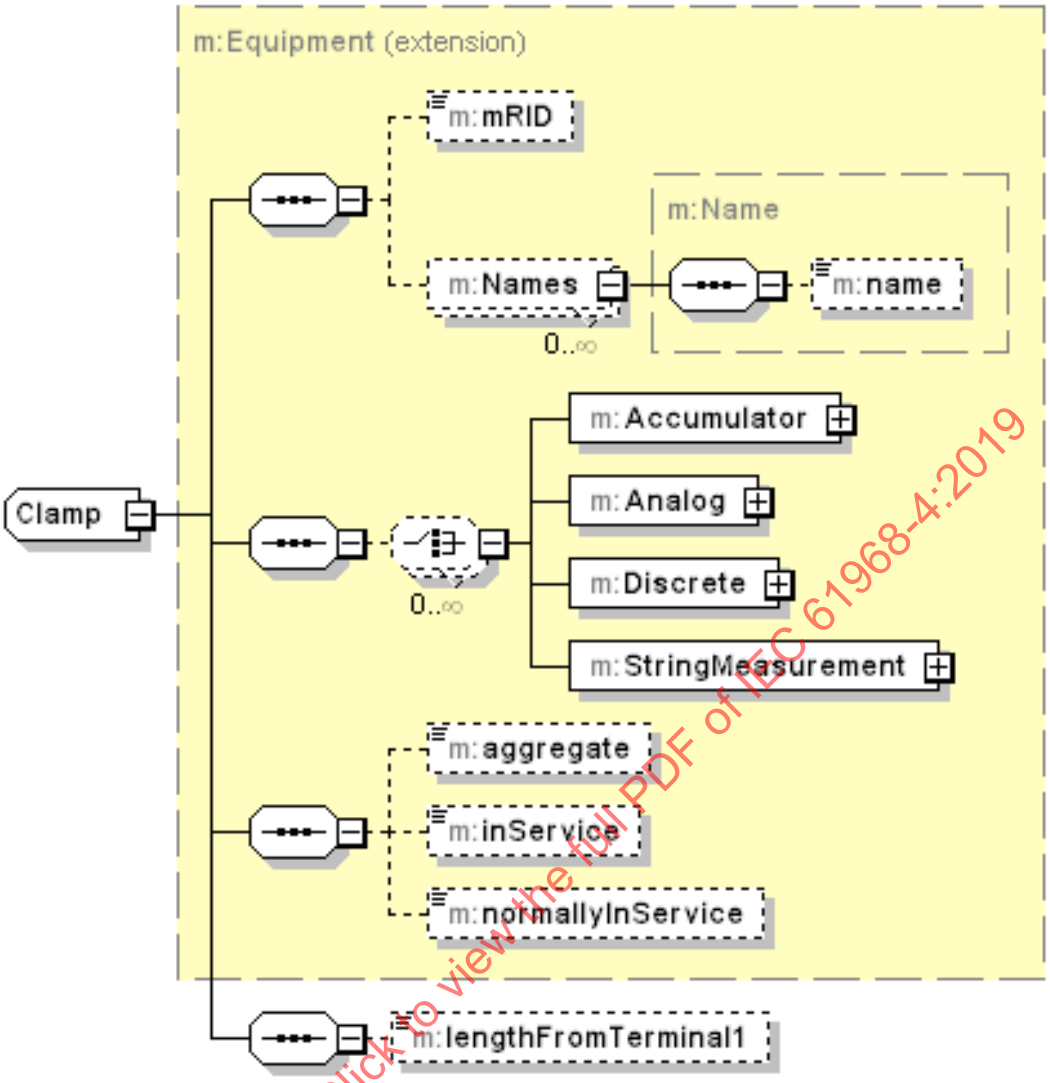


Figure 49 – Message AssetPSRDetails: élément Clamp

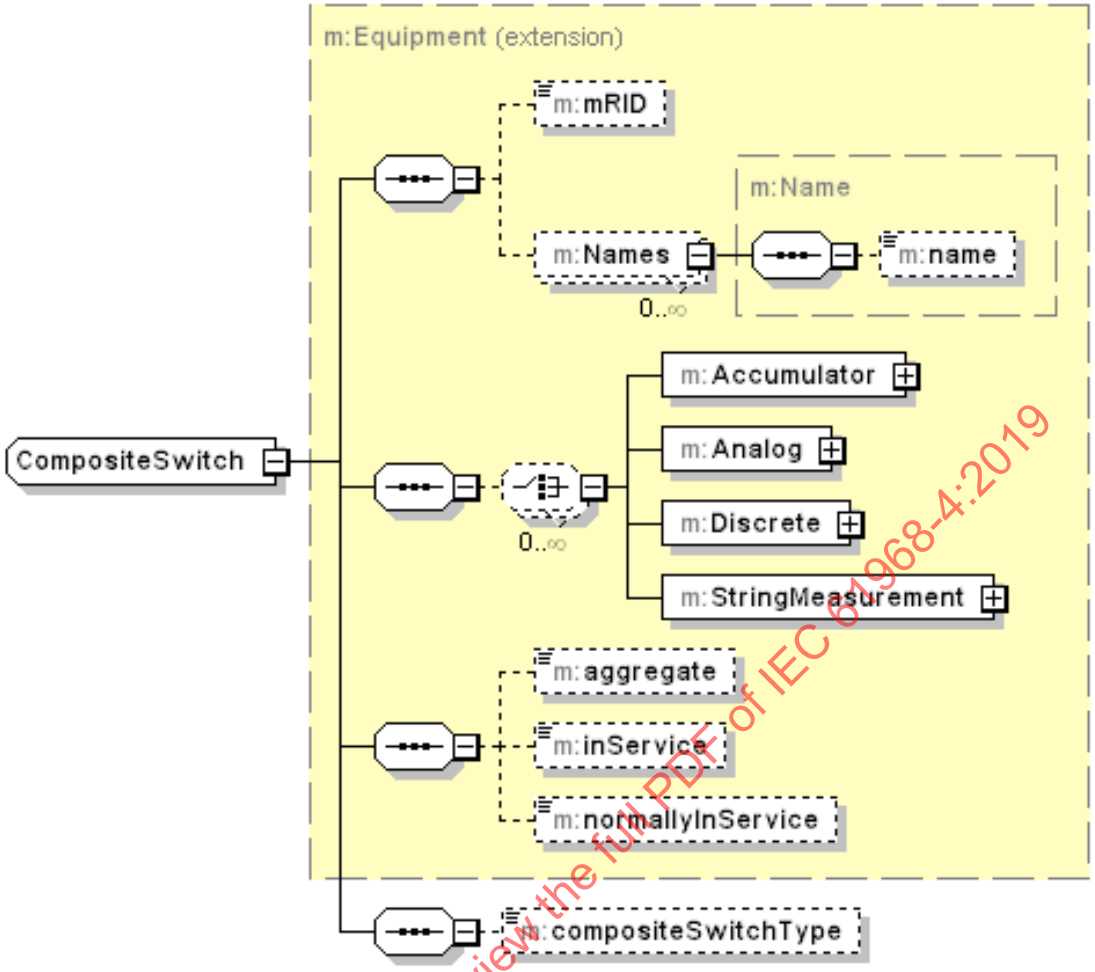


Figure 50 – Message AssetPSRDetails: élément CompositeSwitch

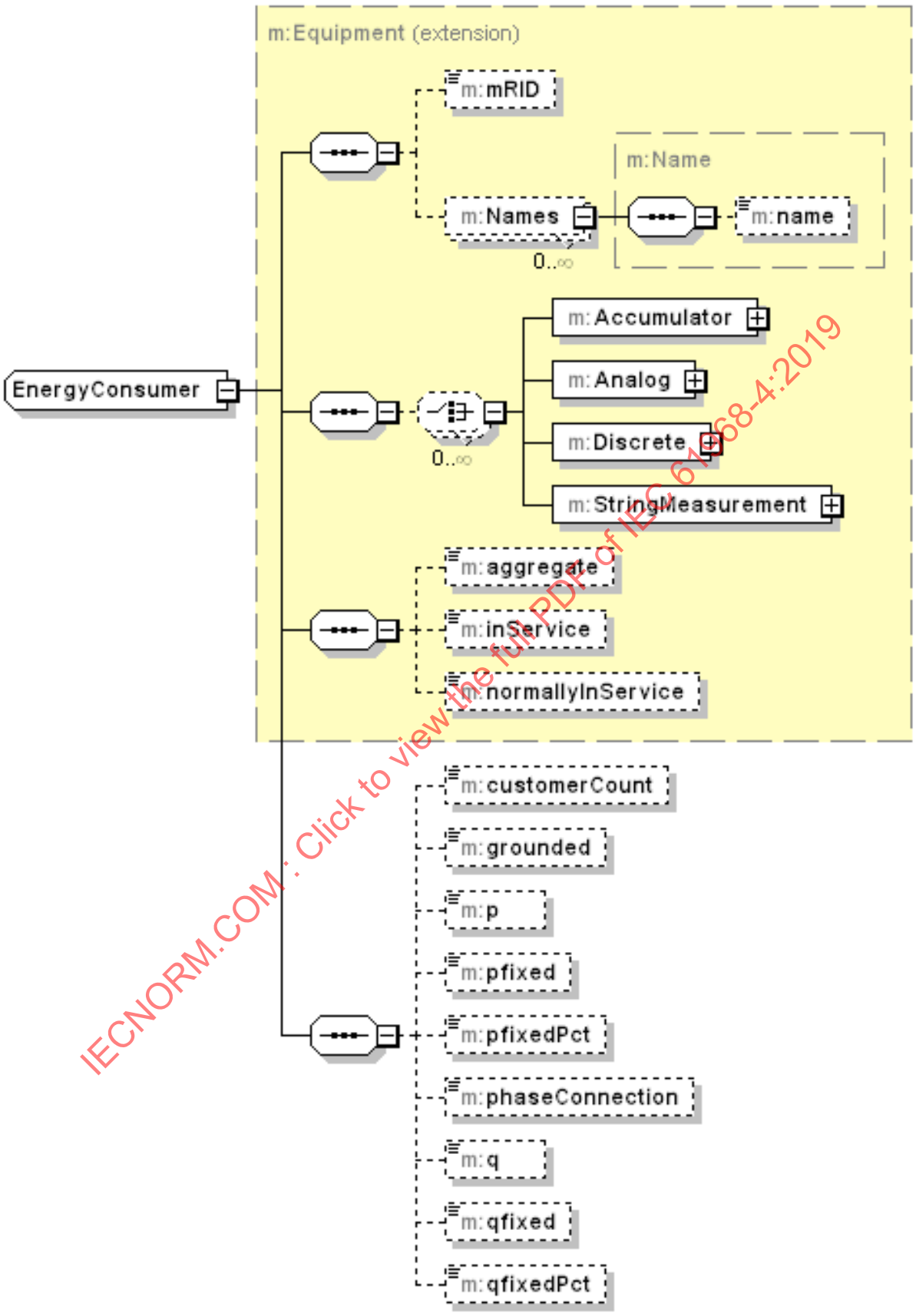


Figure 51 – Message AssetPSRDetails: élément EnergyConsumer

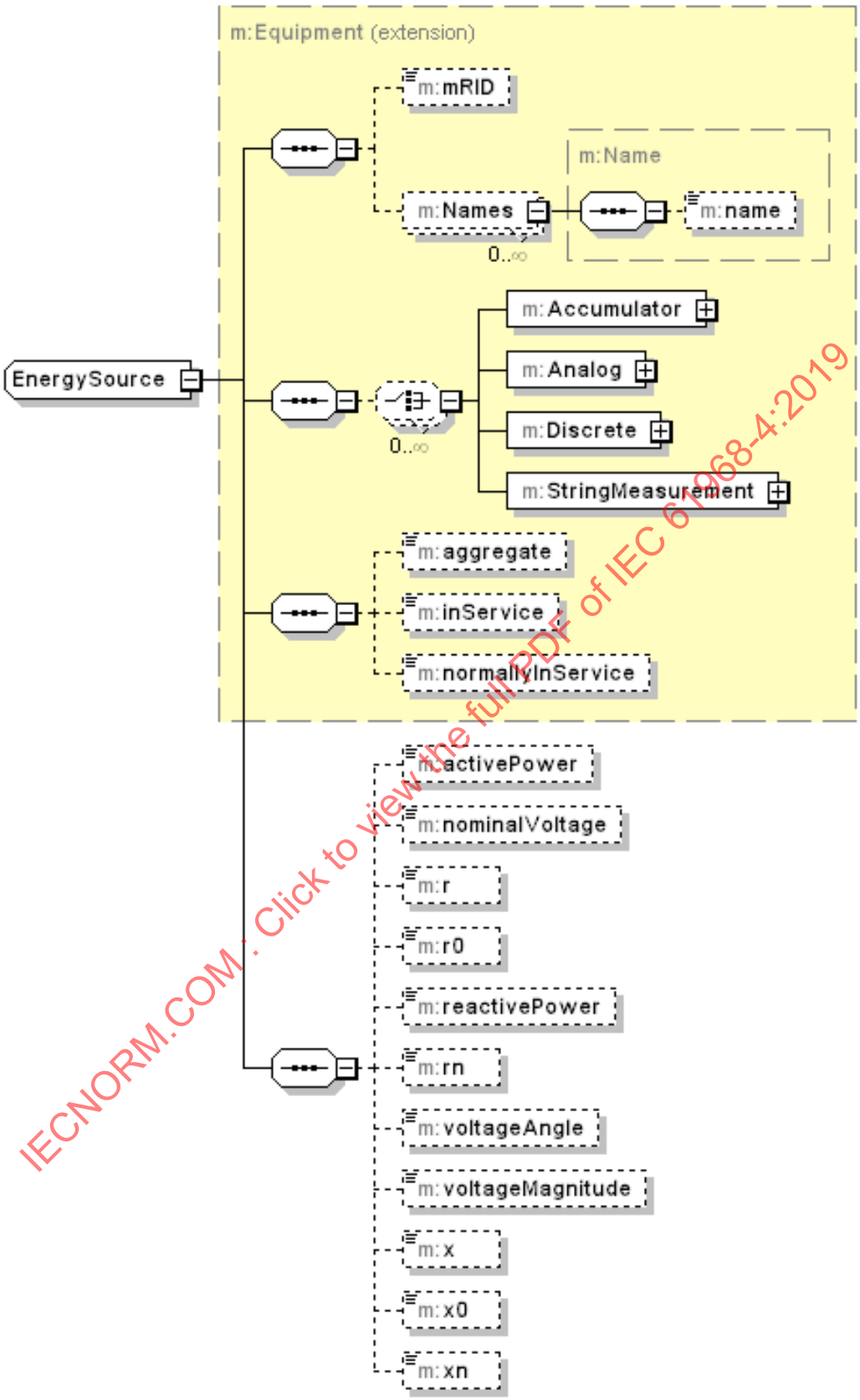


Figure 52 – Message AssetPSRDetails: élément EnergySource

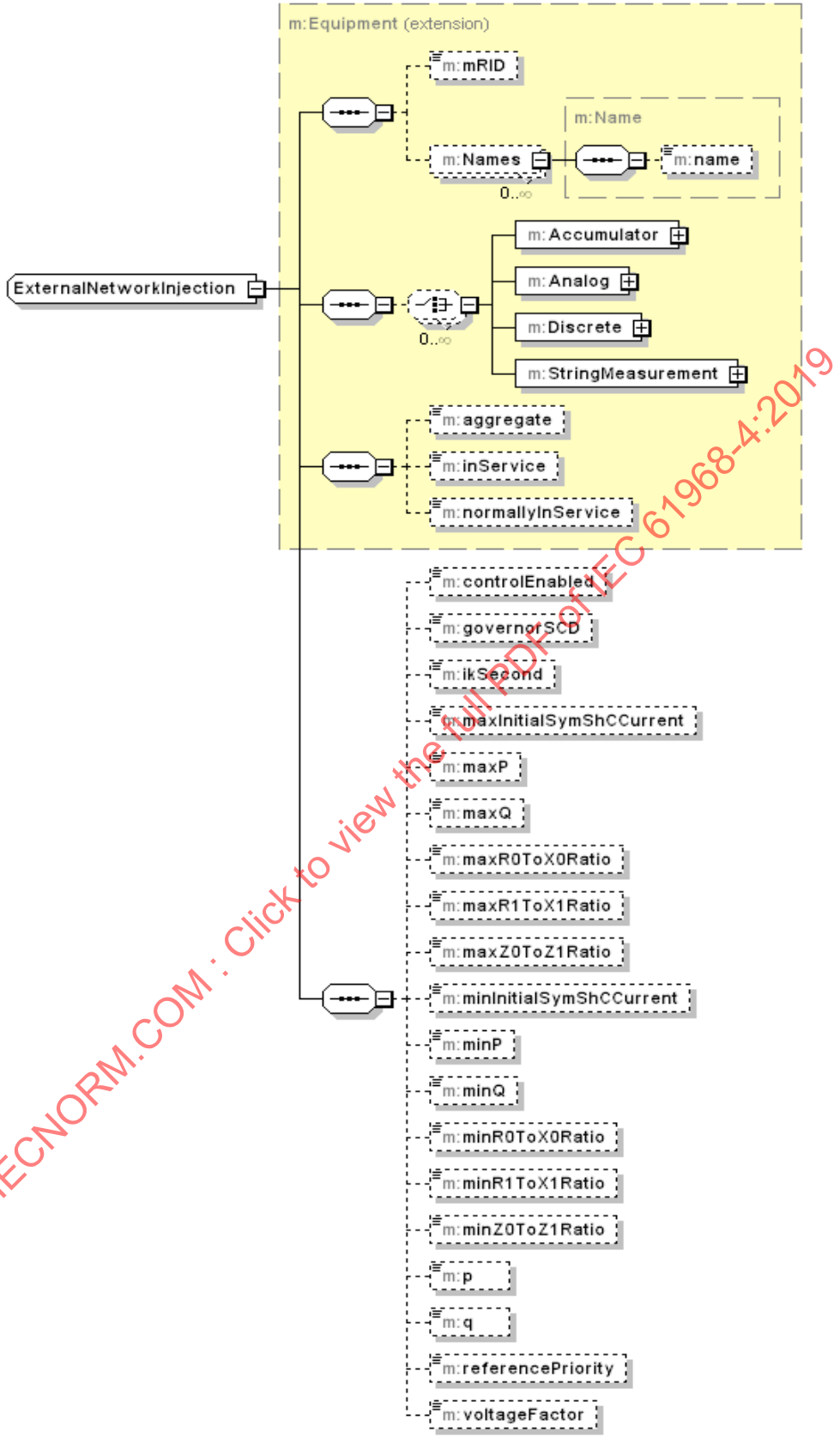


Figure 53 – Message AssetPSRDetails: élément ExternalNetworkInjection

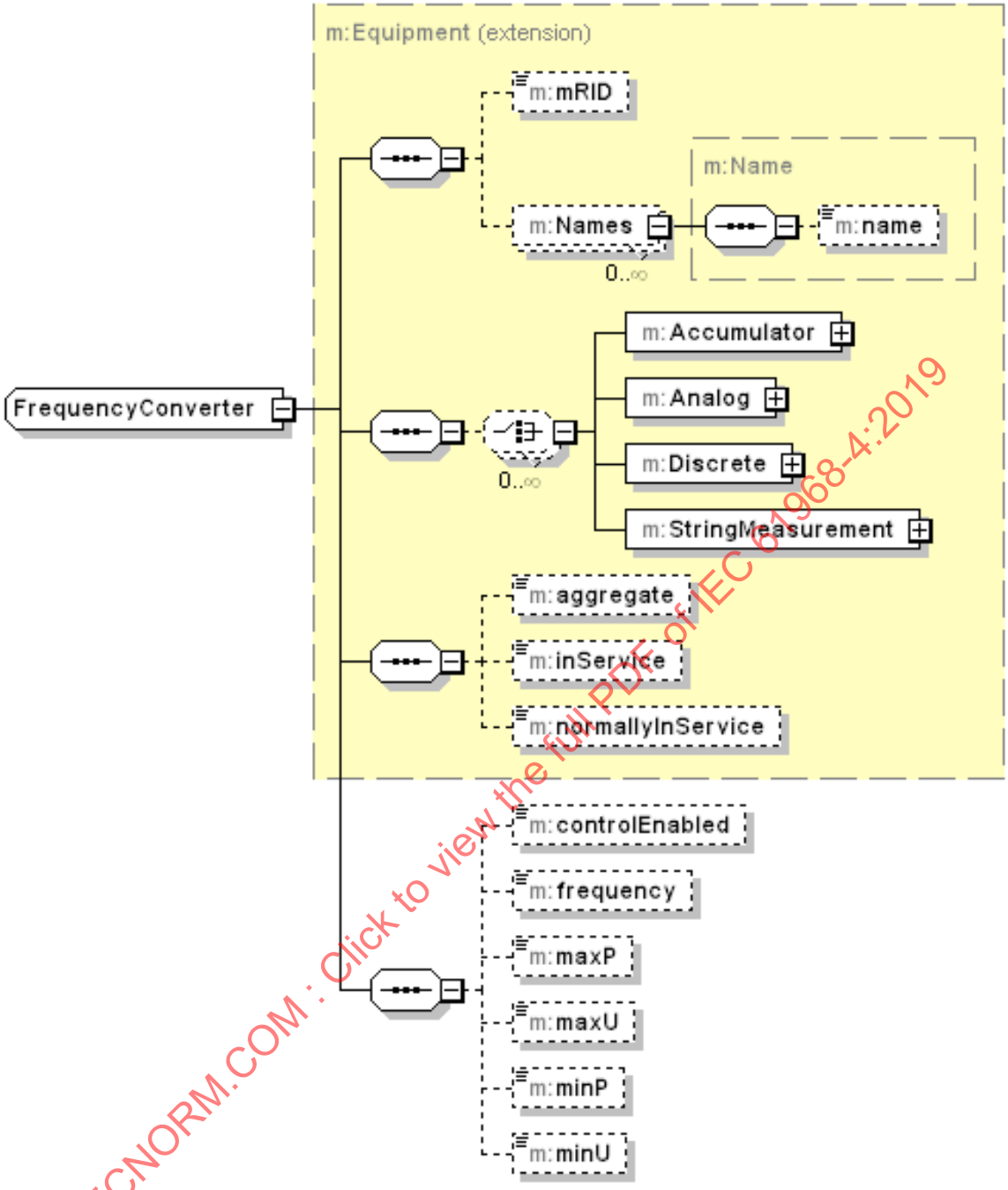


Figure 54 – Message AssetPSRDetails: élément FrequencyConverter

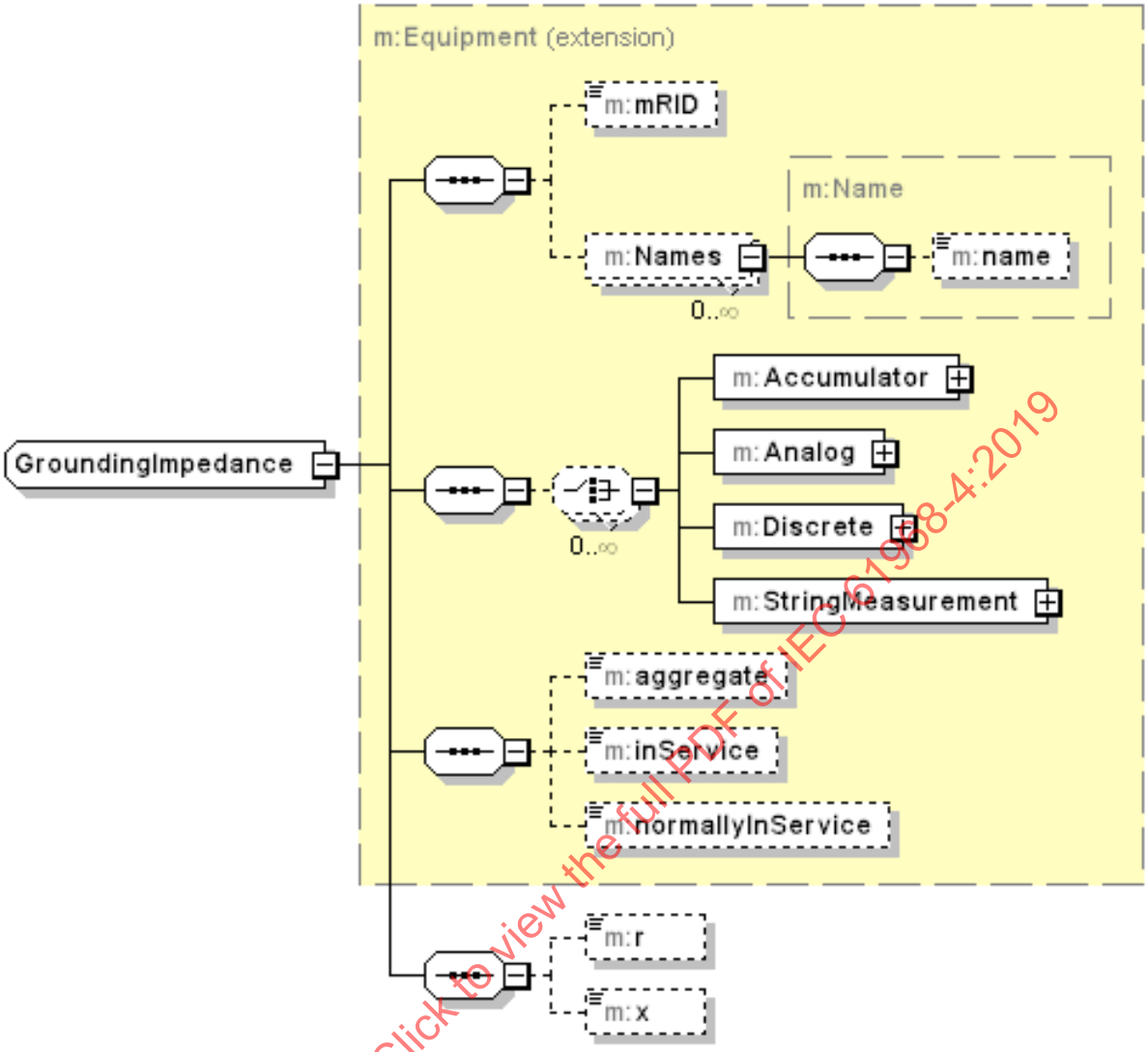


Figure 55 – Message AssetPSRDetails: élément GroundingImpedance

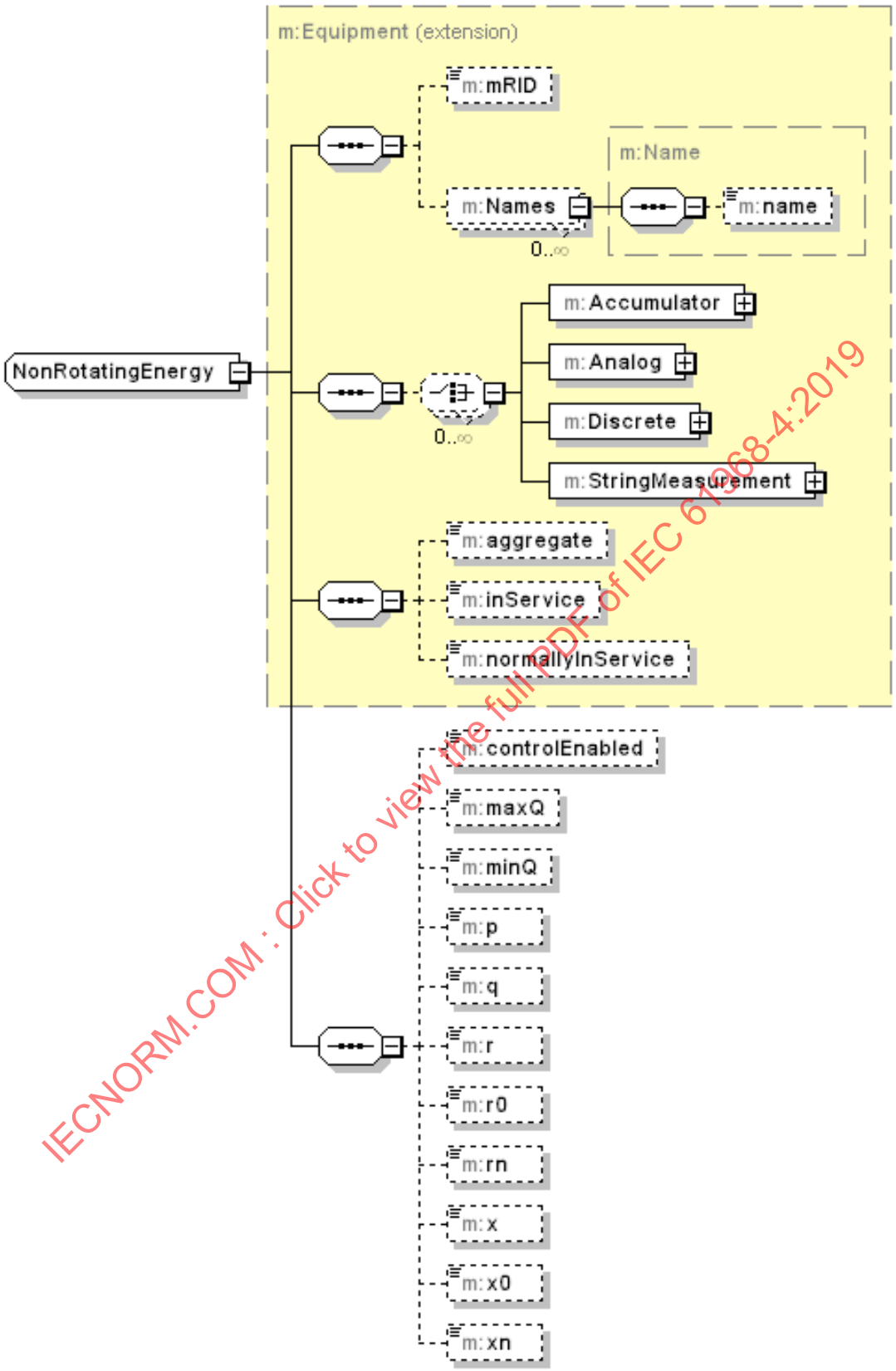


Figure 56 – Message AssetPSRDetails: élément NonRotatingEnergy

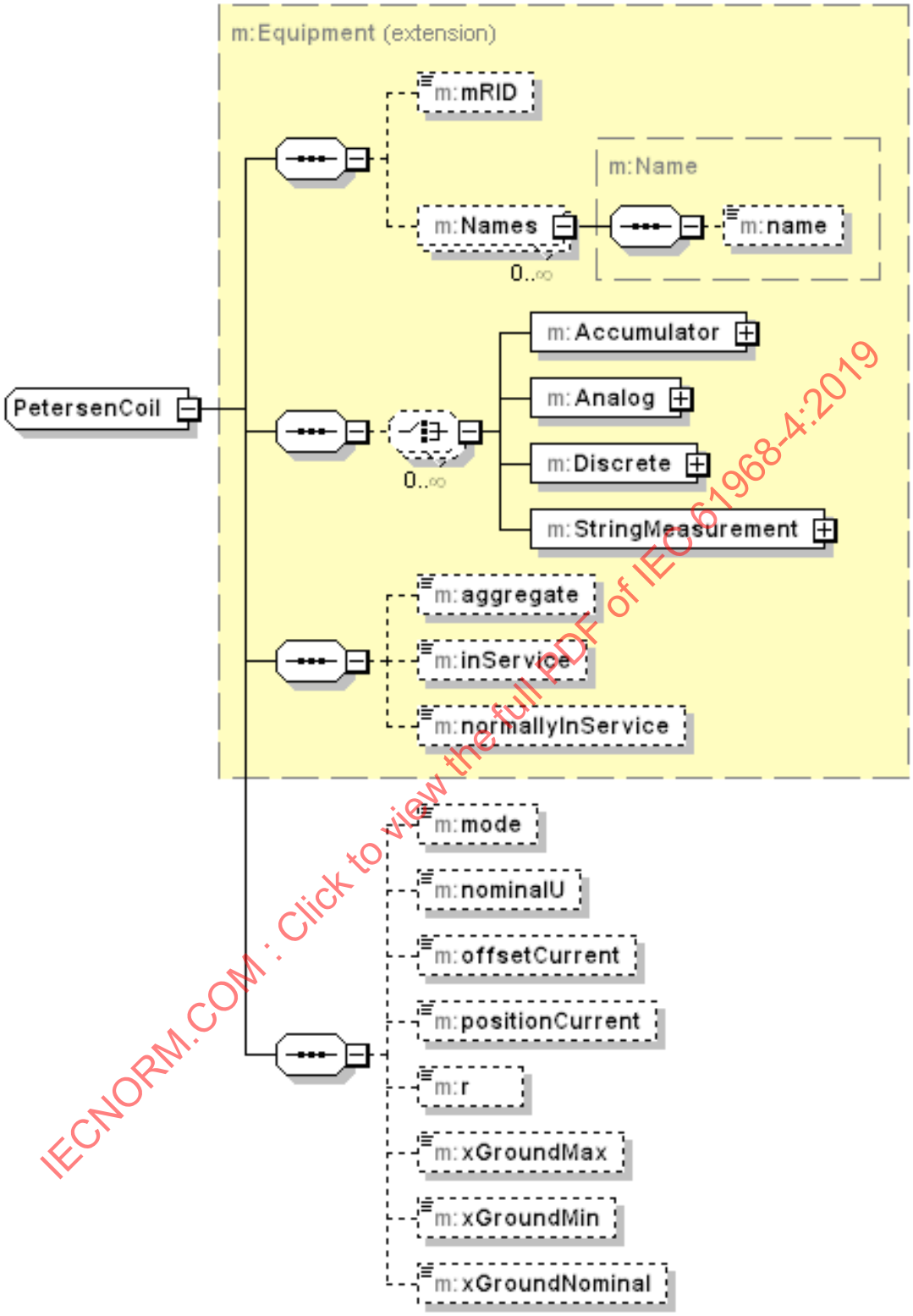


Figure 57 – Message AssetPSRDetails: élément PetersenCoil

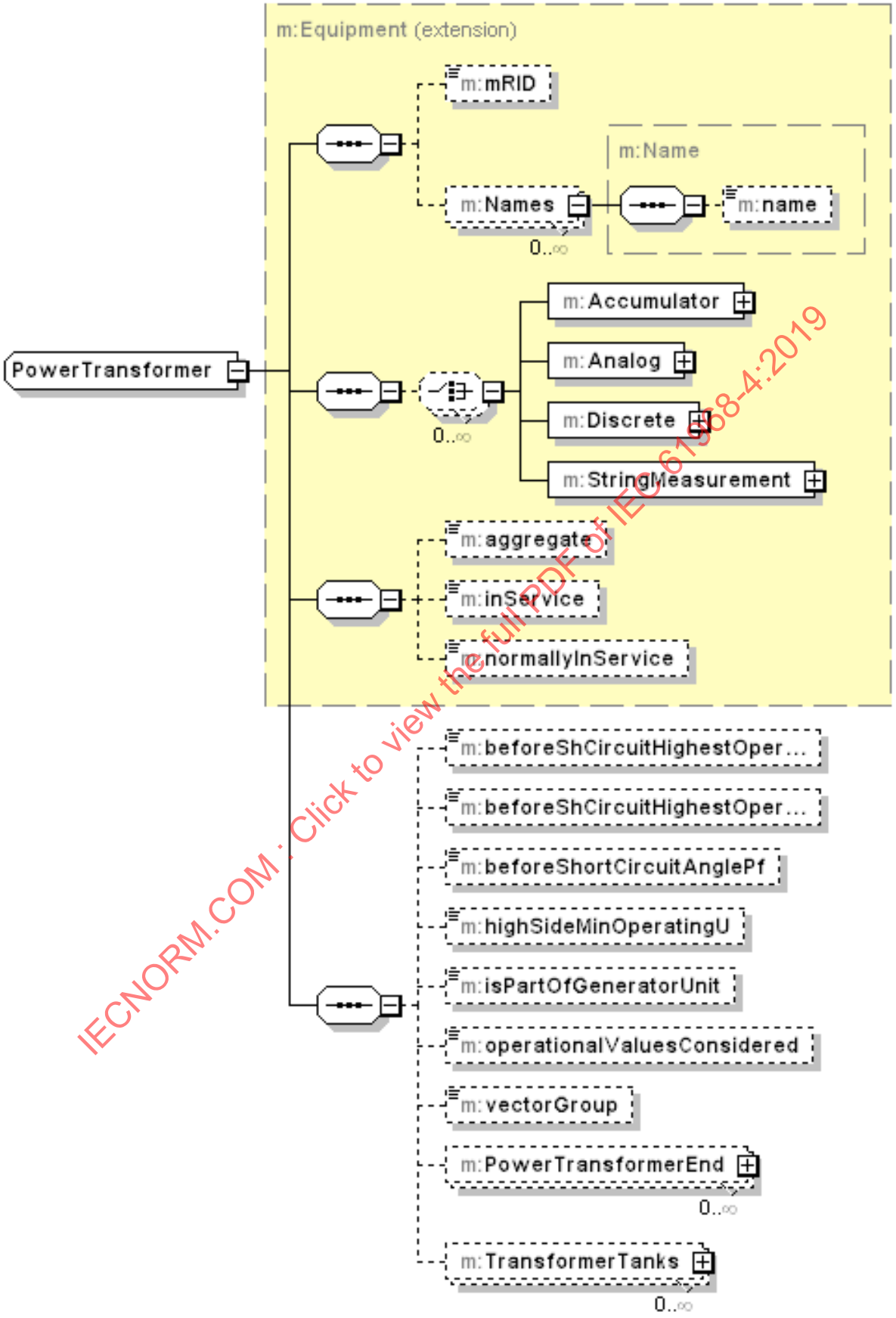


Figure 58 – Message AssetPSRDetails: élément PowerTransformer

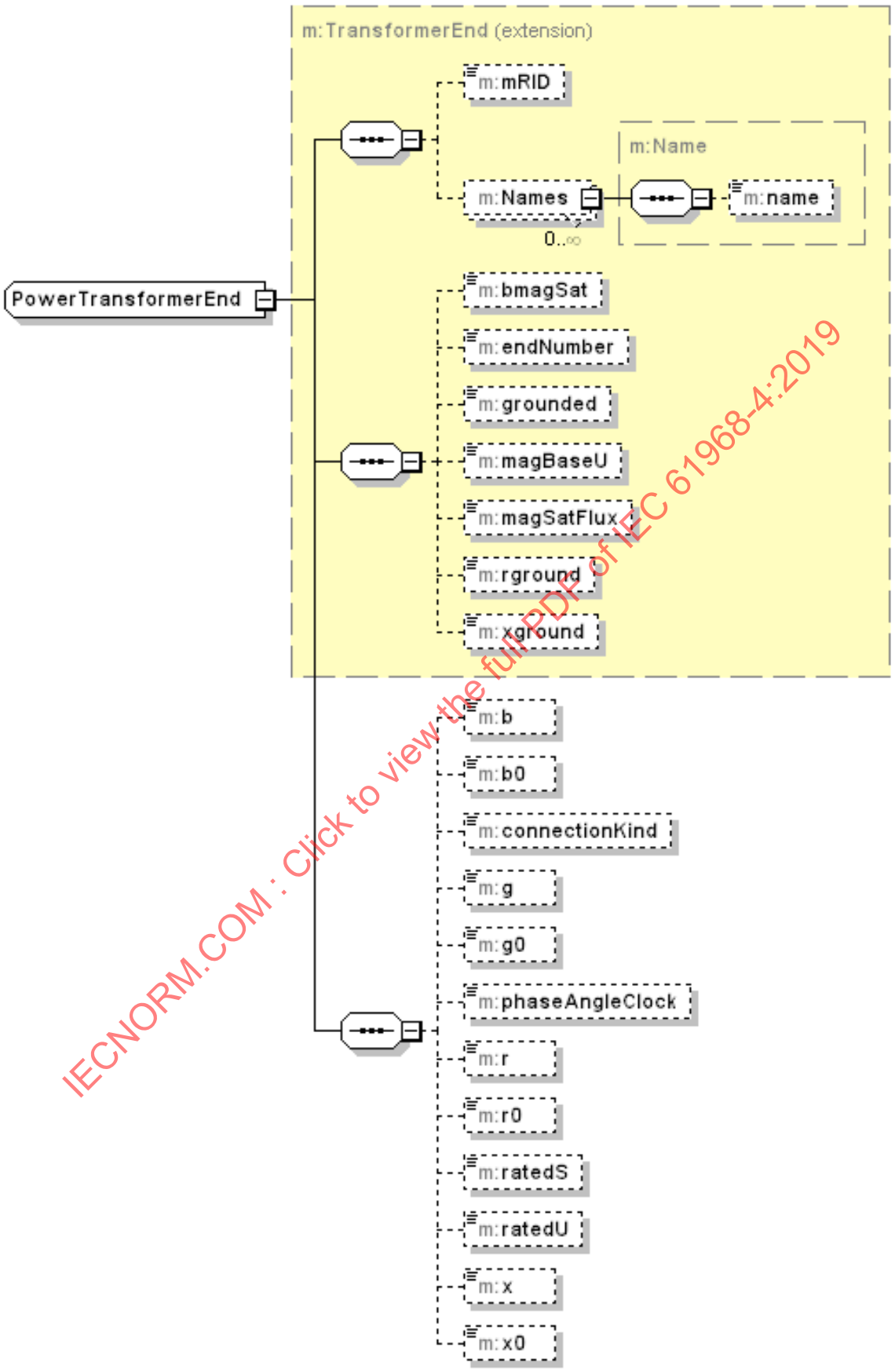


Figure 59 – Message AssetPSRDetails: élément PowerTransformerEnd

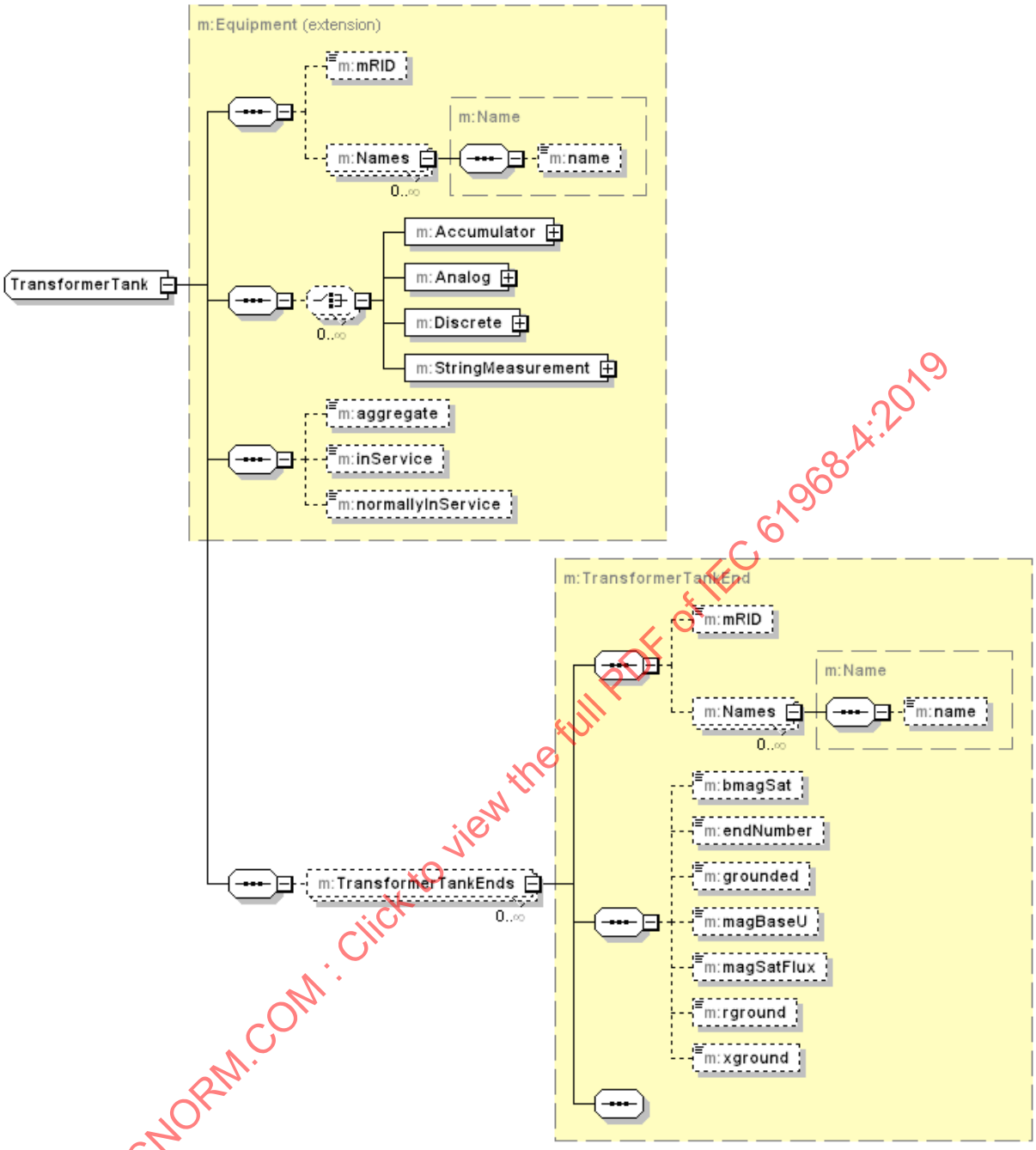


Figure 60 – Message AssetPSRDetails: élément TransformerTank

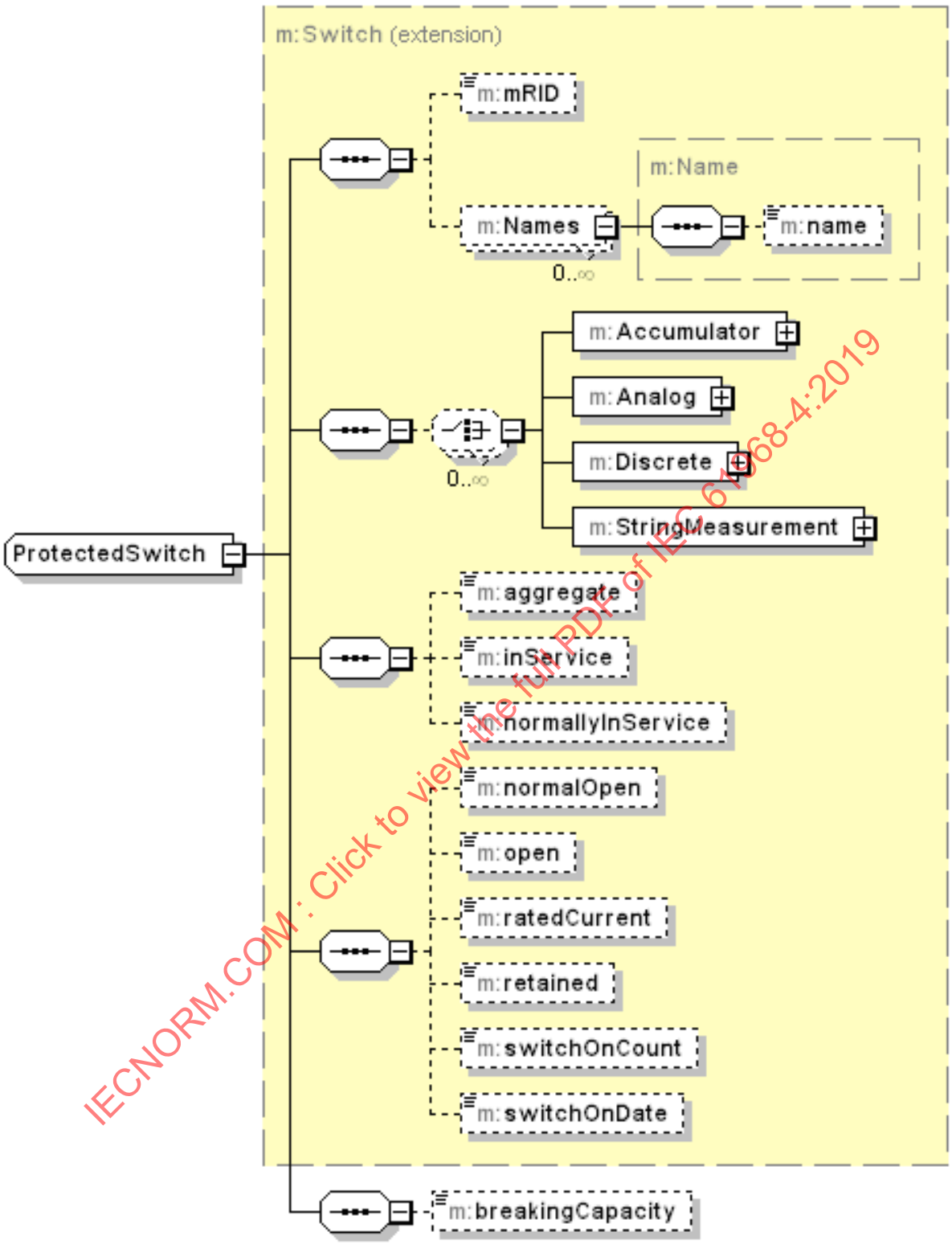


Figure 61 – Message AssetPSRDetails: élément ProtectedSwitch

