IEC 61968-4

Edition 2.0 2019-03

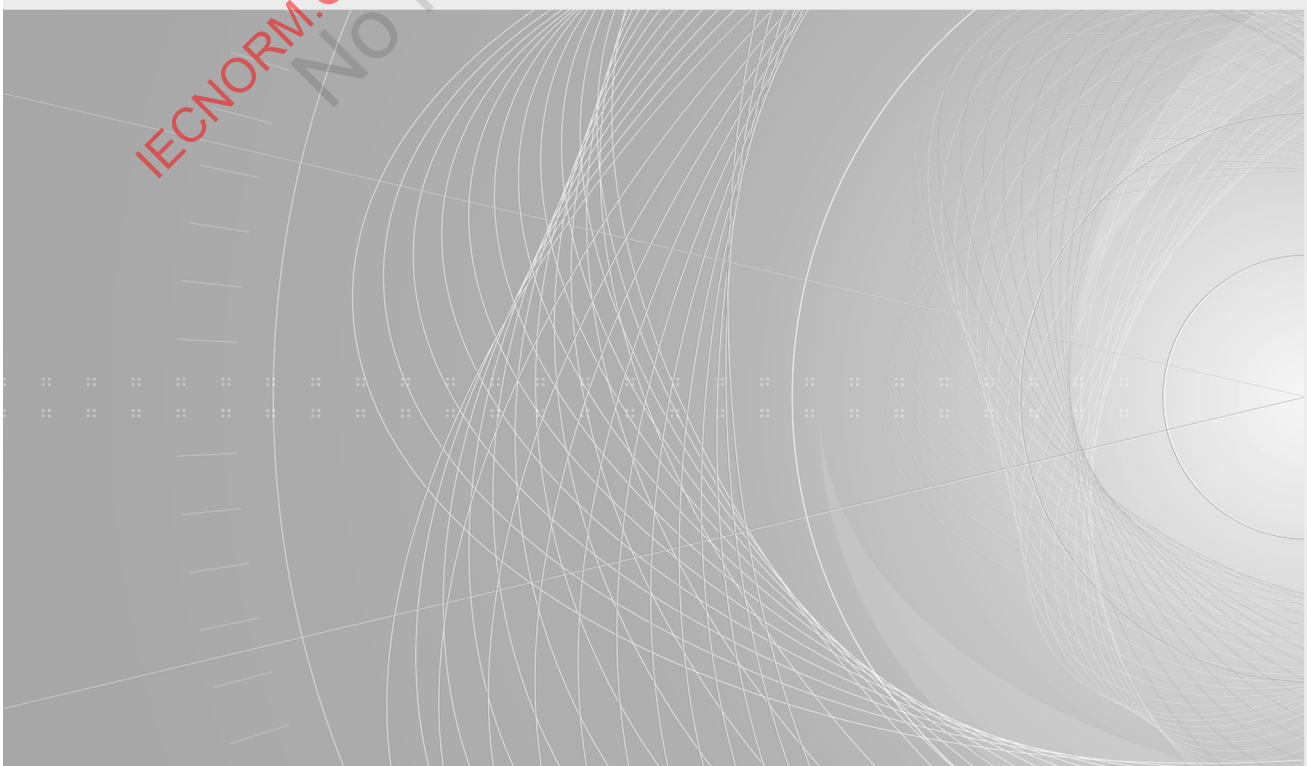
INTERNATIONAL STANDARD

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



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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a) removal of edition 1 profiles whose functionality has been superseded by other parts of IEC 61970 and IEC 61968 standards. In particular, NetworkDataSet and ChangeSet have been superseded by standards such as CDPSM (IEC 61968-13) and other ongoing efforts such as change modelling; and Presentation has been superseded by Diagram Layout Profile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.

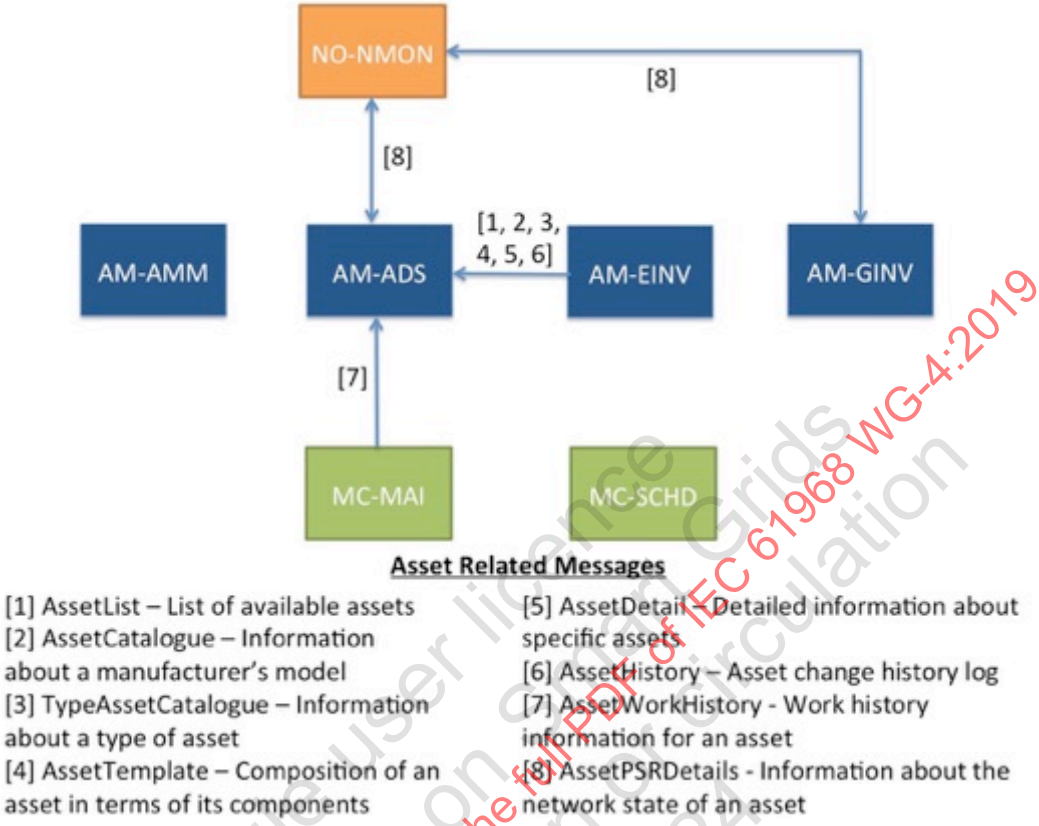

Figure 1 – Illustration of Asset-related message flows

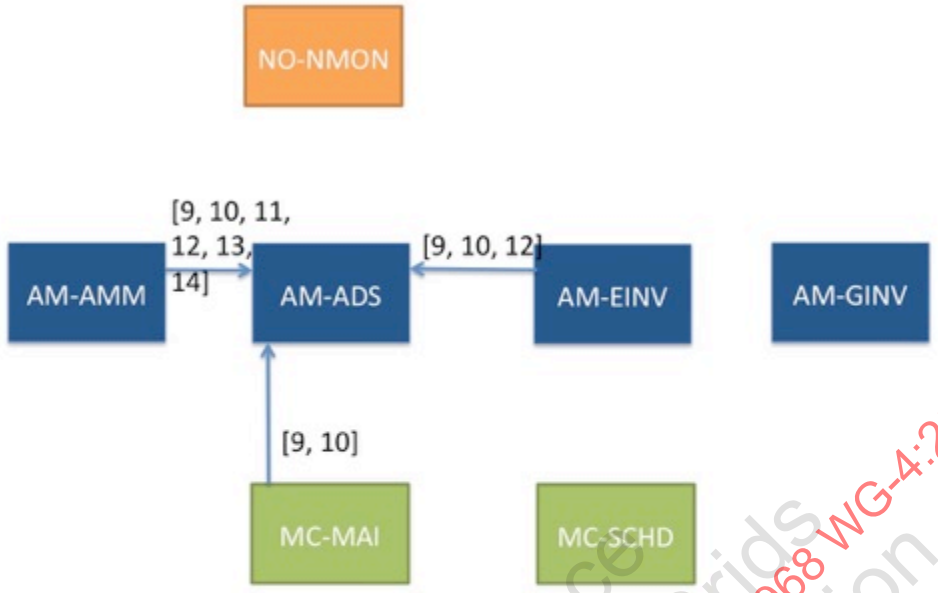

Figure 2 – Illustration of Measurements-related message flows

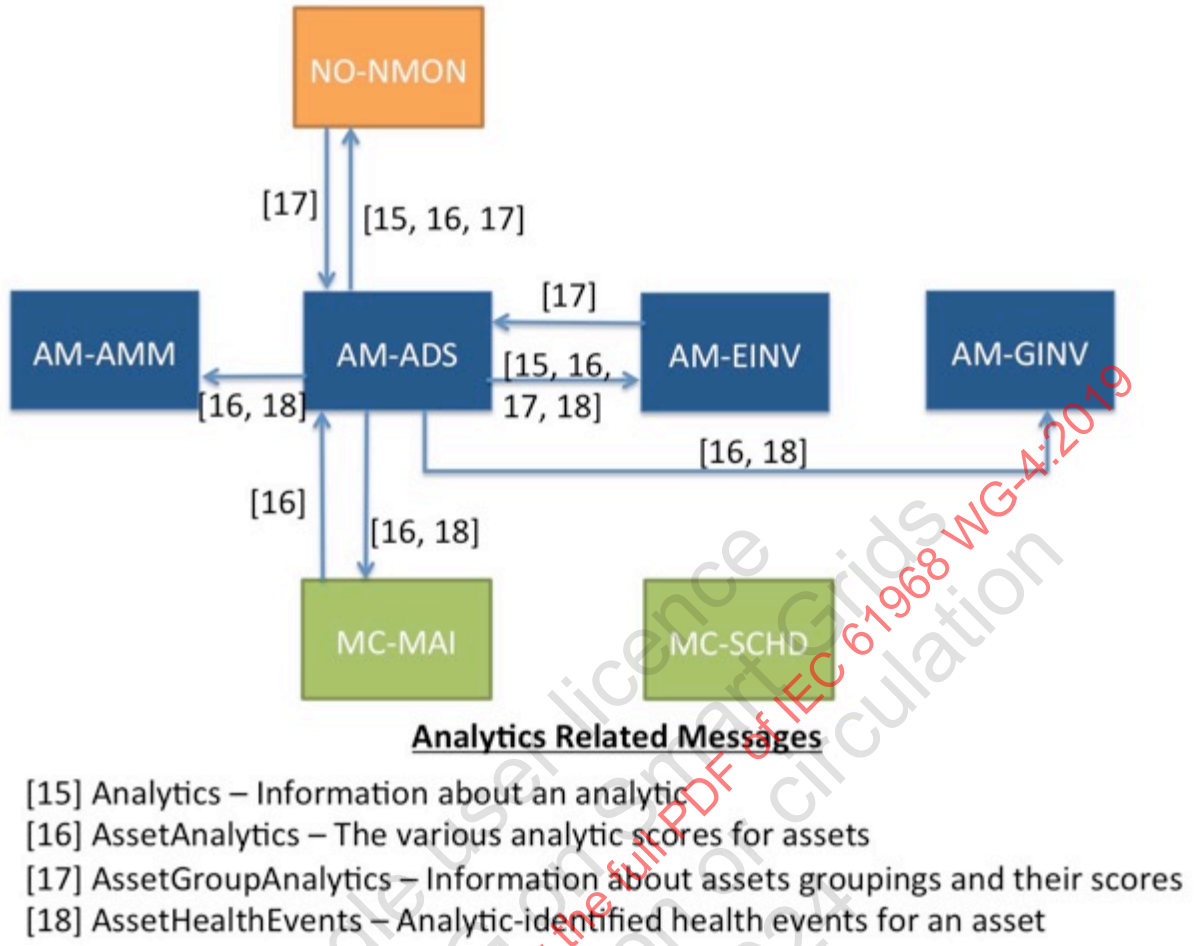

Figure 3 – Illustration of Analytics-related message flows

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.

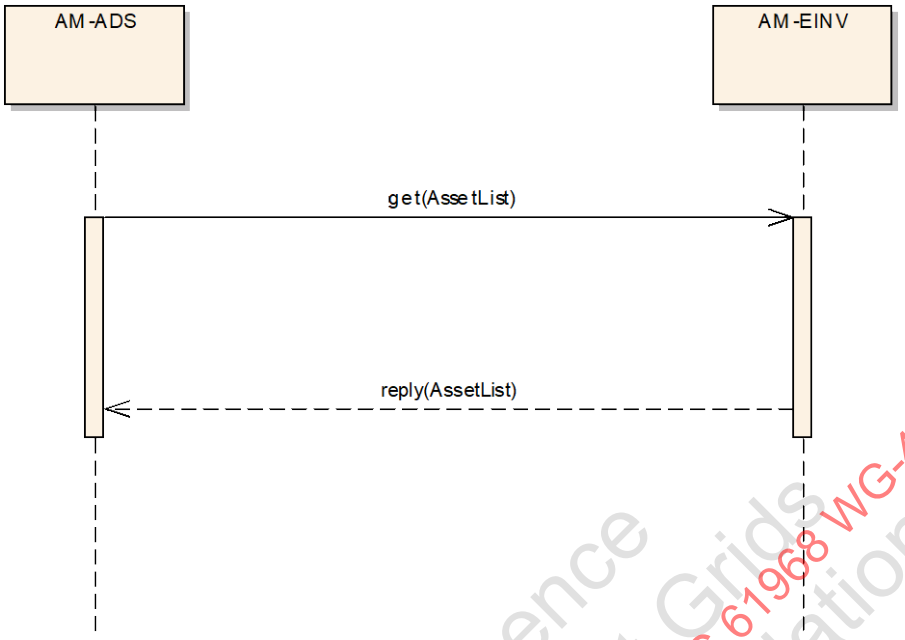


Figure 4 – AssetList message exchange

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.

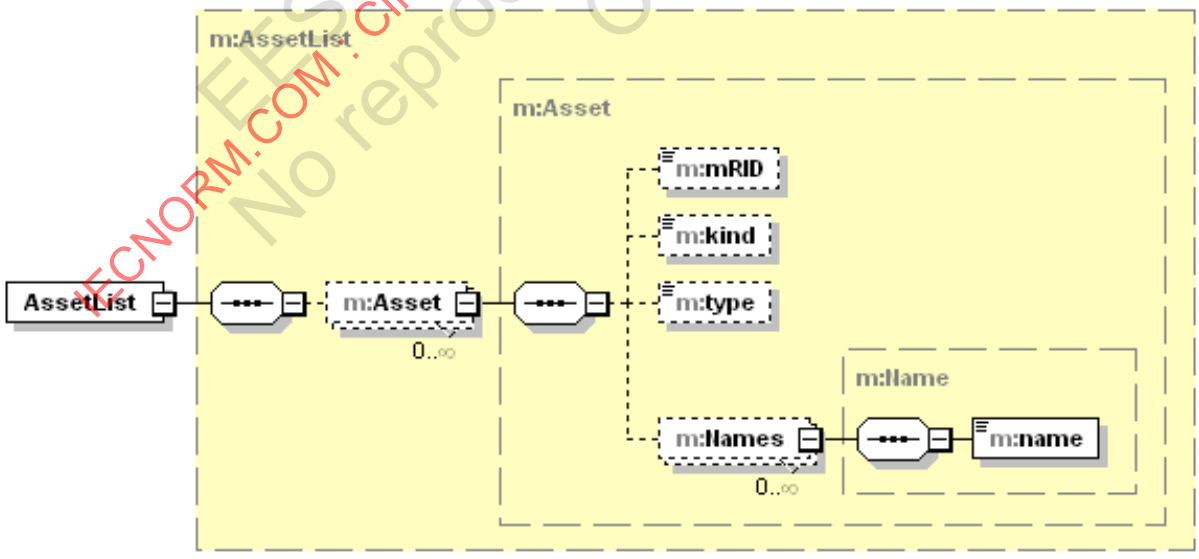


Figure 5 – AssetList message format

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.

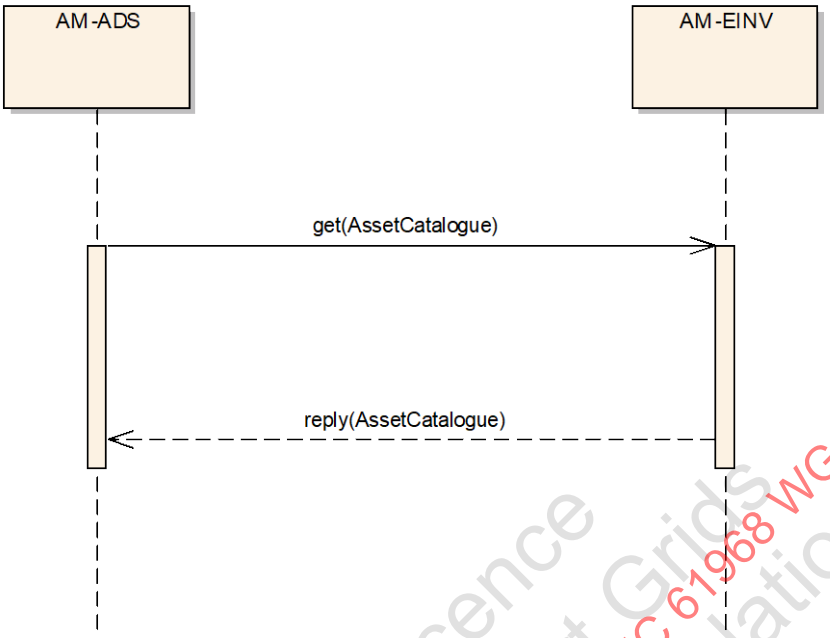


Figure 6 – AssetCatalogue message exchange

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.

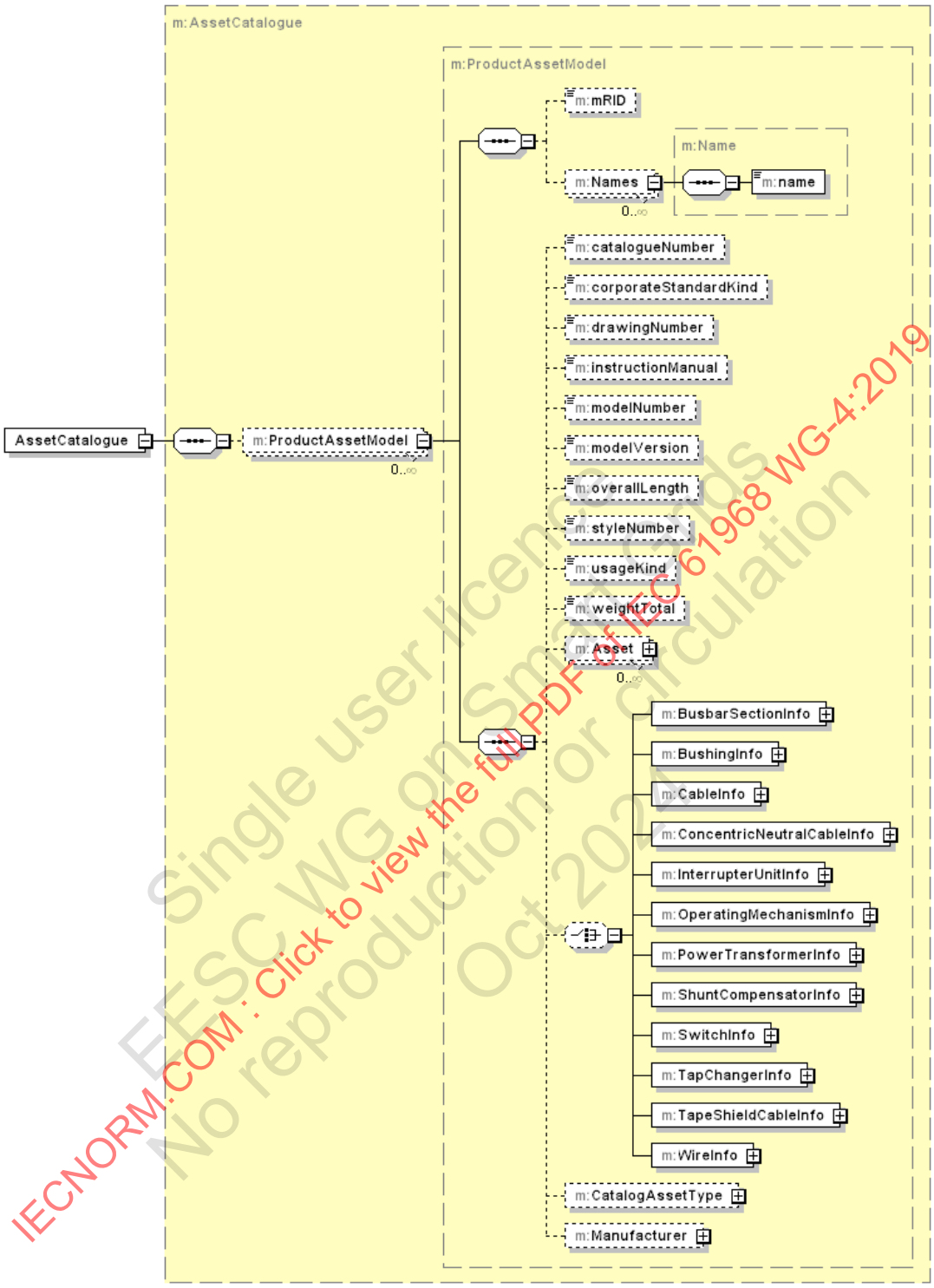


Figure 7 – AssetCatalogue message format

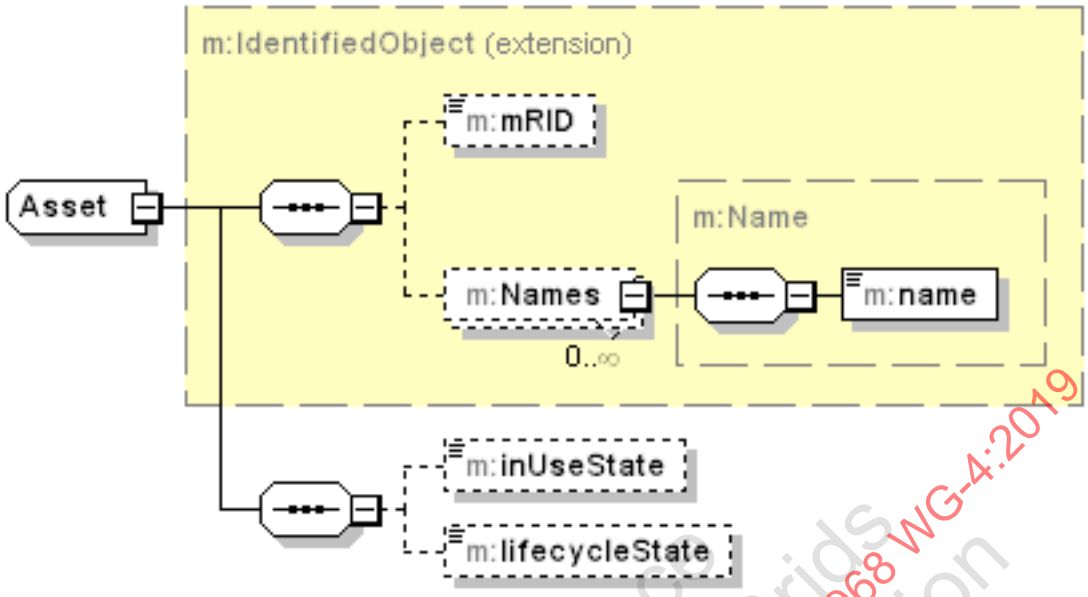


Figure 8 – AssetCatalogue message: Asset element

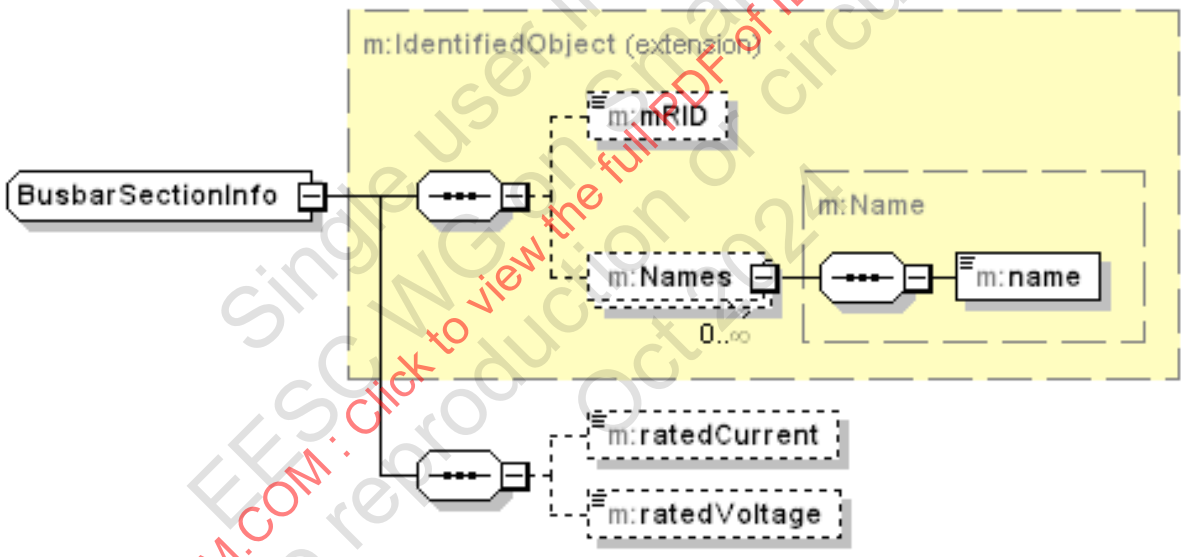


Figure 9 – AssetCatalogue message: BusbarSectionInfo element

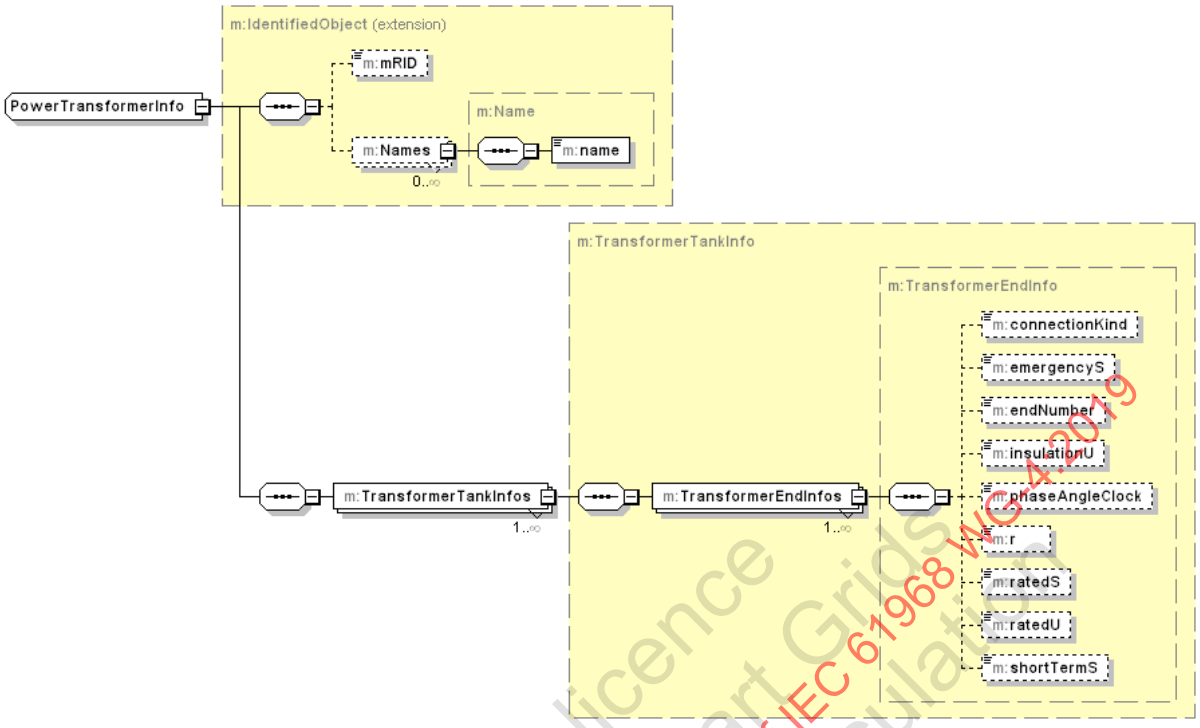


Figure 10 – AssetCatalogue message: PowerTransformerInfo element

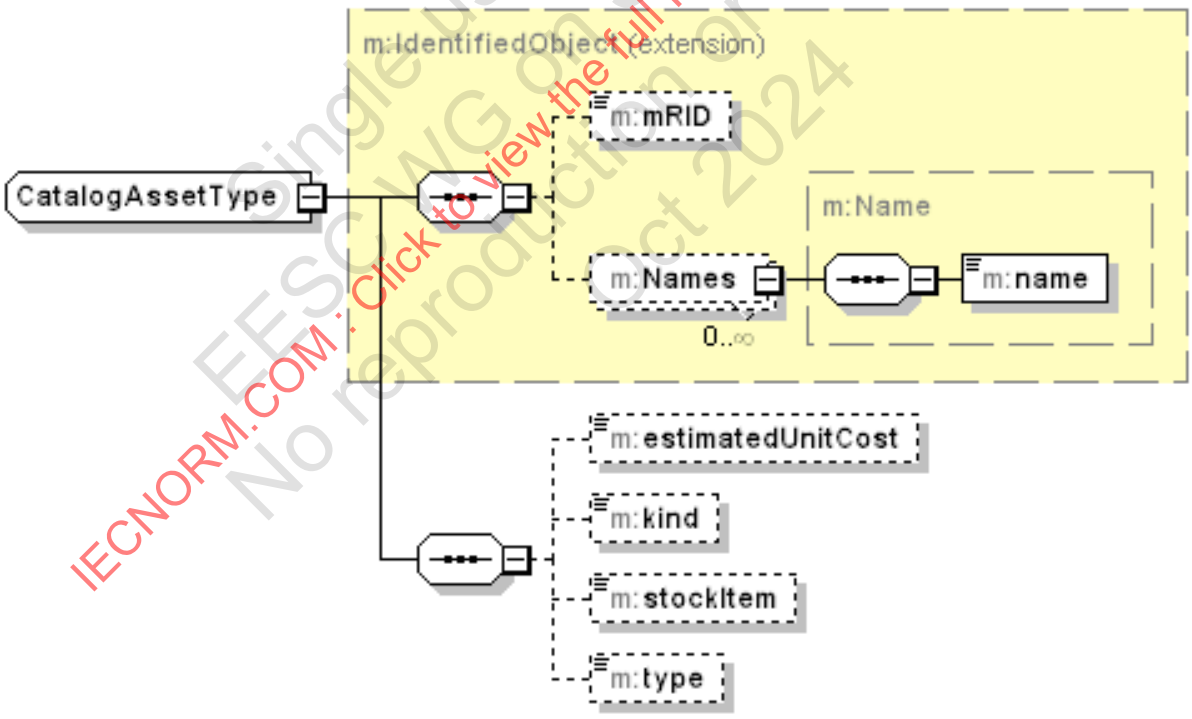


Figure 11 – AssetCatalogue message: CatalogAssetType element

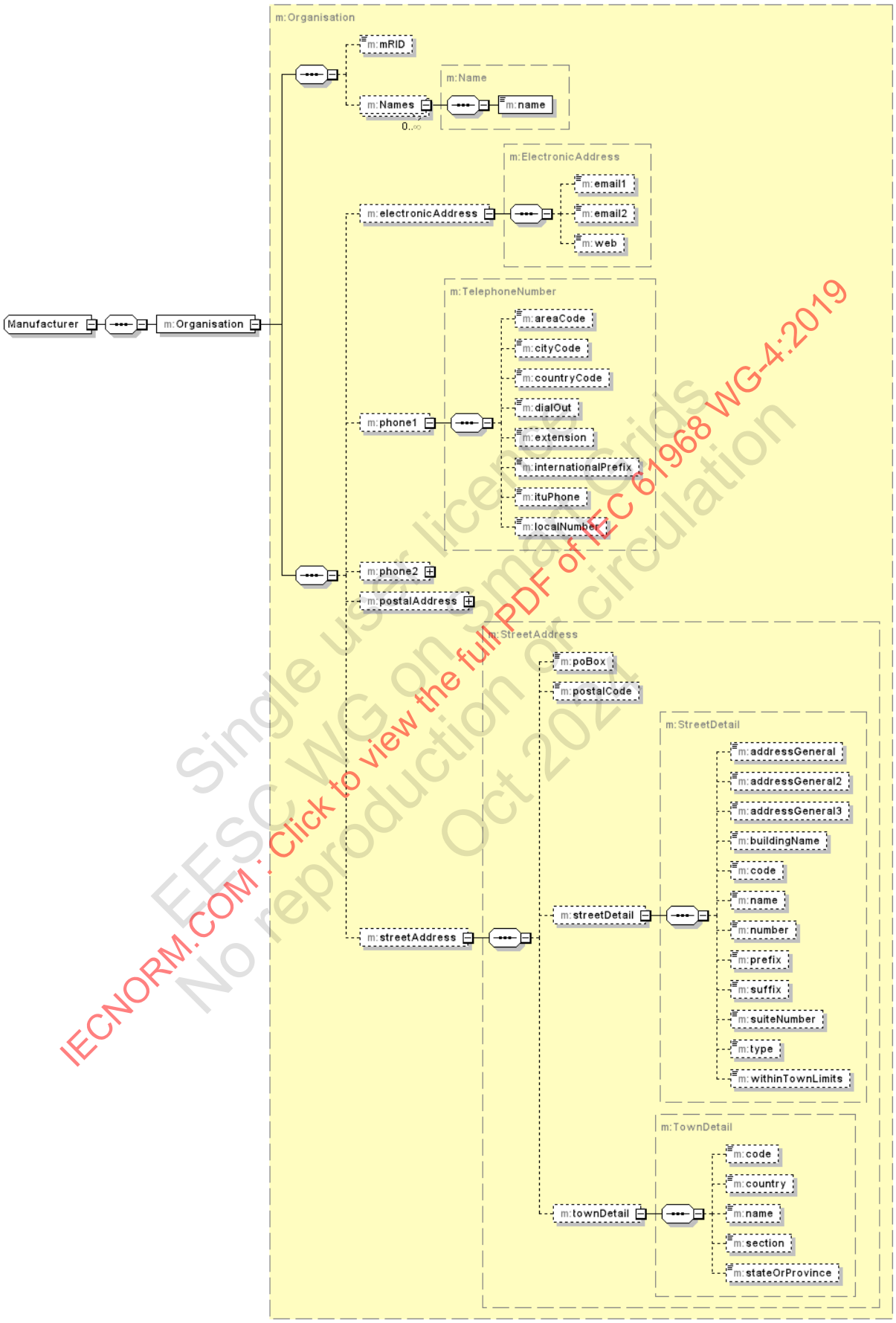


Figure 12 – AssetCatalogue message: Manufacturer element

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.

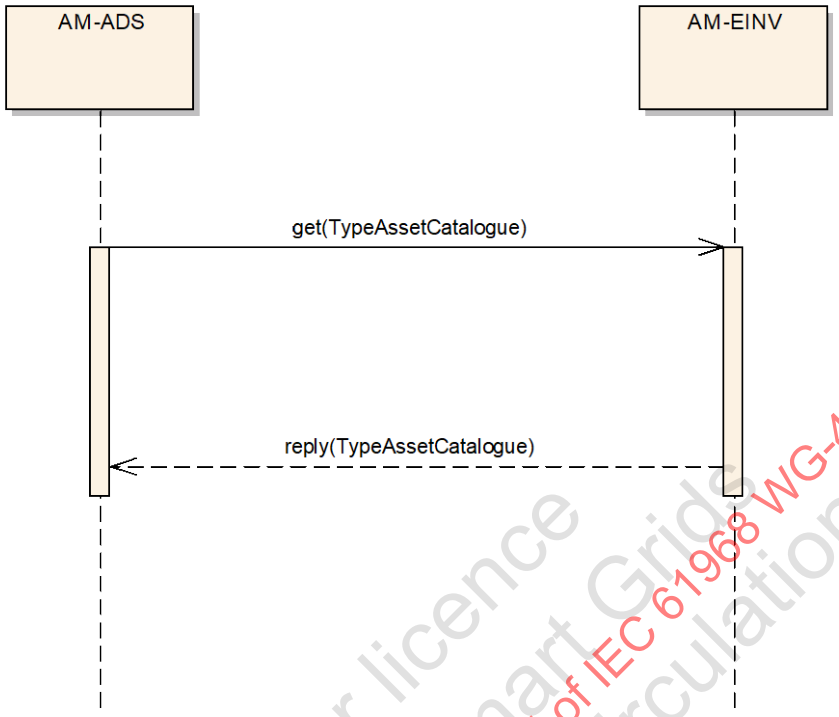


Figure 13 – Type Asset Catalogue message exchange

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.