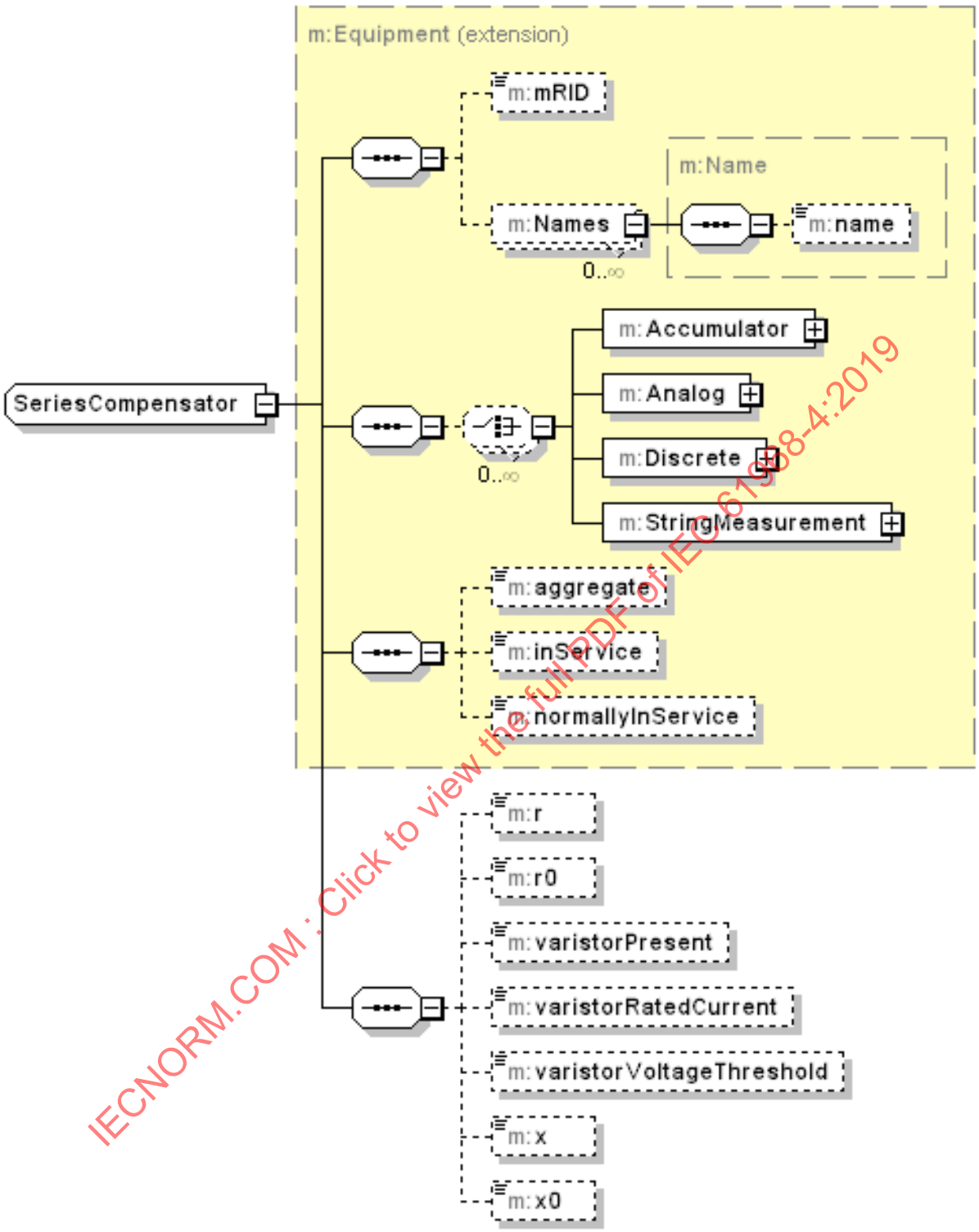


Figure 62 – Message AssetPSRDetails: élément SeriesCompensator

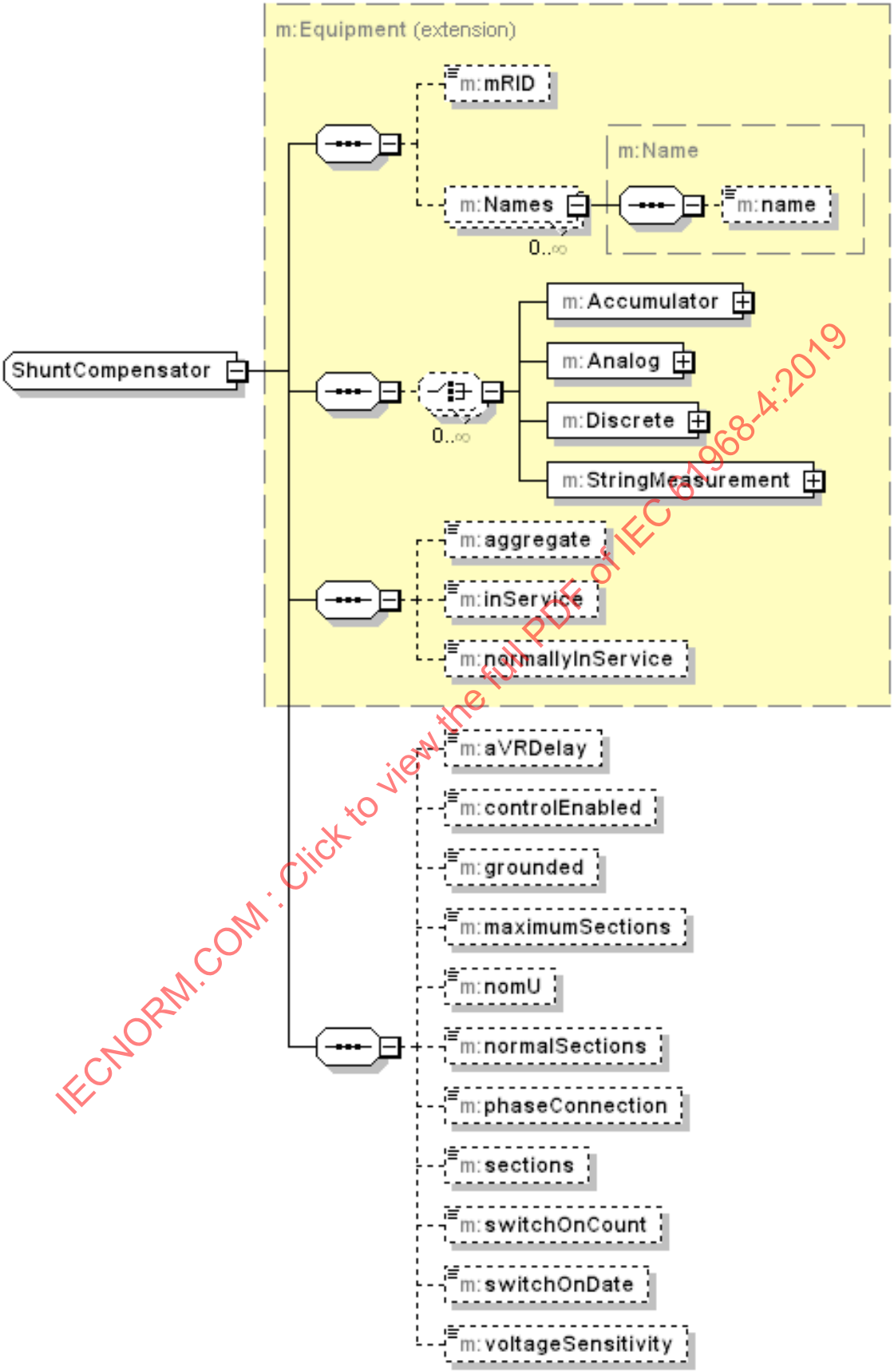


Figure 63 – Message AssetPSRDetails: élément ShuntCompensator

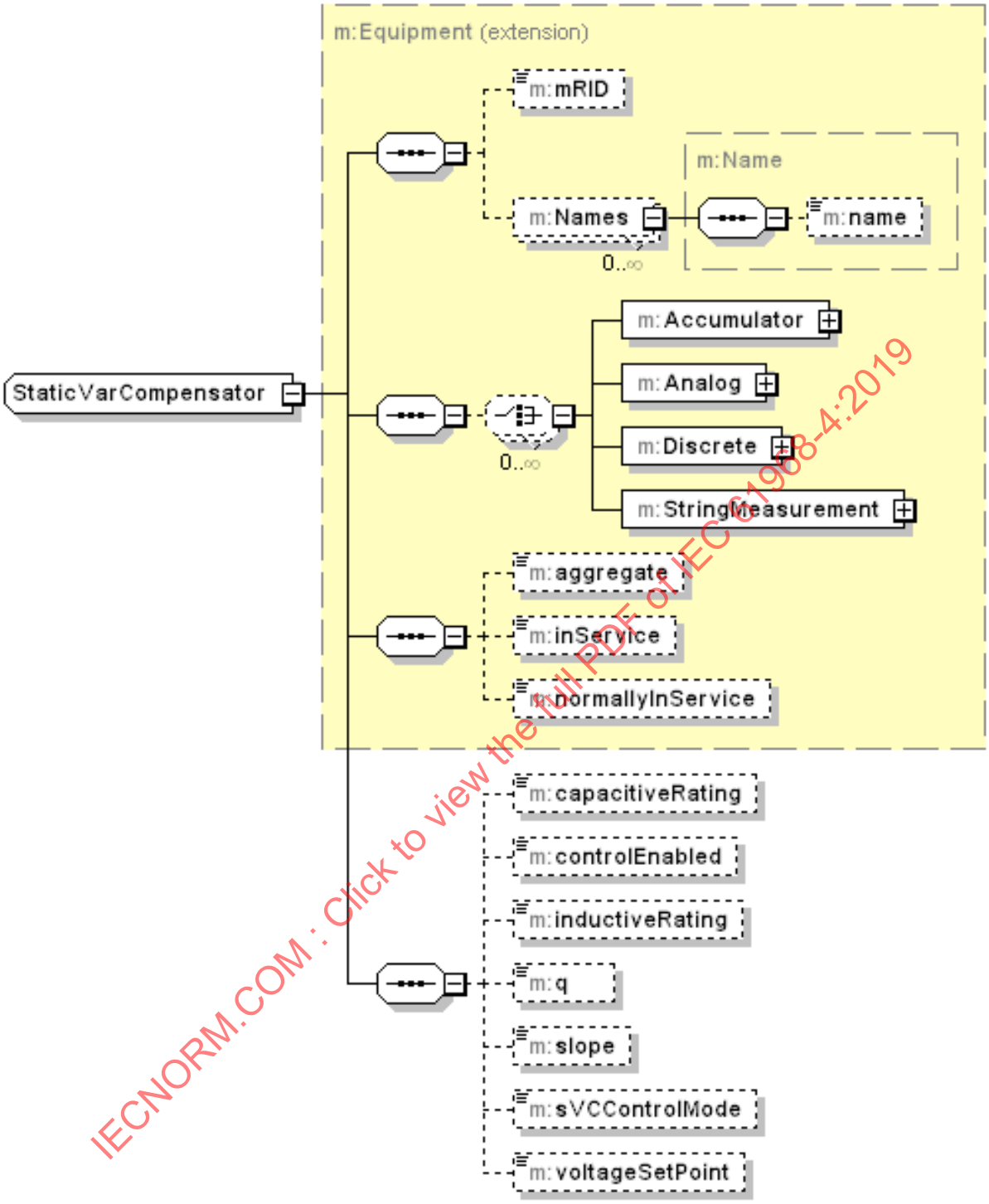


Figure 64 – Message AssetPSRDetails: élément StaticVarCompensator

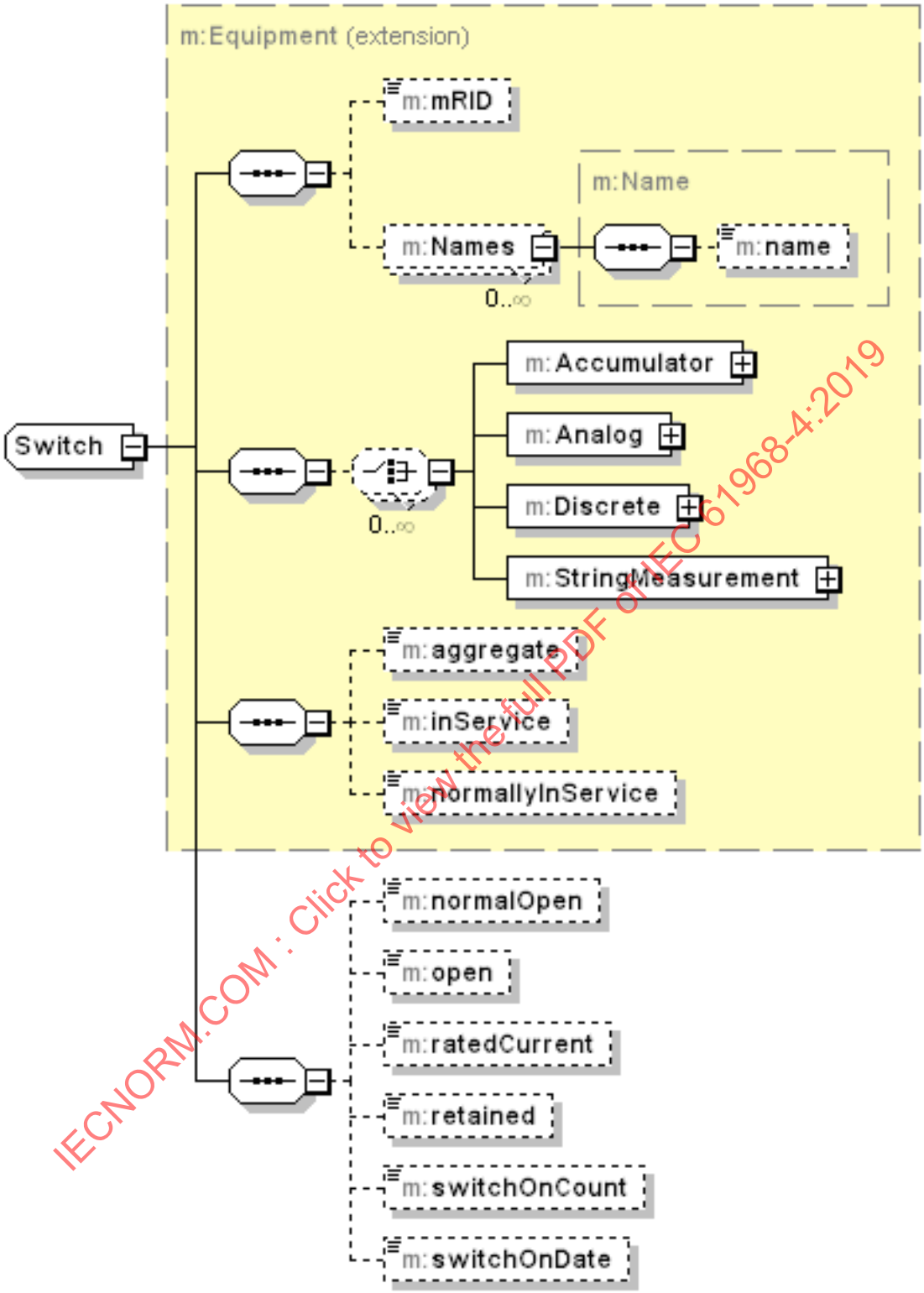


Figure 65 – Message AssetPSRDetails: élément Switch

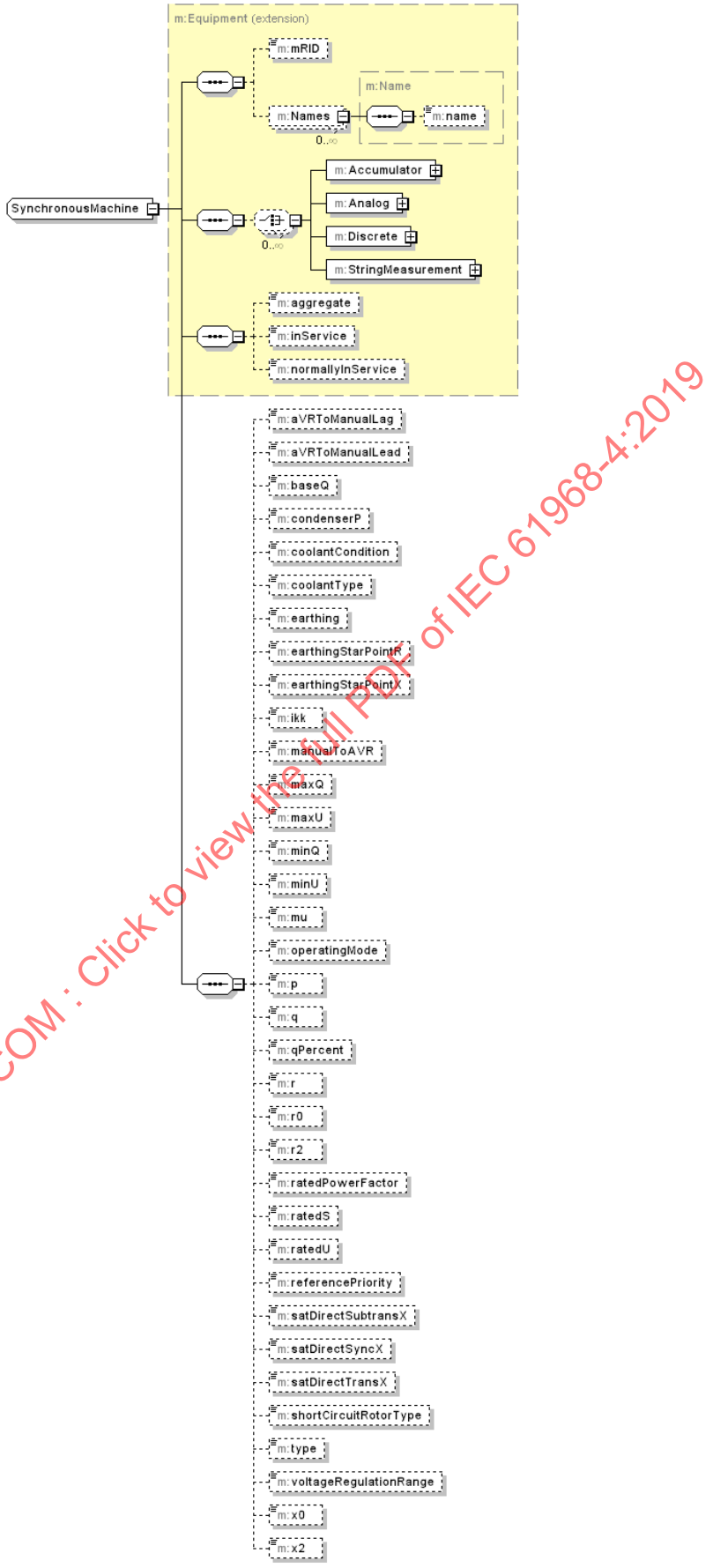


Figure 66 – Message AssetPSRDetails: élément SynchronousMachine

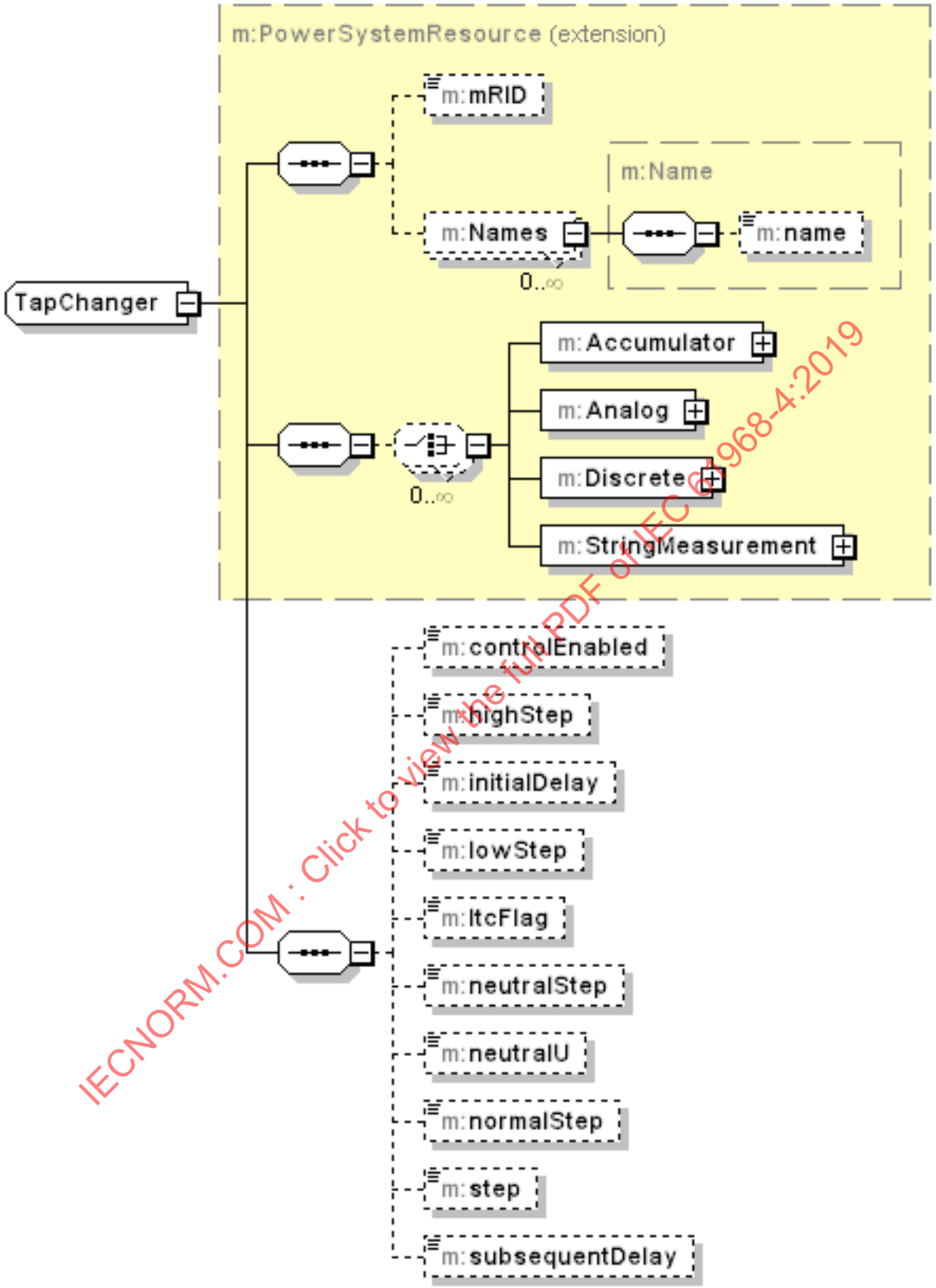


Figure 67 – Message AssetPSRDetails: élément TapChanger

L'exemple qui suit est un exemple XML pour une charge utile de message AssetState, qui montre l'état normalOpen d'un interrupteur, lequel peut nécessiter d'être échangé entre des systèmes lors d'une mise à jour concernant les commutations saisonnières, et pour la longueur d'un conducteur qui peut concerner une modification de la longueur à la conception pour la vérifier par rapport à la longueur conforme à la réalisation.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetState xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetState.xsd">
	<m:Asset>
		<m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
		<m:Switch>
			<m:normalOpen>true</m:normalOpen>
		</m:Switch>
	</m:Asset>
	<m:Asset>
		<m:mRID>6a9fb099-e67d-4c33-88f4-aa3e479ec1da</m:mRID>
		<m:Conductor>
			<m:length>4025</m:length>
		</m:Conductor>
	</m:Asset>
</m:AssetState>
```

5.10 Message AssetProcedures

5.10.1 Généralités

Un message AssetProcedures peut contenir les procédures applicables à un bien et aux jeux de données qui ont été produits à partir de telles procédures. Alors que ce message contient les informations d'identification des Procedures et des ProcedureDataSets, d'autres informations sont obtenues à l'aide des messages Procedures et ProcedureDataSets.

5.10.2 Applications

Le message AssetProcedures sert à identifier les procédures applicables à un ou plusieurs actifs, ainsi que les ProcedureDataSets (ou leurs classes filles) produits à partir de l'application des procédures.

L'interrogation et l'obtention par un système d'analyse des actifs des procédures applicables et des ProcedureDataSets qui en résultent pour les actifs concernés, comme le montre la Figure 68, sont des applications courantes de ce message. Sur cette figure, un système d'analyse des actifs demande à un système de maintenance et d'inspection de trouver les informations Procedure/ProcedureDataSet relatives au bien concerné.

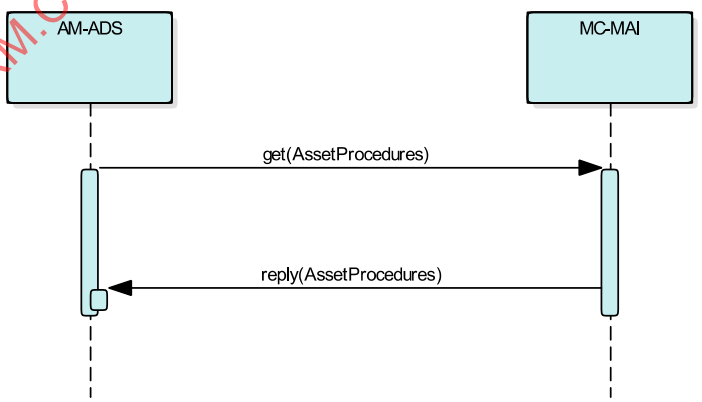


Figure 68 – Échange de messages AssetProcedures

5.10.3 Format du message