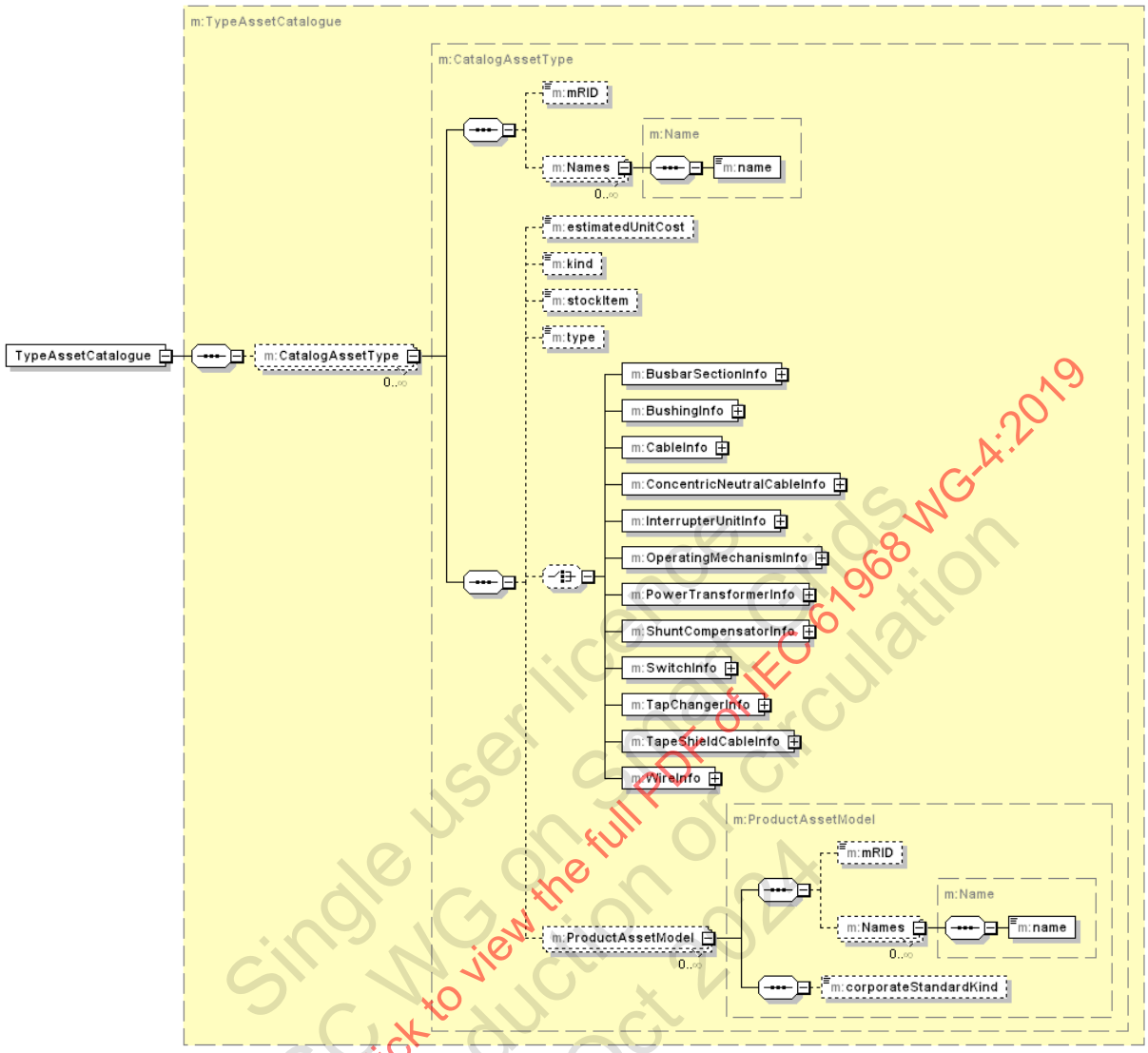


Figure 14 – TypeAssetCatalogue message format

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.

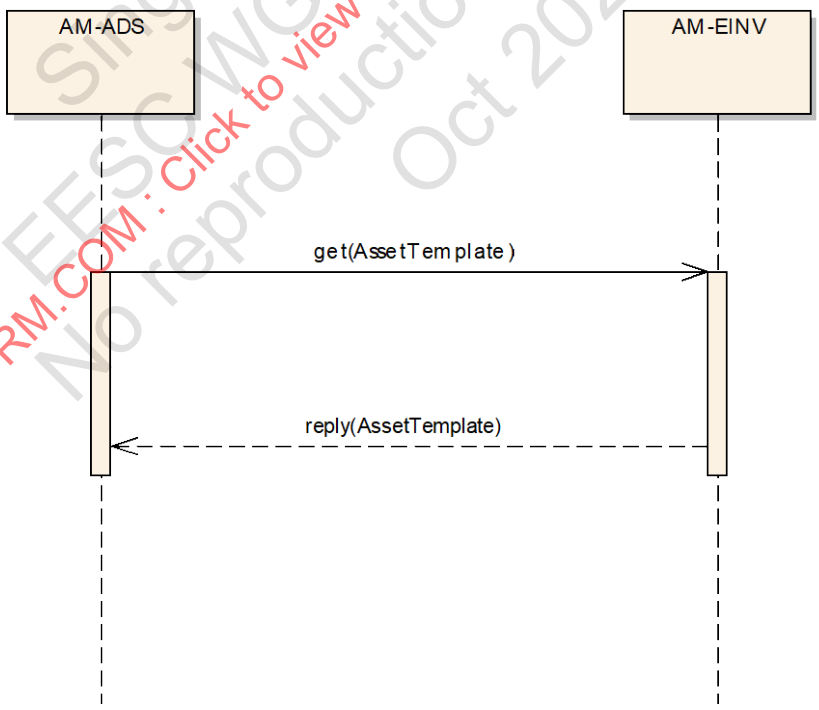


Figure 15 – Asset Template query exchange

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.

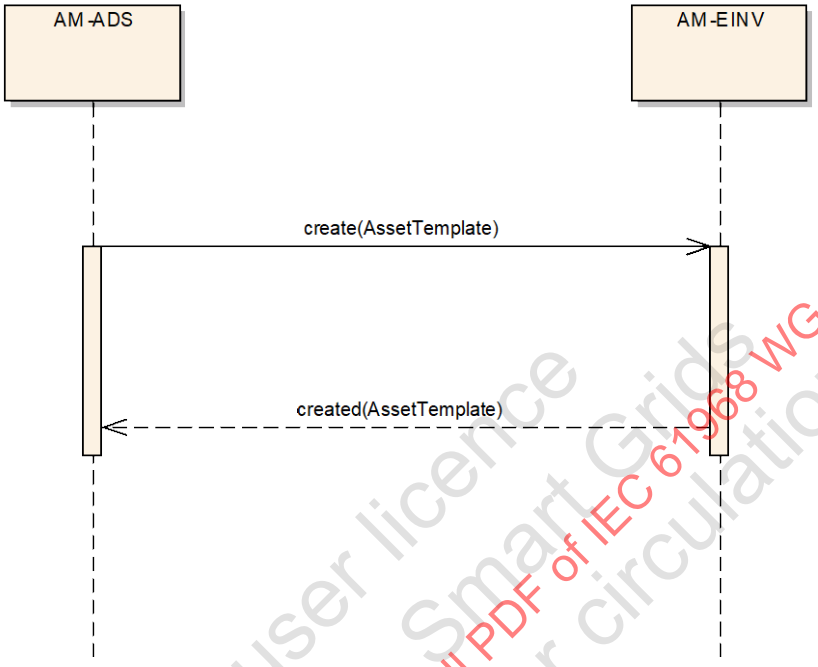


Figure 16 – Asset template creation exchange

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.

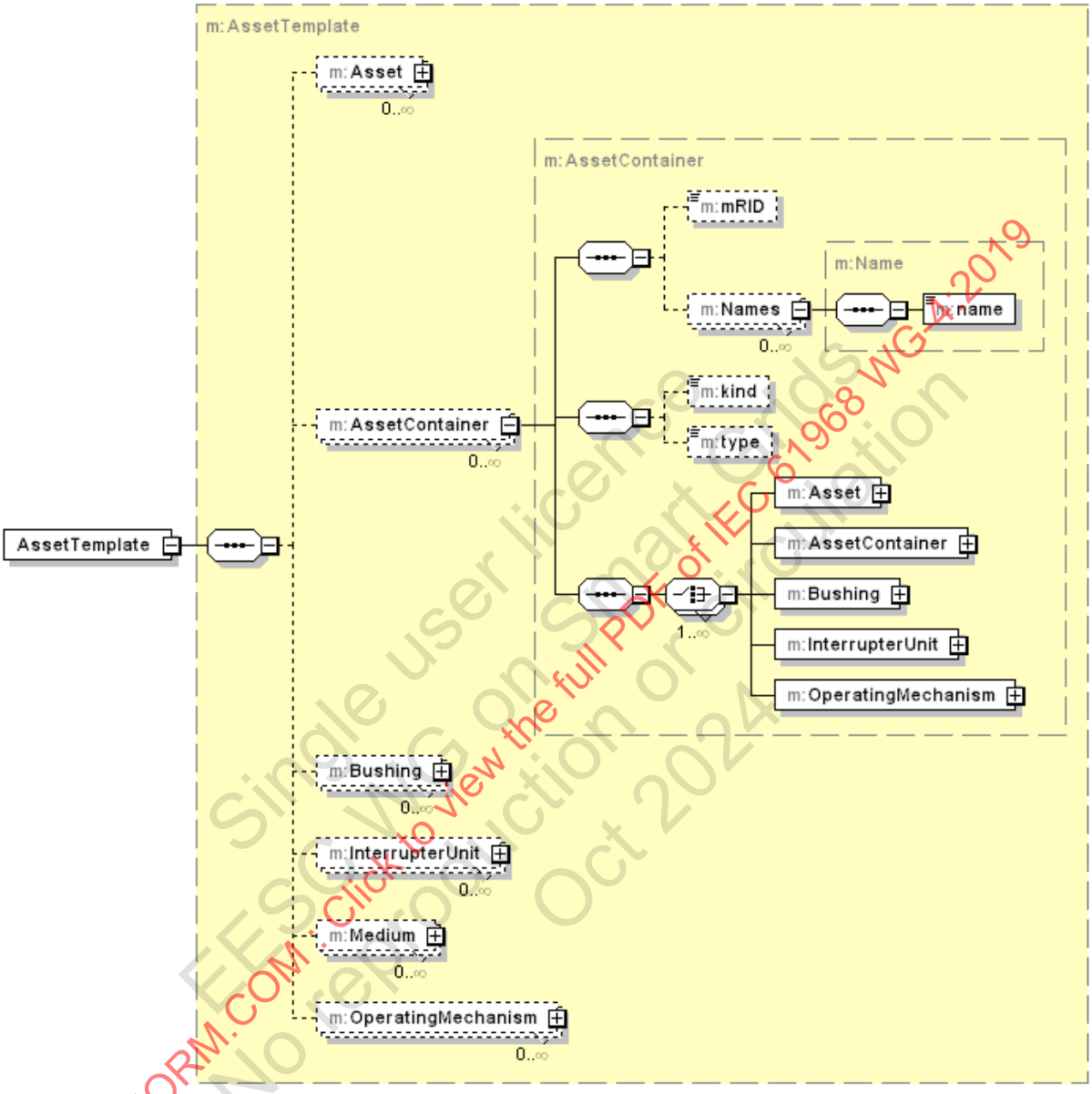


Figure 17 – AssetTemplate message showing the AssetContainer element

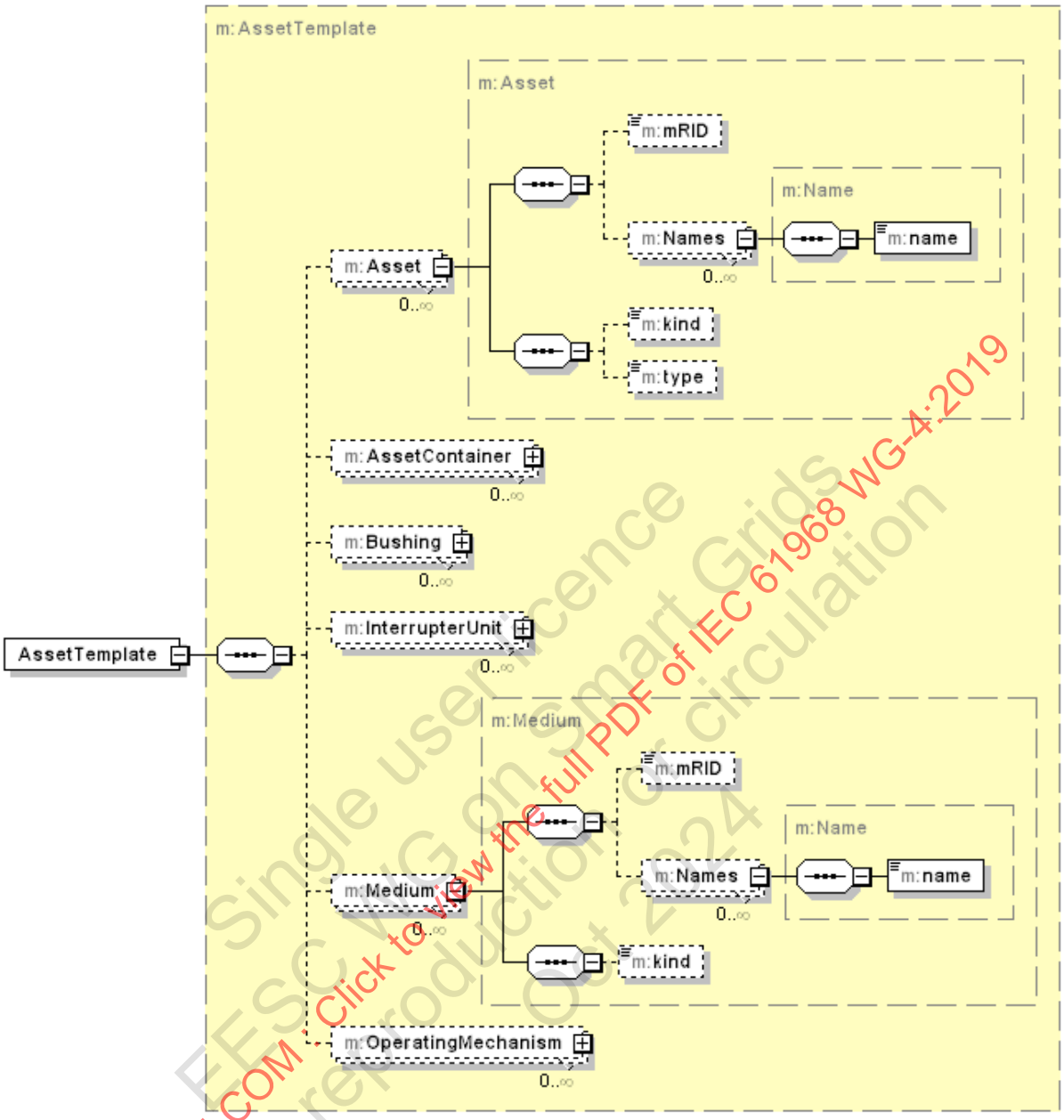


Figure 18 – AssetTemplate message showing the Asset and Medium elements

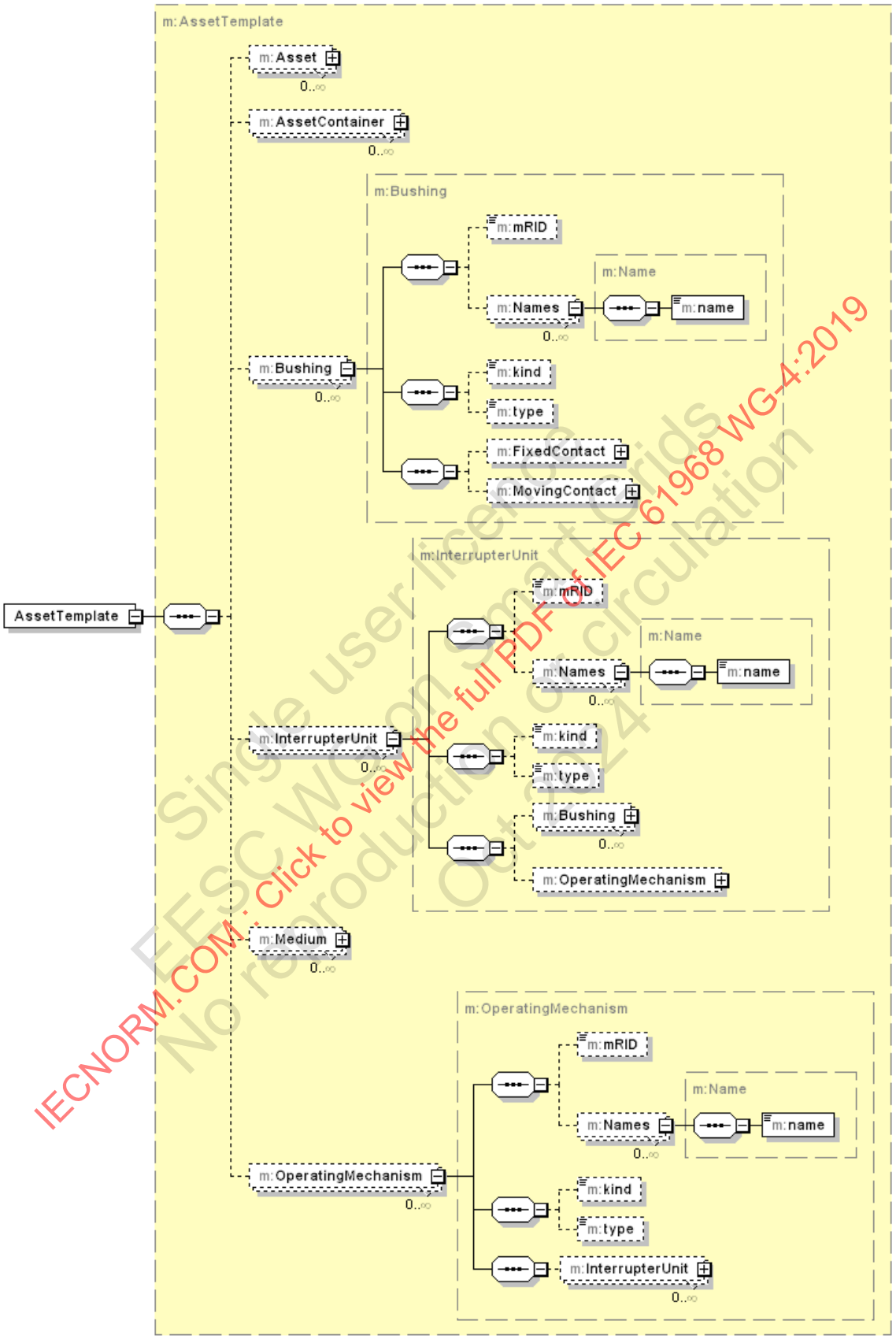


Figure 19 – AssetTemplate message showing the Bushing, InterrupterUnit, and OperatingMechanism elements