La Figure 69 représente le format de message AssetProcedures. La charge utile du message représenté sur la figure est constituée d'un ou plusieurs Assets, qui contiennent une multiplicité de Procedures. De plus, les objets Asset peuvent contenir le ProcedureDataSet

(ou une classe fille) disponible pour cet Asset. Ces objets ProcedureDataSet (ou d'une classe fille) font référence à la procédure qui a produit le jeu de données.

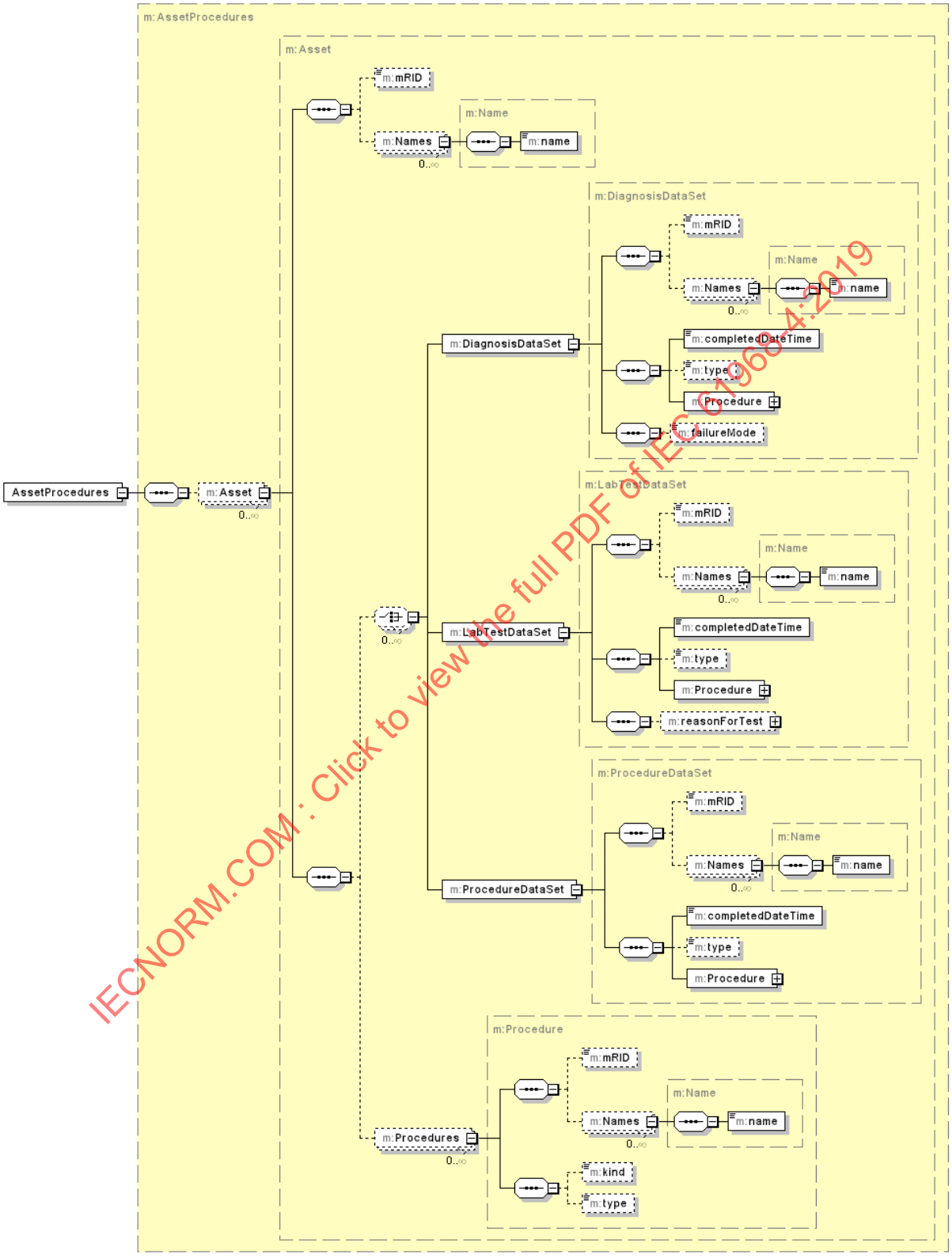


Figure 69 – Format de message AssetProcedures

L'exemple qui suit est un exemple XML pour la charge utile d'un message AssetProcedures. Il présente un Asset avec un objet LabTestDataSet, qui a été produit par une procédure de diagnostic (Procedures.kind = diagnostic).

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetProcedures xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetProcedures.xsd">
      <m:Asset>
            <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            <m:LabTestDataSet>
                  <m:mRID> fe37a60e-d8b7-49e5-8c12-93af7c58d223</m:mRID>
                  <m:completedDateTime>2015-12-19T09:30:47Z</m:completedDateTime>
                  <m:Procedure ref="e0be245f-92d8-4817-8672-48710e3835f2"/>
            </m:LabTestDataSet>
            <m:Procedures>
                  <m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
                  <m:kind>diagnosis</m:kind>
            </m:Procedures>
      </m:Asset>
</m:AssetProcedures>
```

5.11 Message Procedures

5.11.1 Généralités

Un message Procedures peut contenir les informations de Procédure, telles que les attributs qui décrivent la procédure, les Assets auxquels la procédure s'applique et les Measurements que la procédure produit. D'autres informations sur les mesures sont obtenues au moyen du message MeasurementDetails.

5.11.2 Applications

Le message Procedures sert à échanger des informations sur les Procedures concernées. Un élément Procedure de ce message peut également contenir des informations d'identification des Assets auxquels la procédure s'applique et des Measurements obtenues à partir de la procédure.

L'interrogation par un système d'analyse des actifs d'un système de maintenance et d'inspection, en vue d'obtenir des informations sur les procédures et l'identité des Measurements qui en résultent, est une application courante de ce message. Cet échange est semblable à celui de la Figure 68, en remplaçant le message AssetProcedures par le message Procedures.

5.11.3 Format du message

La Figure 70 représente le format de message Procedures. La charge utile du message représenté sur la figure est constituée d'une ou plusieurs Procedures, avec leurs attributs. Comme le montre la figure, l'élément Procedure peut contenir des informations d'identification pour les Assets auxquels la Procedure s'applique. L'élément Procedure peut également contenir les classes filles Measurement résultant de l'exécution de la Procedure. Les informations d'identification d'une des classes filles Measurement, à savoir AssetTemperaturePressureAnalog, sont données à la Figure 71. Comme cette figure peut le démontrer, cela comporte les attributs d'identification hérités des classes mères, tels que measurementType, ainsi que tout attribut d'identification plus spécifique disponible, comme l'attribut "kind" énuméré.