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


```xml
<?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.

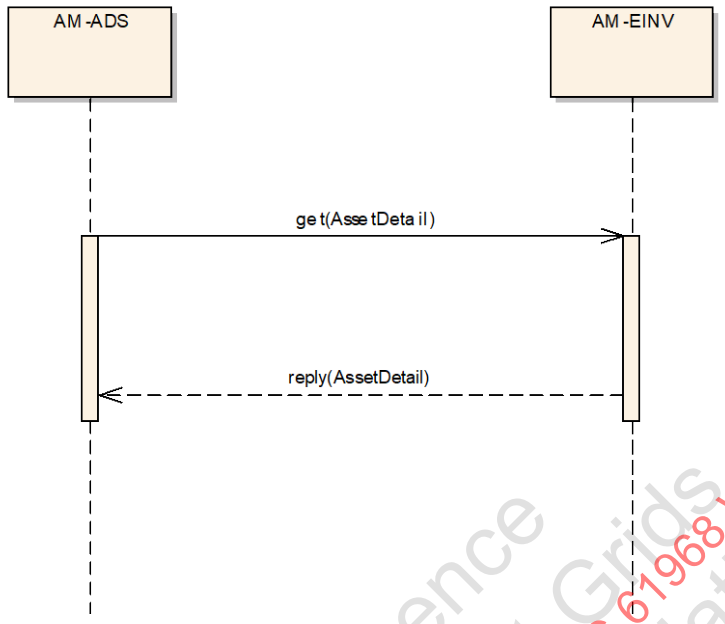


Figure 20 – Asset Detail message exchange

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).

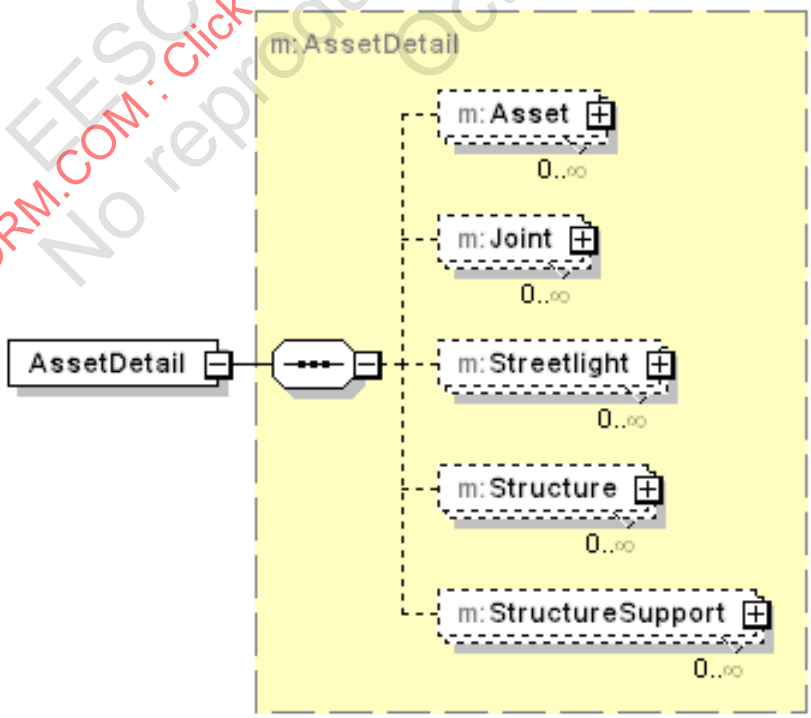


Figure 21 – Asset Detail message format

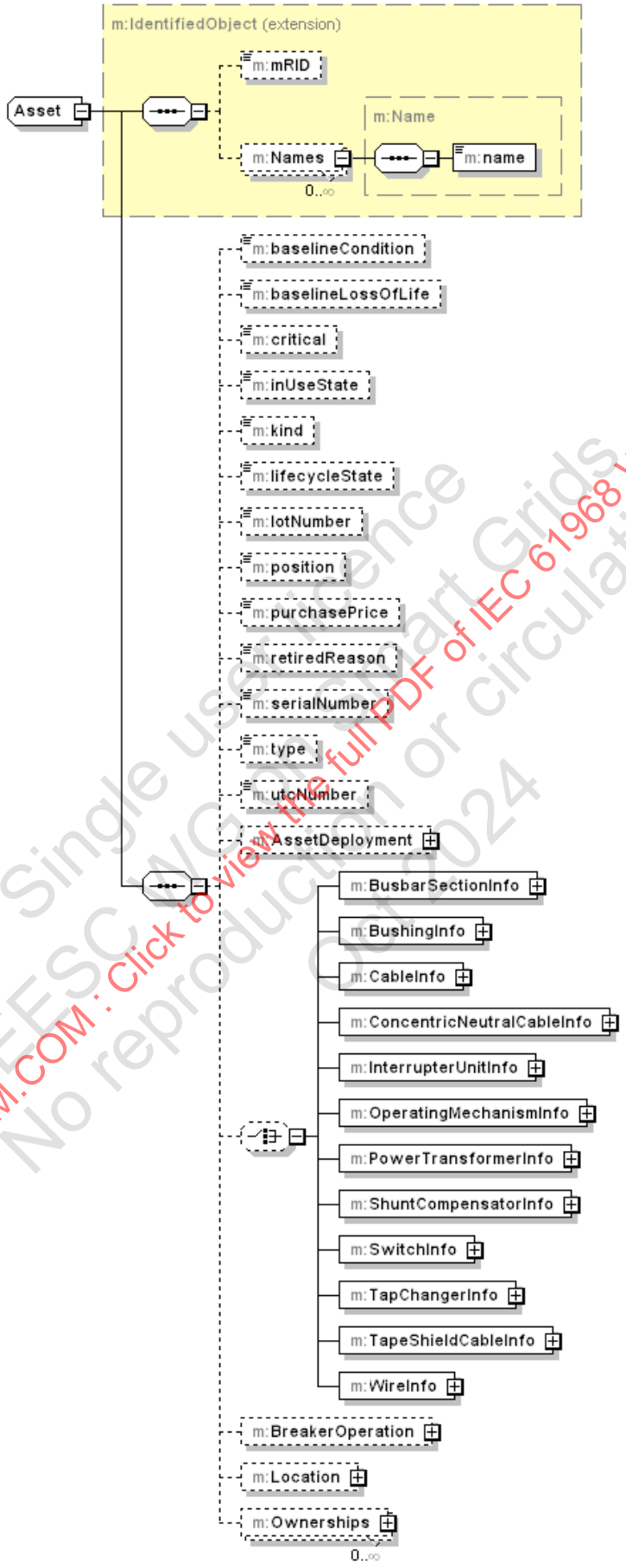


Figure 22 – AssetDetail message: Asset element

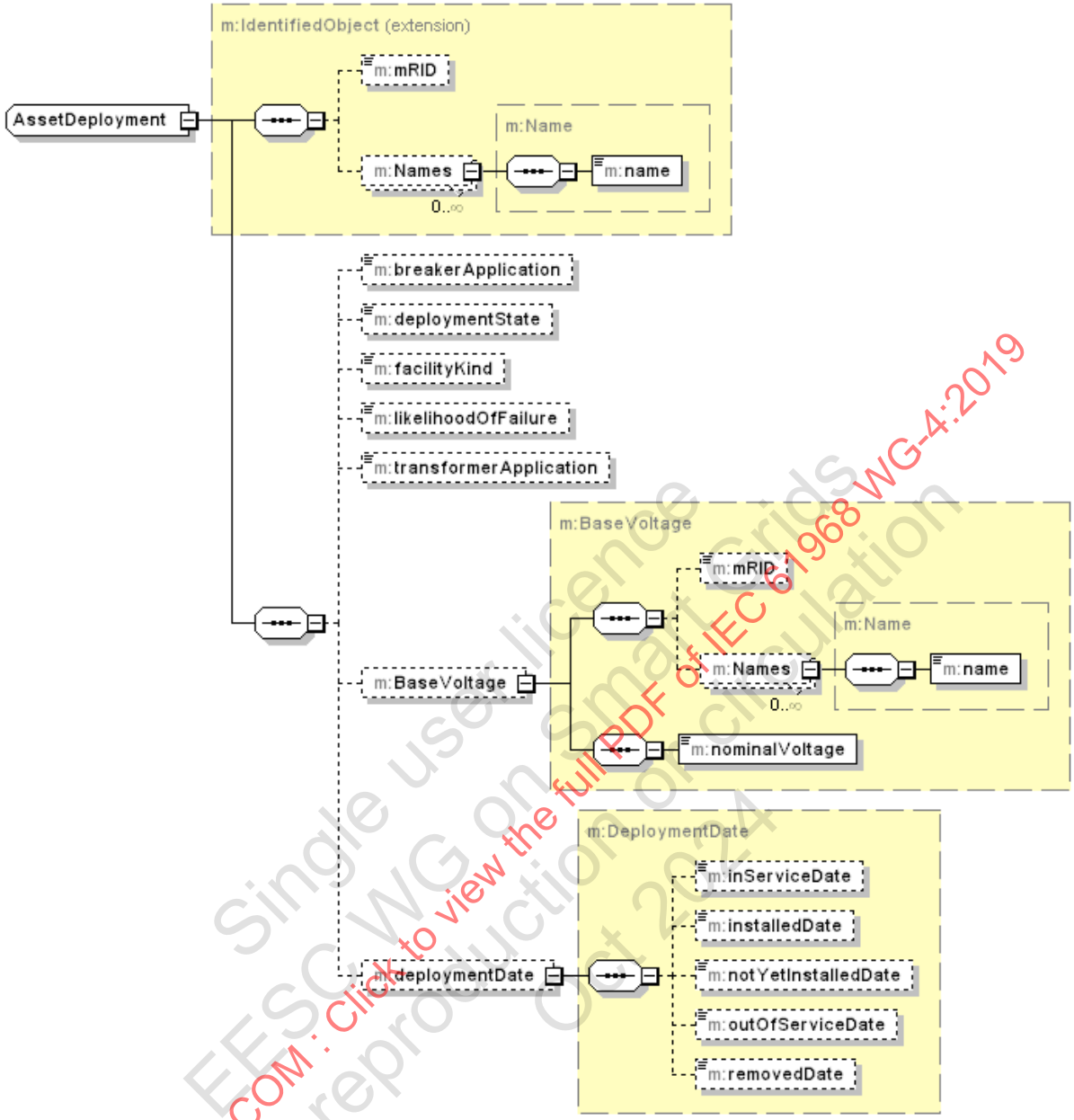


Figure 23 – AssetDetail message: AssetDeployment element (included in the Asset element shown in Figure 22)

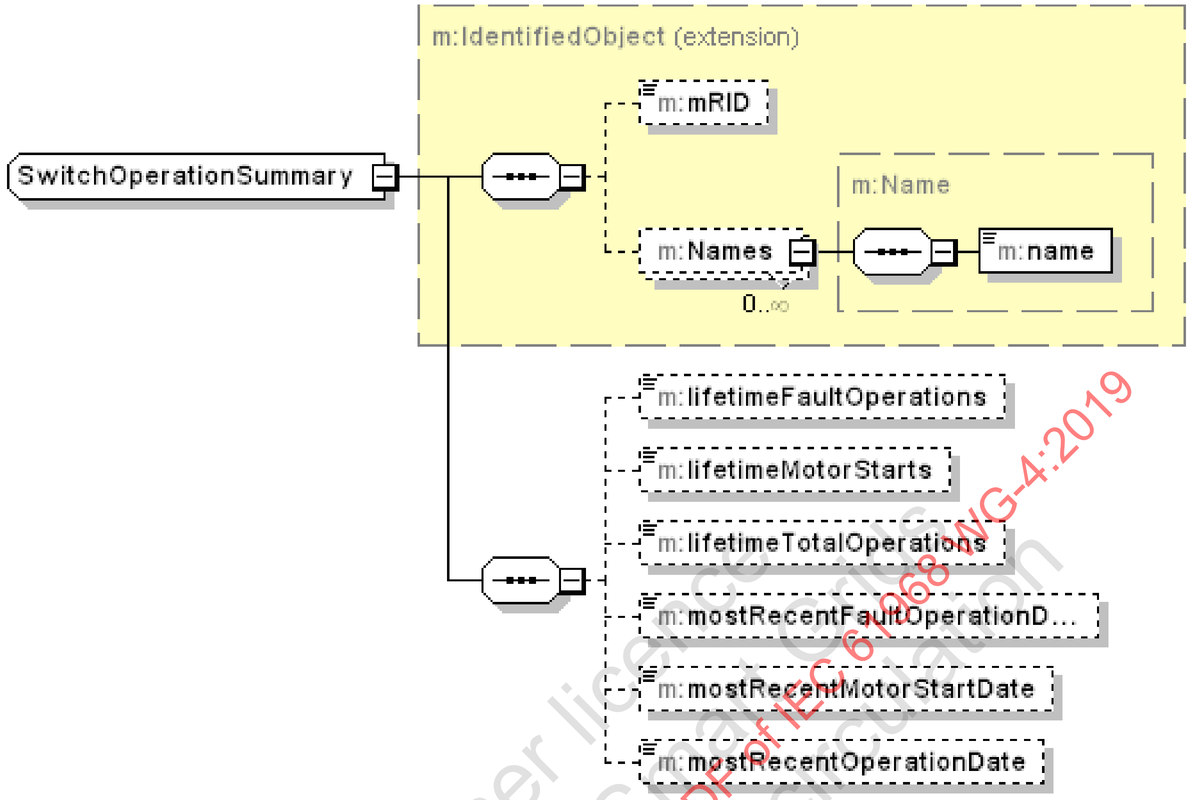


Figure 24 – AssetDetail message: SwitchOperationSummary element (included as BreakerOperation association within the Asset element shown in Figure 22)

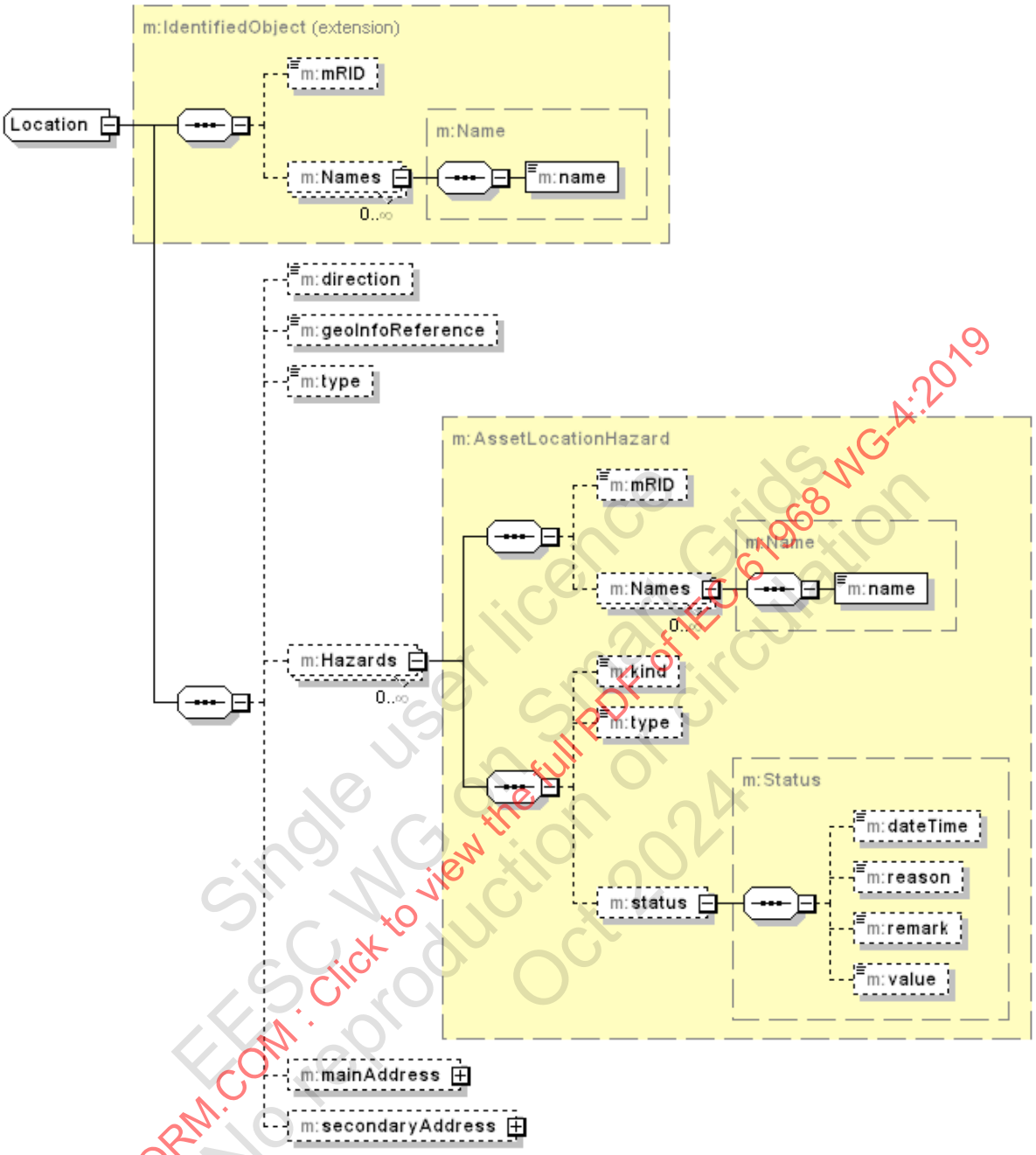


Figure 25 – AssetDetail message: Location element

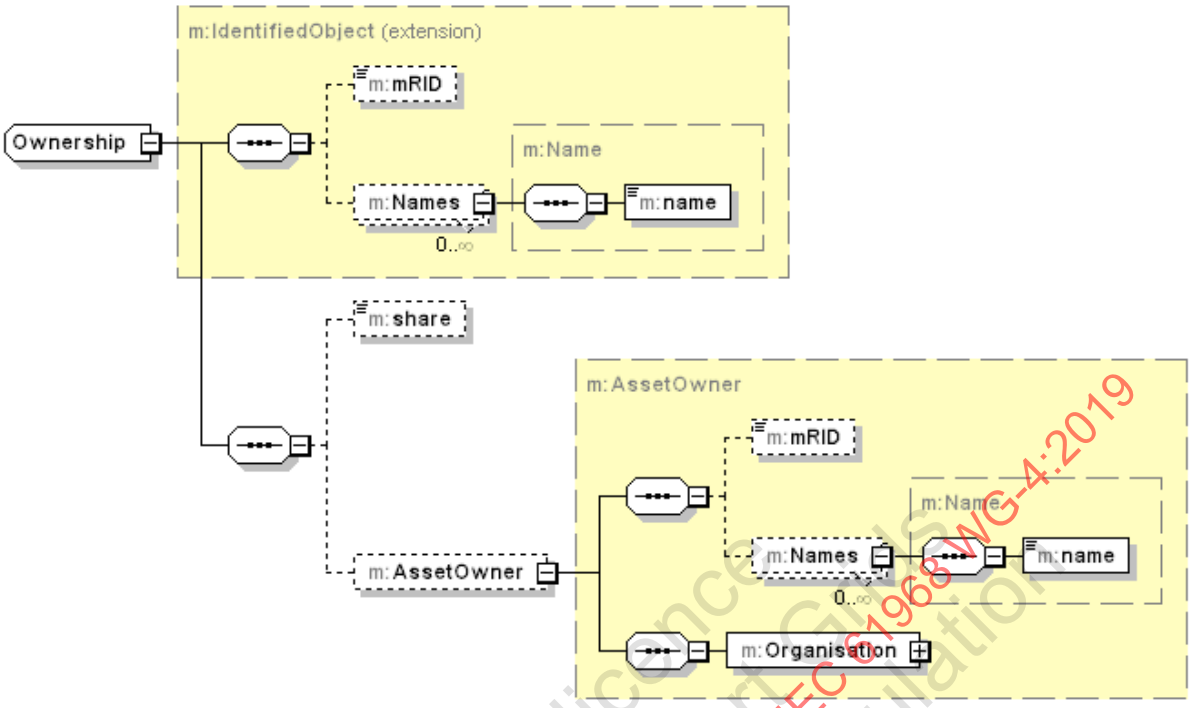


Figure 26 – AssetDetail message: Ownership element

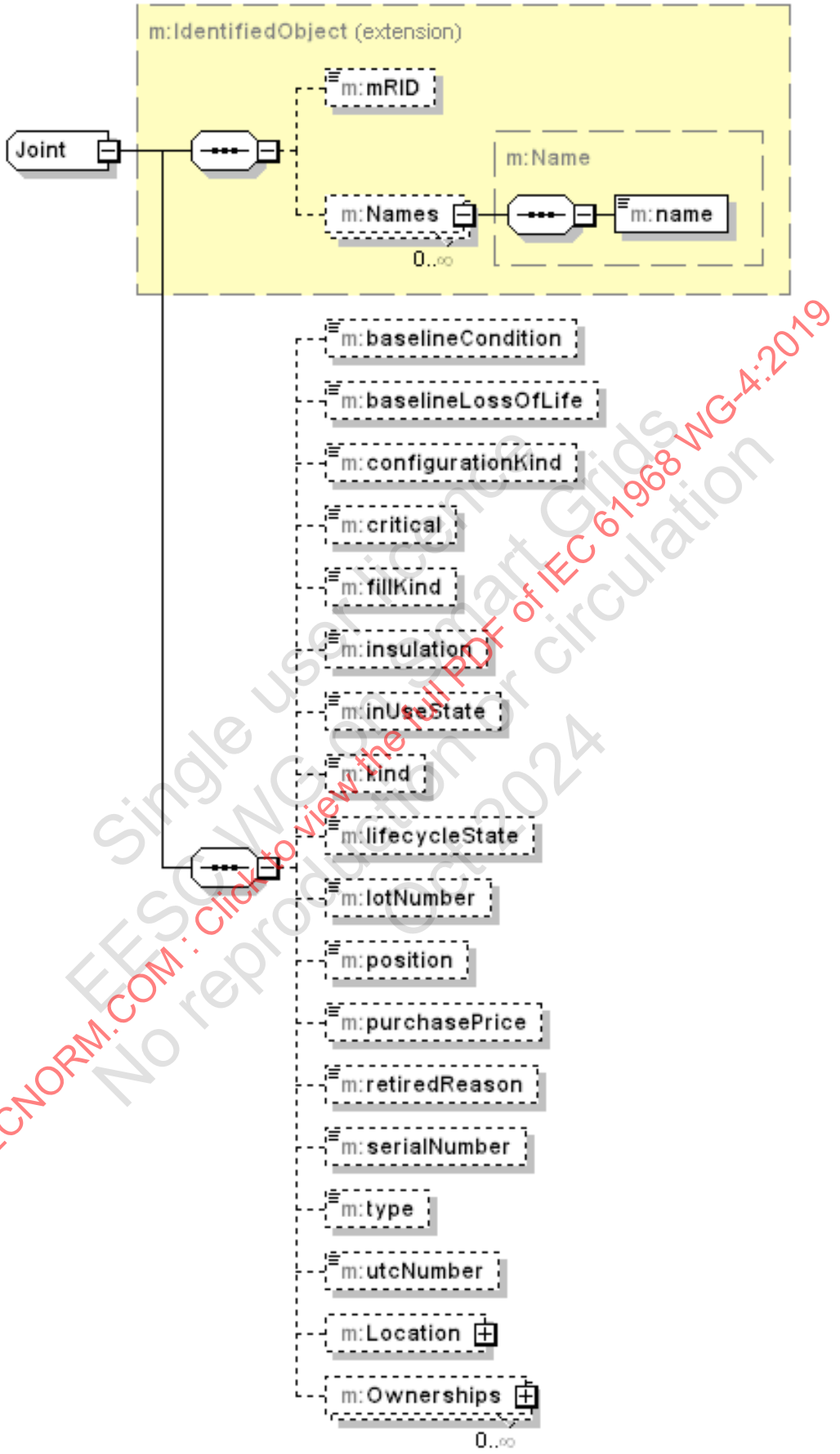


Figure 27 – AssetDetail message: Joint element

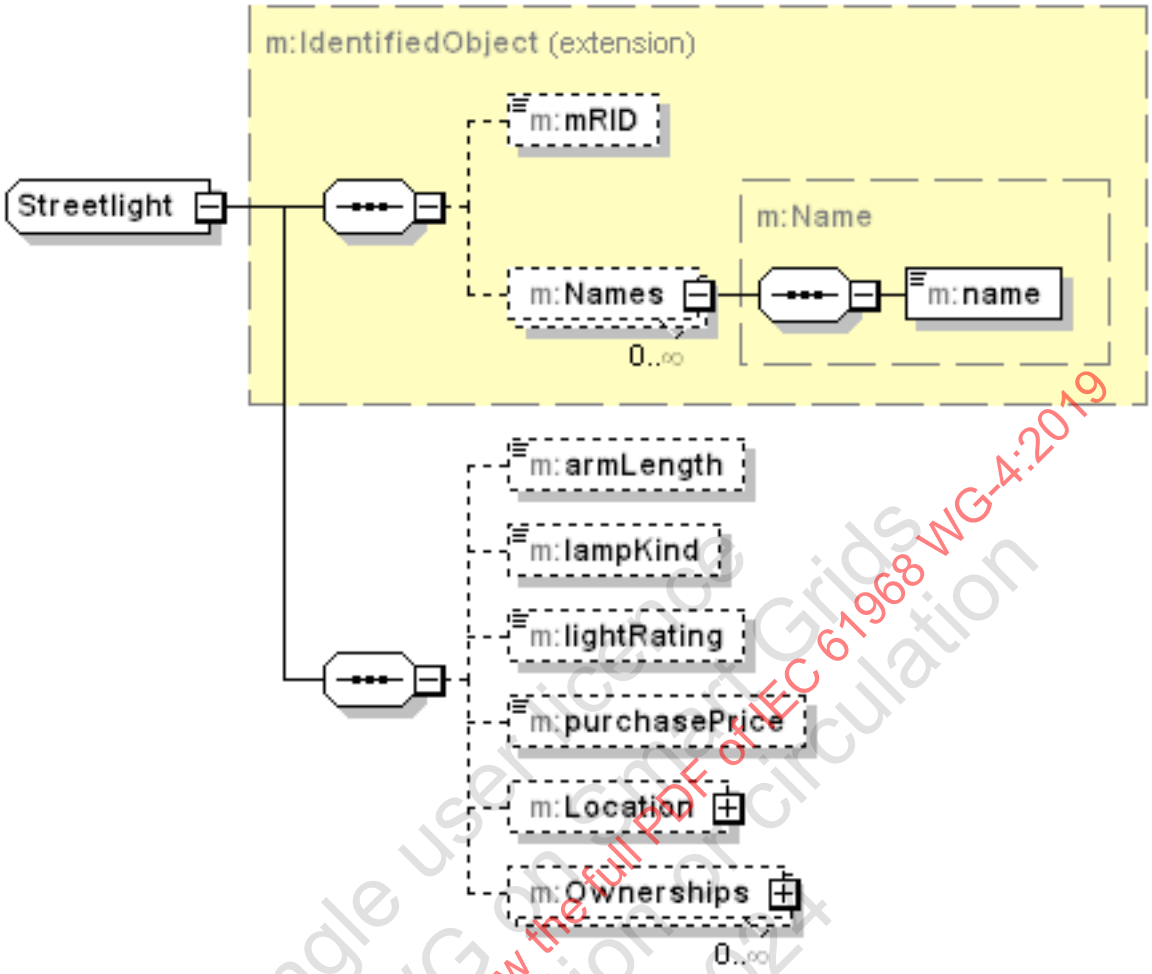


Figure 28 – AssetDetail message: Streetlight element

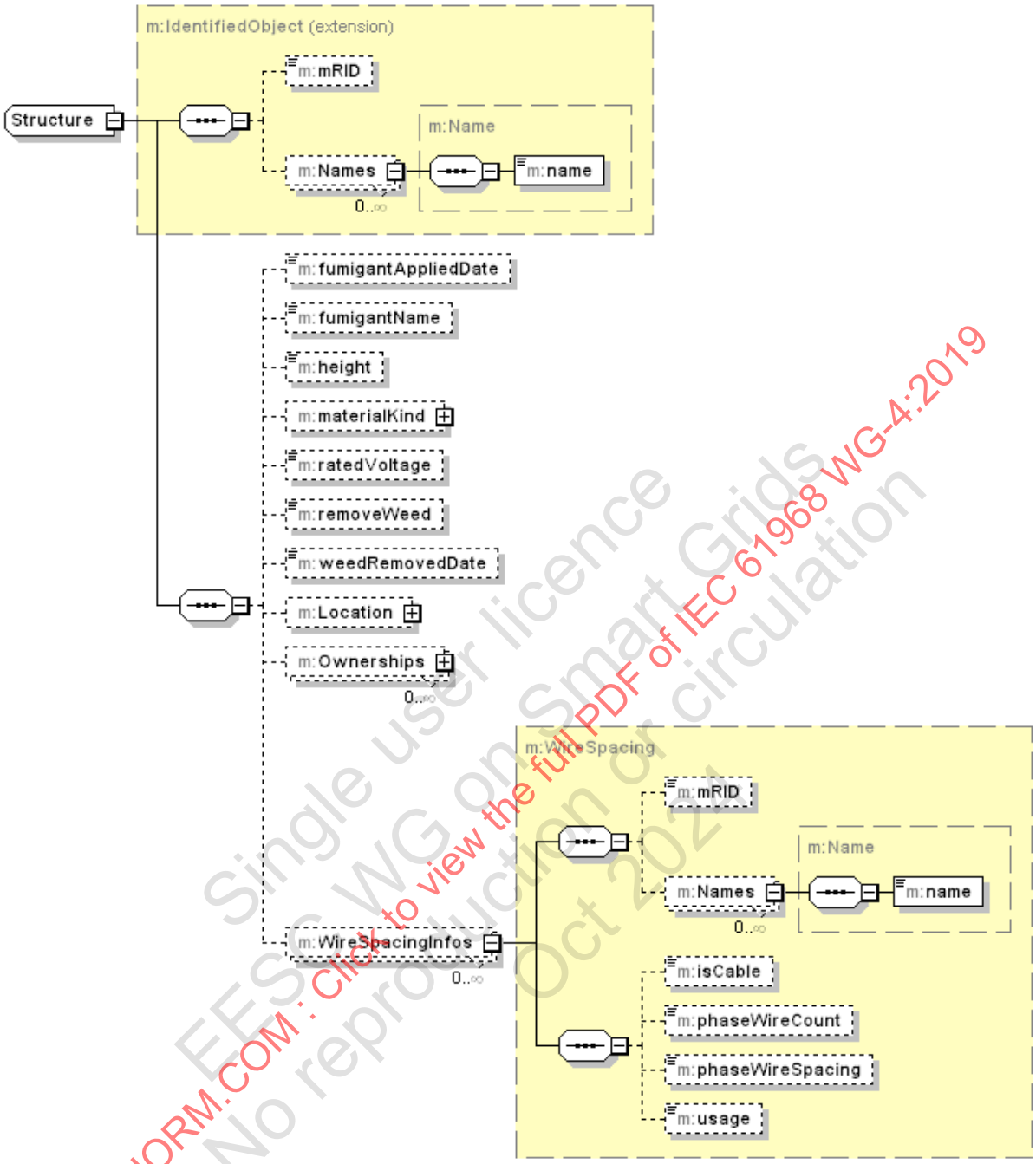


Figure 29 – AssetDetail message: Structure element

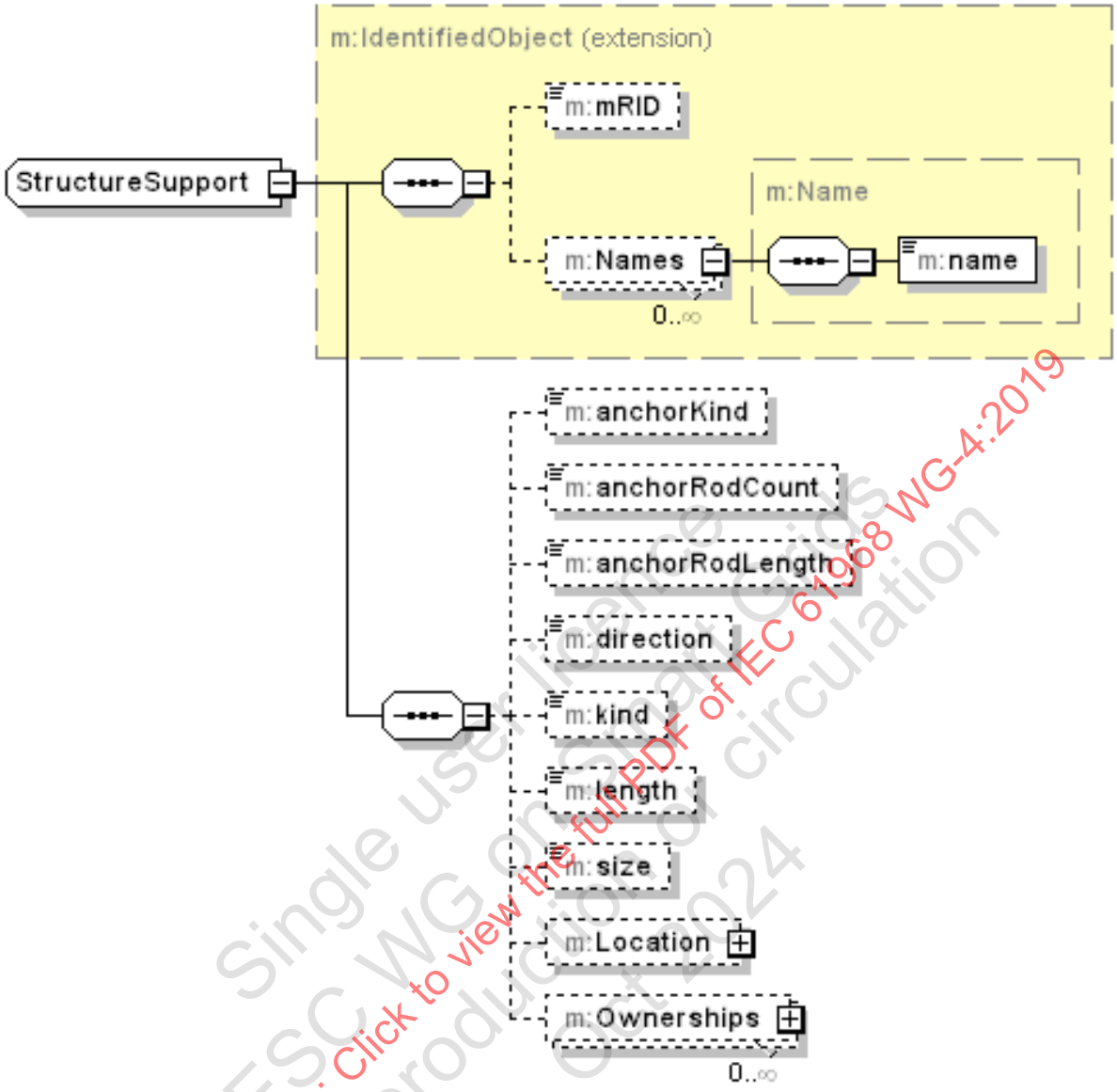


Figure 30 – AssetDetail message: StructureSupport element

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.

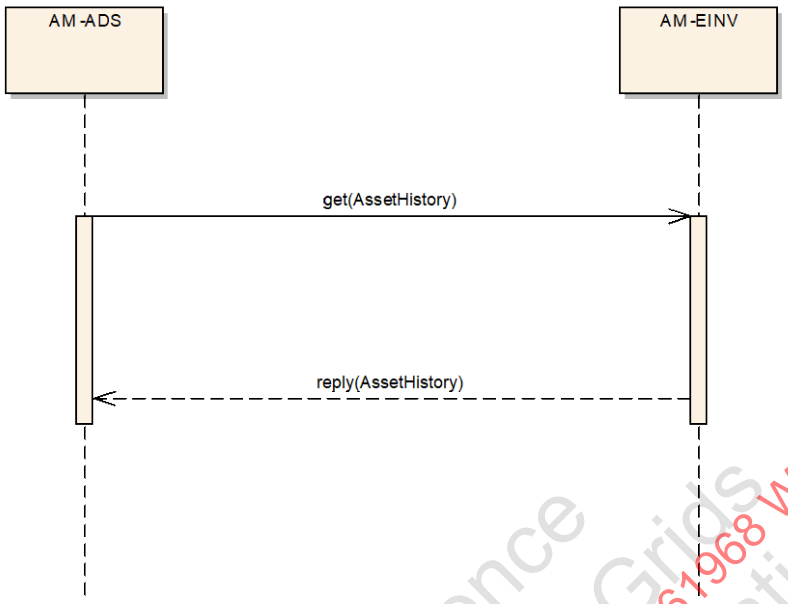


Figure 31 – Asset History message exchange

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.

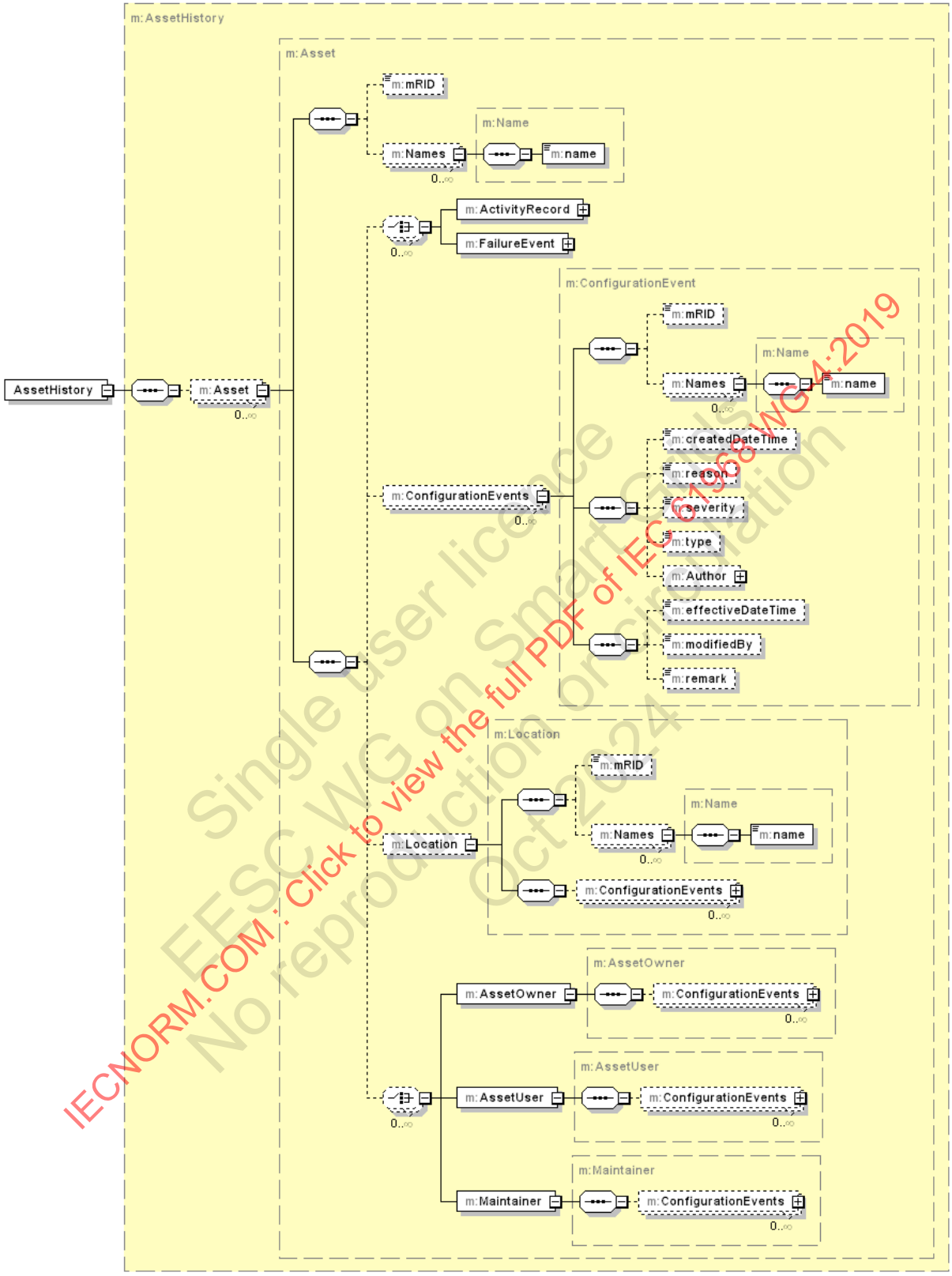


Figure 32 – AssetHistory message format

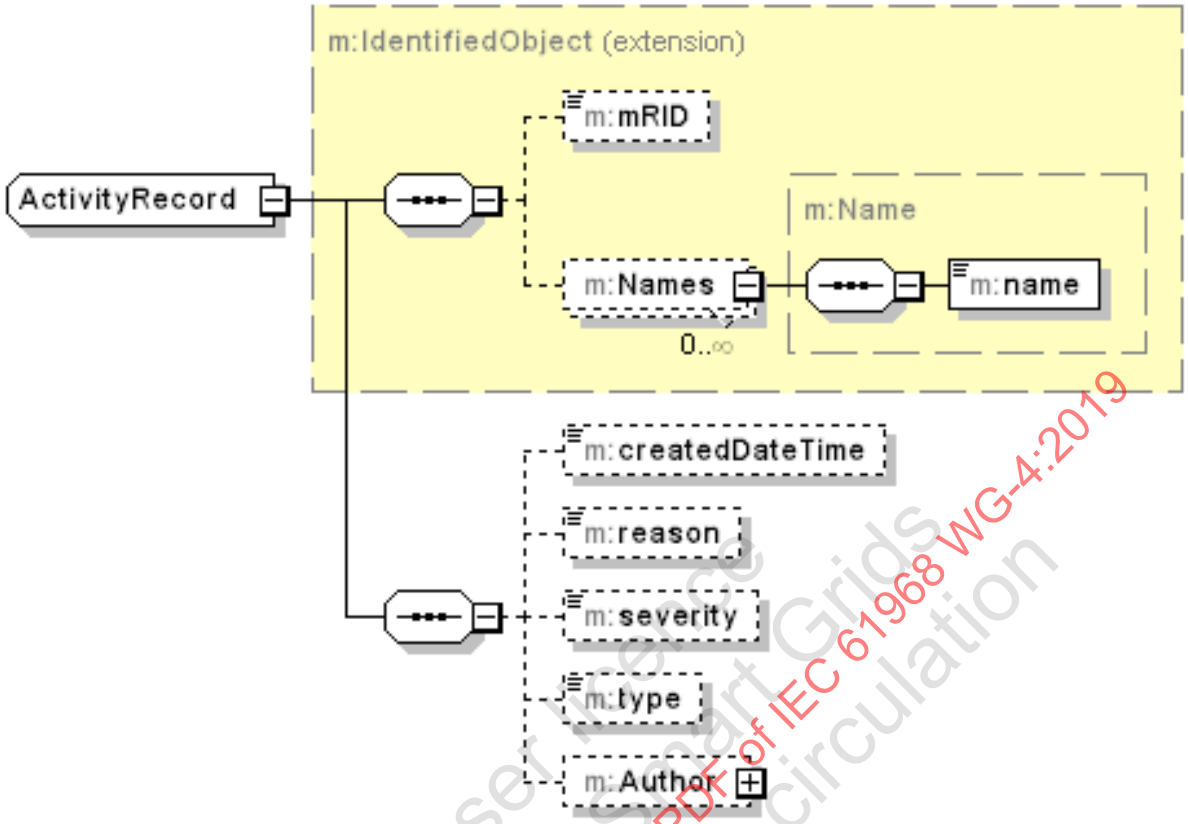


Figure 33 – AssetHistory message: ActivityRecord element

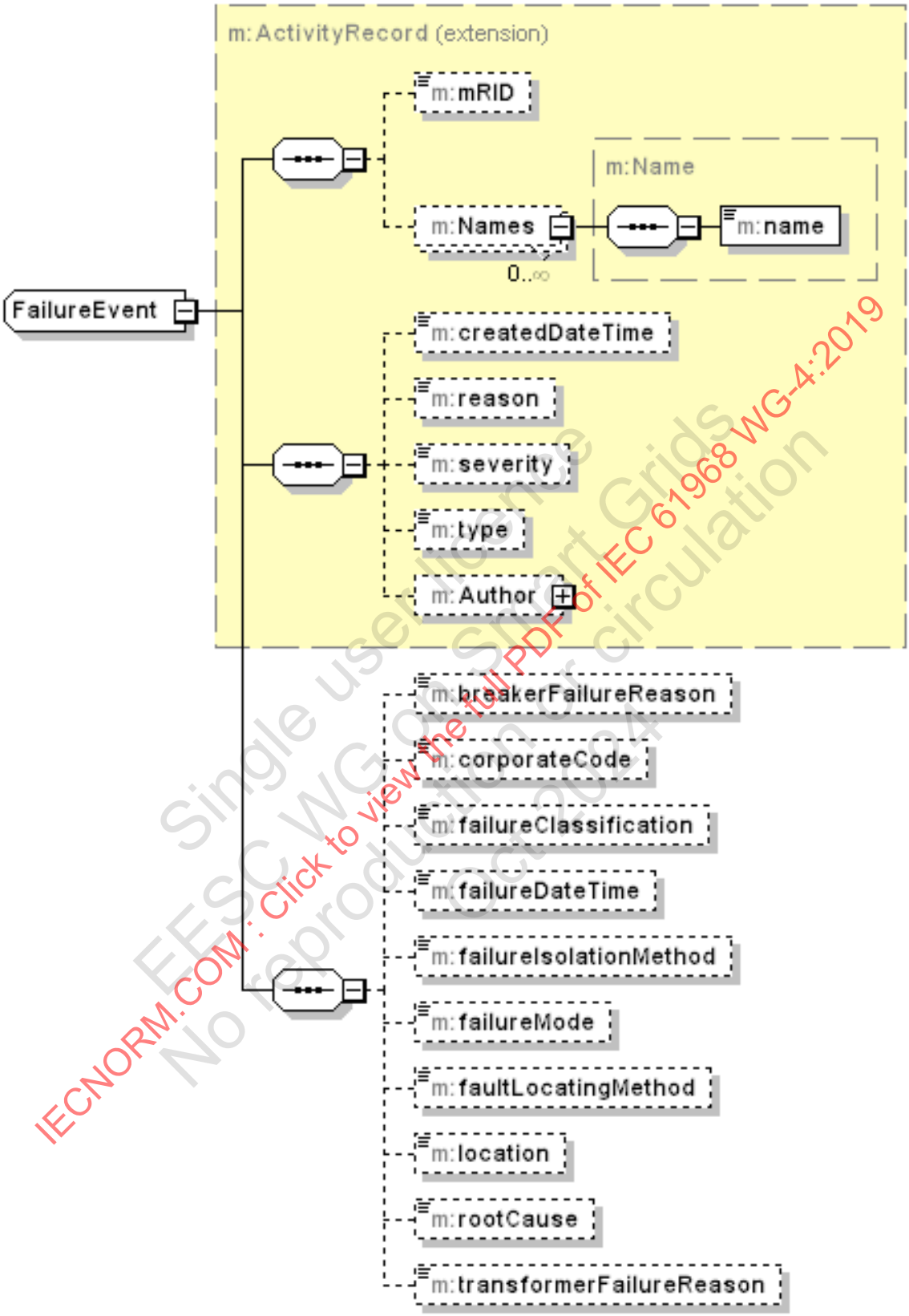


Figure 34 – AssetHistory message: FailureEvent element

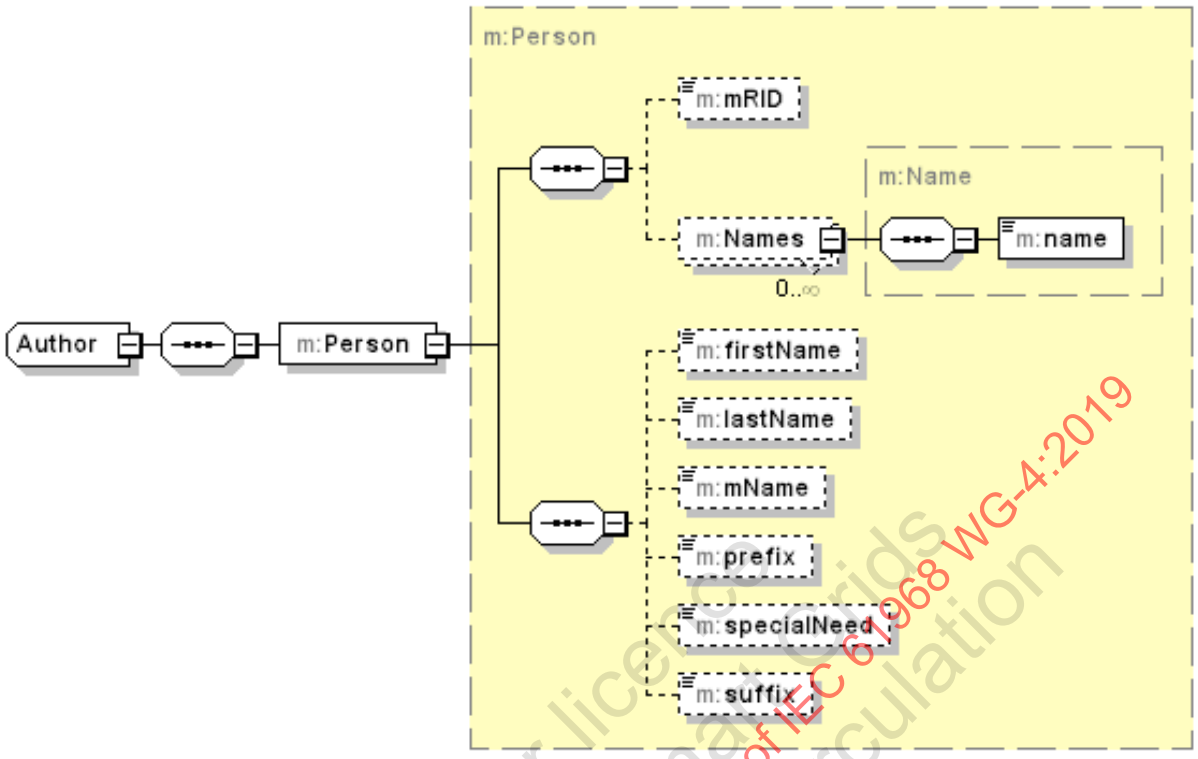


Figure 35 – AssetHistory message: Author element

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.

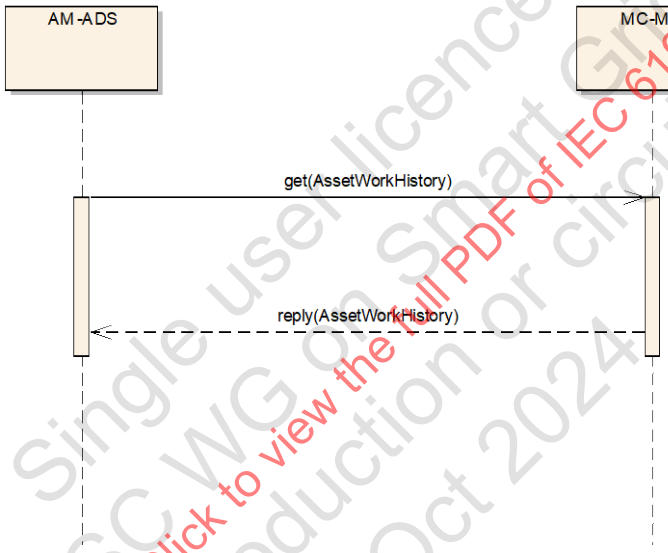


Figure 36 – Asset Work History message exchange

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.

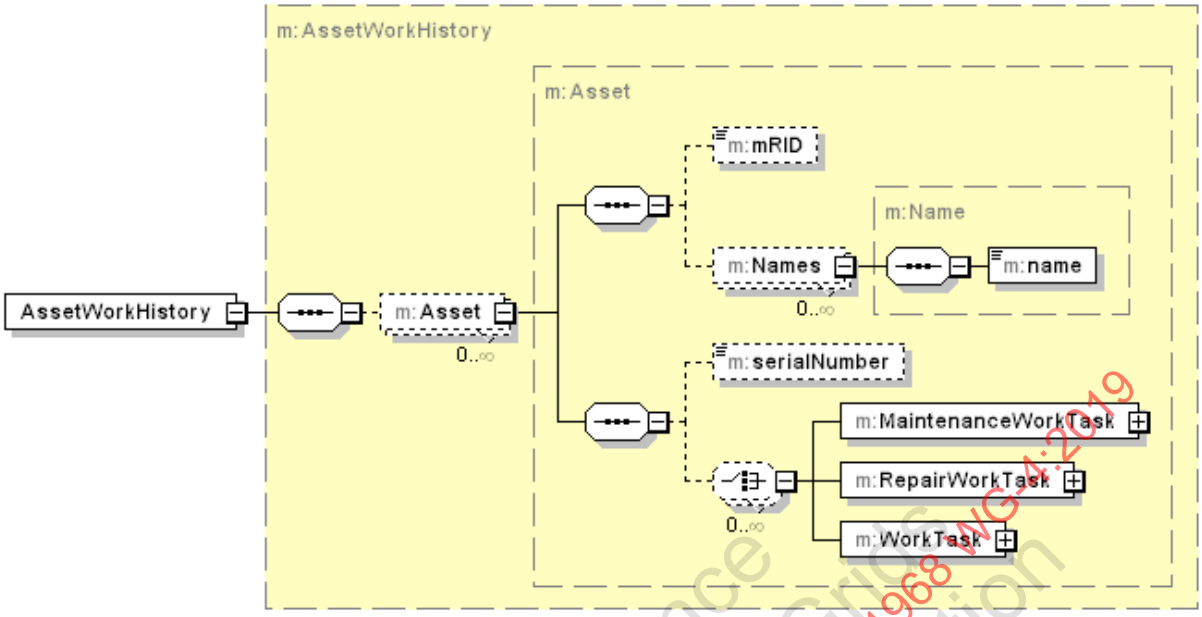


Figure 37 – AssetWorkHistory message format

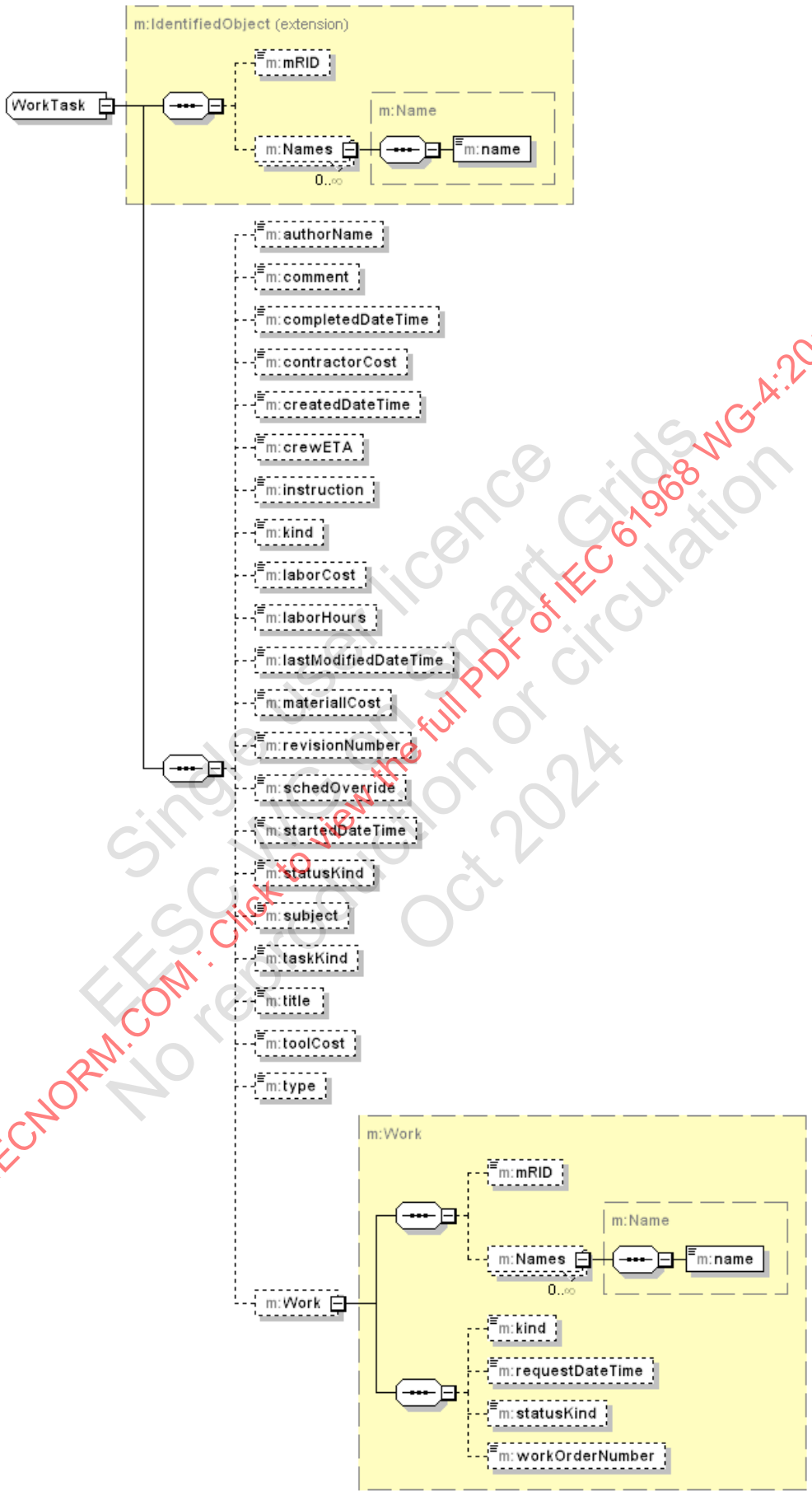


Figure 38 – AssetWorkHistory message: WorkTask element

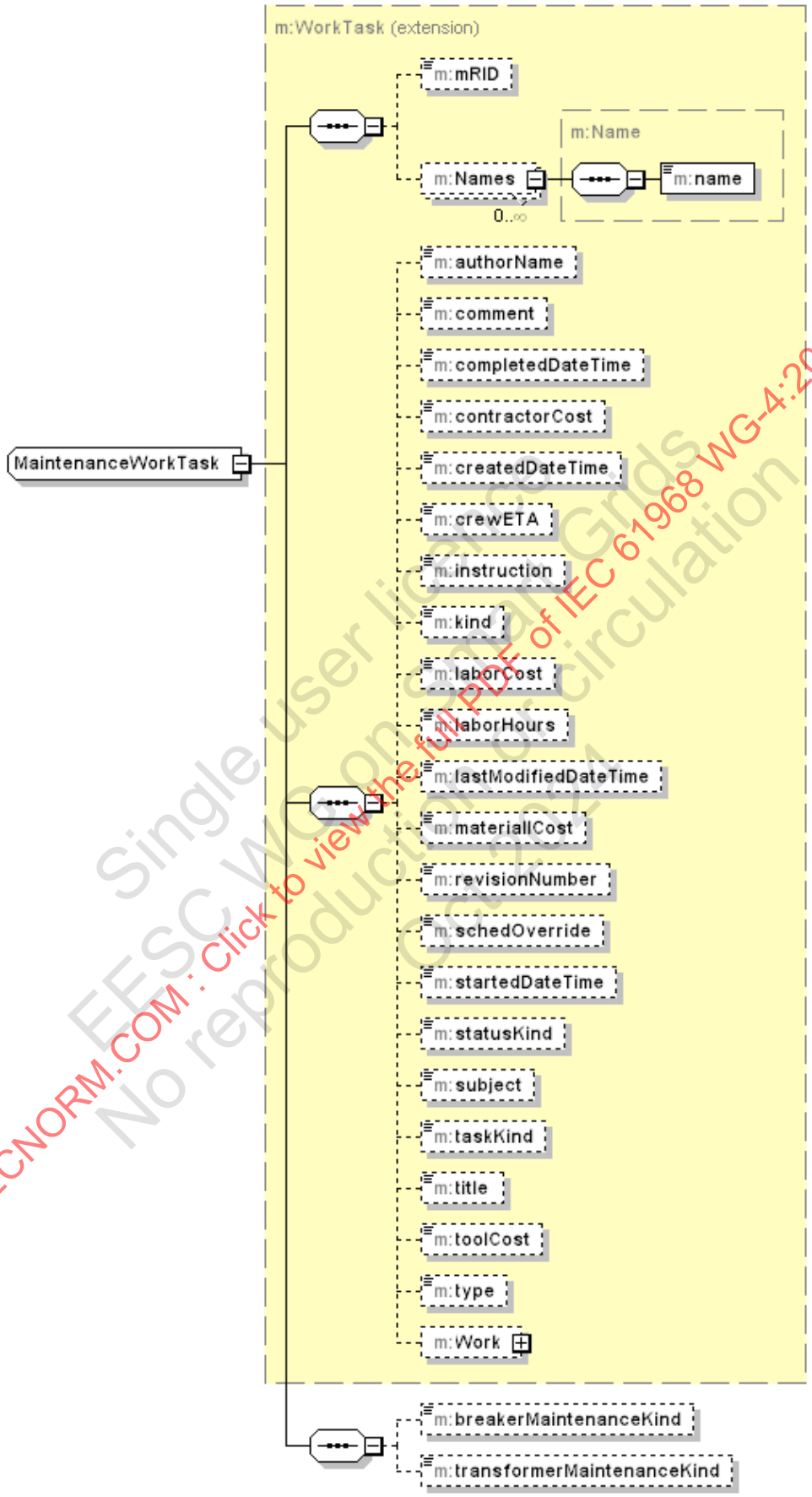


Figure 39 – AssetWorkHistory message: MaintenanceWorkTask element

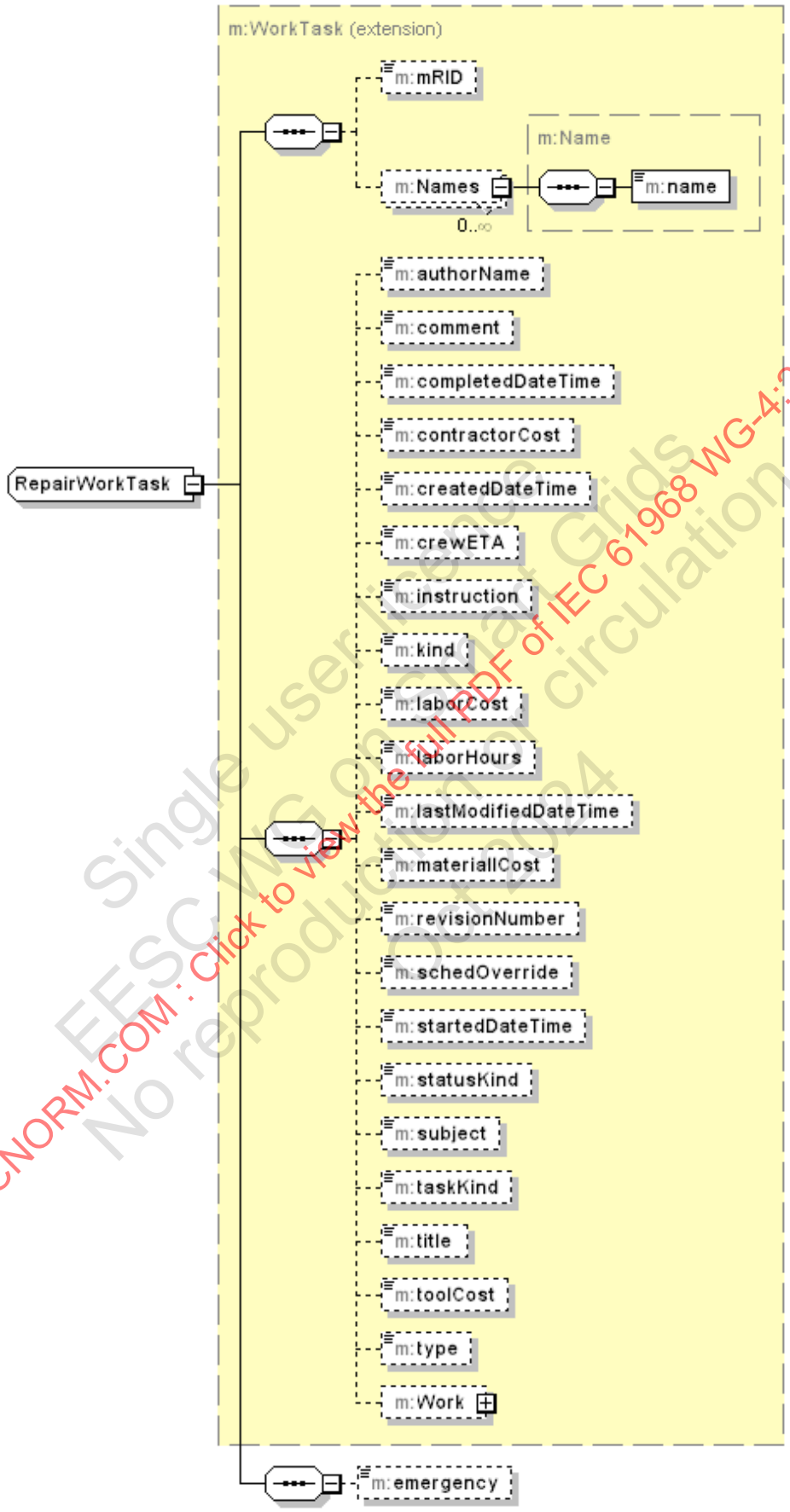


Figure 40 – AssetWorkHistory message: RepairWorkTask element

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.

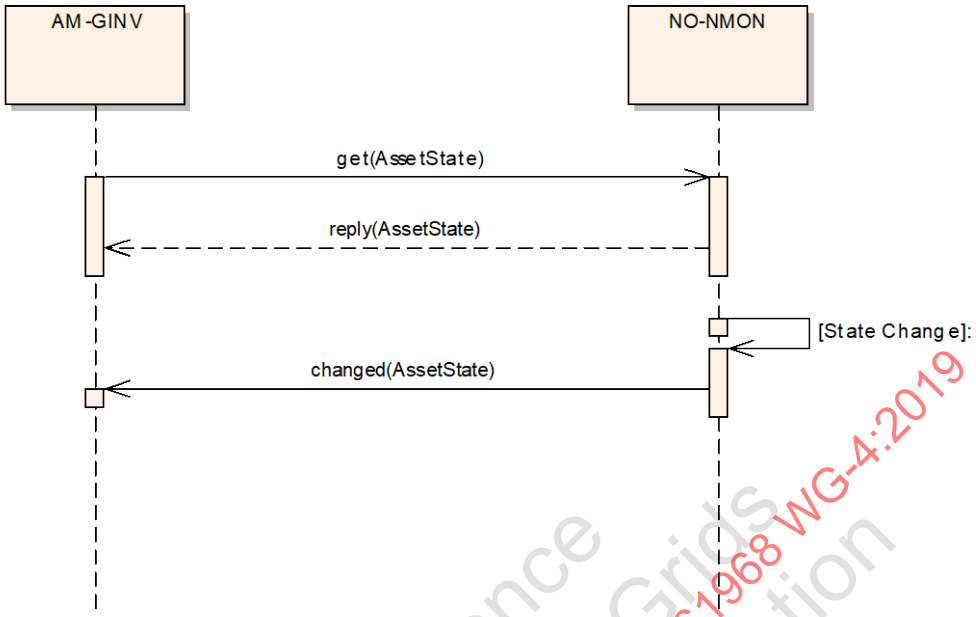


Figure 41 – AssetPSRDetails message exchange 1

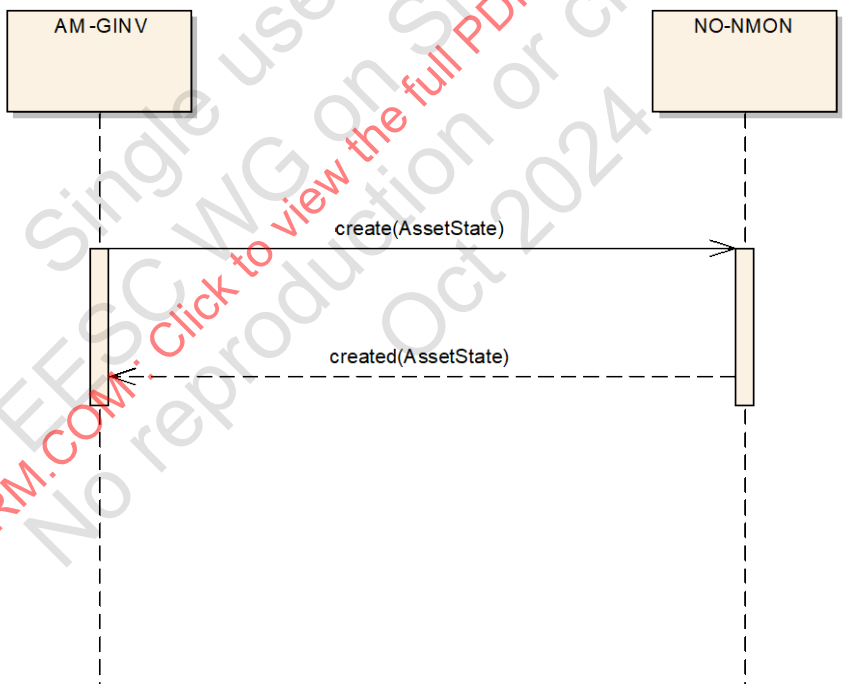


Figure 42 – AssetPSRDetails message exchange 2

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.