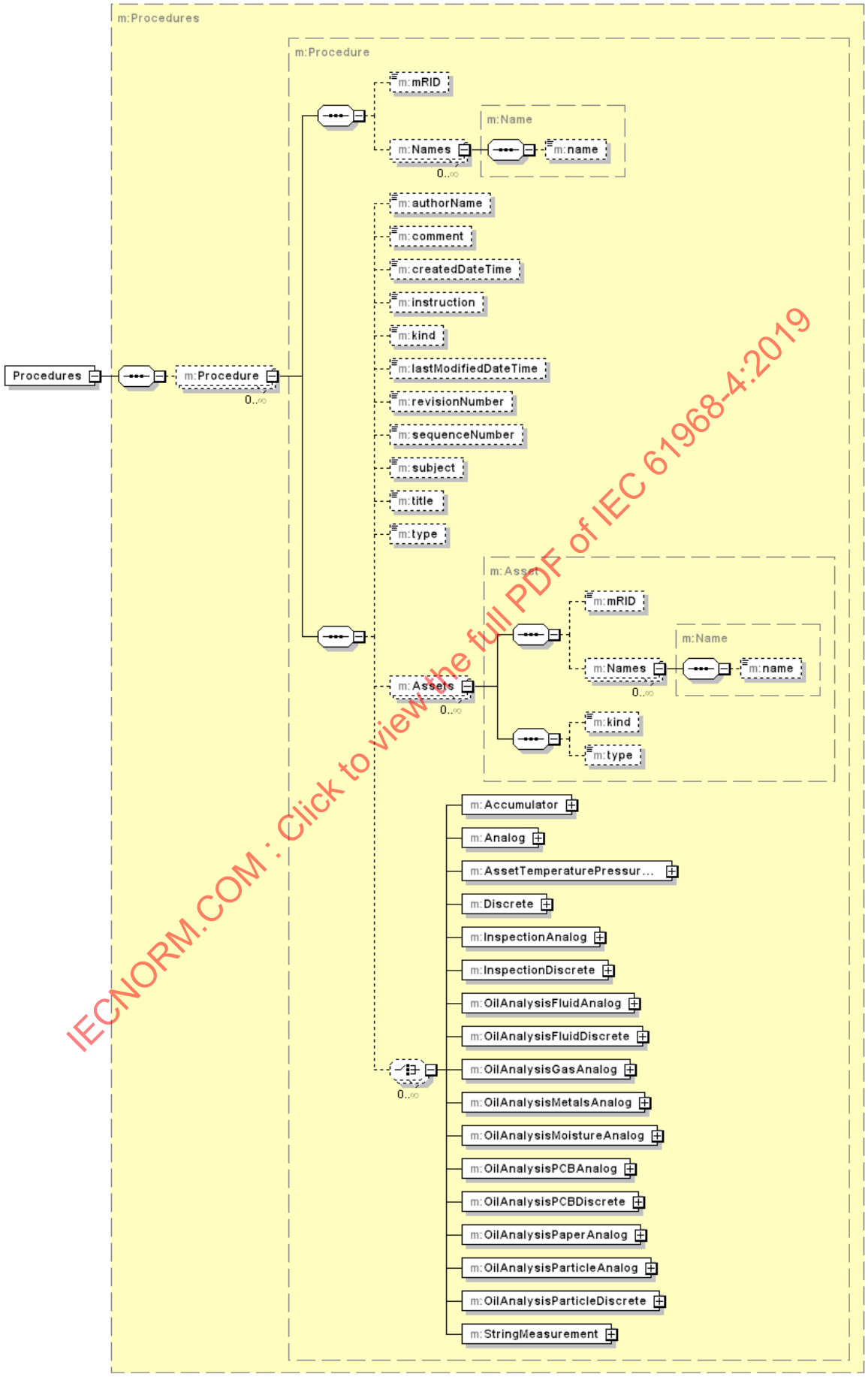


Figure 70 – Format de message Procedures

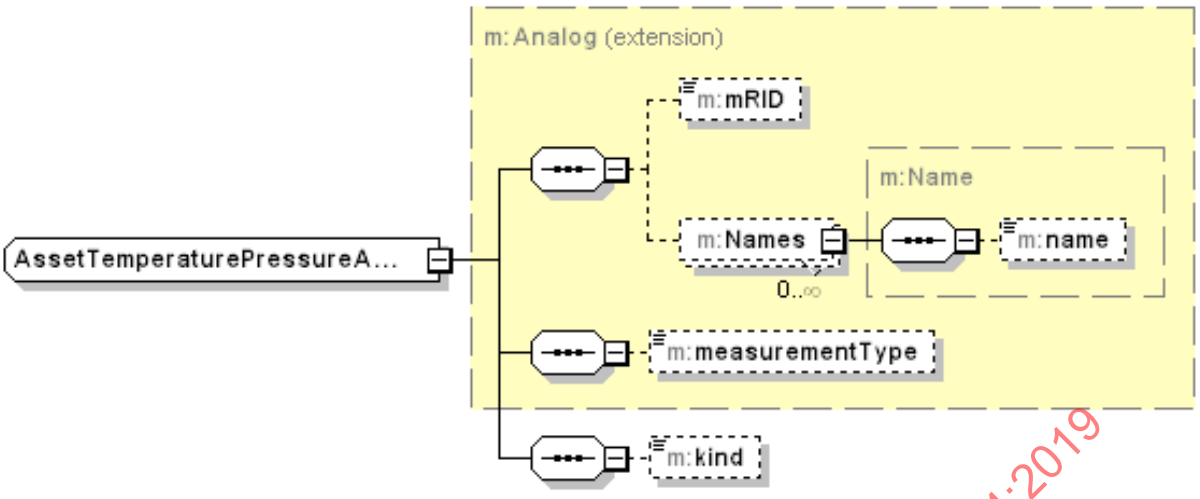


Figure 71 – Format de message Procedures: élément AssetTemperaturePressureAnalog

L'exemple qui suit est un exemple XML pour la charge utile d'un message Procedures. Il présente une procédure de diagnostic (Procedures.kind = diagnosis), en particulier celle qui a été identifiée dans l'exemple XML AssetProcedures en 5.10.3. Il est montré que cette procédure s'applique à l'Asset en 5.10.3 et qu'elle contient un objet du type OilAnalysisPaperAnalog, classe fille de Measurement.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:Procedures xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# Procedures.xsd">
      <m:Procedure>
            <m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
            <m:createdDateTime>2001-12-17T09:30:47Z</m:createdDateTime>
            <m:kind>diagnosis</m:kind>
            <m:Assets>
                  <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            </m:Assets>
            <m:OilAnalysisPaperAnalog>
                  <m:mRID>d5f14947-72b7-456b-8695-18577aebcc9e</m:mRID>
                  <m:kind>degreeOfPolymerization</m:kind>
            </m:OilAnalysisPaperAnalog>
      </m:Procedure>
</m:Procedures>
```


5.12 Message ProcedureDataSets

5.12.1 Généralités

Un message ProcedureDataSets peut contenir des ProcedureDataSets, sa classe fille LabTestDataSet, des informations associées telles que des informations sur l'éprouvette qui a été soumise à essai, ainsi que les classes filles MeasurementValue comprenant le jeu de données.

5.12.2 Applications

Le message ProcedureDataSets sert à échanger des informations sur un ou plusieurs objets ProcedureDataSet. L'interrogation et l'obtention par un système d'analyse des actifs des ProcedureDataSets concernés, comme le montre la Figure 72, sont des applications courantes de ce message. Sur cette figure, un système d'analyse des actifs demande, en tant que système avec gestion d'actif et fonction de mesure, de trouver les informations ProcedureDataSet.

Figure 72 – Échange de messages ProcedureDataSets

5.12.3 Format du message

La Figure 73 représente le format de message ProcedureDataSets. La charge utile du message indiquée sur la figure consiste en une multiplicité d'éléments ProcedureDataSet et LabTestDataSet (qui est une spécialisation de ProcedureDataSet). La Figure 73 représente également l'élément ProcedureDataSet étendu. En plus des attributs de ProcedureDataSet, cet élément contient également une ou plusieurs instances de classes filles MeasurementValue qui constituent le jeu de données. Comme le montre la Figure 74, l'élément AnalogValue (de même que les autres spécialisations de MeasurementValue) contient des informations d'identification, la valeur de mesure effective et les informations d'identification de la spécialisation de Measurement à laquelle appartient la MeasurementValue.

Comme le montre la Figure 75, l'élément LabTestDataSet, en plus des informations susceptibles d'être contenues dans l'élément ProcedureDataSet, dispose également des attributs supplémentaires tels que "conclusion" et des objets de type AssetTestLab et Specimen. AssetTestLab identifie l'organisation qui a réalisé les essais. Comme le montre la Figure 76, Specimen donne des informations sur l'échantillon qui a fait l'objet d'essais.

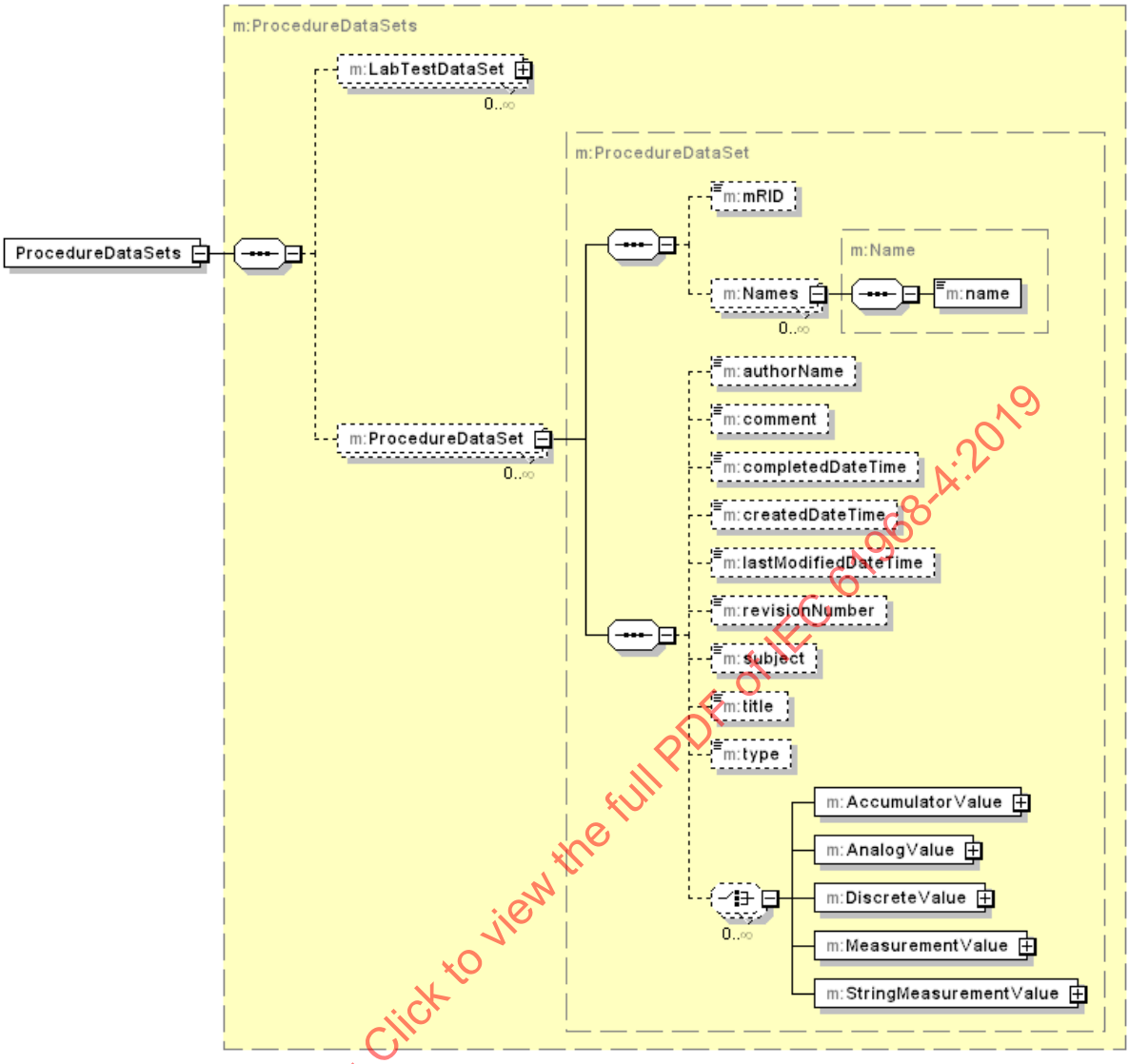


Figure 73 – Format de message ProcedureDataSets

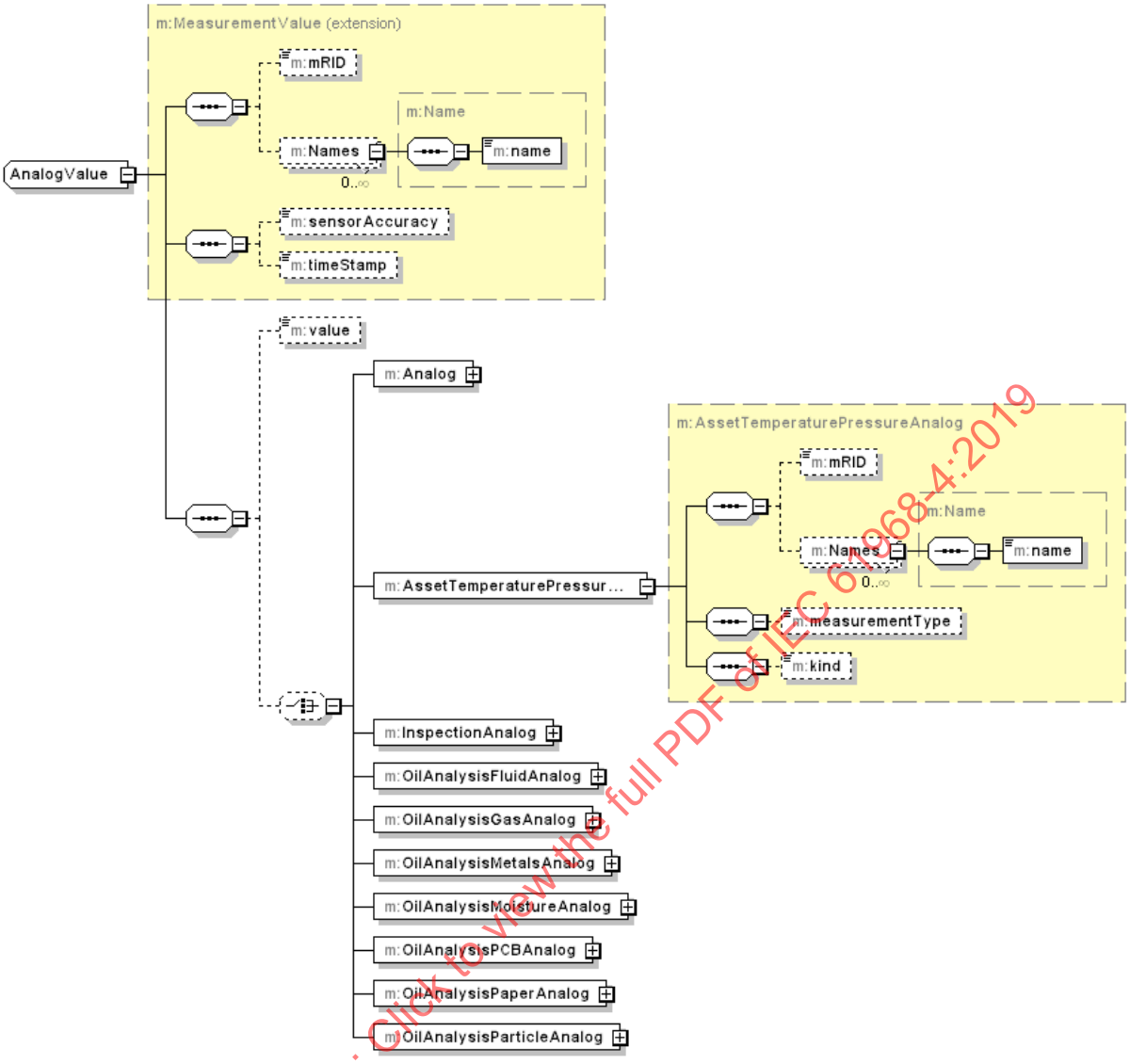


Figure 74 – Message ProcedureDatasets: élément AnalogValue

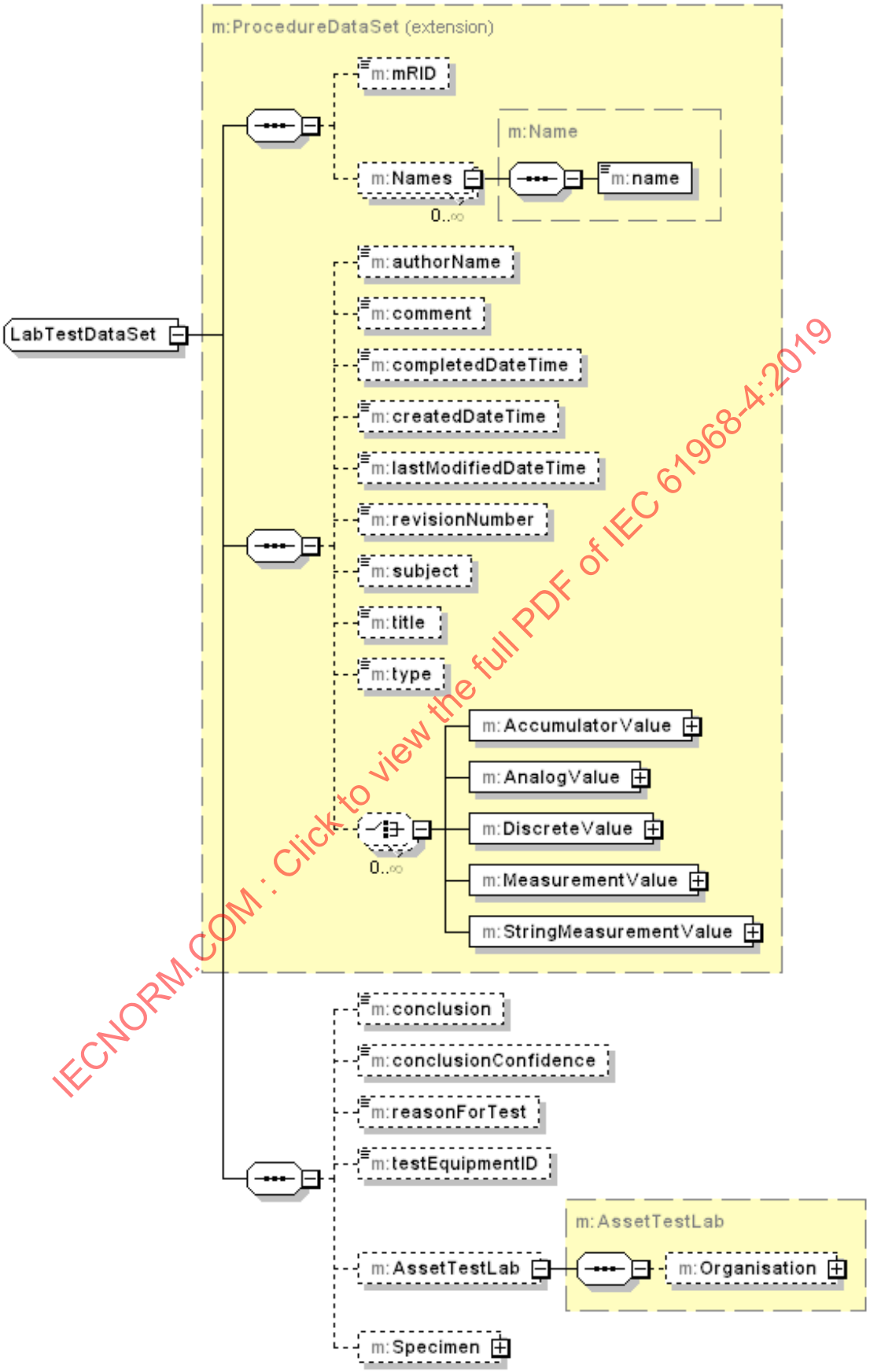


Figure 75 – Message ProcedureDataSets: élément LabTestDataSet

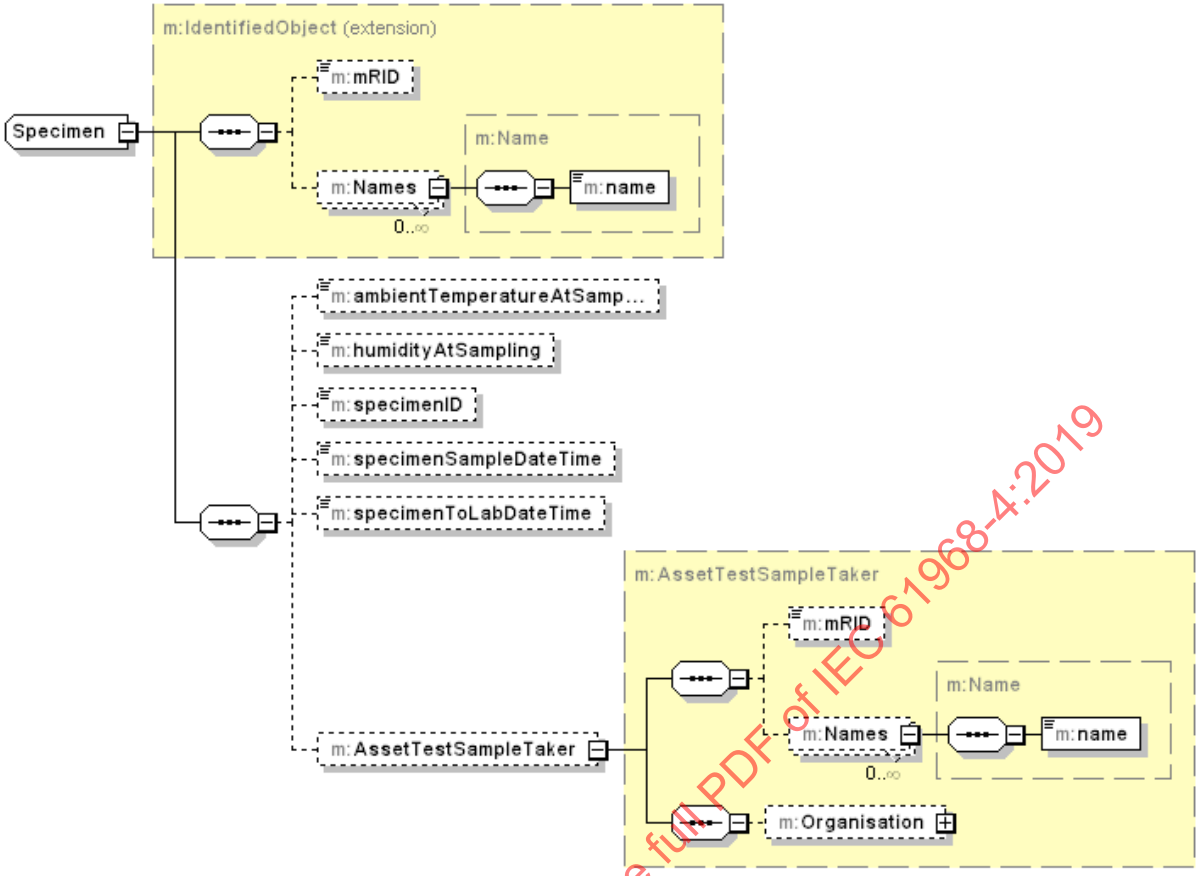


Figure 76 – Format de message ProcedureDataSets: élément Specimen

L'exemple qui suit est un exemple XML pour la charge utile d'un message ProceduresDataSets. Il présente un LabTestDataSet avec des informations précises sur l'échantillon et les informations d'identification pour une AnalogValue. Cette valeur fille de MeasurementValue correspond à l'OilAnalysisPaperAnalog du type (kind) degreeOfPolymerization, en particulier à celle qui a été identifiée dans l'exemple Procedures XML en 5.11.3.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:ProcedureDataSets xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# ProcedureDataSets.xsd">
      <m:LabTestDataSet>
            <m:mRID>fe37a60e-d8b7-49e5-8c12-93af7c58d223</m:mRID>
            <m:completedDateTime>2015-12-19T09:30:47Z </m:completedDateTime>
            <m:createdDateTime>2015-12-19T09:30:47Z </m:createdDateTime>
            <m:AnalogValue>
                  <m:value>4.1</m:value>
                  <m:OilAnalysisPaperAnalog>
                        <m:mRID>d5f14947-72b7-456b-8695-18577aebcc9e</m:mRID>
                        <m:kind>degreeOfPolymerization</m:kind>
                  </m:OilAnalysisPaperAnalog>
            </m:AnalogValue>
            <m:conclusion>Insulation paper degraded significantly, take asset out of service
immediately.</m:conclusion>
            <m:conclusionConfidence>High</m:conclusionConfidence>
            <m:reasonForTest>routine</m:reasonForTest>
      </m:LabTestDataSet>
</m:ProcedureDataSets>
```

5.13 Message AssetMeasurements

5.13.1 Généralités

Un message AssetMeasurements peut contenir les Measurements (mesures) pratiquées sur des actifs. Ce message permet de récupérer des mesures en cours effectuées directement sur les actifs, telles que celles qui sont provenues à l'origine d'un dispositif électronique intelligent (IED) assurant des fonctions de surveillance en ligne. Pour des Measurements qui résultent de procédures appliquées à un Asset, utiliser le message Procedures. De même, le message AssetMeasurements ne donne que des informations permettant d'identifier les Measurements, les informations des mesures concernées pouvant être obtenues à l'aide du message MeasurementDetails.

5.13.2 Applications

Le message AssetMeasurements sert à obtenir différentes mesures concernant un ou plusieurs actifs. L'interrogation et l'obtention par un système d'analyse des actifs des données Measurement disponibles pour les actifs qu'il souhaite estimer, comme le montre la Figure 77, sont des applications courantes de ce message. De telles données peuvent indiquer l'état de l'actif et, par conséquent, elles sont précieuses pour la gestion des actifs. Sur la Figure 77, un système d'analyse des actifs demande à un système de mesure et de surveillance d'actifs de trouver des données relatives à l'actif concerné.

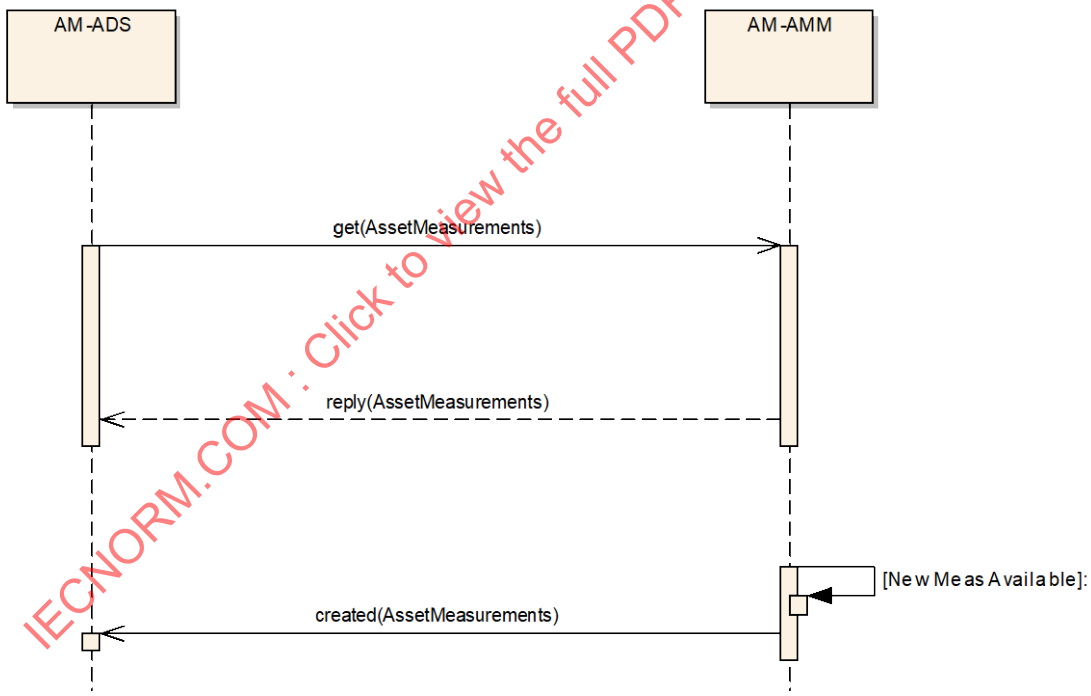


Figure 77 – Échange de messages AssetMeasurements

5.13.3 Format du message

La Figure 78 représente le format de message AssetMeasurements. La charge utile du message indiquée sur la figure est constituée de plusieurs éléments racines. Les éléments racines sont des Assets qui peuvent contenir les informations d'identification pour les objets Measurement relevant de l'Asset concerné. Les classes filles Measurement contiennent les informations d'identification pour la classe fille Measurement, ainsi que pour la classe fille MeasurementValue associée. D'autres informations sur les mesures concernées peuvent être obtenues au moyen du message MeasurementDetails. Les valeurs de mesure peuvent être obtenues à l'aide du message MeasurementValues.