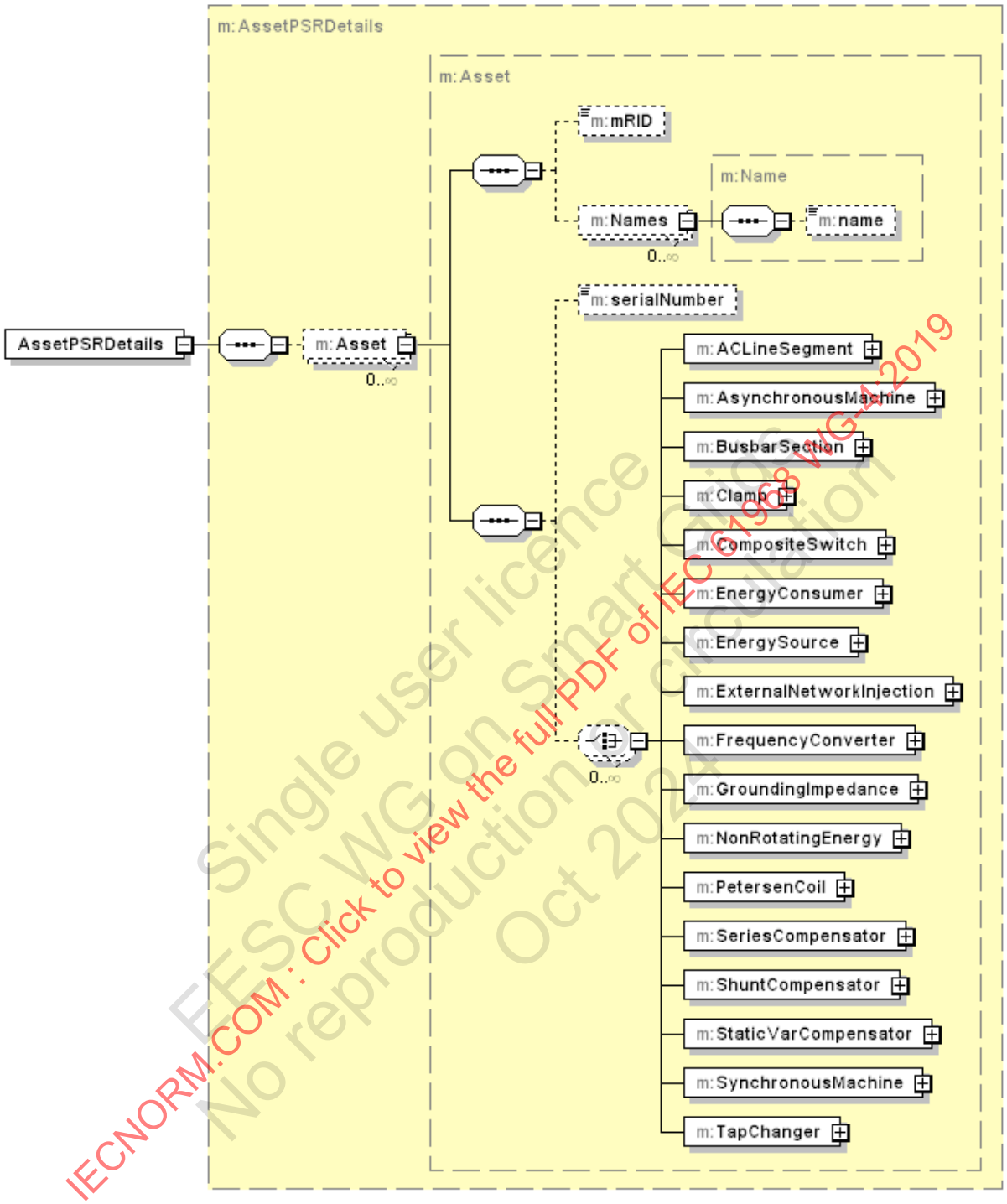


Figure 43 – AssetPSRDetails message format

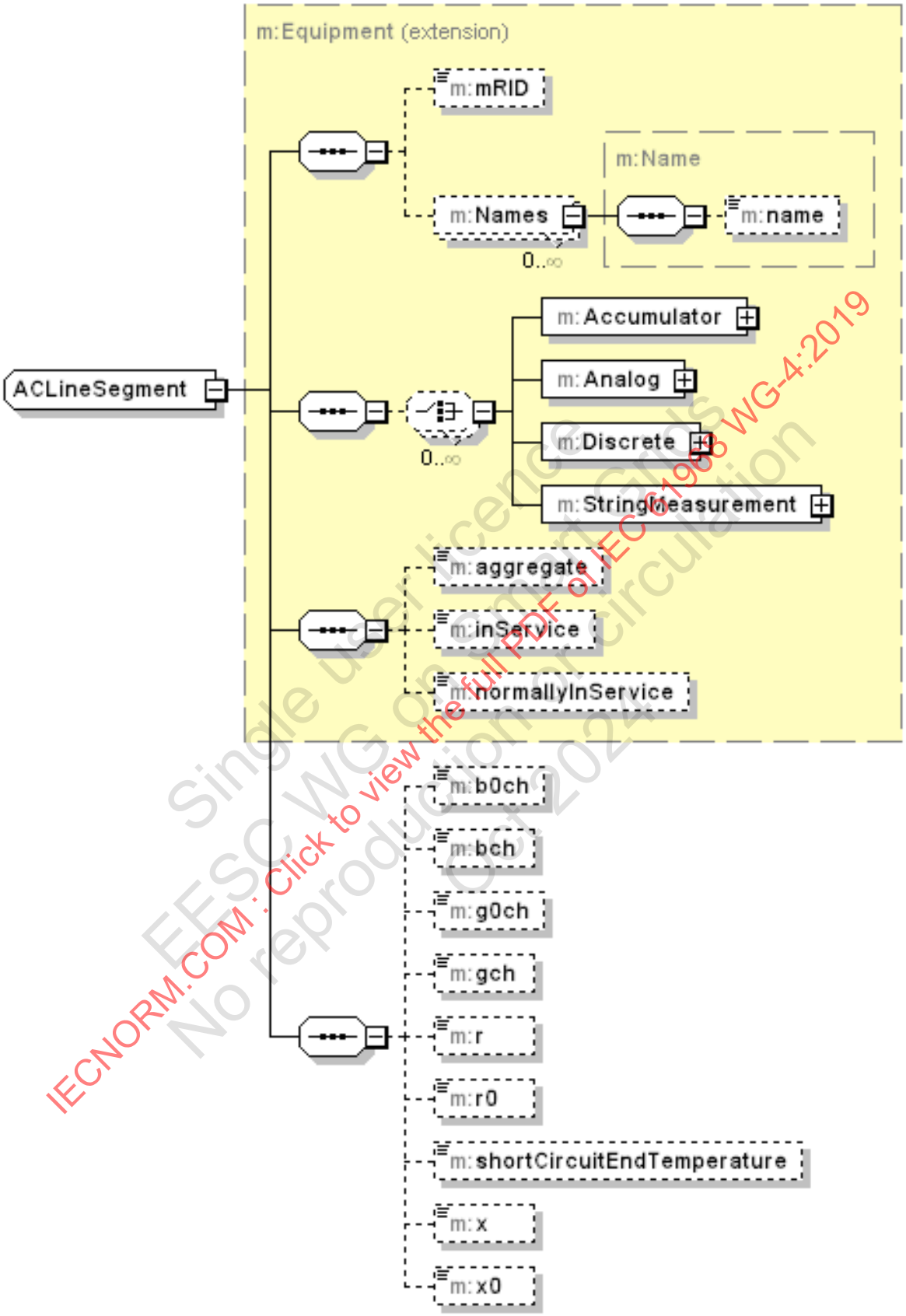


Figure 44 – AssetPSRDetails message: ACLineSegment element

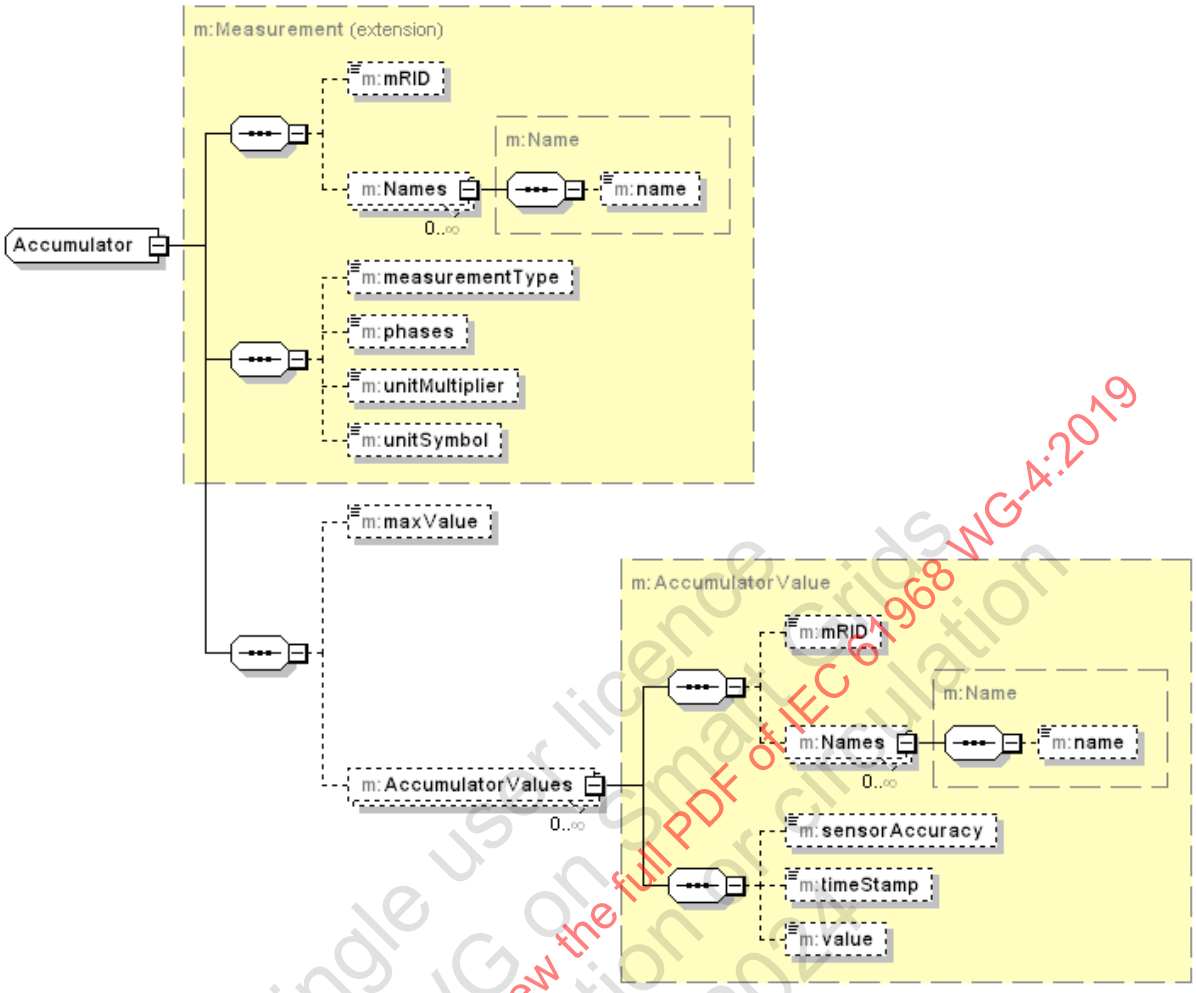


Figure 45 – AssetPSRDetails message: Accumulator element

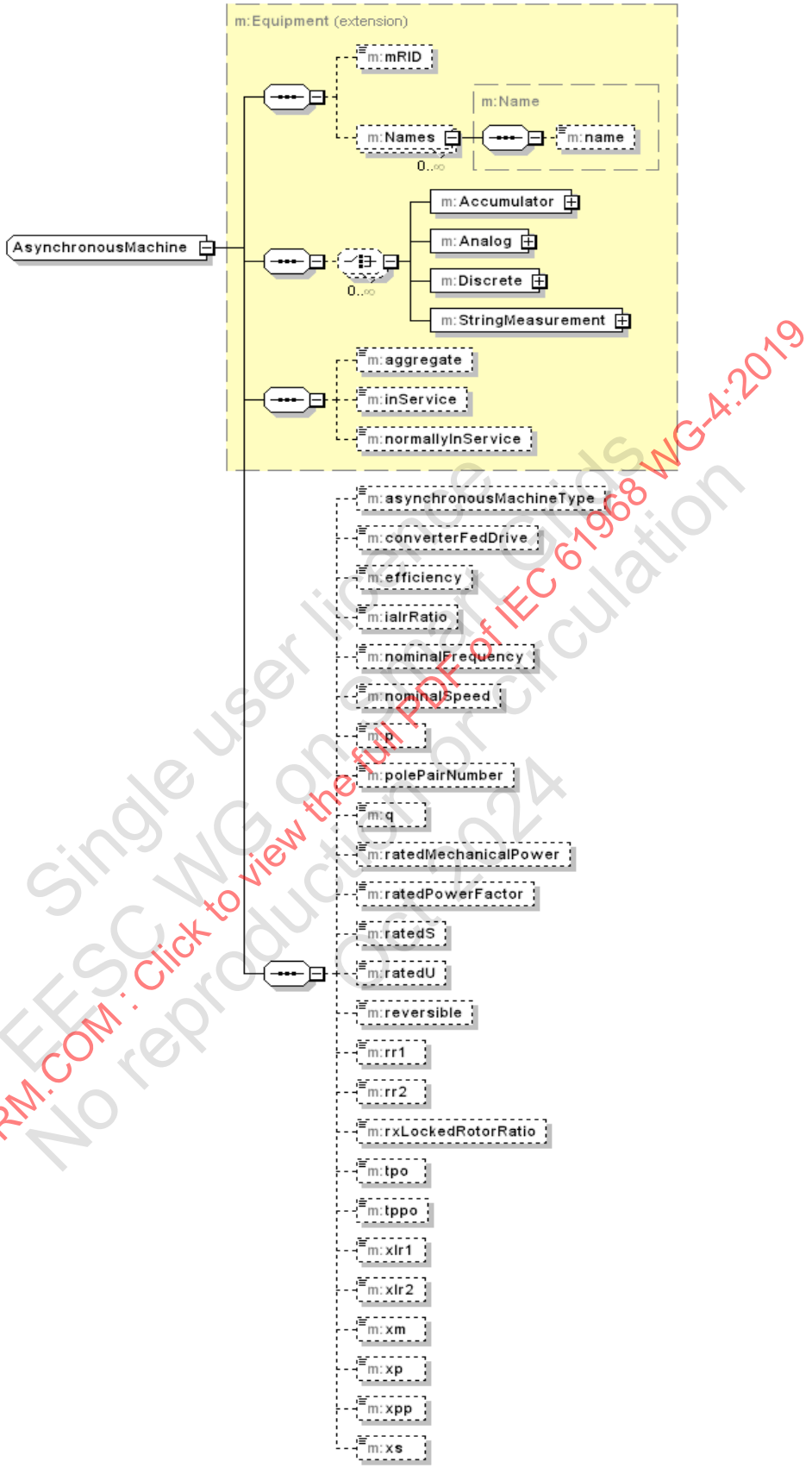


Figure 46 – AssetPSRDetails message: AsynchronousMachine element

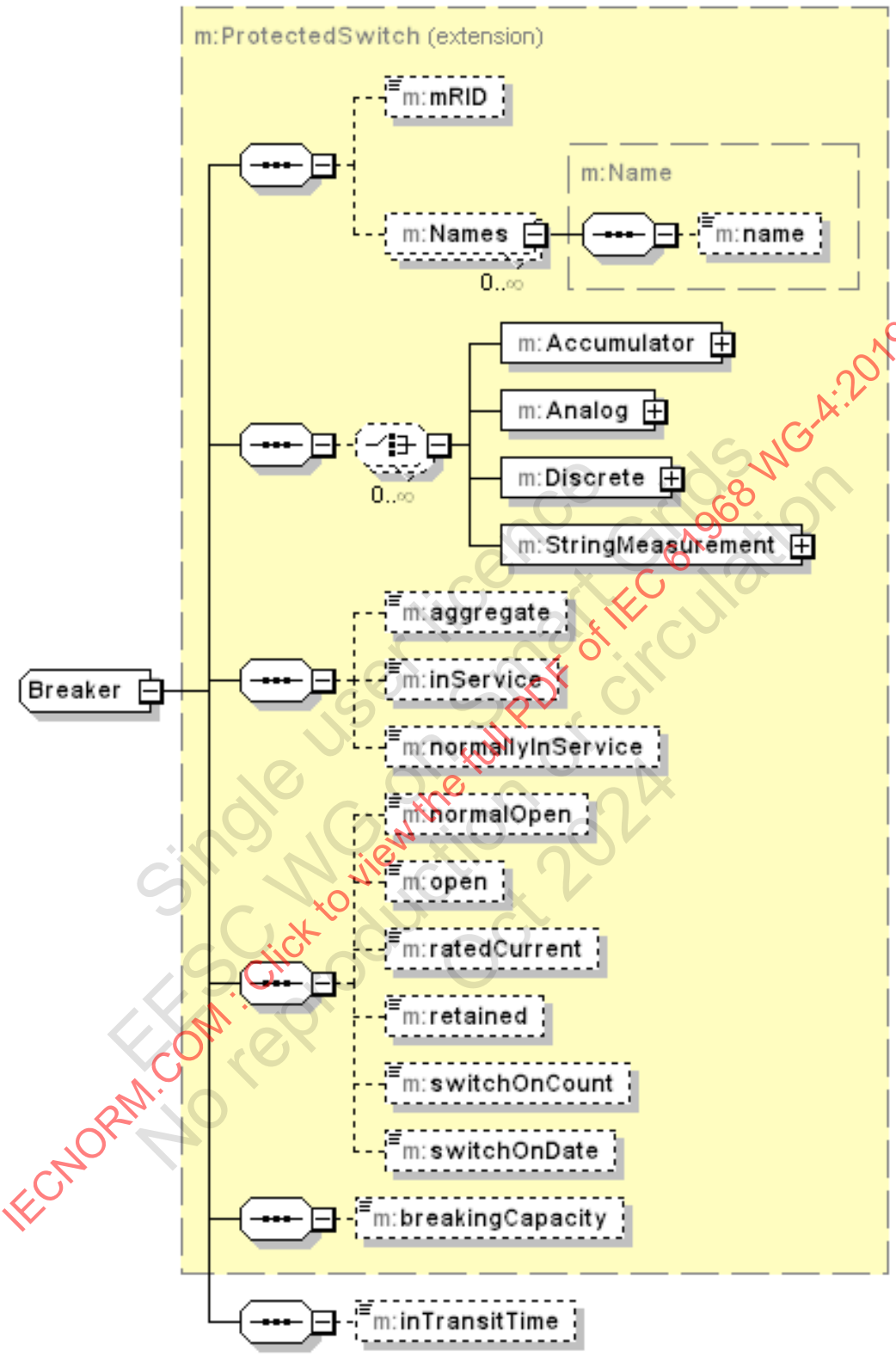


Figure 47 – AssetPSRDetails message: Breaker element

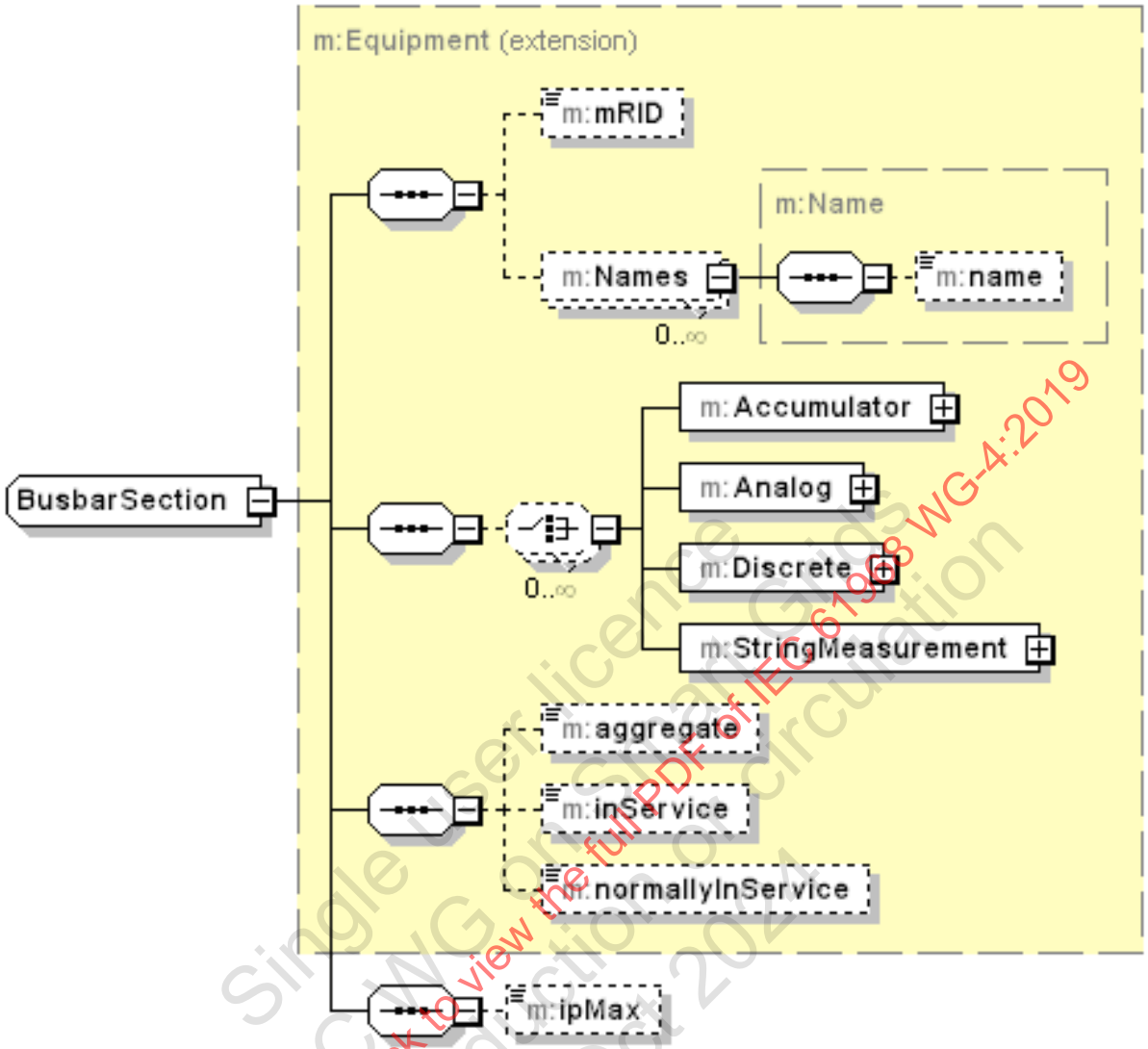


Figure 48 – AssetPSRDetails message: BusbarSection element

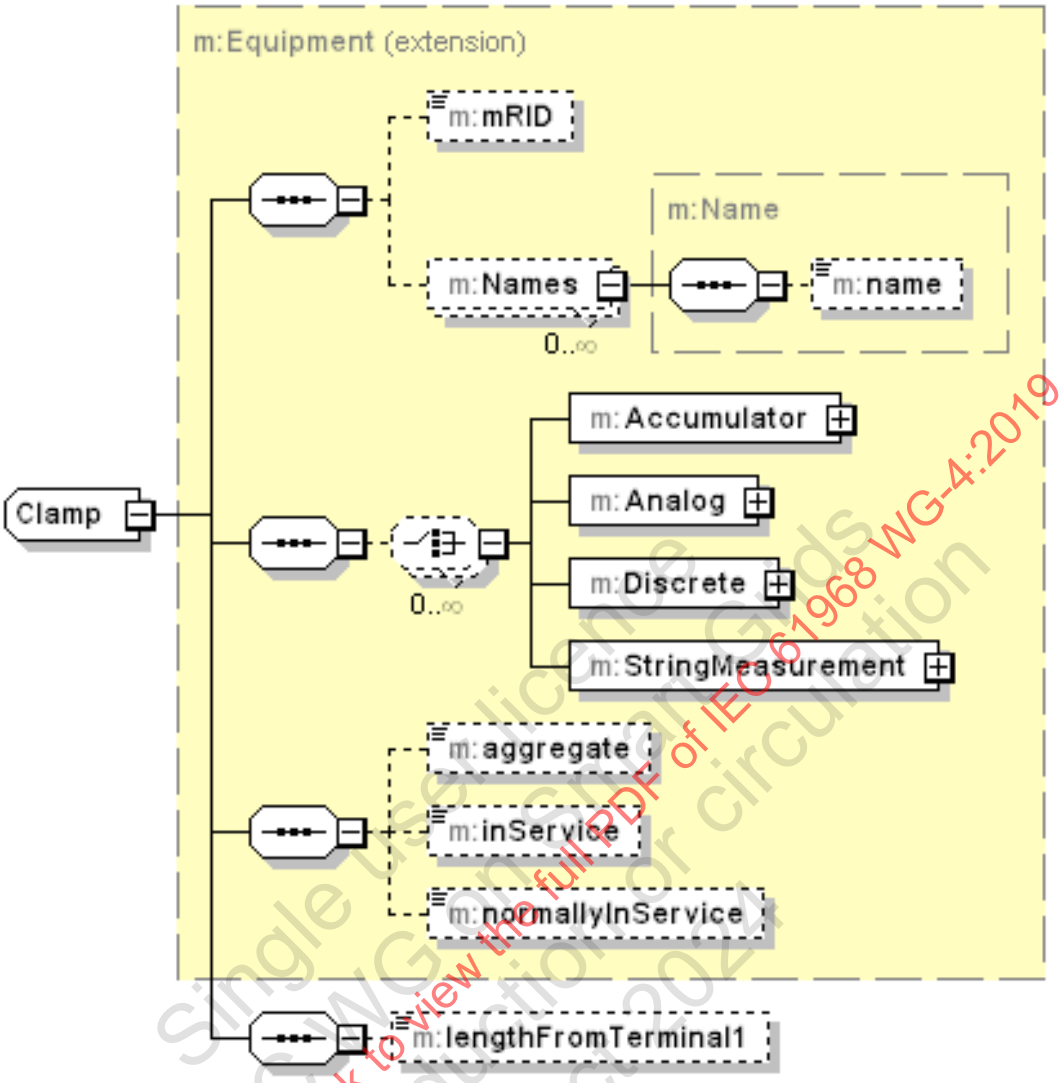


Figure 49 – AssetPSRDetails message: Clamp element

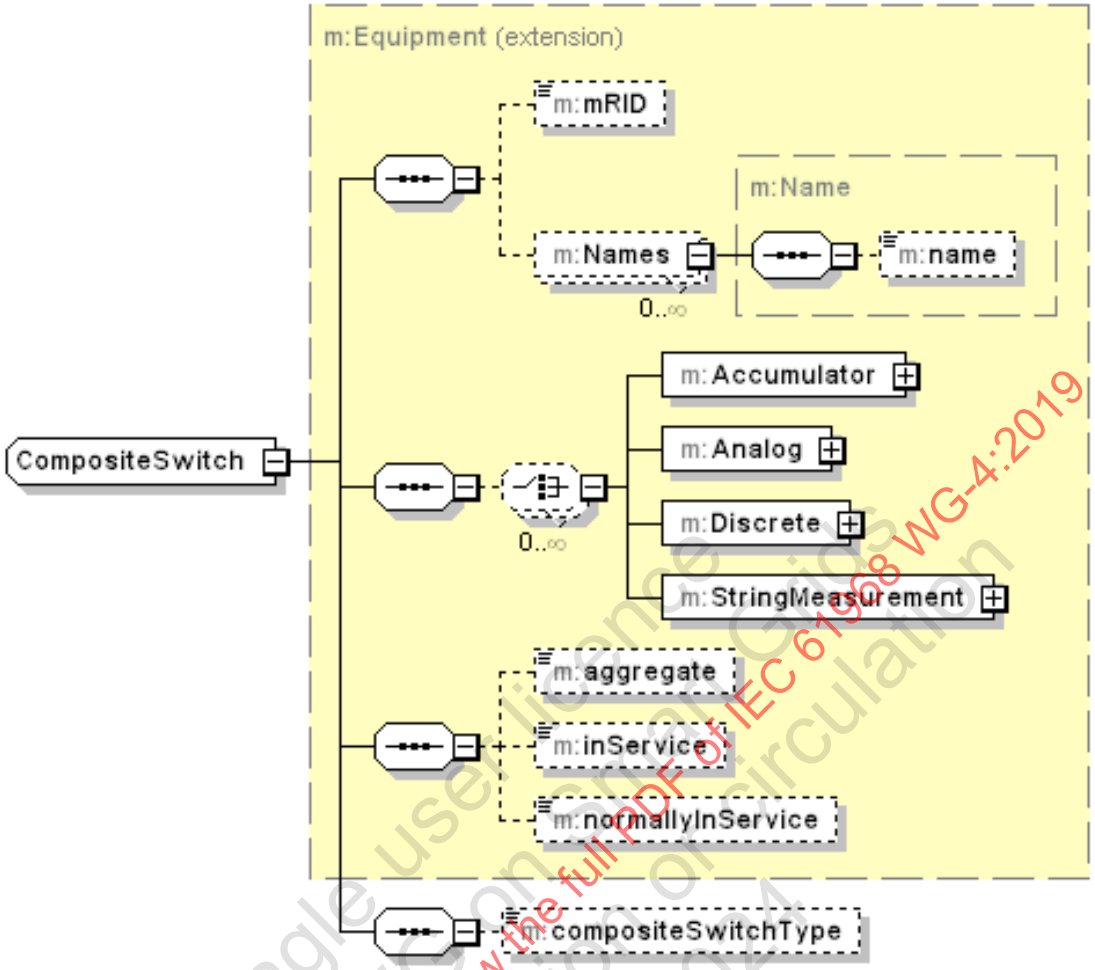


Figure 50 – AssetPSRDetails message: CompositeSwitch element

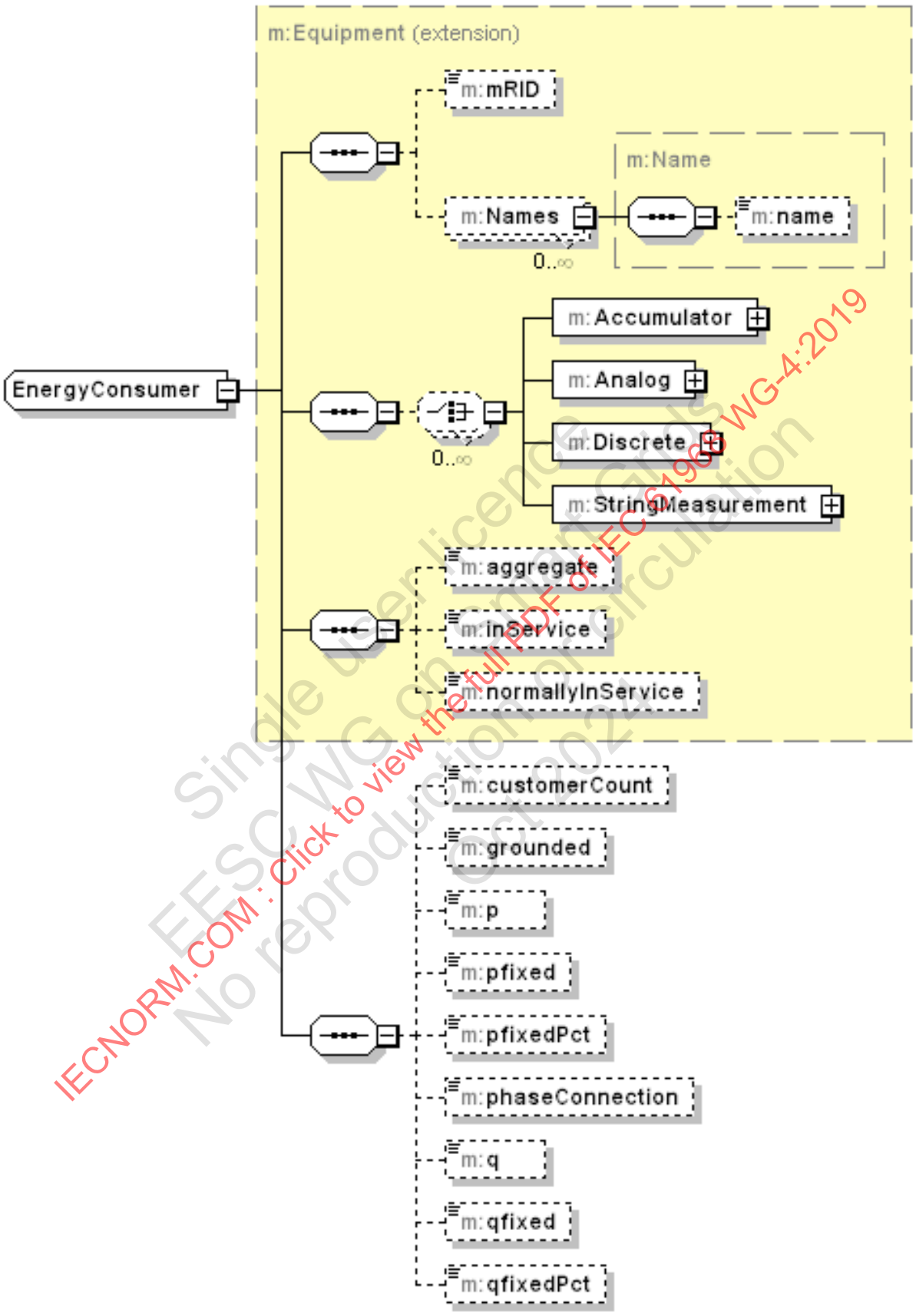


Figure 51 – AssetPSRDetails message: EnergyConsumer element

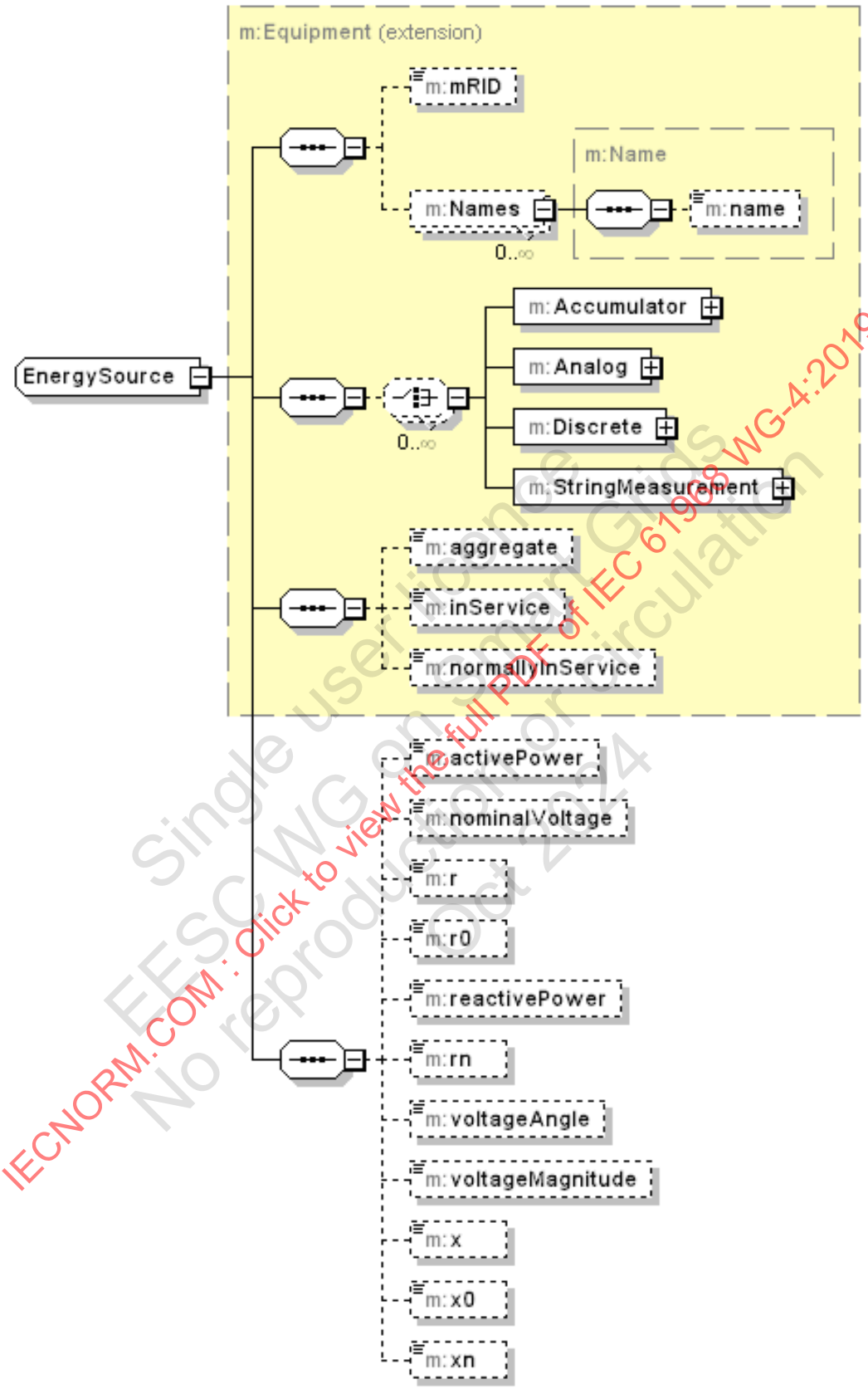


Figure 52 – AssetPSRDetails message: EnergySource element

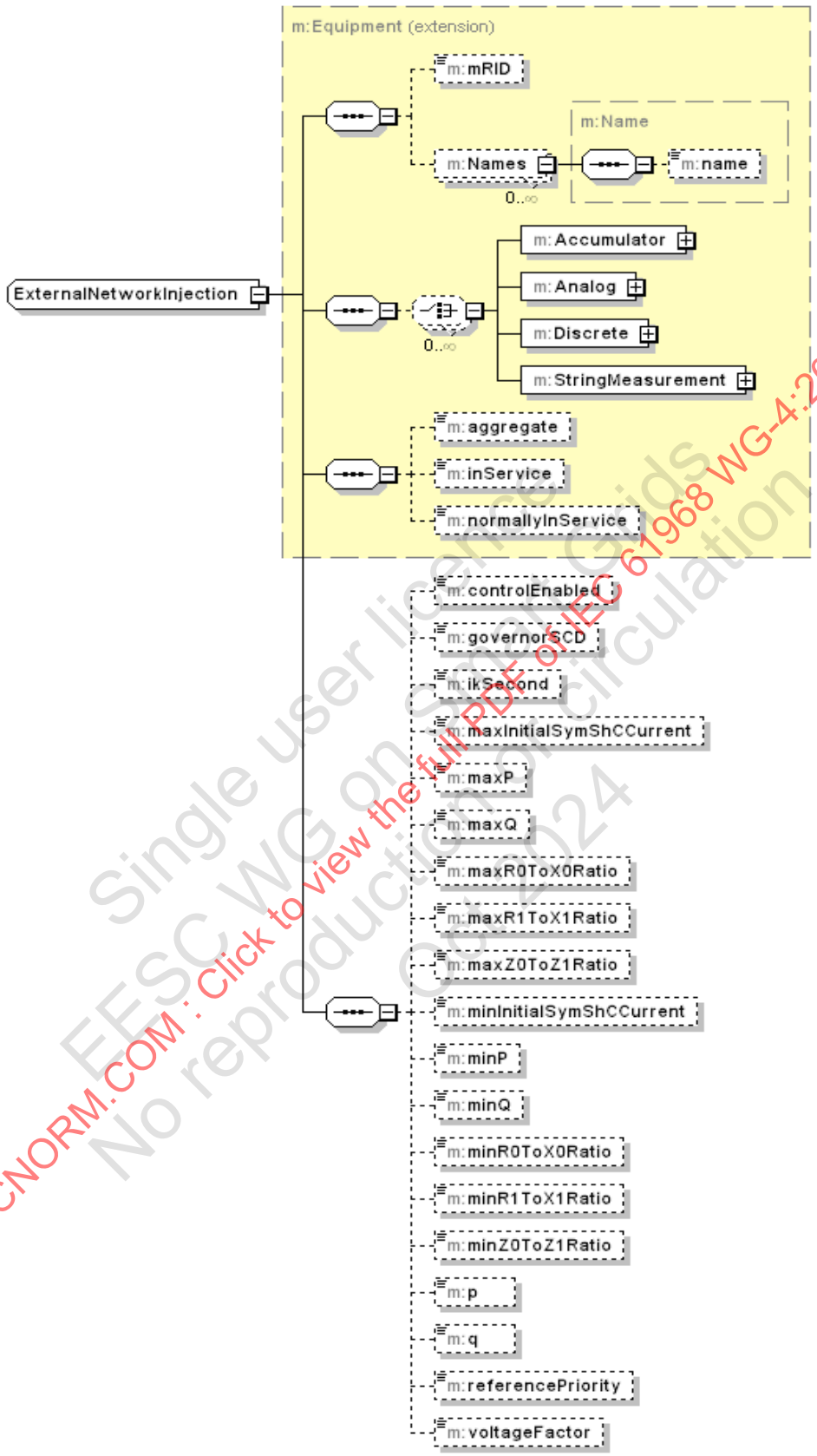


Figure 53 – AssetPSRDetails message: ExternalNetworkInjection element

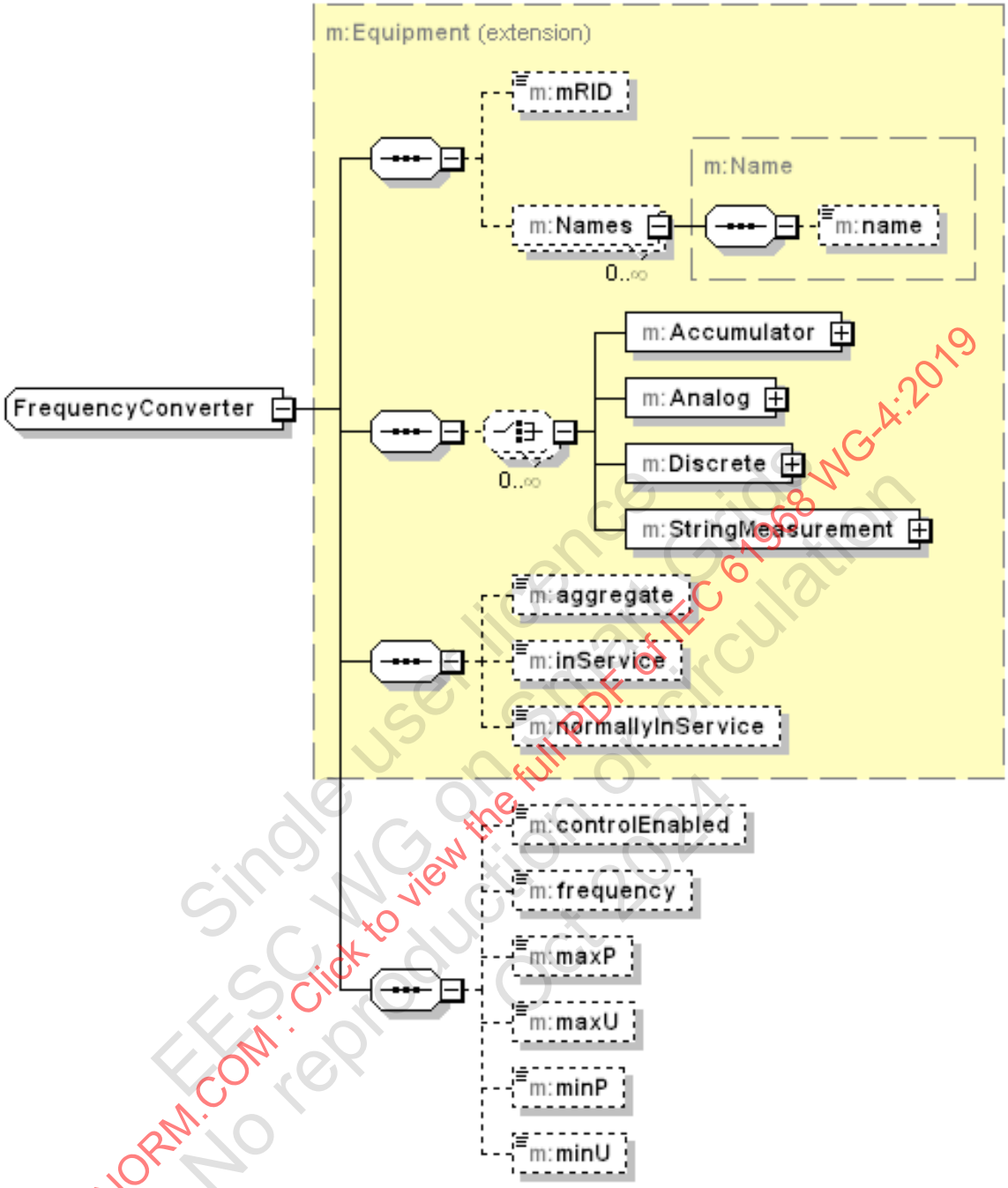


Figure 54 – AssetPSRDetails message: FrequencyConverter element

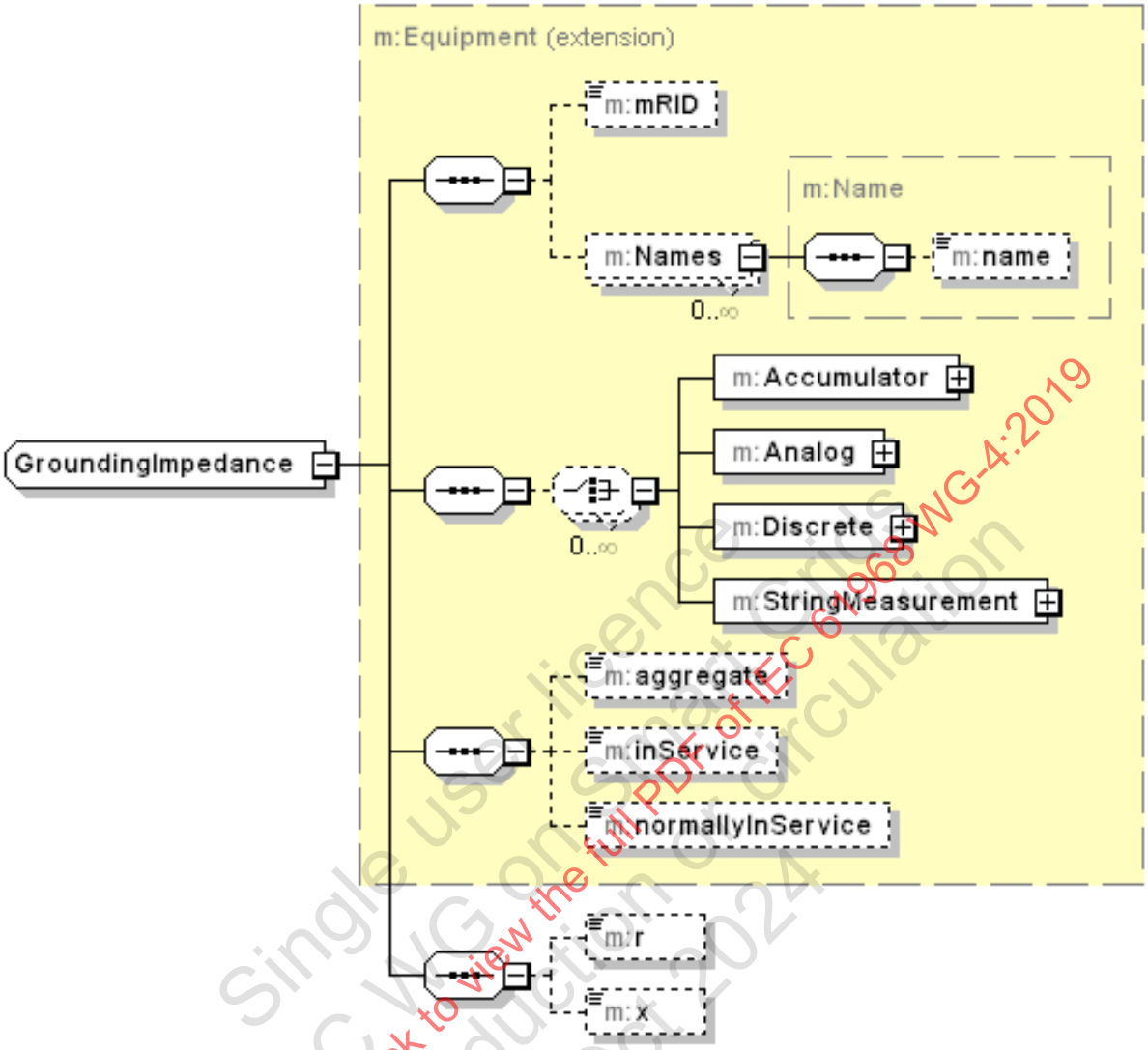


Figure 55 – AssetPSRDetails message: GroundingImpedance element

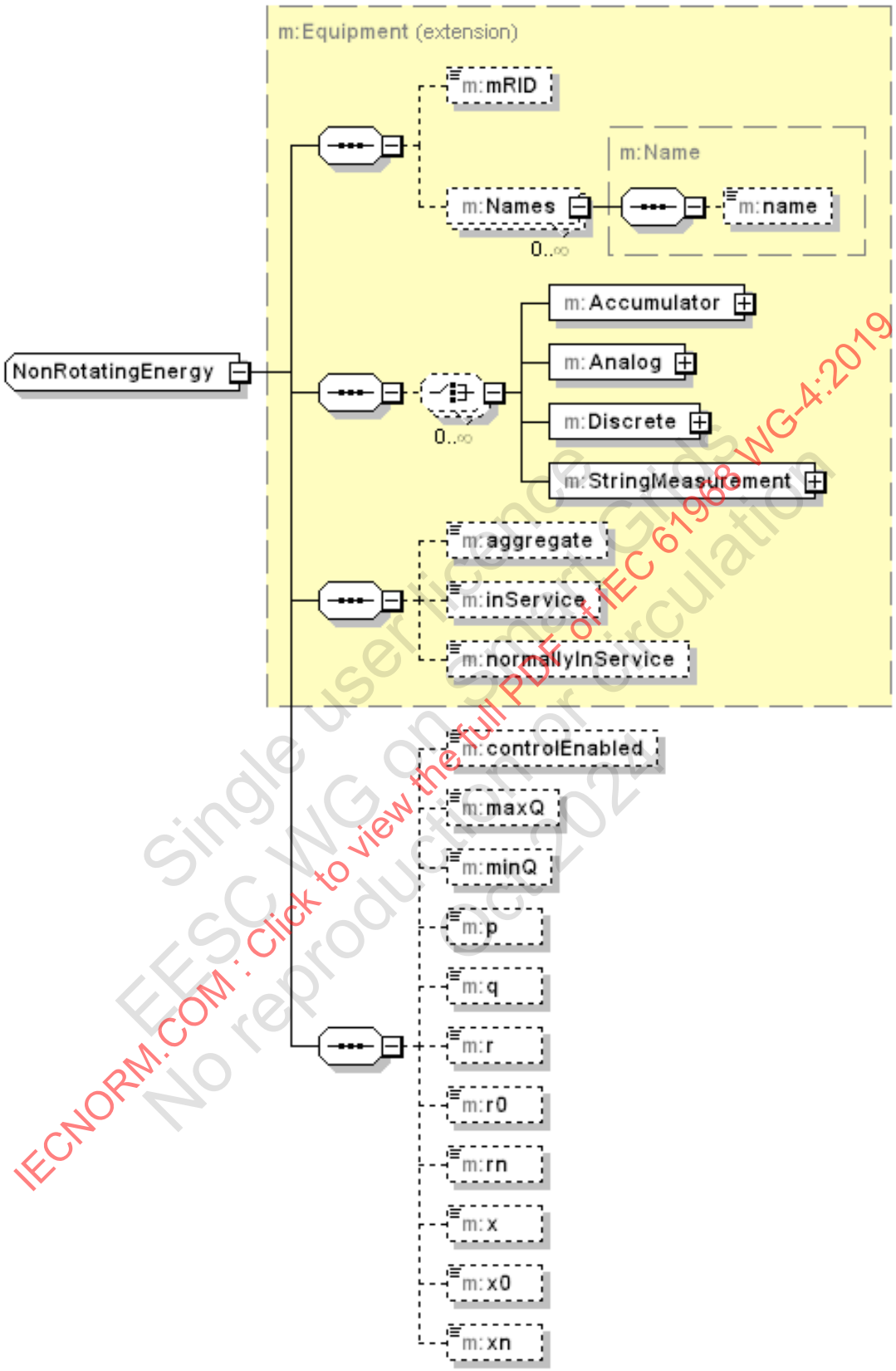


Figure 56 – AssetPSRDetails message: NonRotatingEnergy element