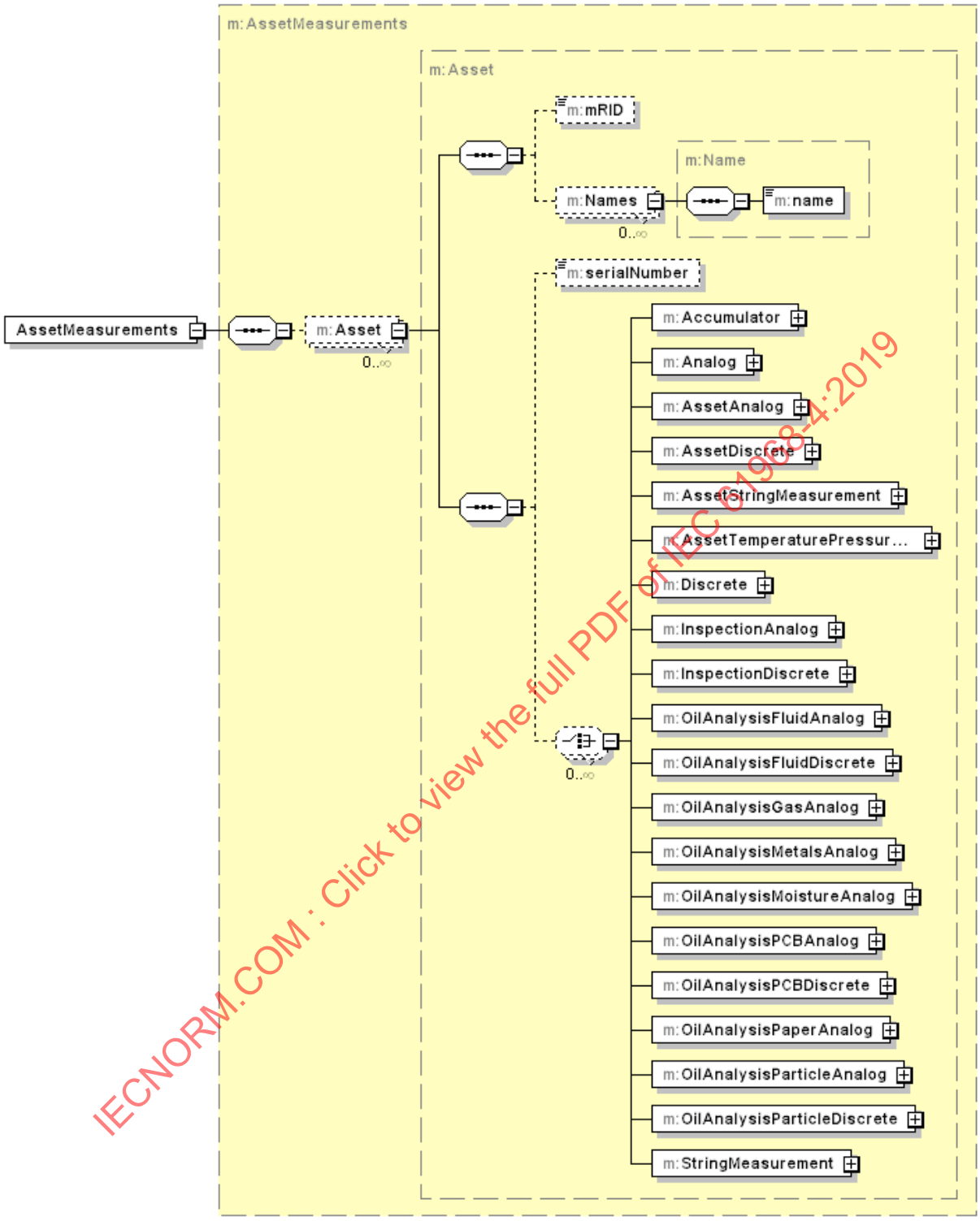


Figure 78 – Format de message AssetMeasurements

L'exemple qui suit est un exemple XML pour la charge utile d'un message AssetMeasurements. Il présente la mesure OilAnalysisGasAnalog du total des gaz combustibles dissous (TDCG) en pourcentage pour le même Asset présenté dans l'exemple XML du 5.10.3. L'objet OilAnalysisGasAnalog identifie également la MeasurementValue (AnalogValue) qui le concerne.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:AssetMeasurements xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# AssetMeasurements.xsd">
      <m:Asset>
            <m:mRID>63eb750e-1360-4a73-acd5-d5638045f78e</m:mRID>
            <m:OilAnalysisGasAnalog>
                  <m:mRID>d2deff03-2b29-4f03-b850-c6823672da61</m:mRID>
                  <m:AnalogValues>
                        <m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
                  </m:AnalogValues>
                  <m:kind>totalDissolvedCombustibleGas</m:kind>
            </m:OilAnalysisGasAnalog>
      </m:Asset>
</m:AssetMeasurements>
```

5.14 Message MeasurementDetails

5.14.1 Généralités

Un message MeasurementDetails peut contenir des informations précises sur les mesures concernées, telles que les valeurs unitaires, minimales et maximales, tous les calculs ayant été faits pour obtenir la mesure, ainsi que la norme d'essai ayant été utilisée.

5.14.2 Applications

Le message MeasurementDetails sert à obtenir des informations précises sur une ou plusieurs classes filles Measurement. L'interrogation et l'obtention par un système d'analyse des actifs d'informations sur les données Measurement qu'il souhaite traiter sont des applications courantes de ce message. Cet échange est semblable à celui de la Figure 72, en remplaçant le message ProcedureDataSets par le message MeasurementDetails.

5.14.3 Format du message

La Figure 79 représente le format de message MeasurementDetails. Il peut contenir une multiplicité d'éléments qui sont des spécialisations de Measurement. La Figure 80 représente un élément de ce type, Analog, qui contient les attributs Measurement tels que les informations unitaires et les attributs supplémentaires appartenant à la spécialisation, tels que maxValue et minValue. CalculationMethodHierarchy peut être incorporée pour donner des informations sur les calculs effectués (représentés plus loin sur la Figure 81).

La Figure 82 représente un autre exemple, un élément du type AssetTemperaturePressureAnalog. En plus des attributs d'Analog, elle présente également des attributs tels que "kind", detectionLimit et "precision". De plus, l'élément TestStandard peut être incorporé pour donner les informations de la norme d'essais qui a été utilisée pour obtenir la mesure (représentés plus loin sur la Figure 83).

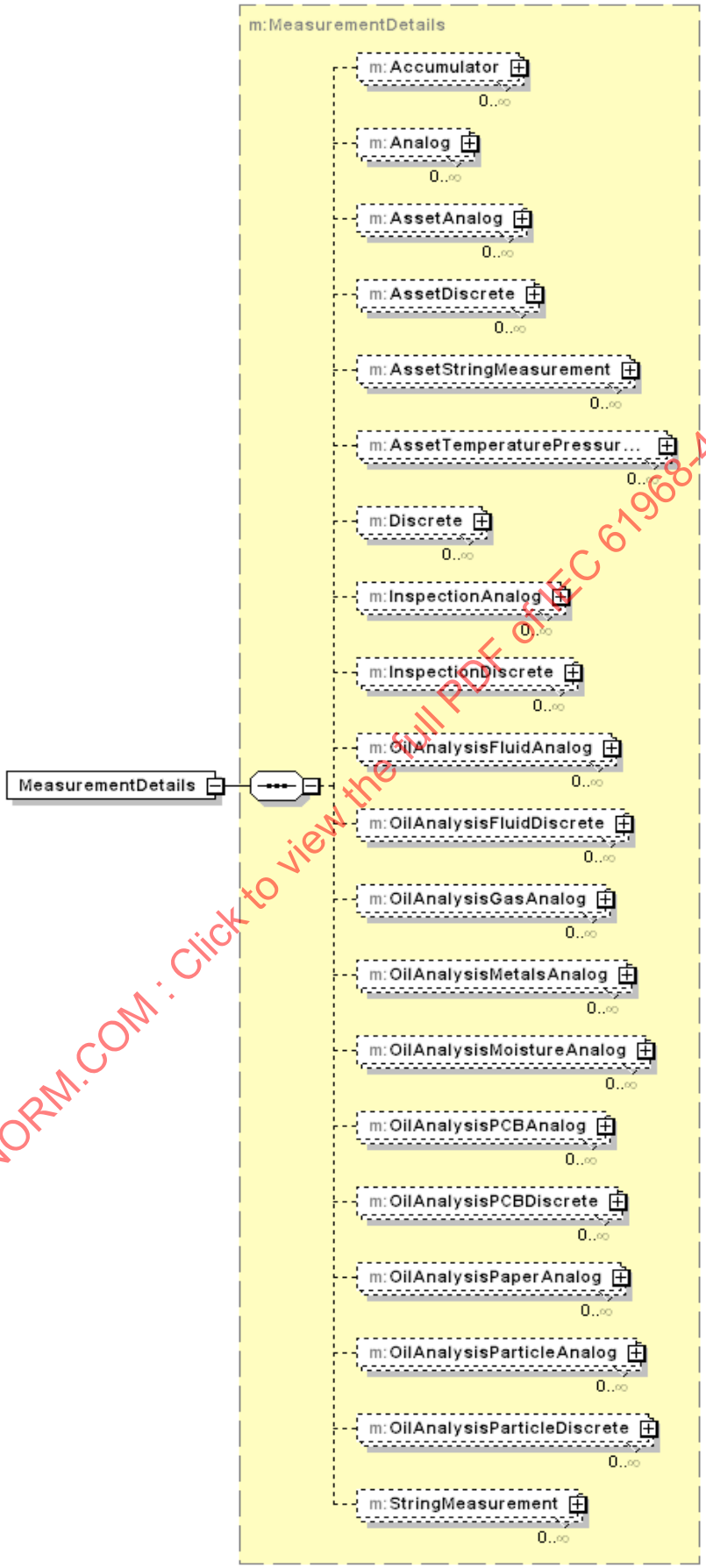


Figure 79 – Format de message MeasurementDetails

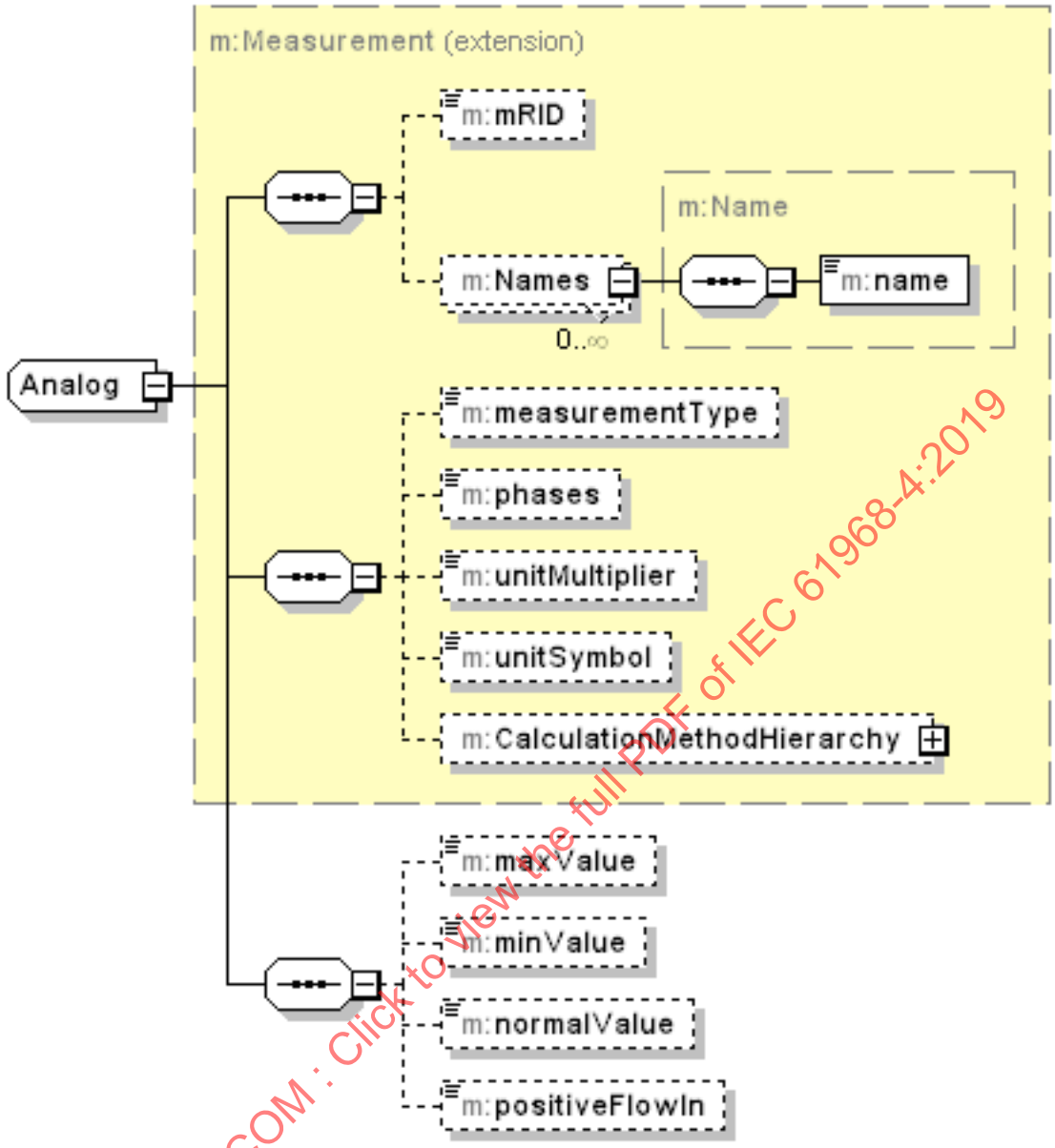


Figure 80 – Format de message MeasurementDetails: élément Analog

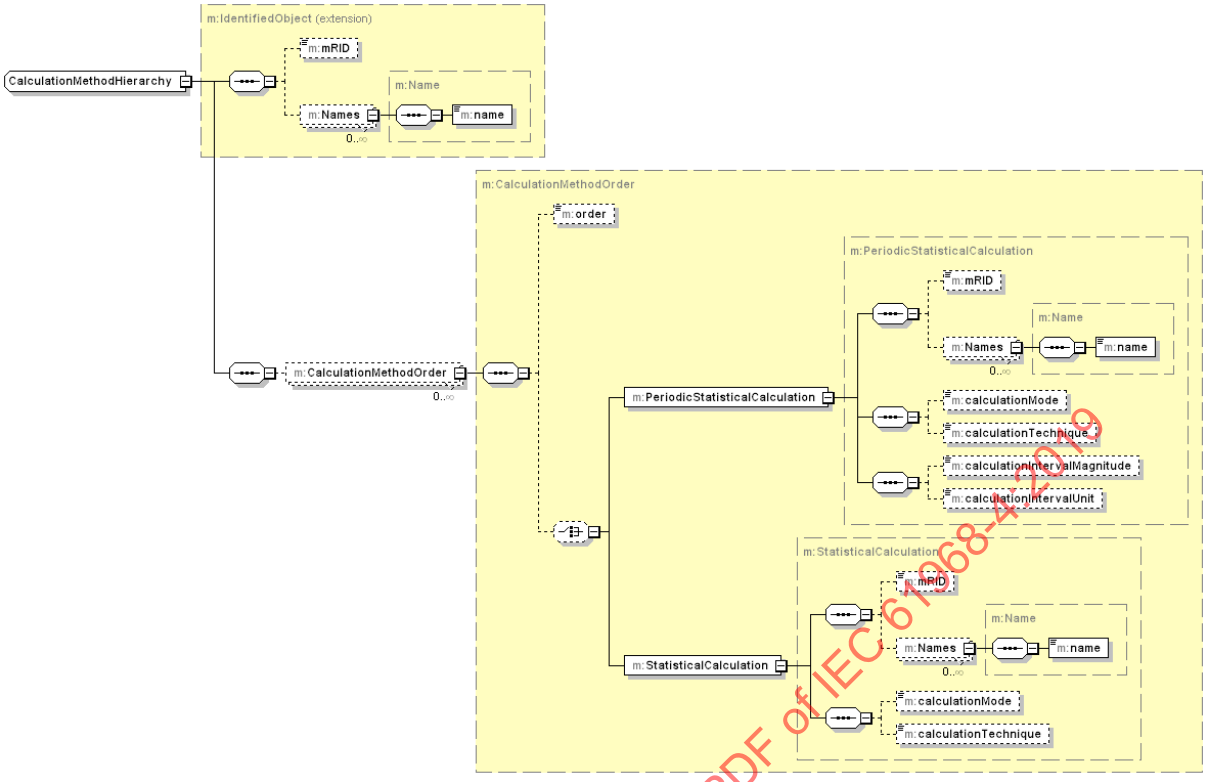


Figure 81 – Format de message MeasurementDetails: élément CalculationMethodHierarchy

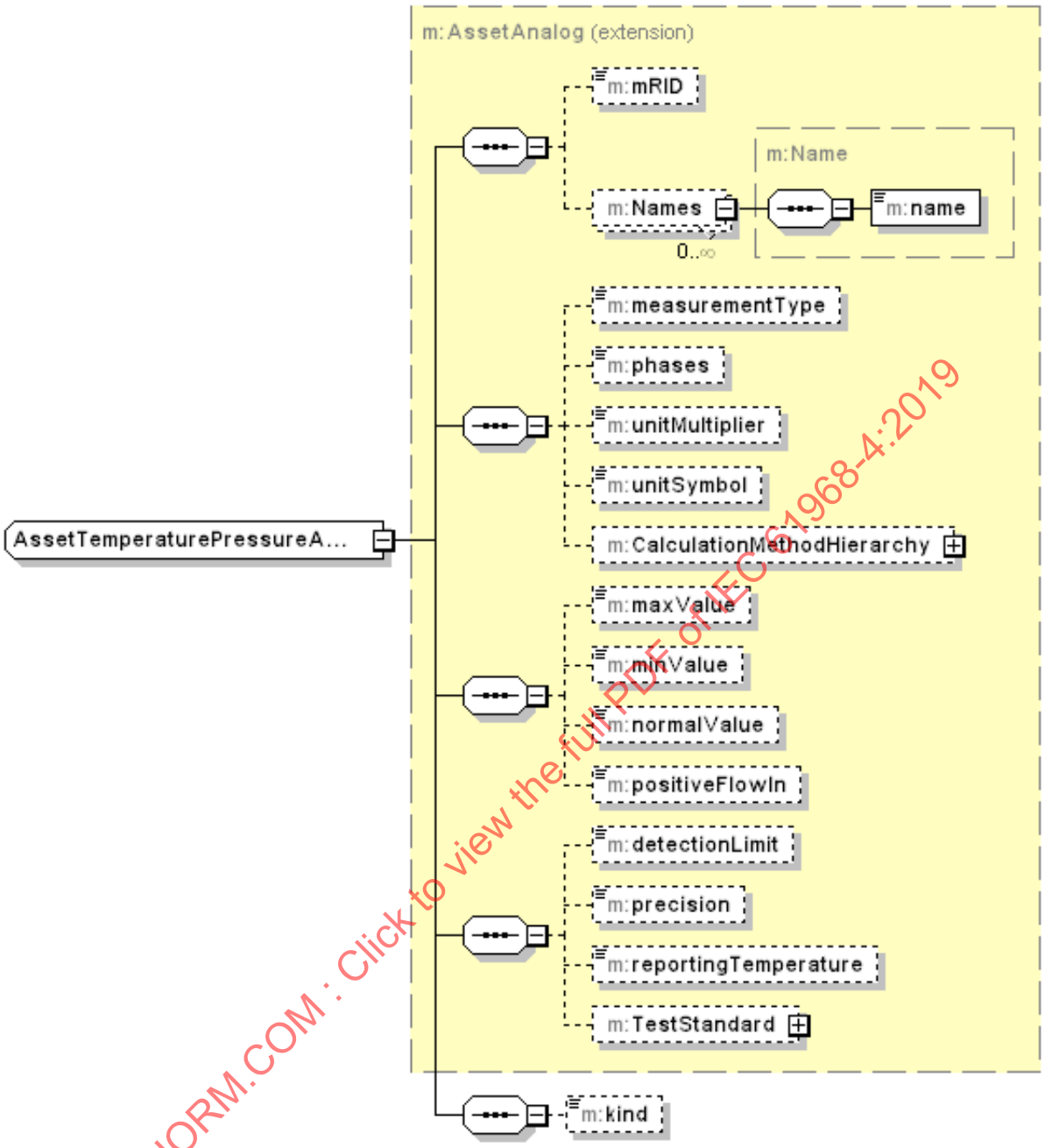


Figure 82 – Format de message MeasurementDetails: élément AssetTemperaturePressureAnalog

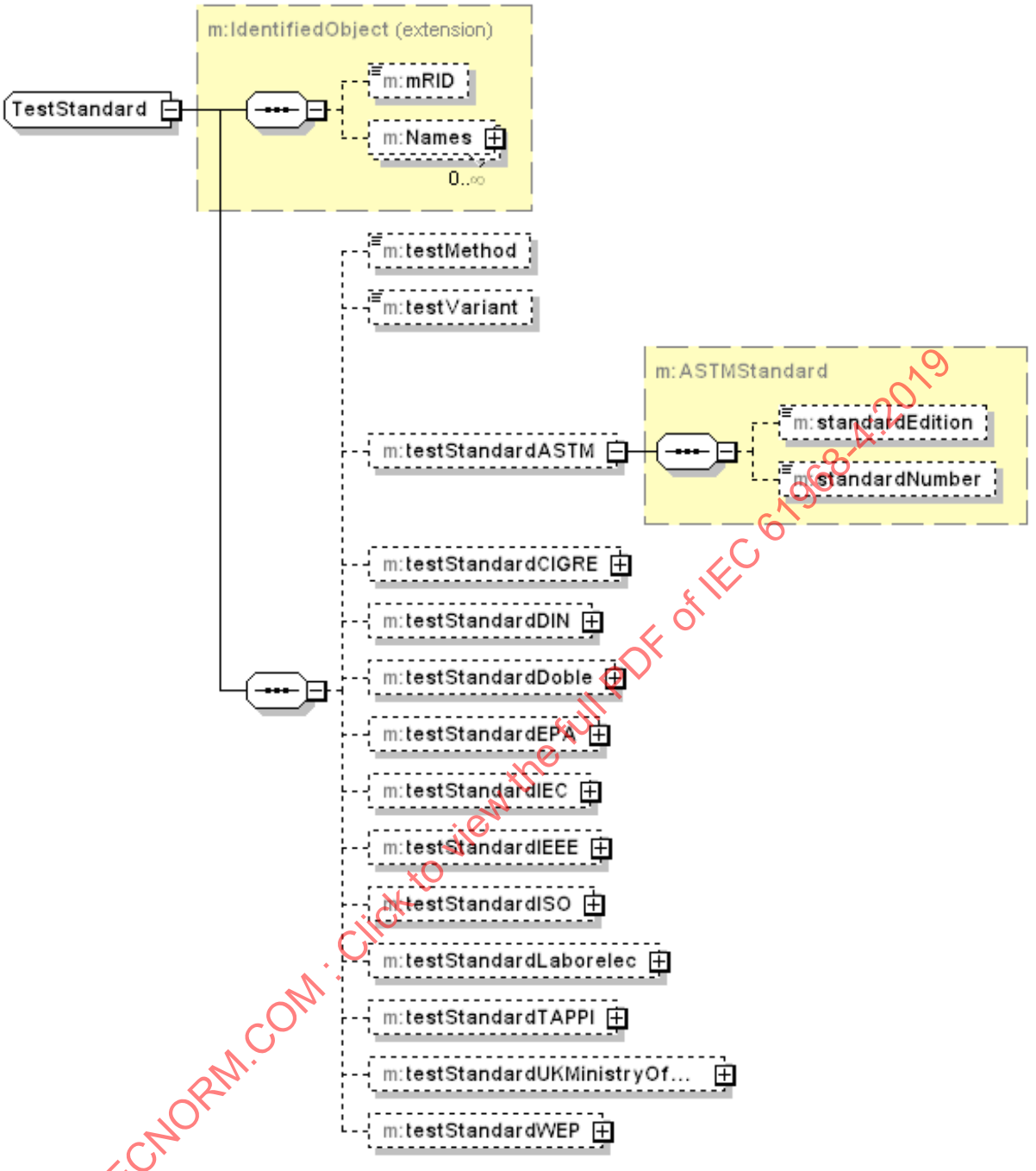


Figure 83 – Format de message MeasurementDetails: élément TestStandard

L'exemple qui suit est un exemple XML pour la charge utile d'un message MeasurementDetails. Il comporte une OilAnalysisGasAnalog de type (kind) totalCombustibleGasPercent, qui a été identifié pour la première fois dans l'exemple XML du 5.13.3.

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Sample XML file generated by XMLSpy v2016 sp1 (http://www.altova.com)-->
<m:MeasurementDetails xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# MeasurementDetails.xsd">

      <m:OilAnalysisGasAnalog>
            <m:mRID> f5d3fc3d-041e-44c7-bda1-0c75b7c89a05</m:mRID>
            <m:unitMultiplier>none</m:unitMultiplier>
            <m:unitSymbol>none</m:unitSymbol>
            <m:maxValue>100</m:maxValue>
            <m:minValue>0</m:minValue>
            <m:normalValue>1.5</m:normalValue>
            <m:CalculationMethodHierarchy>
                  <m:CalculationMethodOrder>
                        <m:order>0</m:order>
                        <m:PeriodicStatisticalCalculation>
                              <m:calculationMode>period</m:calculationMode>
                              <m:calculationTechnique>average</m:calculationTechnique>

      <m:calculationIntervalMagnitude>1</m:calculationIntervalMagnitude>
                              <m:calculationIntervalUnit>day</m:calculationIntervalUnit>
                        </m:PeriodicStatisticalCalculation>
                  </m:CalculationMethodOrder>
            </m:CalculationMethodHierarchy>
            <m:kind>totalCombustibleGasPercent</m:kind>
      </m:OilAnalysisGasAnalog>

</m:MeasurementDetails>
```

5.15 Message MeasurementValues

5.15.1 Généralités

Un message MeasurementValues peut contenir des MeasurementValues. Tandis que les messages relatifs aux procédures et aux mesures tels que AssetProcedures, Procedures, AssetMeasurements et MeasurementDetails servent à différentes informations relatives à des données mesurables liées aux actifs, la valeur effective qui a été mesurée est obtenue à l'aide du message MeasurementValues.