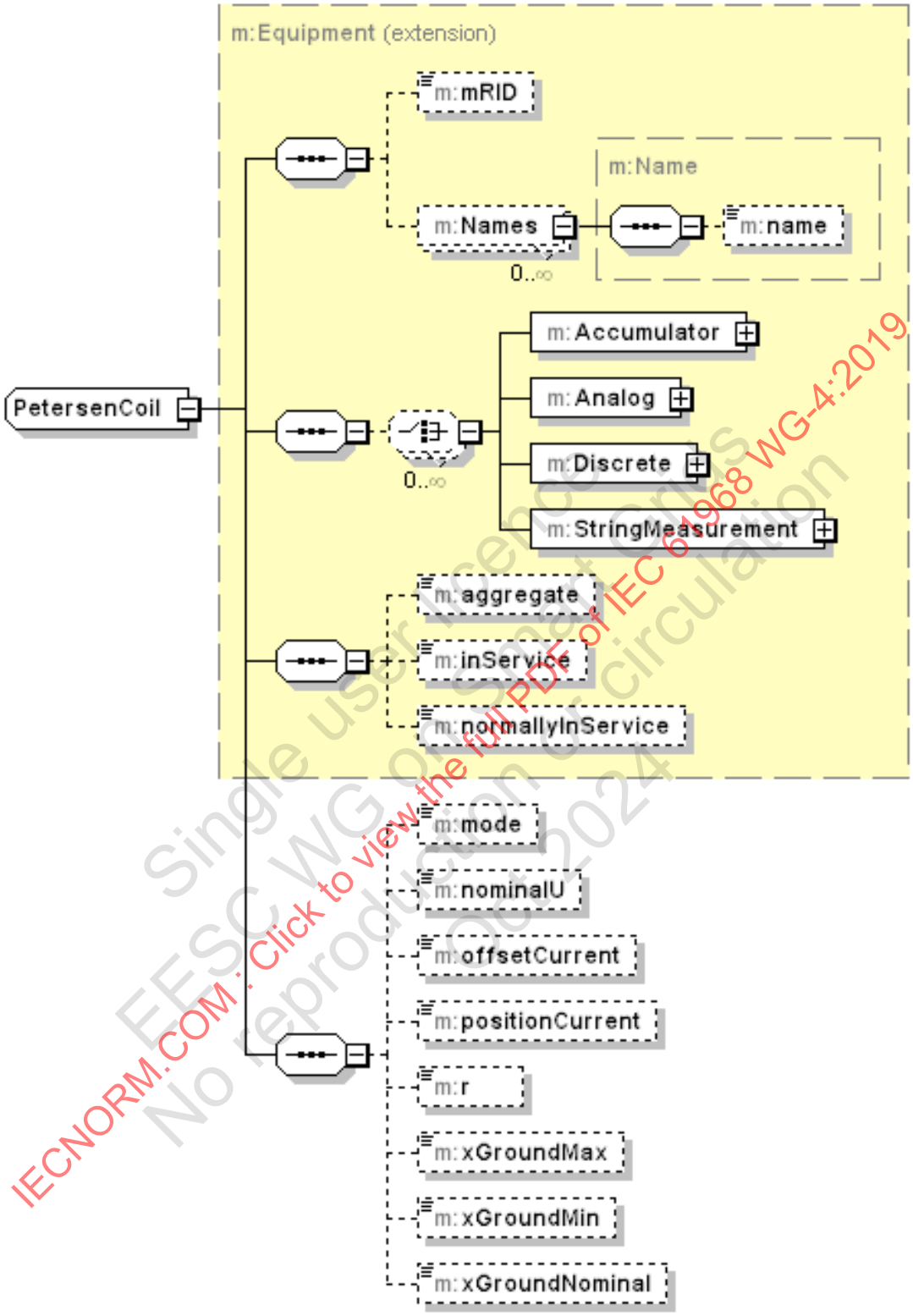


Figure 57 – AssetPSRDetails message: PetersenCoil element

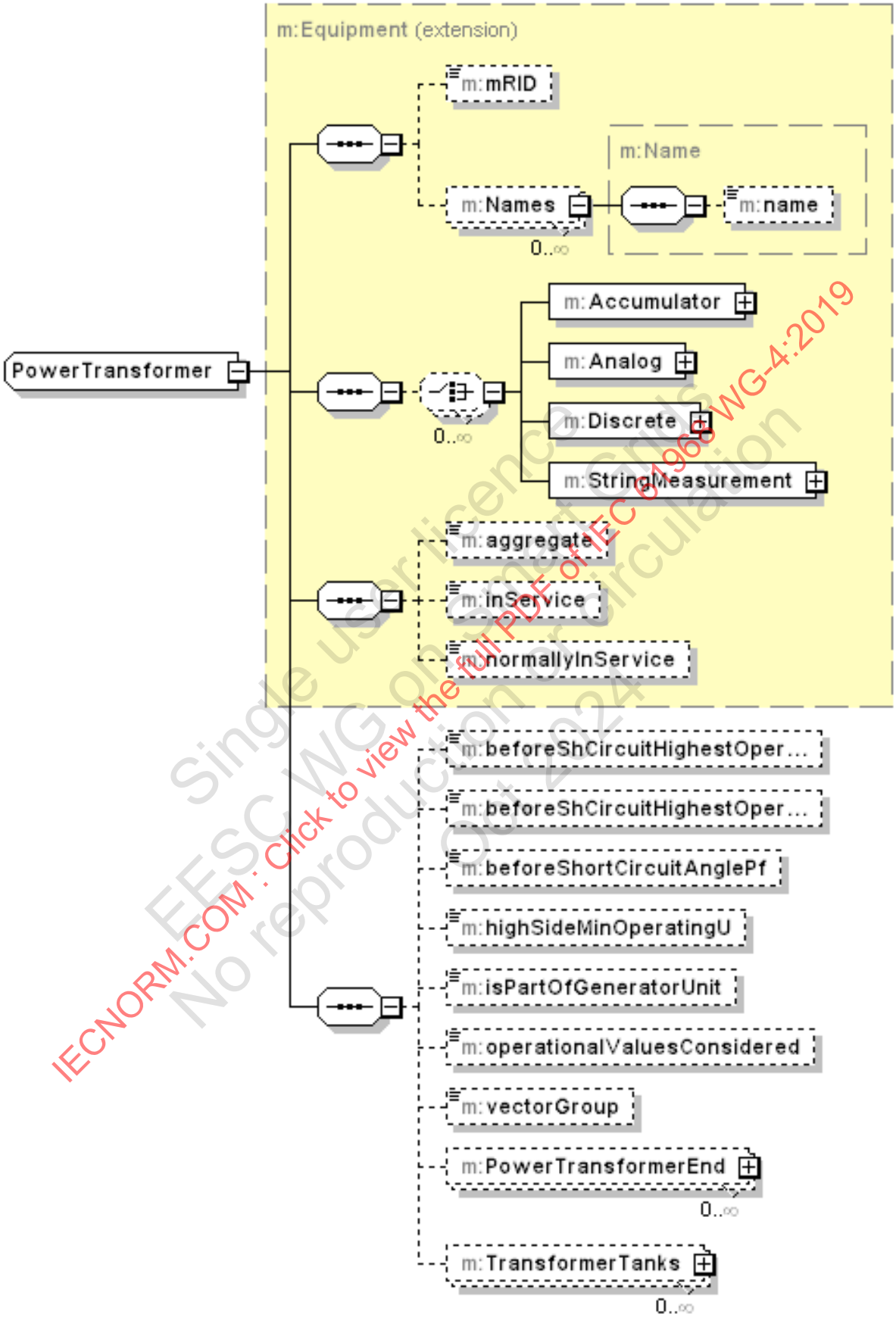


Figure 58 – AssetPSRDetails message: PowerTransformer element

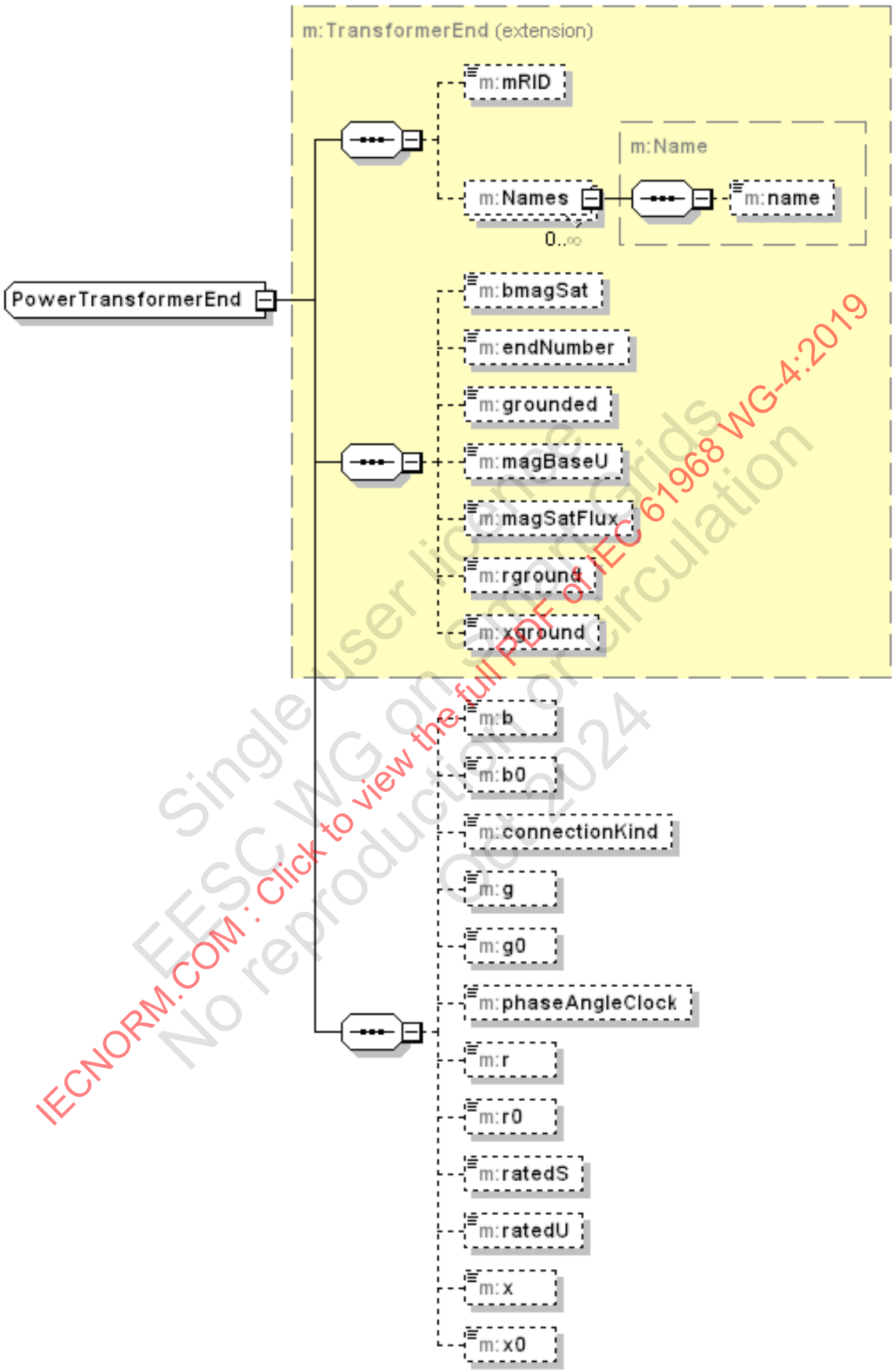


Figure 59 – AssetPSRDetails message: PowerTransformerEnd element

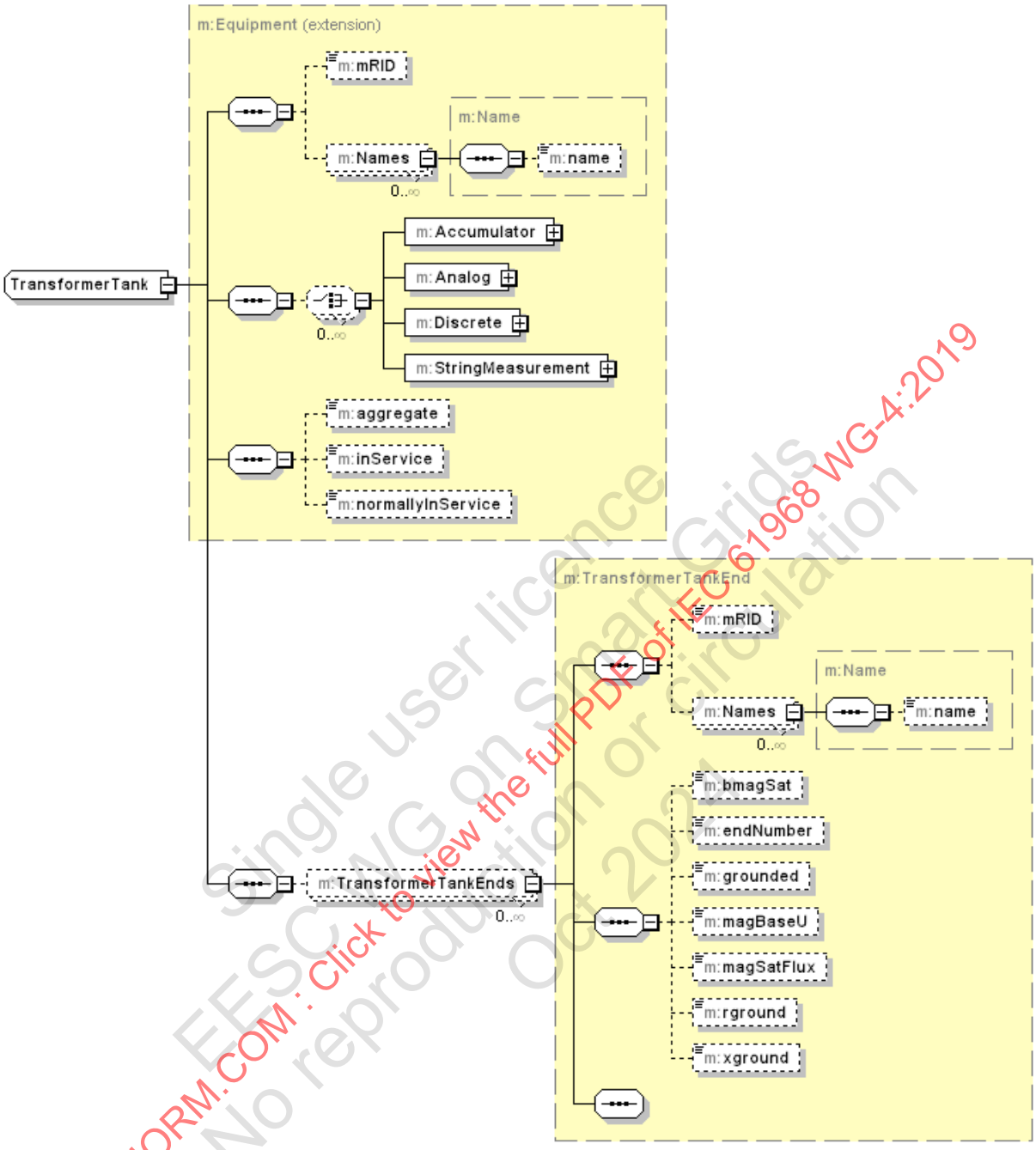


Figure 60 – AssetPSRDetails message: TransformerTank element

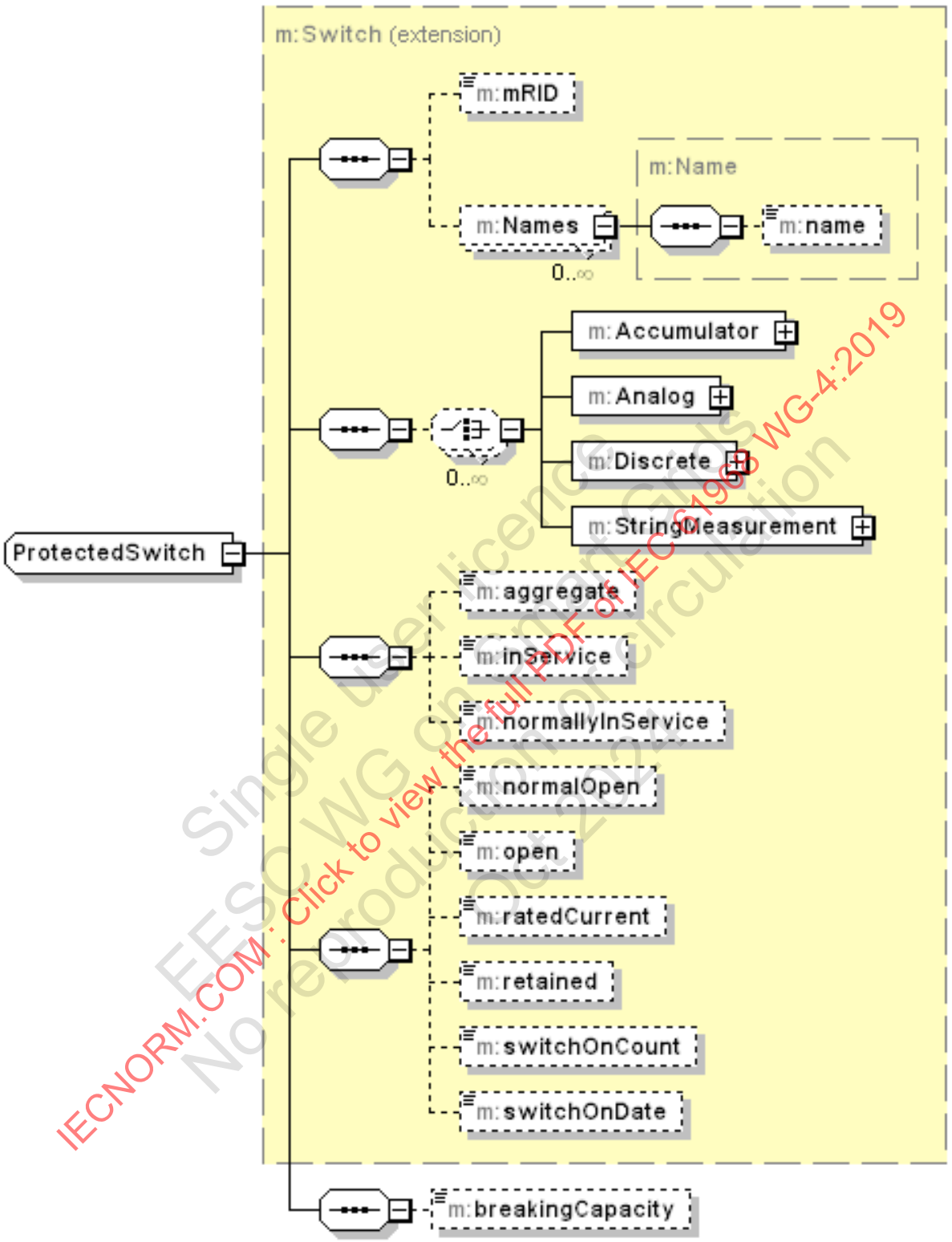


Figure 61 – AssetPSRDetails message: ProtectedSwitch element

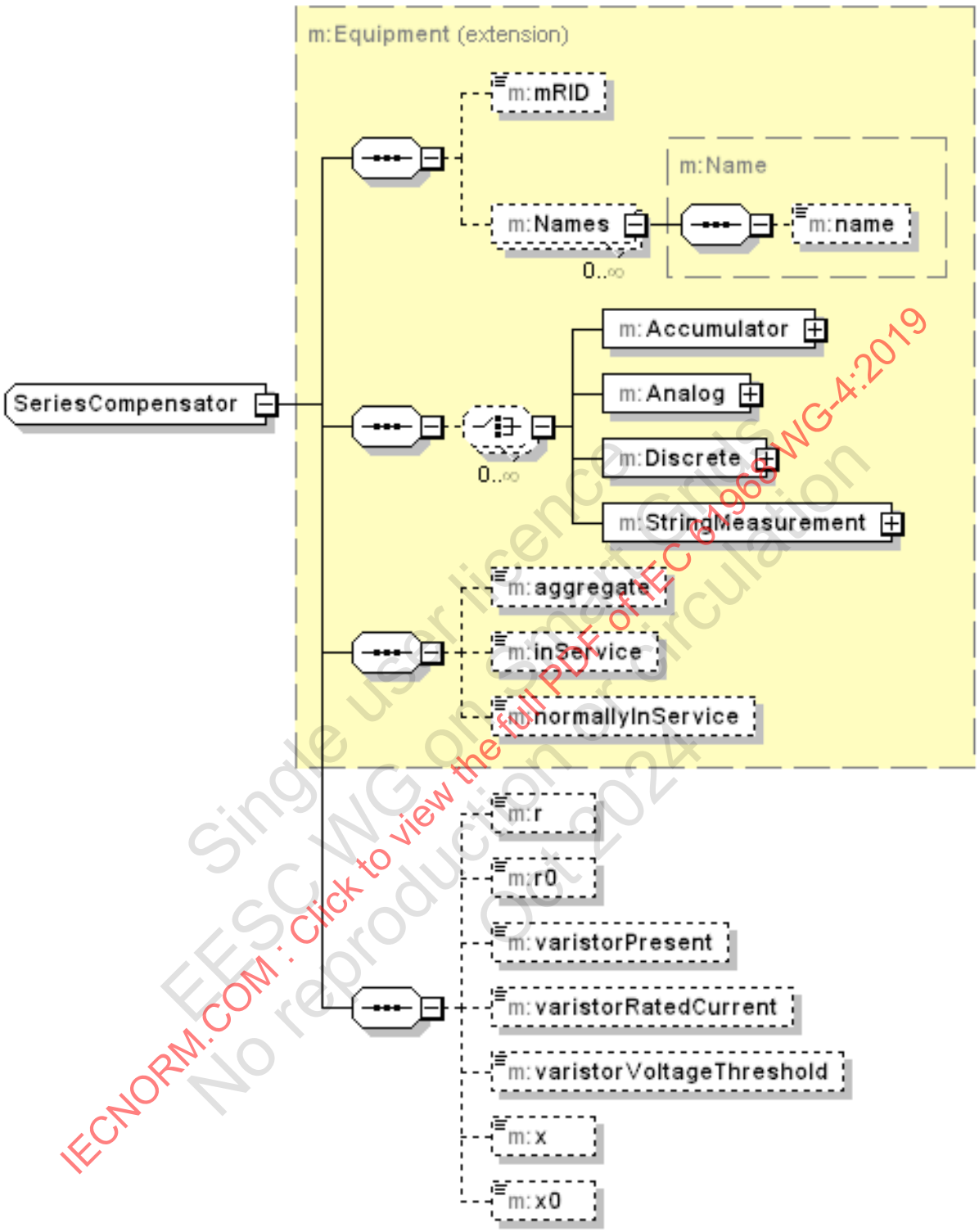


Figure 62 – AssetPSRDetails message: SeriesCompensator element

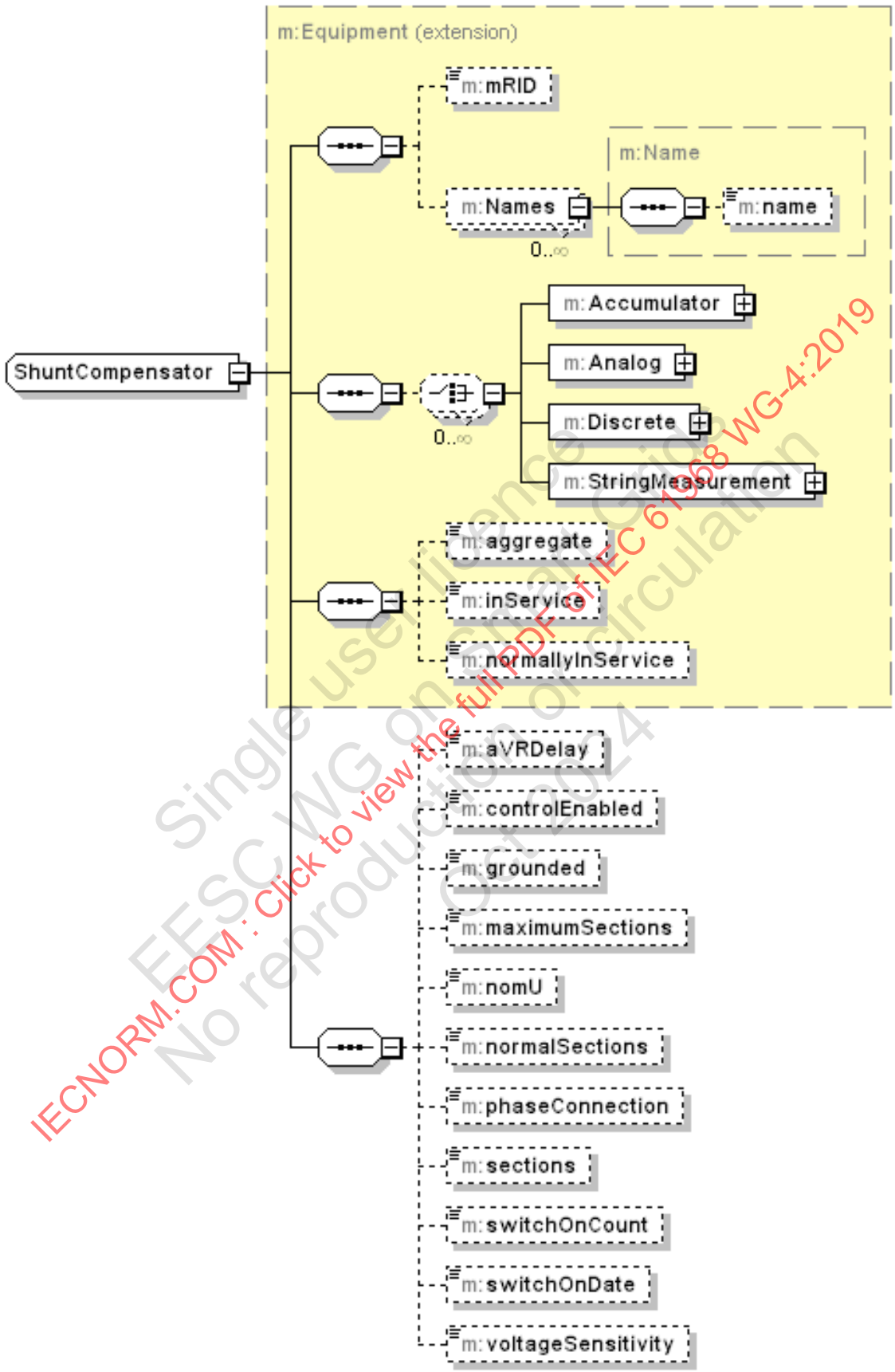


Figure 63 – AssetPSRDetails message: ShuntCompensator element

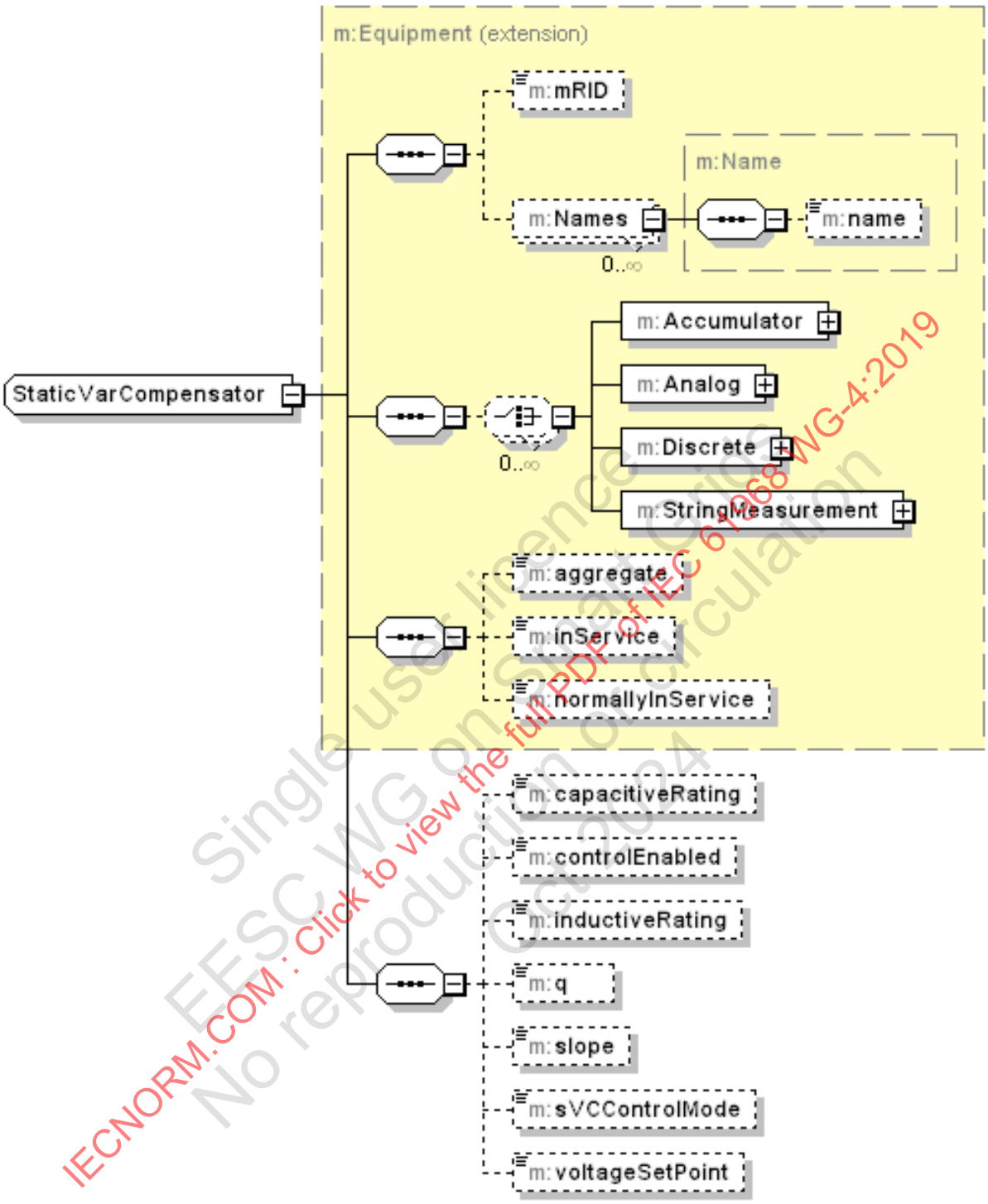


Figure 64 – AssetPSRDetails message: StaticVarCompensator element

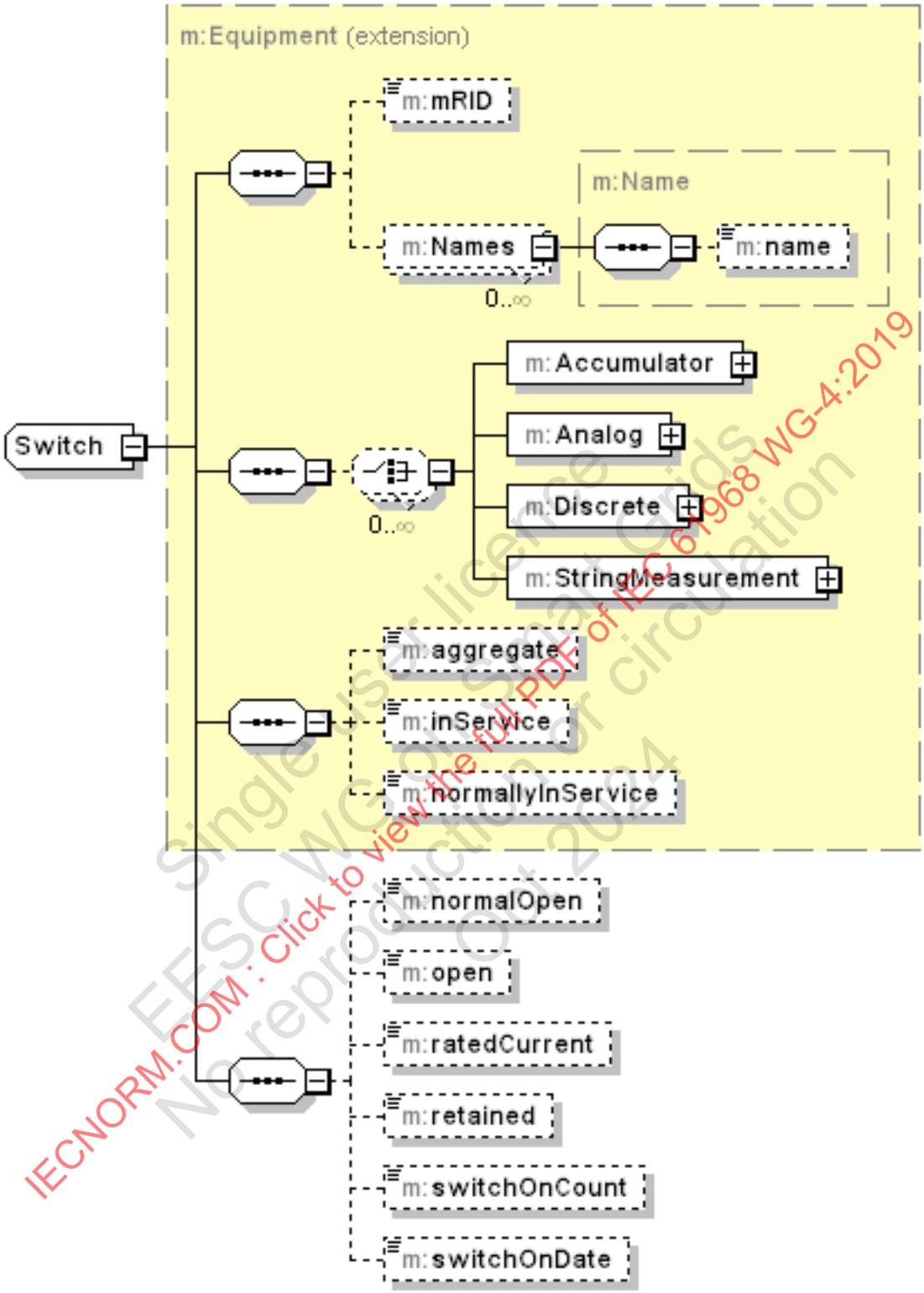


Figure 65 – AssetPSRDetails message: Switch element

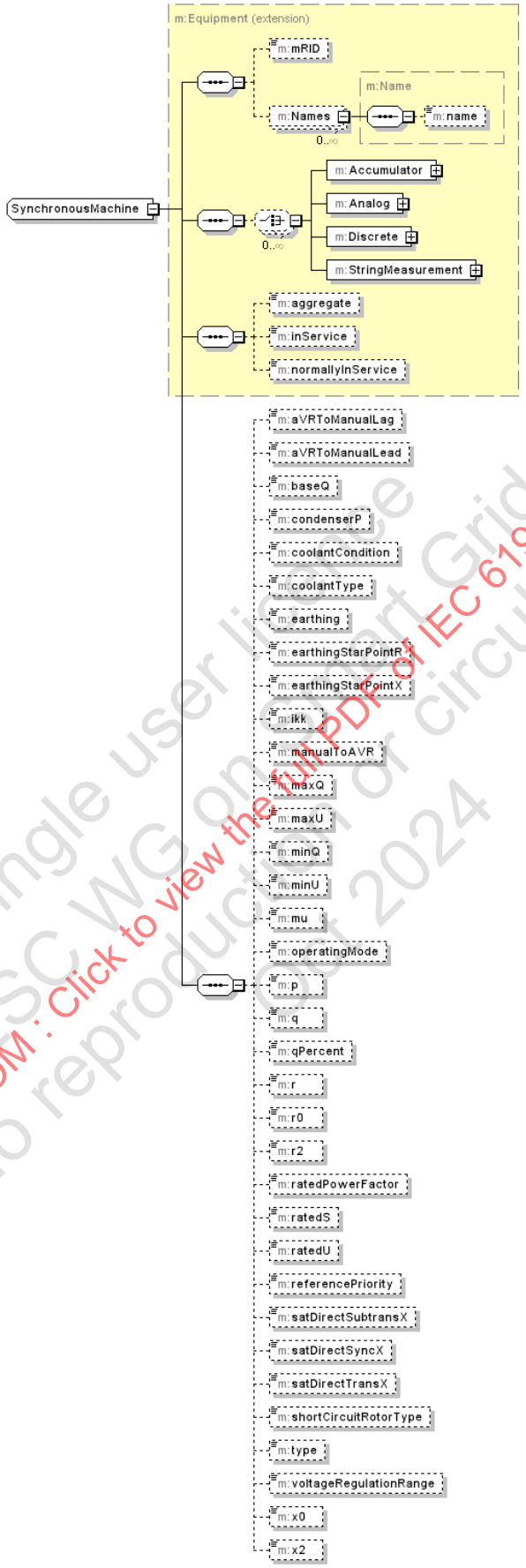


Figure 66 – AssetPSRDetails message: SynchronousMachine element

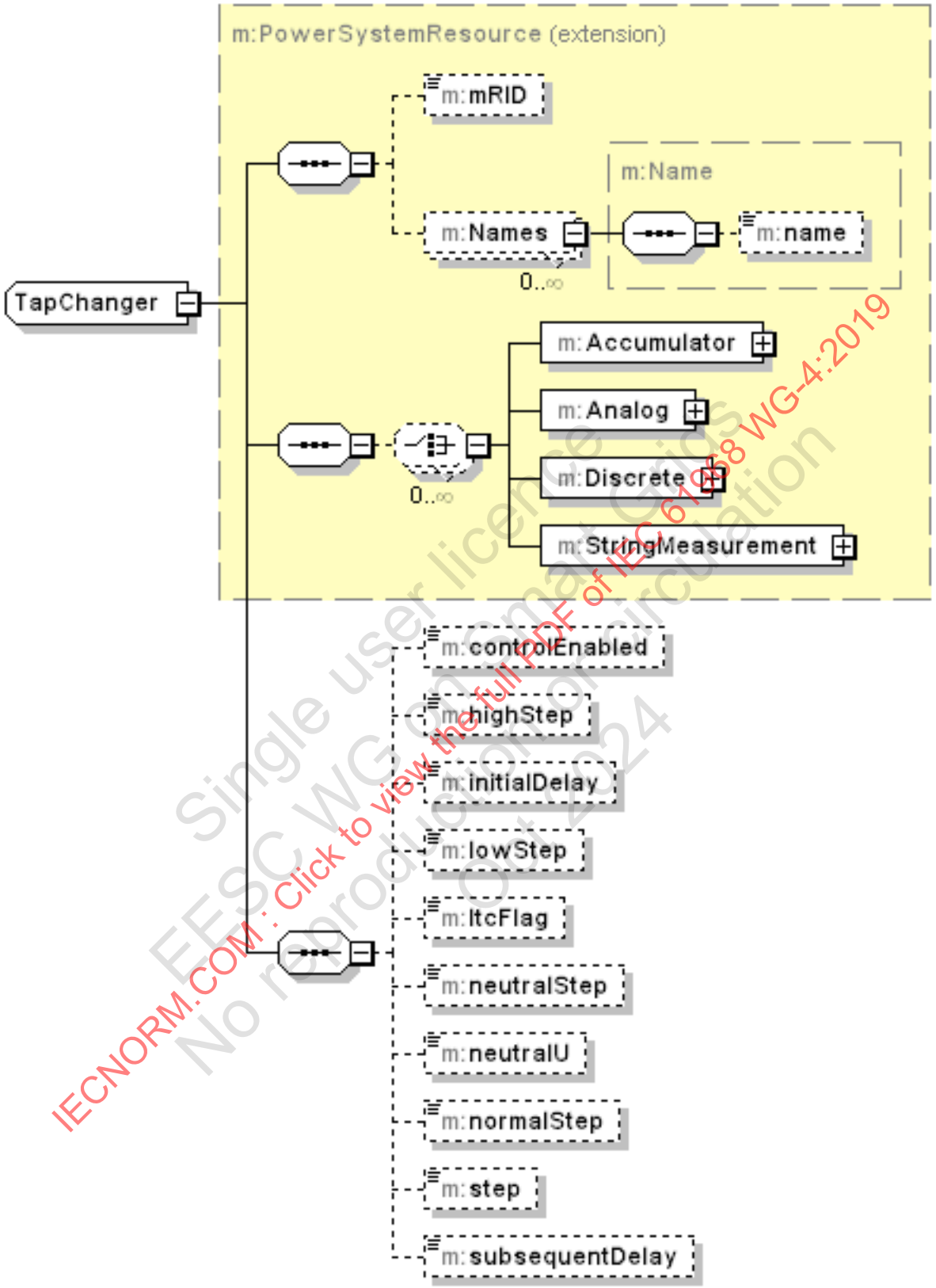


Figure 67 – AssetPSRDetails message: TapChanger element

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.

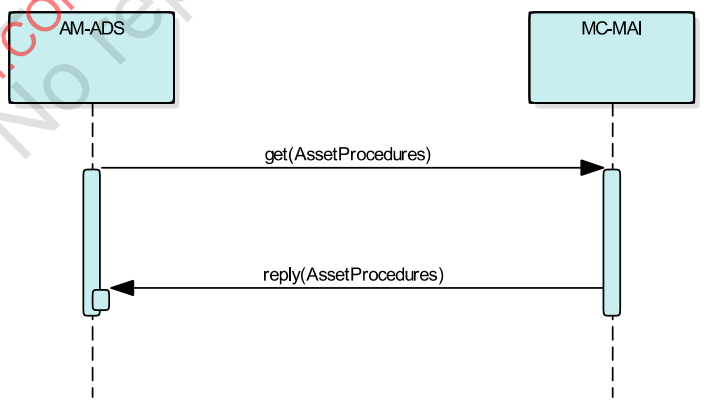


Figure 68 – AssetProcedures message exchange

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.

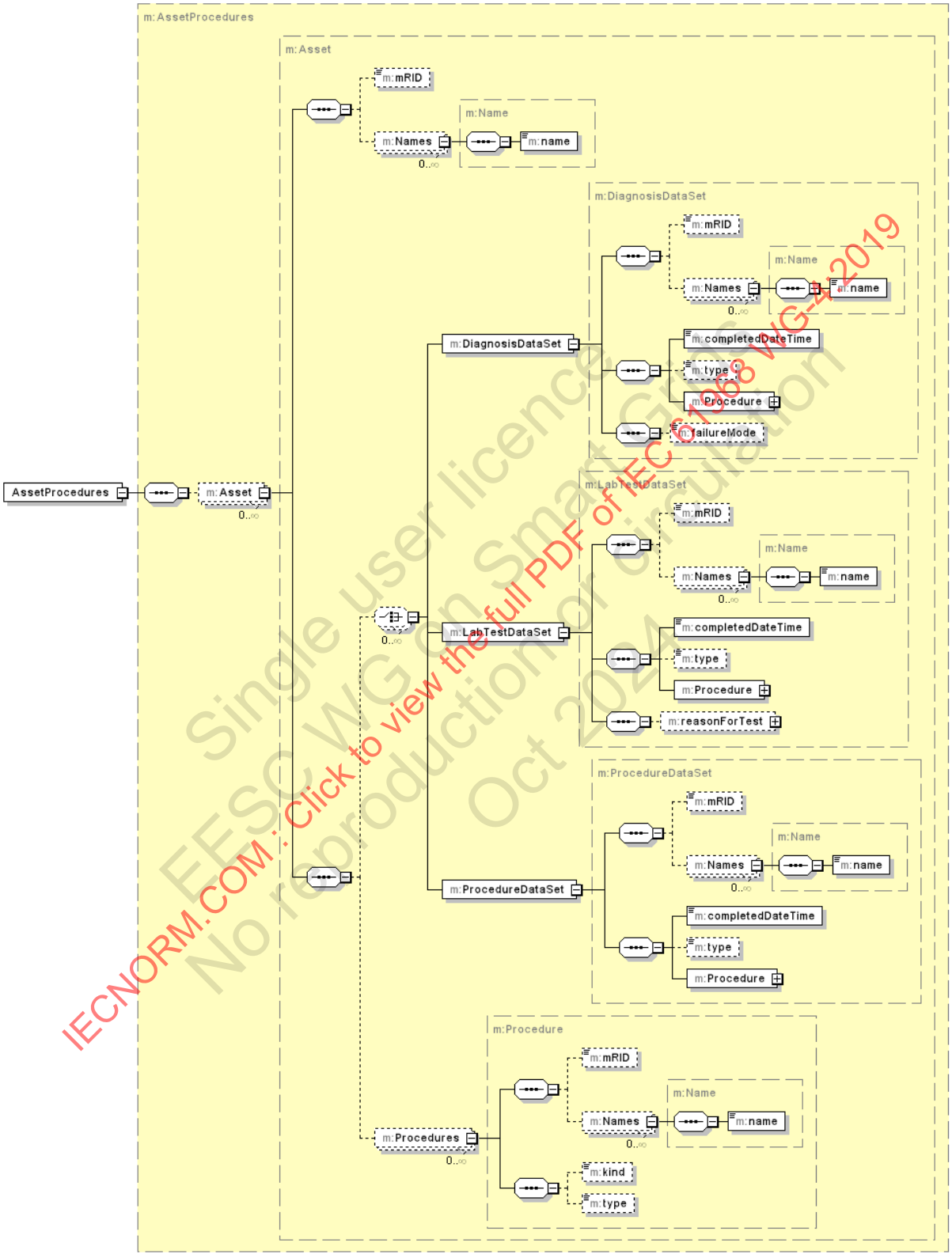


Figure 69 – AssetProcedures message format

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.

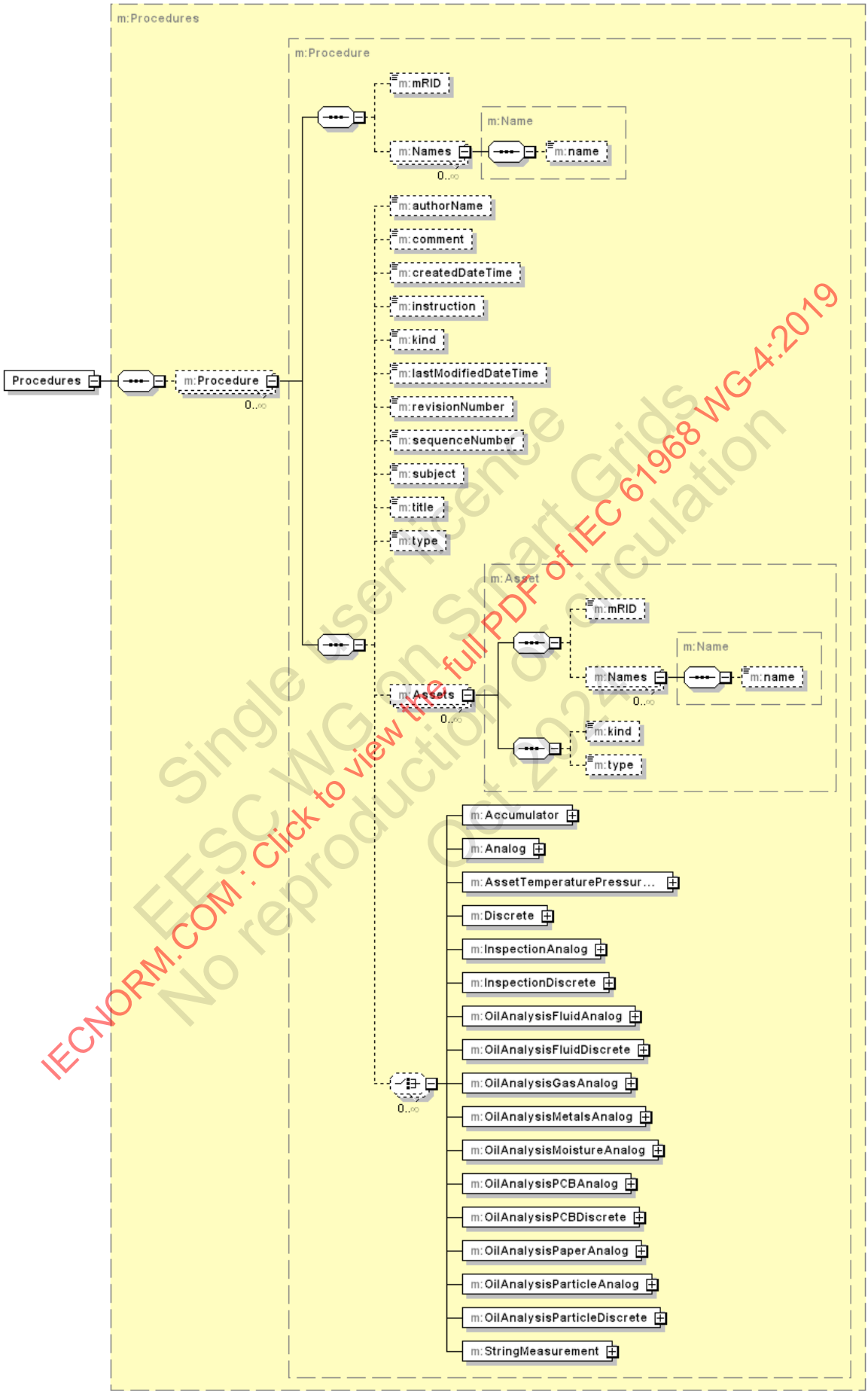


Figure 70 – Procedures message format

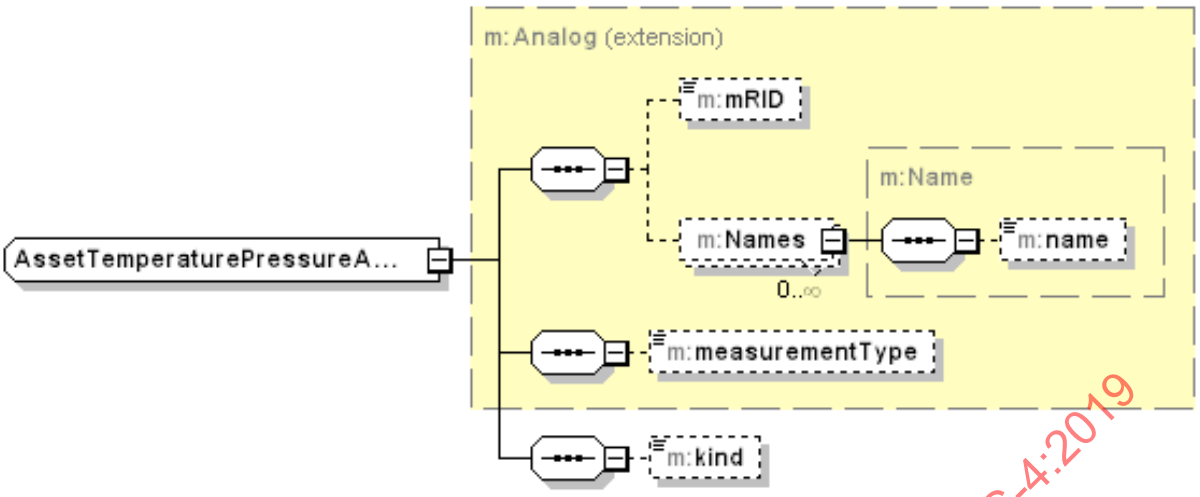


Figure 71 – Procedures message format: AssetTemperaturePressureAnalog element

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.

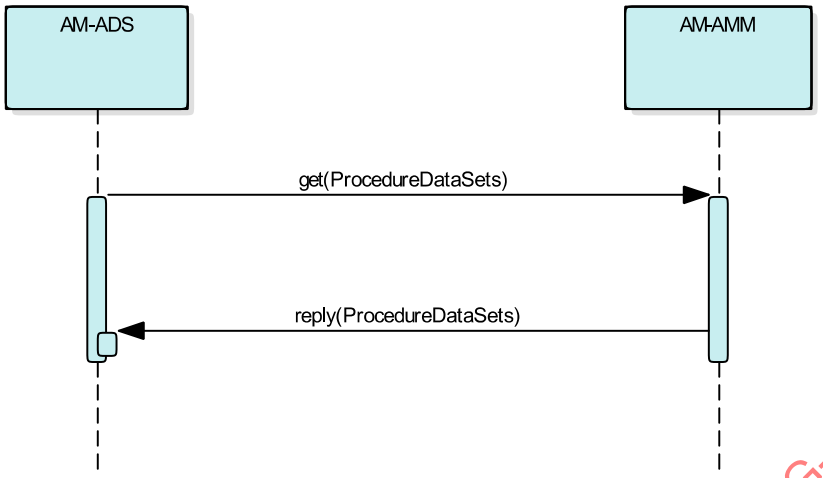


Figure 72 – ProcedureDataSets message exchange

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.

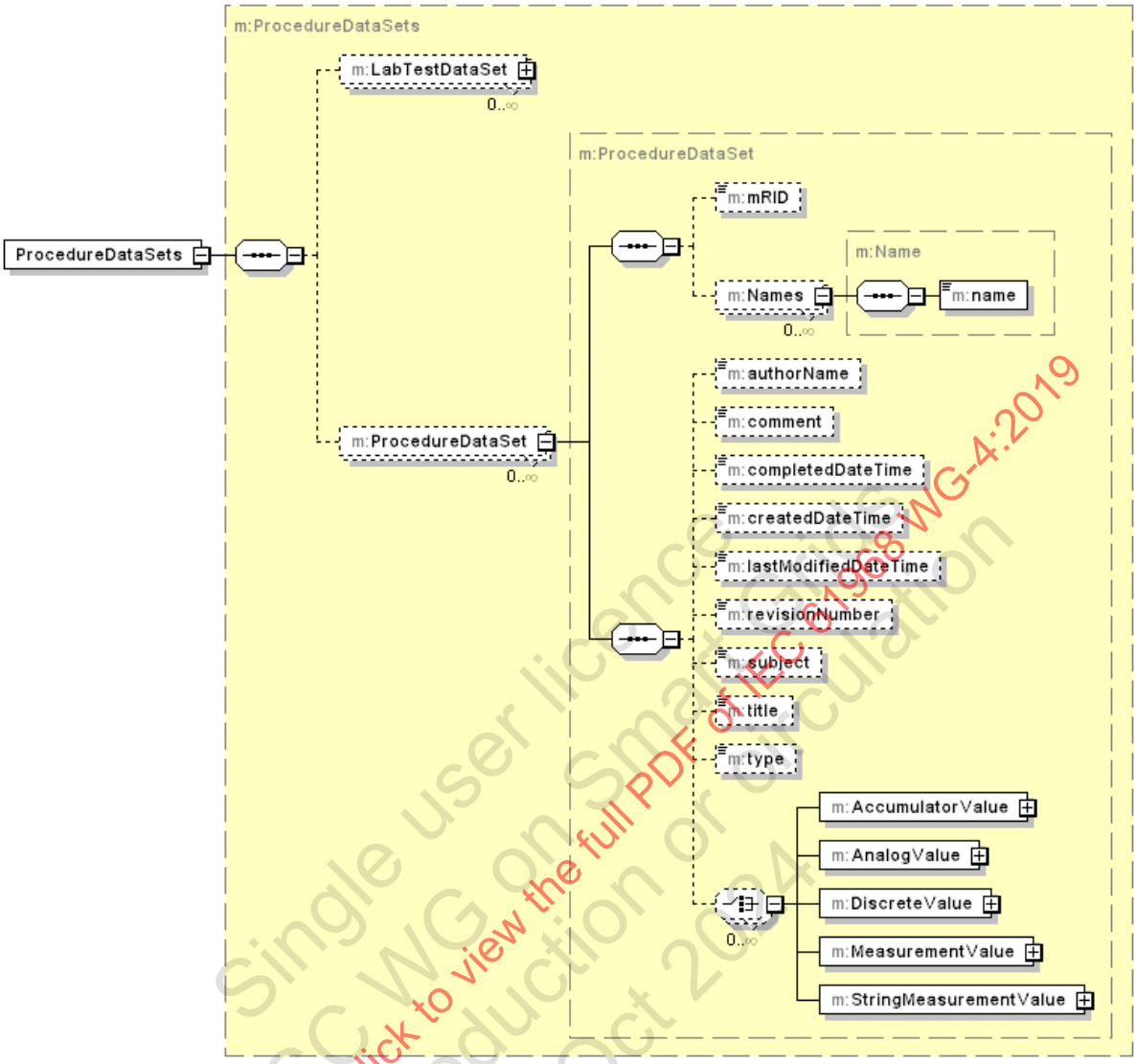


Figure 73 – ProcedureDataSets message format

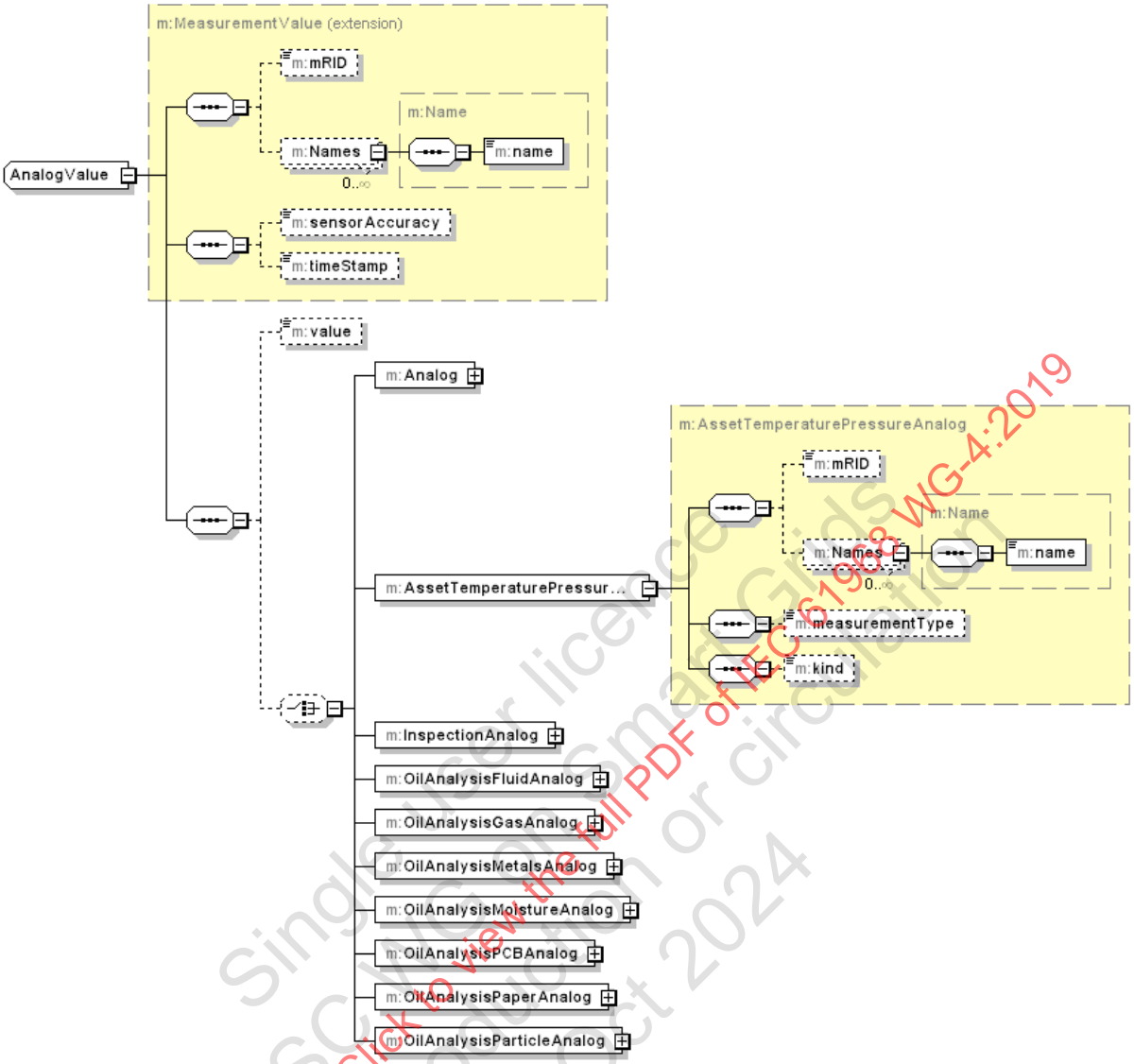


Figure 74 – ProcedureDatasets message: AnalogValue element

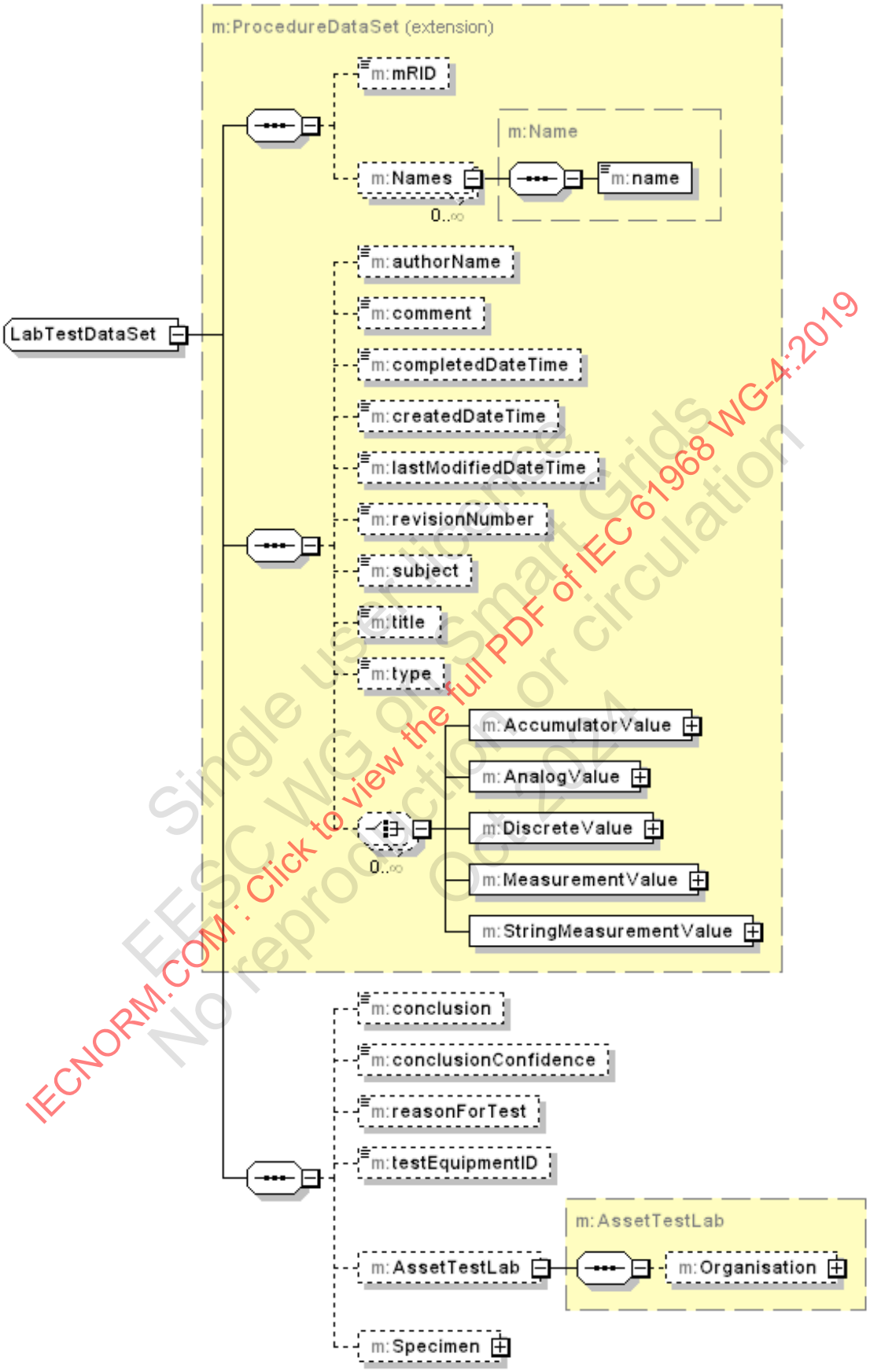


Figure 75 – ProcedureDataSets message: LabTestDataSet element

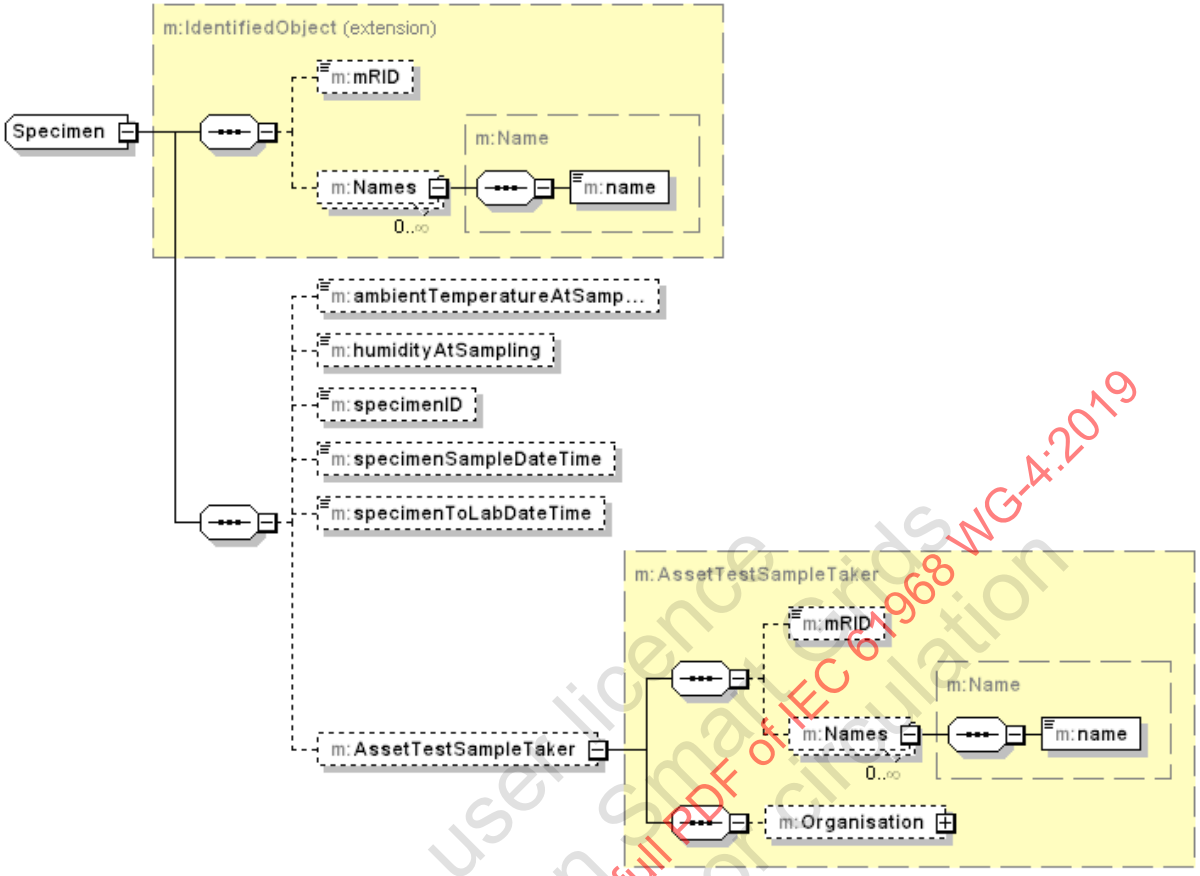


Figure 76 – ProcedureDataSets message format: Specimen element

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.

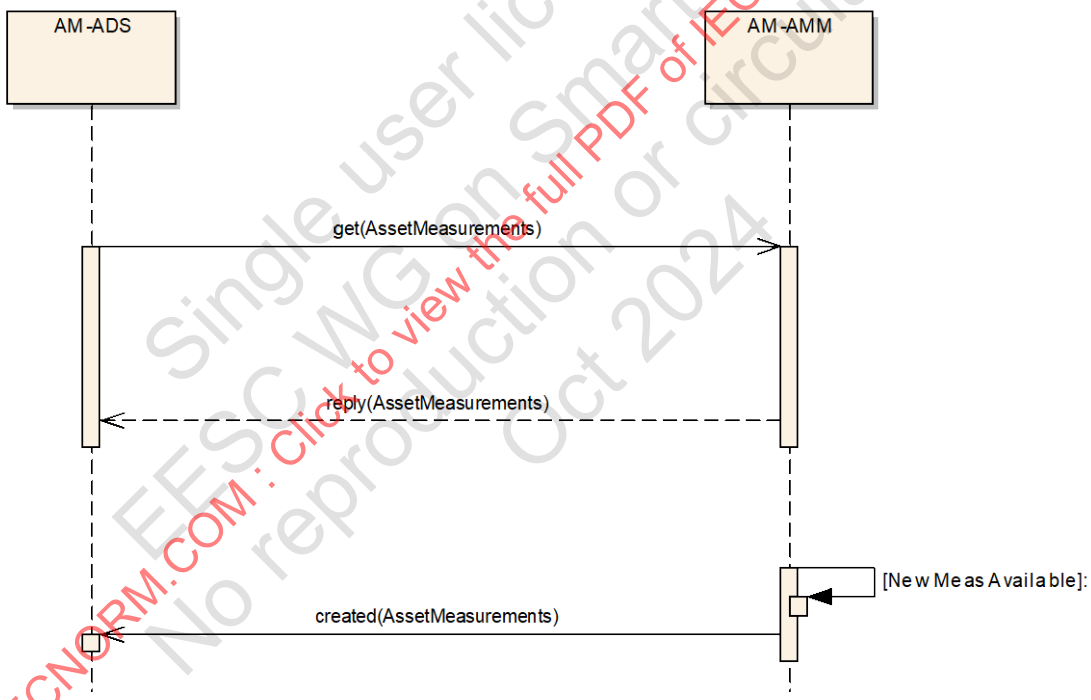


Figure 77 – Asset Measurements message exchange

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.

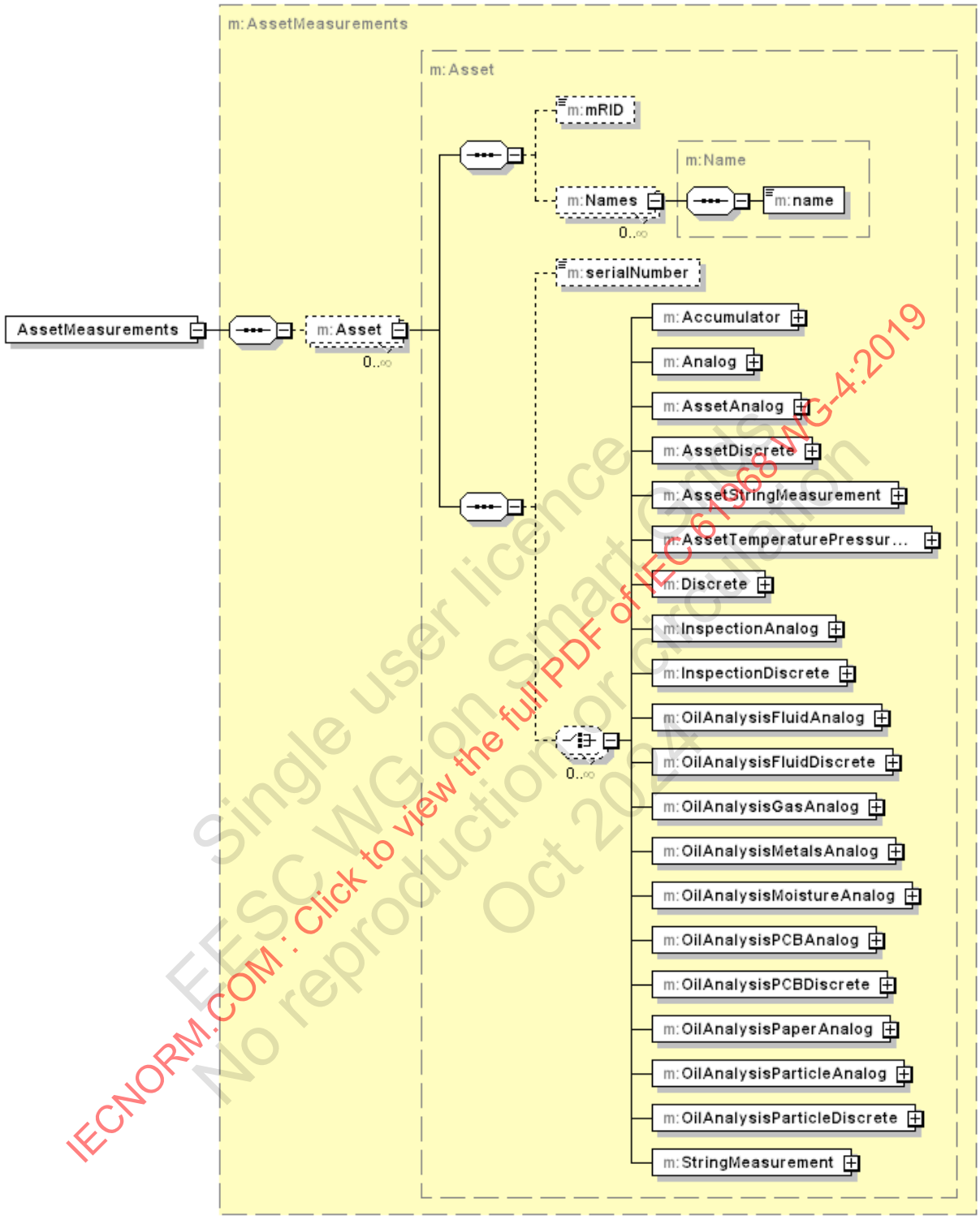


Figure 78 – AssetMeasurements message format

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).

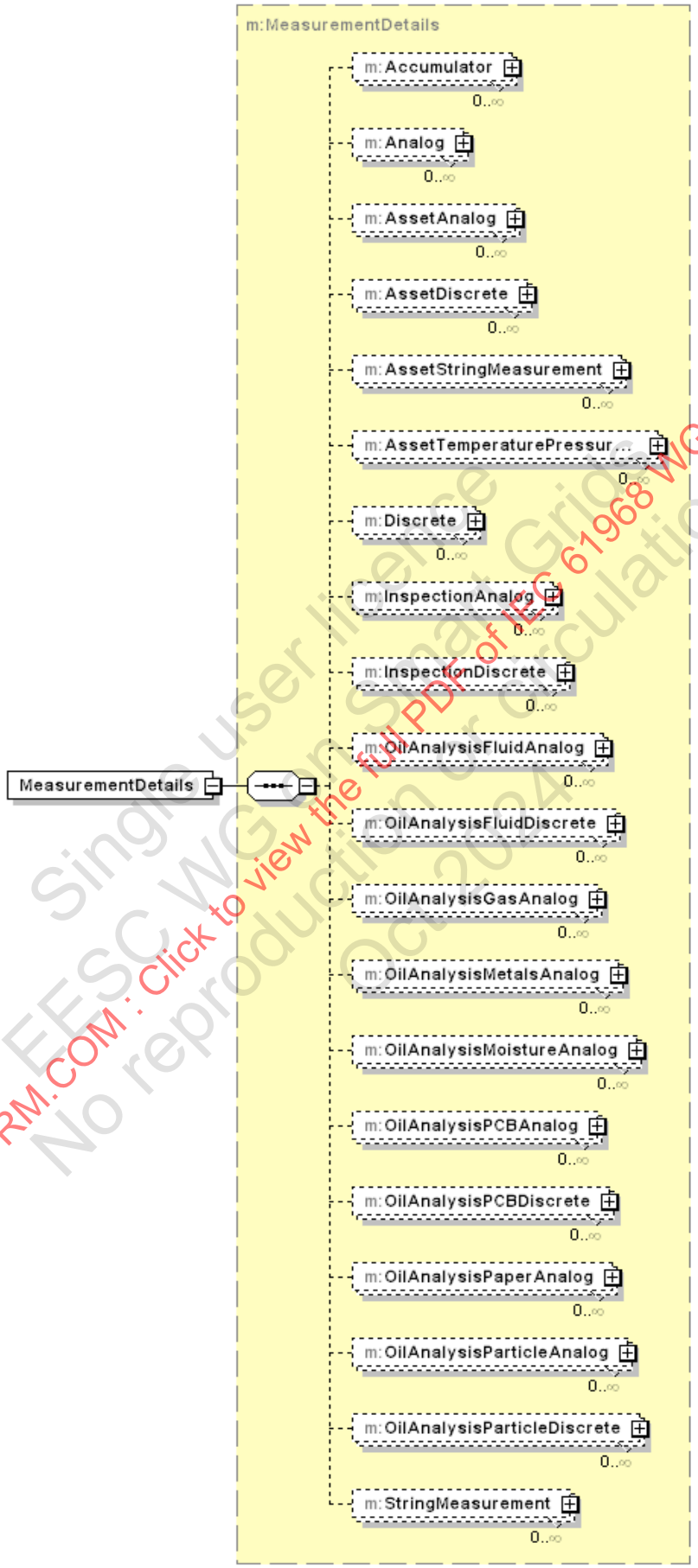


Figure 79 – MeasurementDetails message format

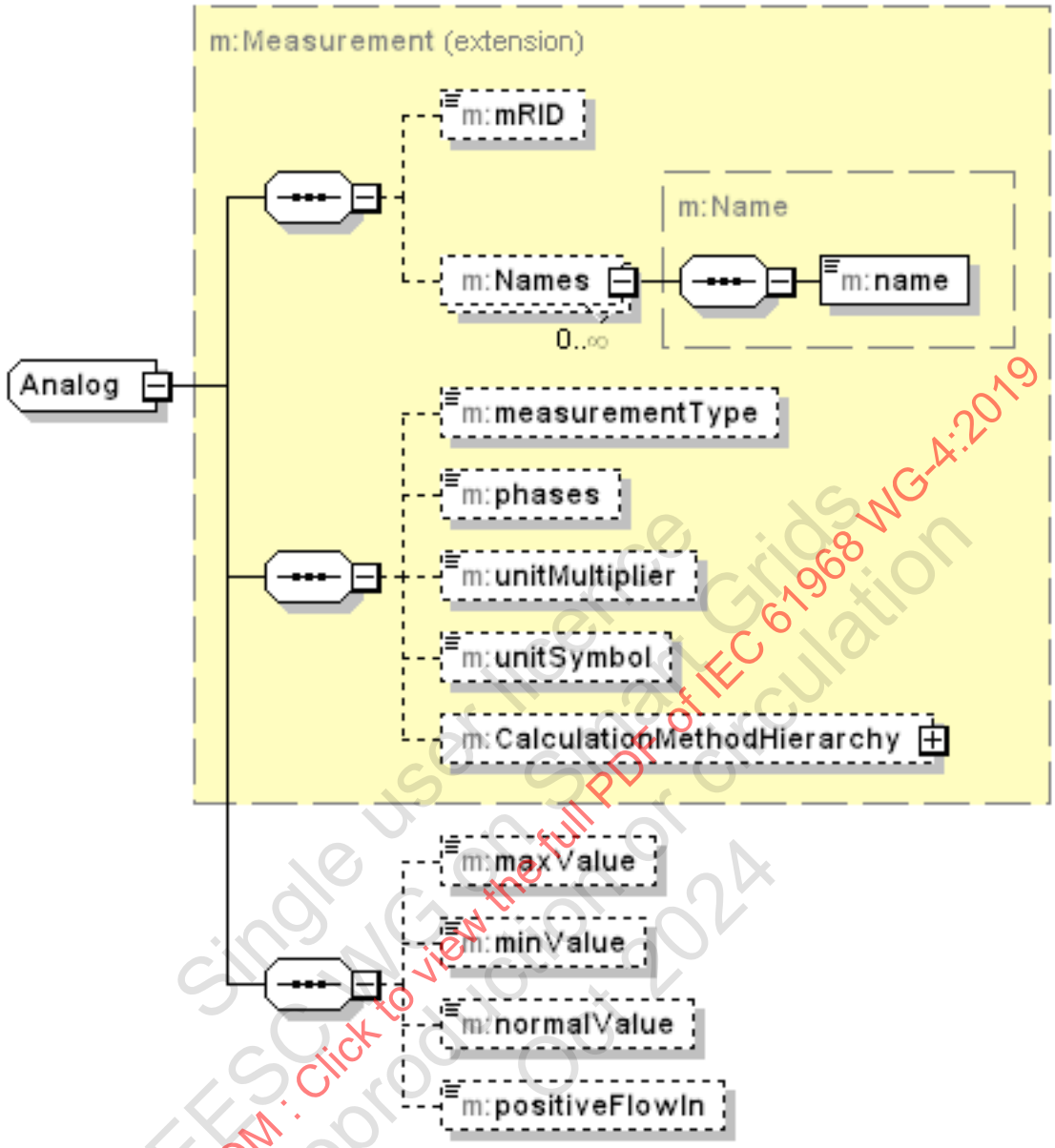


Figure 80 – MeasurementDetails message format: Analog element