5.15.2 Applications

Le message MeasurementValues sert à obtenir un ou plusieurs objets qui sont des spécialisations de MeasurementValue. L'interrogation et l'obtention par un système d'analyse des actifs des valeurs de mesure qu'il souhaite traiter sont des applications courantes de ce message. Cet échange est semblable à celui qui est représenté sur la Figure 72, en remplaçant le message ProcedureDataSets par le message MeasurementValues.

5.15.3 Format du message

La Figure 84 représente le format de message MeasurementValues. Il peut contenir une multiplicité d'éléments qui sont des spécialisations de MeasurementValue, à savoir AccumulatorValue, AnalogValue, DiscreteValue ou StringValue.

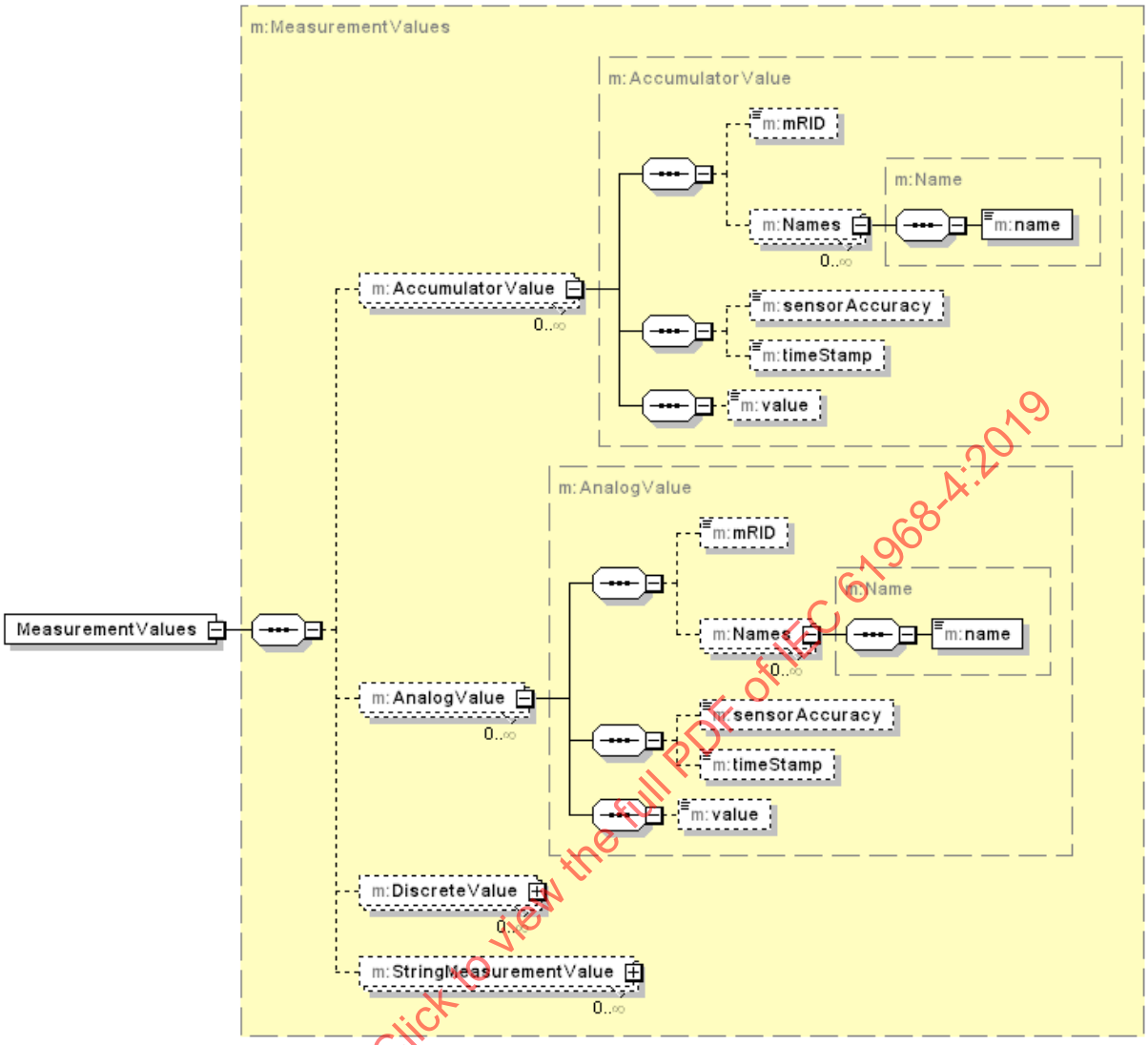


Figure 84 – Format de message MeasurementValues

L'exemple qui suit est un exemple XML pour la charge utile d'un message MeasurementValues. Il comporte une AnalogValue à trois instances timeStamp différentes. Noter que cette AnalogValue a été identifiée pour la première fois dans l'exemple XML du 5.13.3 en tant que valeur associée à une OilAnalysisGasAnalog du type (kind) totalCombustibleGasPercent.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:MeasurementValues xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# MeasurementValues.xsd">
      <m:AnalogValue>
            <m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
            <m:timeStamp>2015-12-14T09:00:00Z</m:timeStamp>
            <m:value>3.5</m:value>
      </m:AnalogValue>
            <m:AnalogValue>
            <m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
            <m:timeStamp>2015-12-15T09:00:00Z</m:timeStamp>
            <m:value>3.7</m:value>
      </m:AnalogValue>
            <m:AnalogValue>
            <m:mRID>9343e63b-fcb1-4fb3-9e9a-e9b519754c13</m:mRID>
            <m:timeStamp>2015-12-16T09:00:00Z</m:timeStamp>
            <m:value>4.1</m:value>
      </m:AnalogValue>
</m:MeasurementValues>
```

5.16 Message Analytics

5.16.1 Généralités

Un message Analytics peut contenir la description d'une analyse, comme les attributs qui décrivent l'analyse, et les Assets et/ou AssetGroups auxquels l'analyse s'applique. Les résultats d'évaluation effectifs de l'analyse sont obtenus à partir des messages AssetAnalytics et AssetGroupAnalytics. Les notifications liées aux événements concernant l'état des actifs sont obtenues à partir de l'analyse au moyen du message AssetHealthEvents.

5.16.2 Applications

Le message Analytics sert à échanger des informations sur les analyses concernées. Un élément Analytic dans ce message peut aussi contenir des informations d'identification des Assets et/ou des AssetGroups auxquels l'analyse s'applique.

L'acheminement par un système d'analyse des actifs des informations de l'analyse qu'il effectue, comme le montre la Figure 85, est une application courante de ce message. Sur cette figure, différents systèmes tels que des systèmes d'inventaire de postes, un système de maintenance et d'inspection et un système de surveillance du réseau interrogent un système d'analyse d'actifs pour obtenir des informations sur ses capacités analytiques.

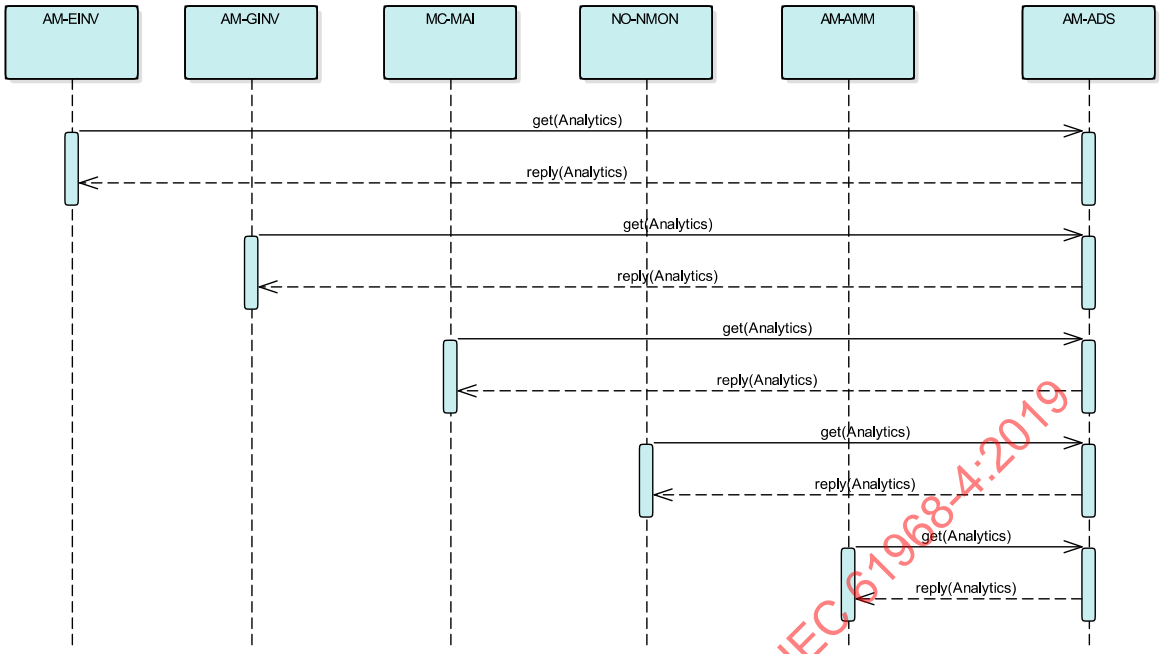


Figure 85 – Échange de messages Analytics

5.16.3 Format du message

La Figure 86 représente le format de message Analytics. La charge utile du message représenté sur la figure est constituée d'une ou plusieurs Analytics, avec leurs attributs. Comme le montre la figure, l'élément Analytics peut contenir des informations d'identification pour les Assets et/ou les AssetGroups auxquels l'analyse s'applique.

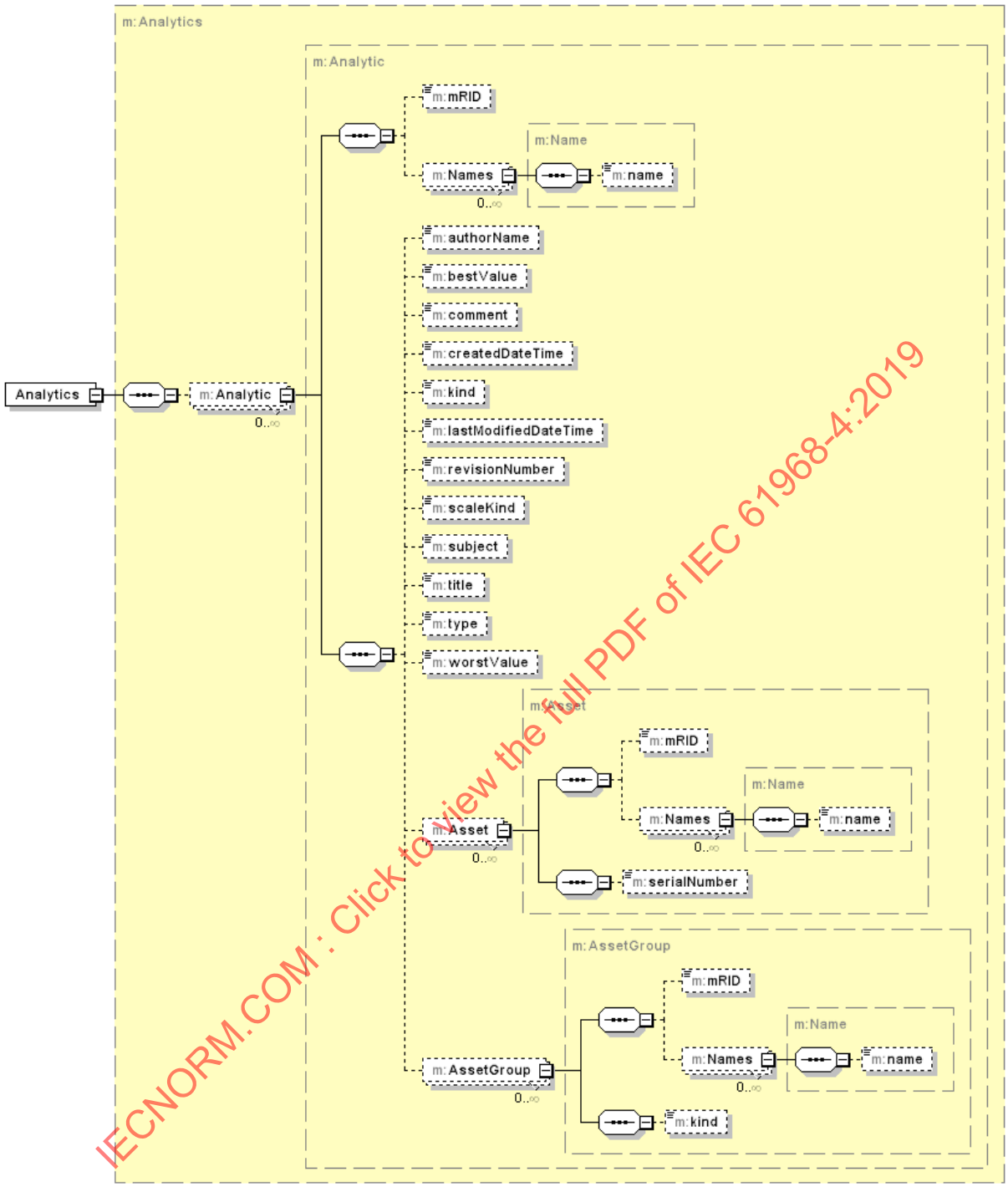


Figure 86 – Format de message Analytics

L'exemple qui suit est un exemple XML pour la charge utile d'un message Analytics. Cela décrit une analyse consistant en une analyse de santé (Analytic.kind = healthAnalytic) et comprend également la liste des Assets auxquels l'analyse s'applique.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:Analytics xmlns:m="http://iec.ch/TC57/2007/profile#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2007/profile# Analytics.xsd">
      <m:Analytic>
            <m:mRID> df37a60e-d8b7-49e5-8c12-93af7c58d257</m:mRID>
            <m:createdDateTime>2001-12-17T09:30:47Z</m:createdDateTime>
            <m:kind>healthAnalytic</m:kind>
            <m:lastModifiedDateTime>2010-06-03T10:22:14Z</m:lastModifiedDateTime>
            <m:revisionNumber>2.1</m:revisionNumber>
            <m:title>Dielectric Health</m:title>
            <m:Asset/>
<m:mRID>e0be245f-92d8-4817-8672-48710e3835f2</m:mRID>
            </m:Asset>
            <m:Asset/>
<m:mRID>6a9fb099-e67d-4c33-88f4-aa3e479ec1da</m:mRID>
            </m:Asset>
      </m:Analytic>
</m:Analytics>
```

5.17 Message AssetAnalytics

5.17.1 Généralités

Un message AssetAnalytics peut contenir les informations de plusieurs analyses applicables à des actifs, ainsi que les résultats générés par ces analyses sur l'évaluation de l'état du type d'actif et le risque associé.

5.17.2 Applications

Le message AssetAnalytics sert à échanger des évaluations sur un ou plusieurs actifs. Ces estimations peuvent, par exemple, être des indicateurs de santé/d'état des actifs ou du risque lié aux actifs sous la forme de résultats quantitatifs d'évaluation. Ces estimations sont effectuées par analyse. Le message AssetAnalytics peut aussi servir à échanger des informations sur l'analyse.

L'acheminement par un système d'analyse des actifs de son évaluation des différents actifs est une application courante de ce message. De telles données indiquent l'état des actifs et les risques liés à ces actifs. Elles sont, par conséquent, précieuses pour la gestion des actifs. Le motif d'échange pour AssetAnalytics est identique à celui qui est représenté à la Figure 85, avec le message AssetAnalytics à la place du message Analytics. Différents systèmes tels que les systèmes d'inventaire des postes et d'inventaire géographique d'un poste, les systèmes de maintenance et d'inspection, ainsi que les systèmes de mesure et de surveillance des actifs interrogent un système d'analyse des actifs pour obtenir des évaluations relatives aux actifs concernés.

5.17.3 Format du message

La Figure 87 et la Figure 88 représentent le format de message AssetAnalytics. Ce message peut avoir une multiplicité d'objets Asset, qui peuvent contenir plusieurs objets Analytic pour décrire l'analyse appliquée à l'actif, plusieurs objets de type AnalyticScore et leurs objets fils pour acheminer les résultats d'évaluation attribués à l'actif, ainsi que plusieurs objets AssetHealthEvent qui décrivent les événements détectés par l'analyse et relatifs à l'actif concerné.

Les objets AssetScore, HealthScore et RiskScore sont représentés de la Figure 89 à la Figure 91. En plus d'une description quantitative du résultat obtenu, ces objets peuvent également contenir la référence à l'analyse qui a généré ce résultat d'évaluation. De plus, un objet HealthScore peut contenir une référence à un objet RiskScore qui en dépend, et l'objet RiskScore peut contenir des références à une multiplicité d'objets HealthScore qui ont été utilisés pour le calcul du RiskScore.