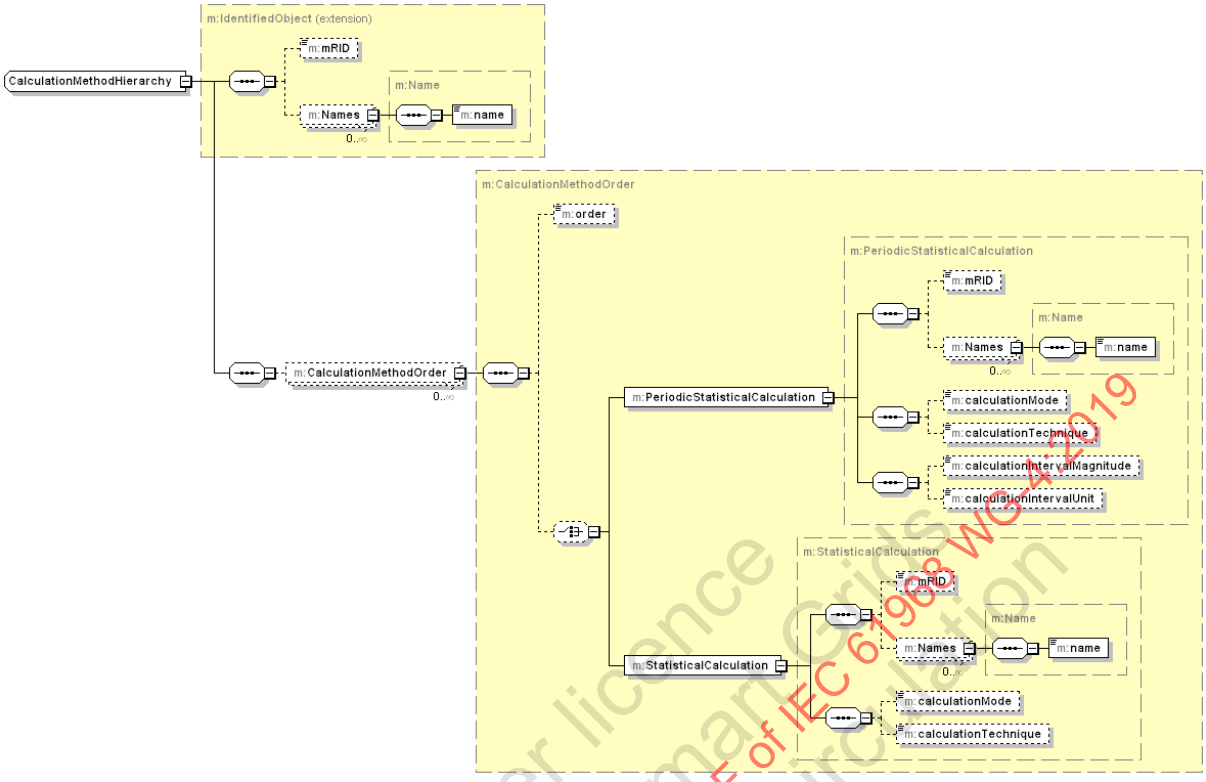


Figure 81 – MeasurementDetails message format: CalculationMethodHierarchy element

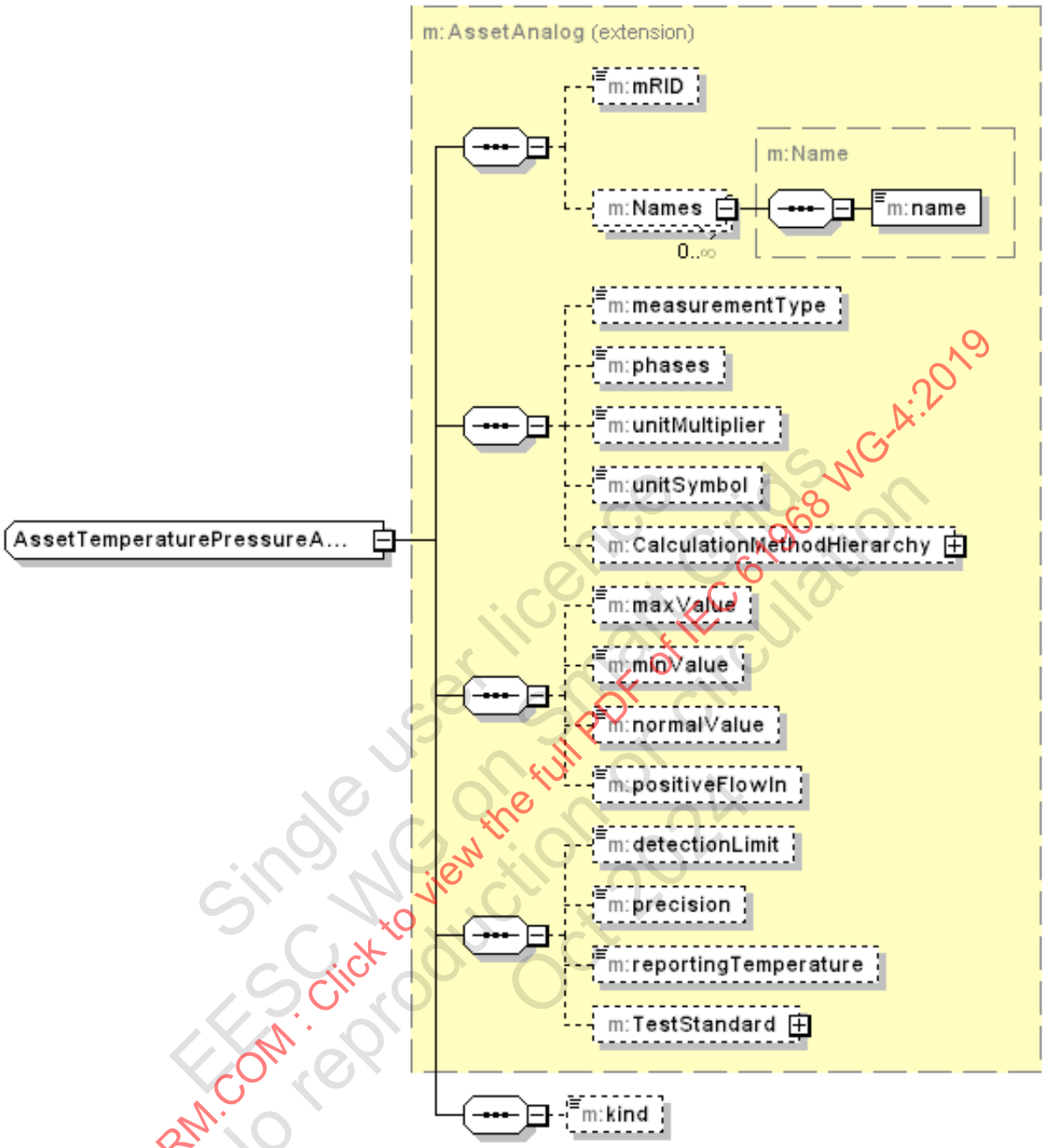


Figure 82 – MeasurementDetails message format: AssetTemperaturePressureAnalog element

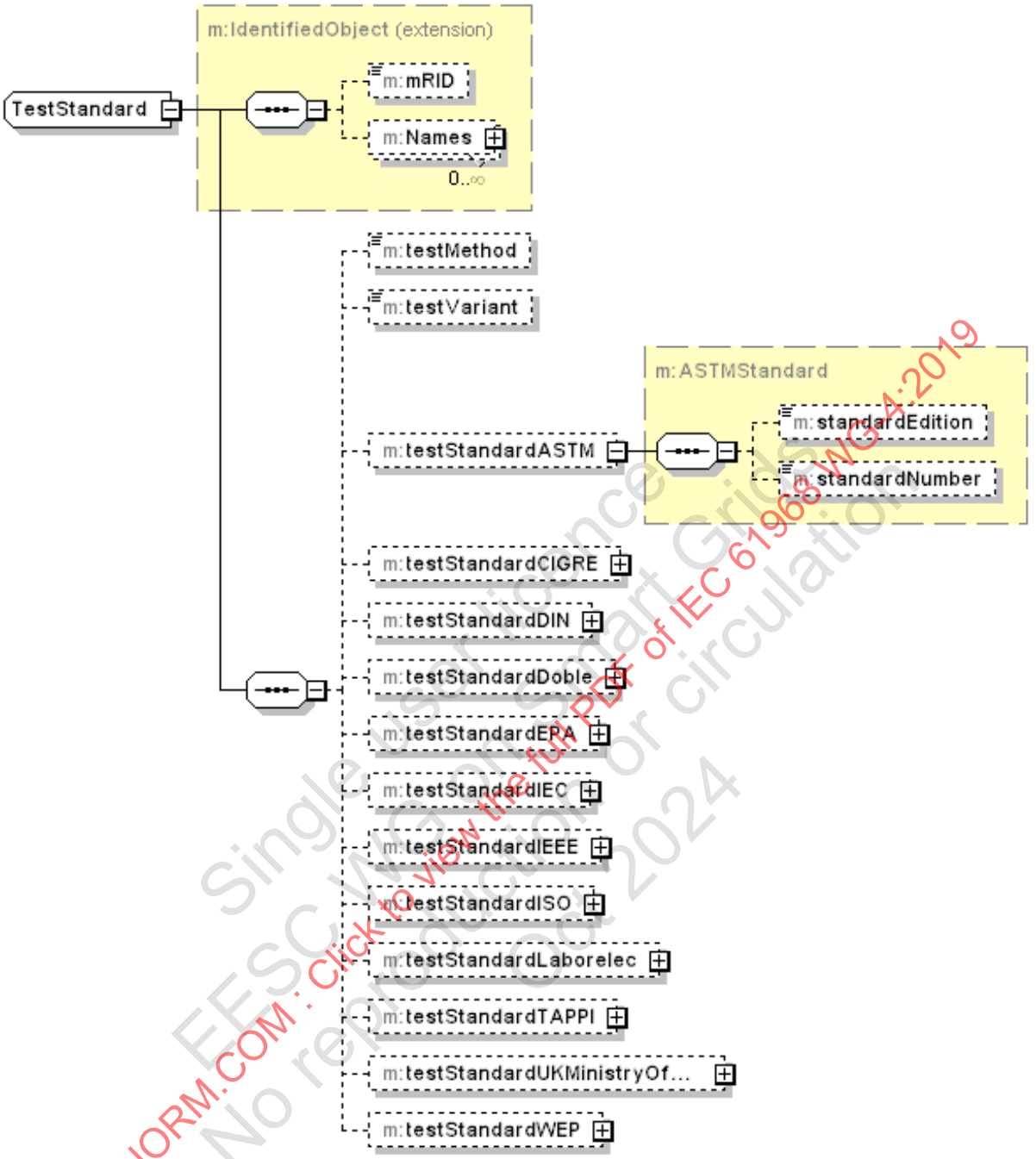


Figure 83 – MeasurementDetails message format: TestStandard element

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.

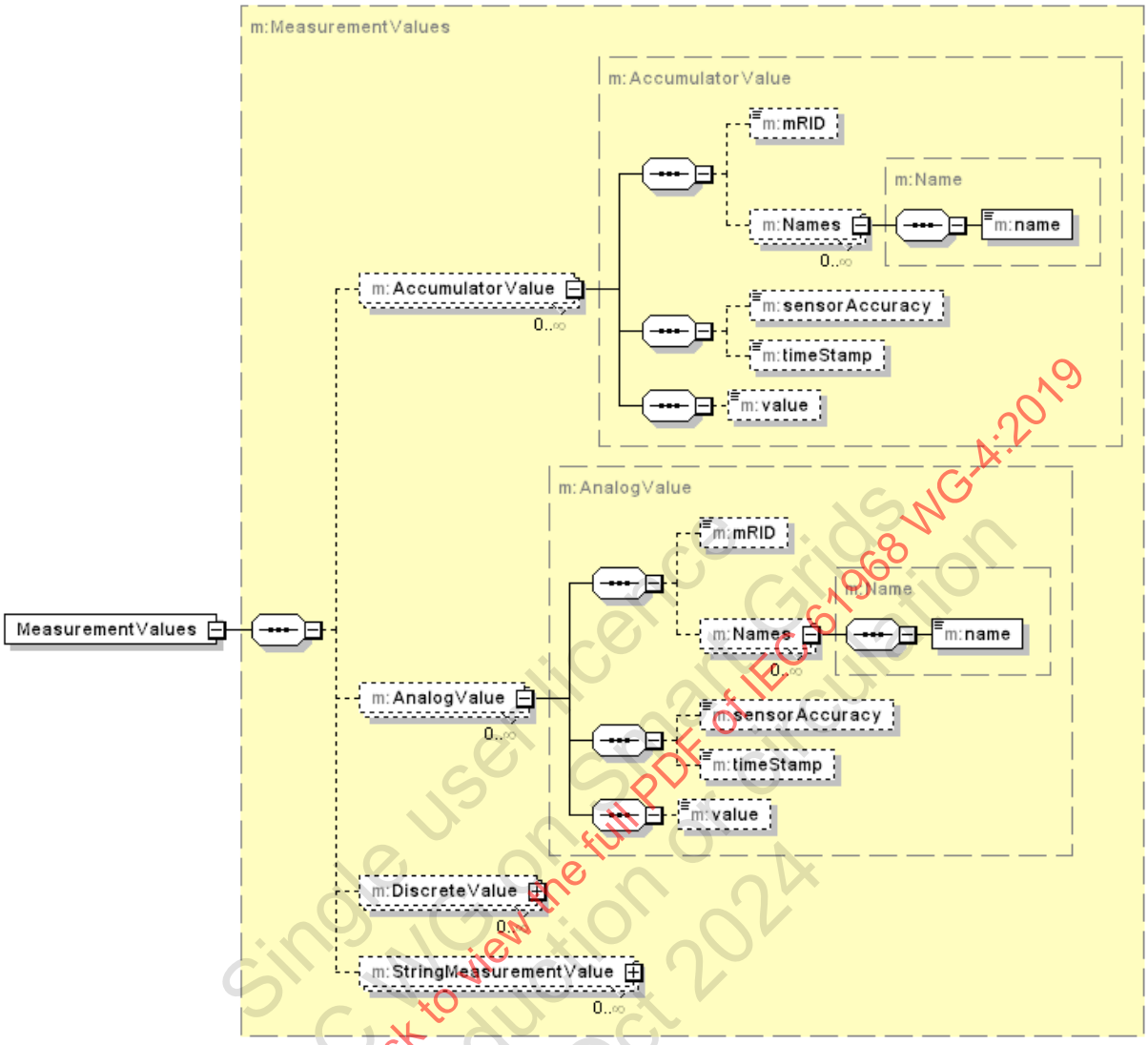


Figure 84 – MeasurementValues message format

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.

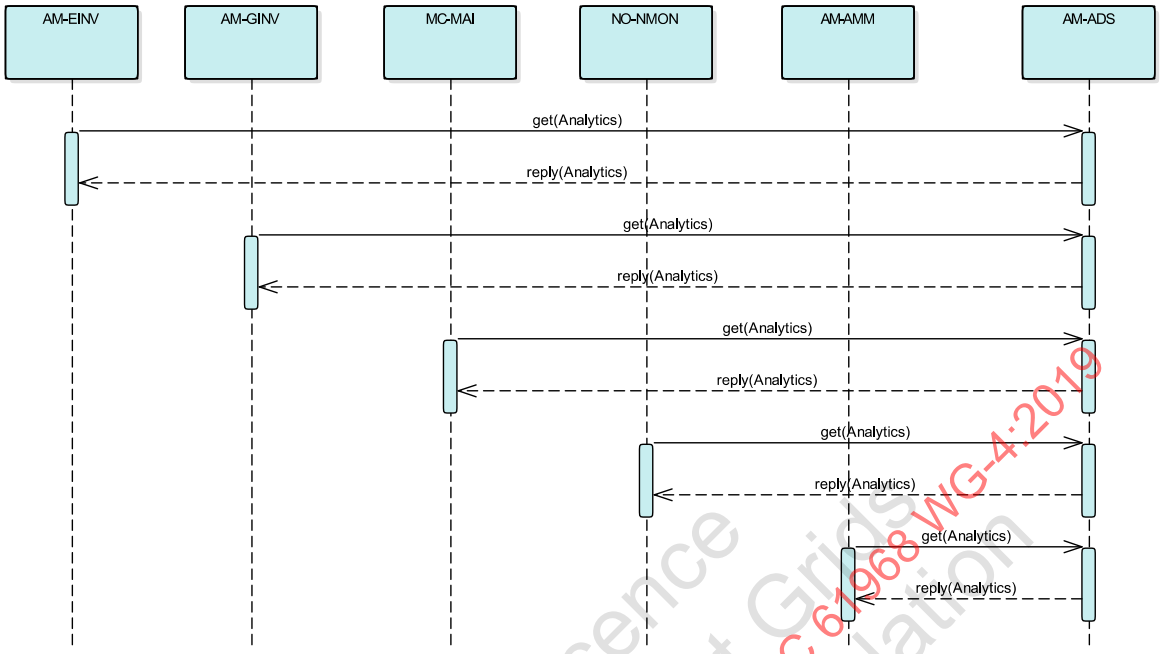


Figure 85 – Analytics message exchanges

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.

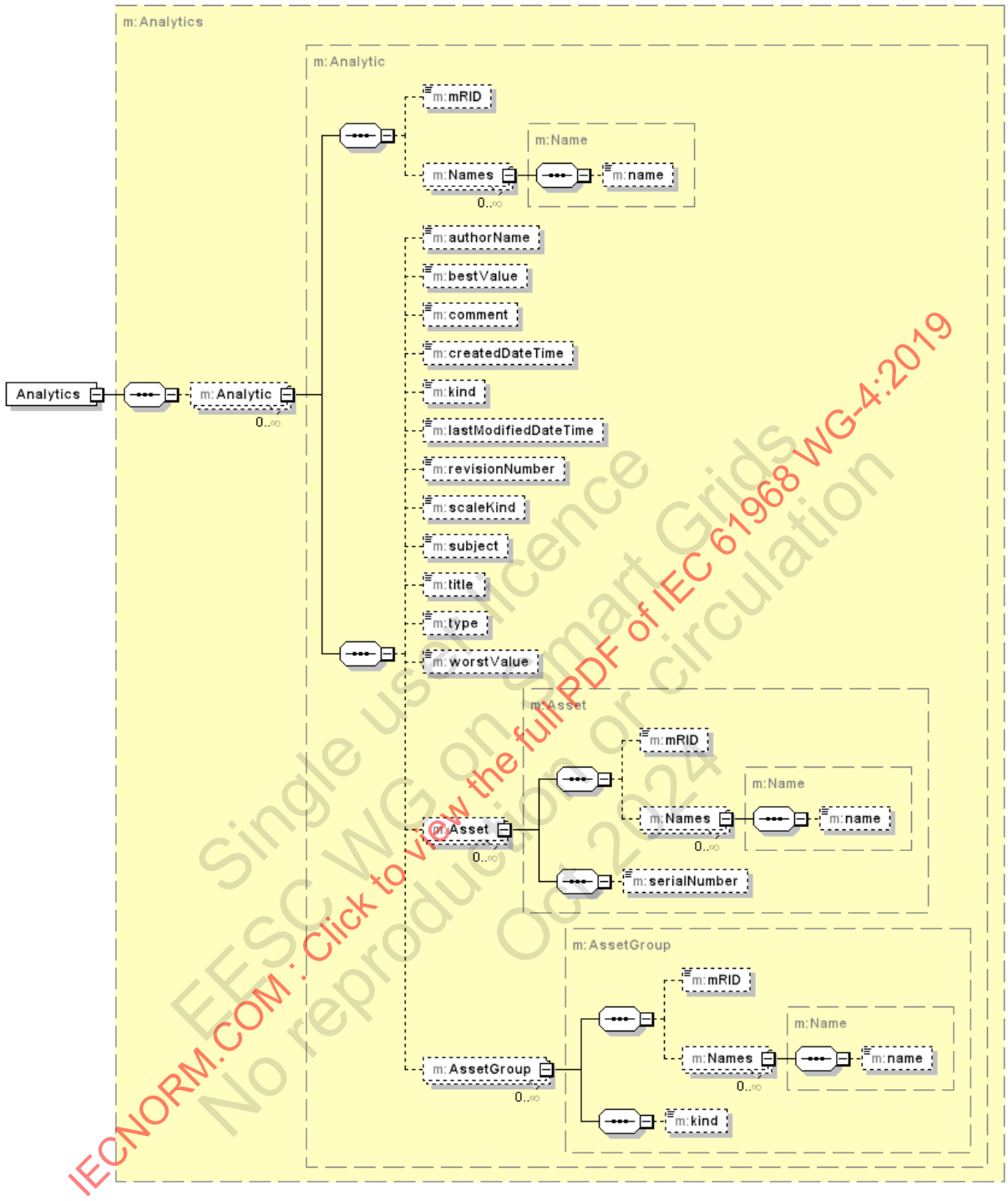


Figure 86 – Analytics message format

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.

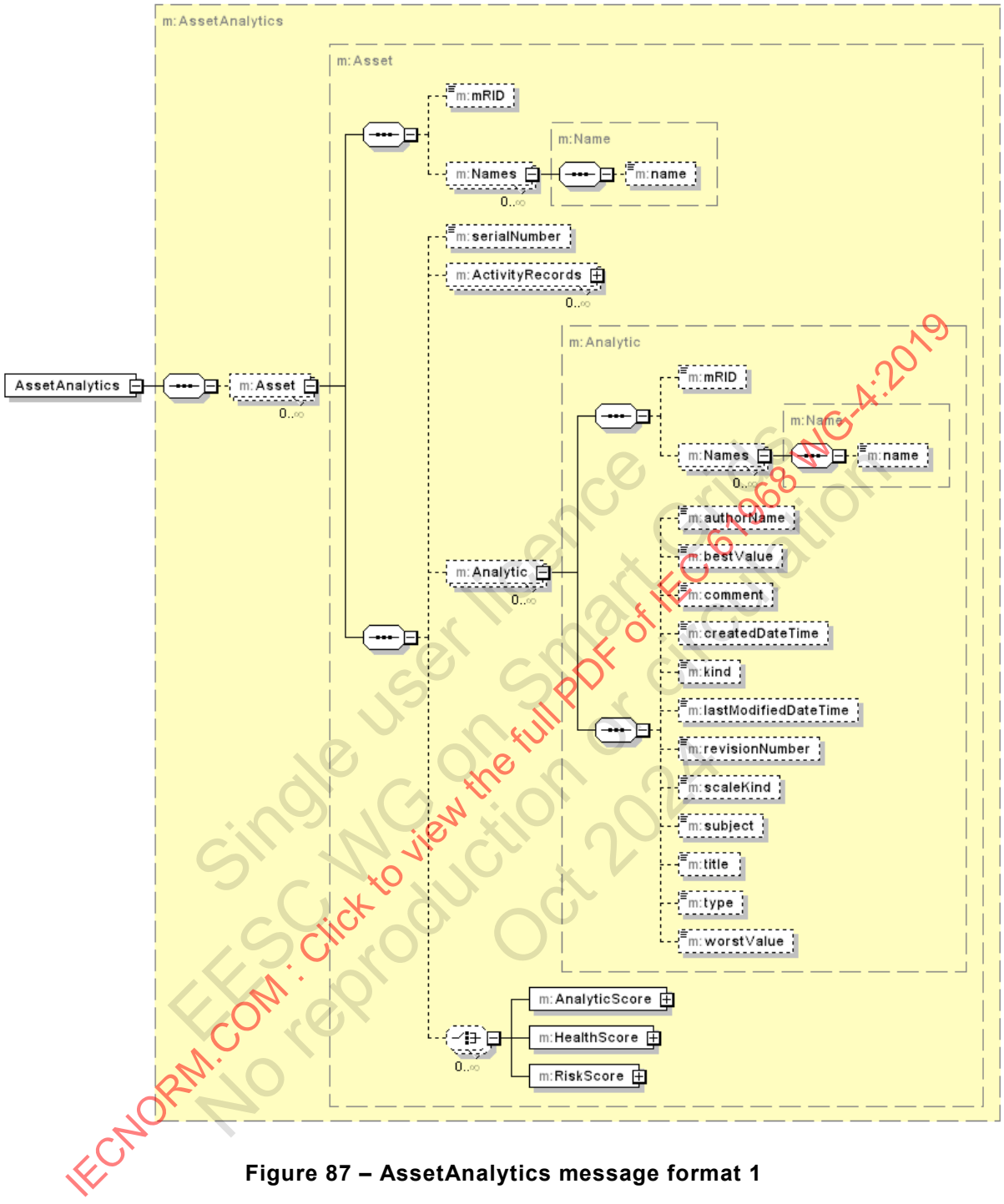


Figure 87 – AssetAnalytics message format 1

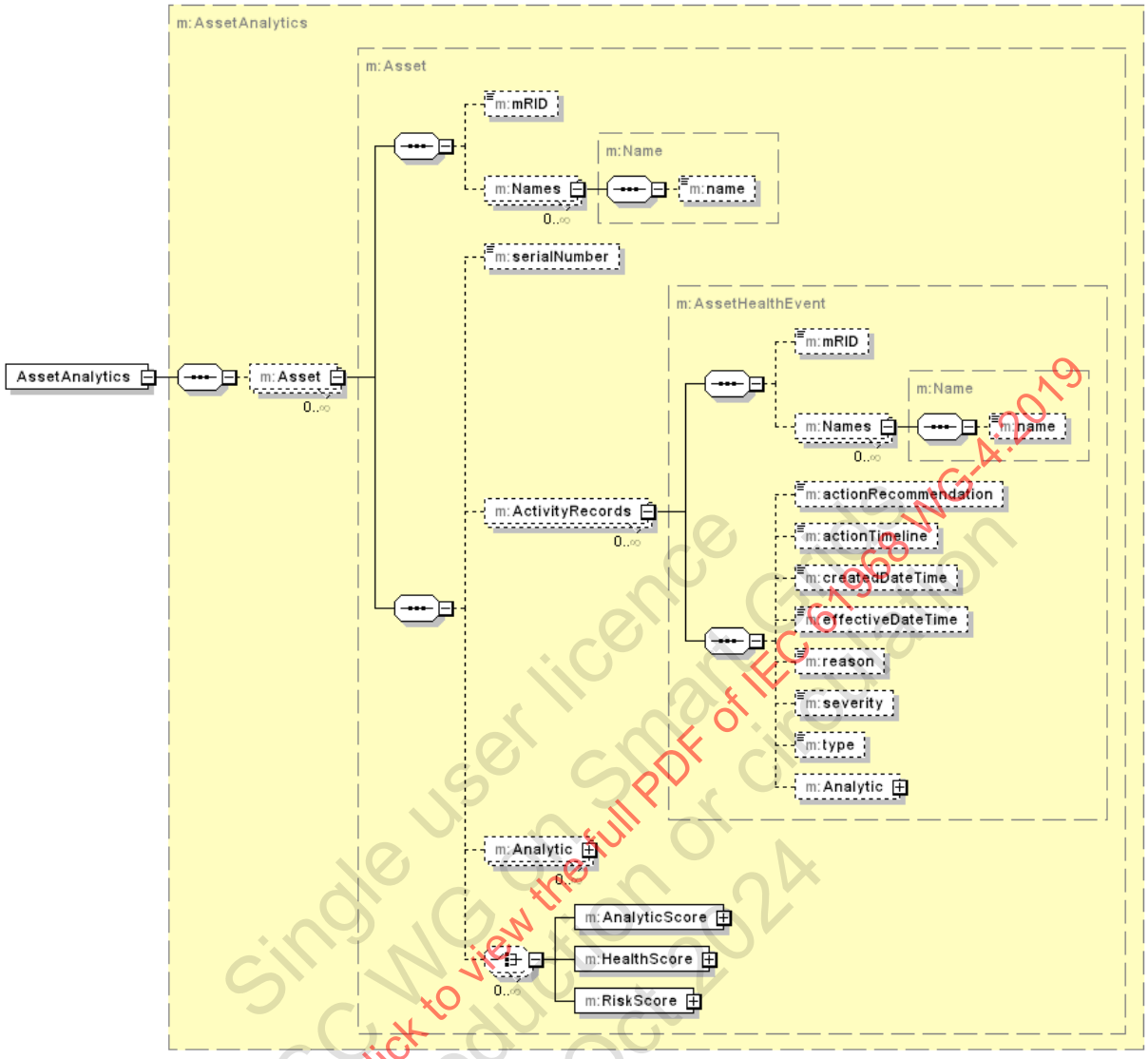


Figure 88 – AssetAnalytics message format 2

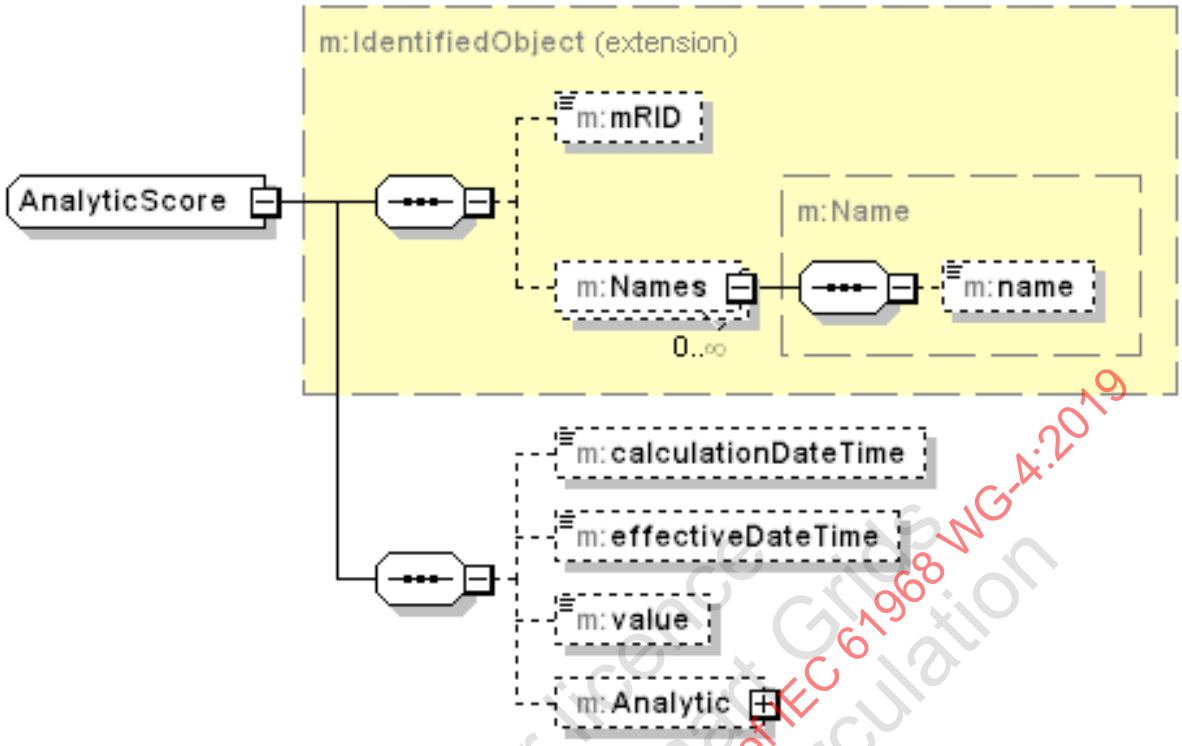


Figure 89 – AssetAnalytics message format: AnalyticScore element

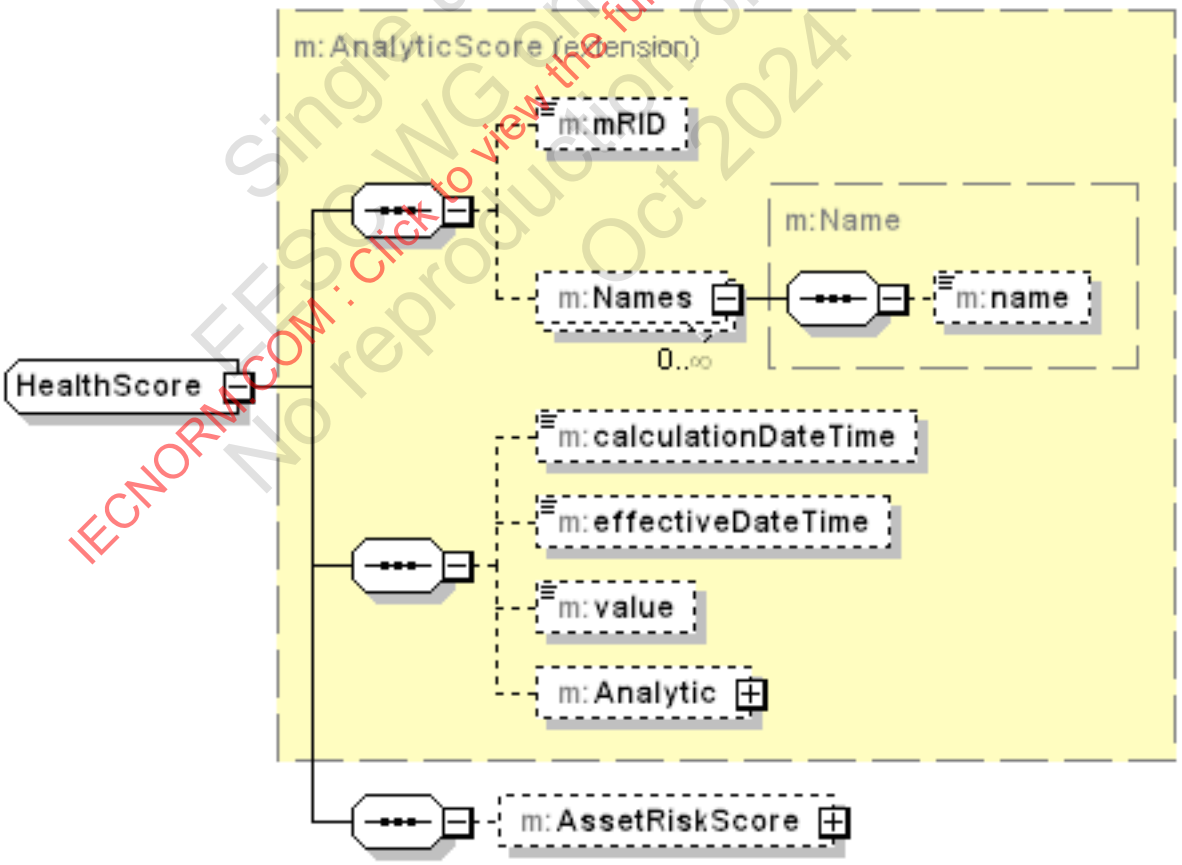


Figure 90 – AssetAnalytics message format: HealthScore element

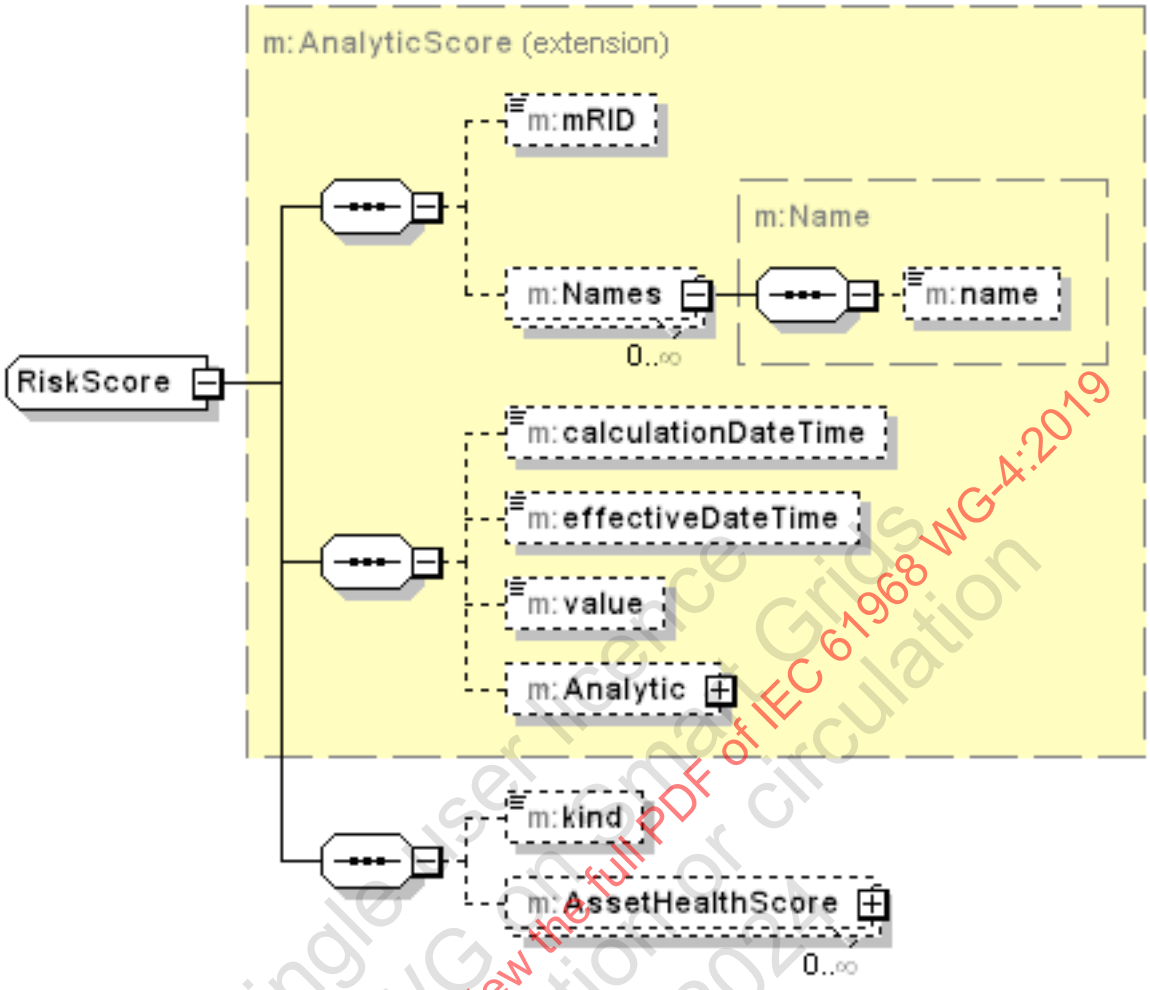


Figure 91 – AssetAnalytics message format: RiskScore element

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.

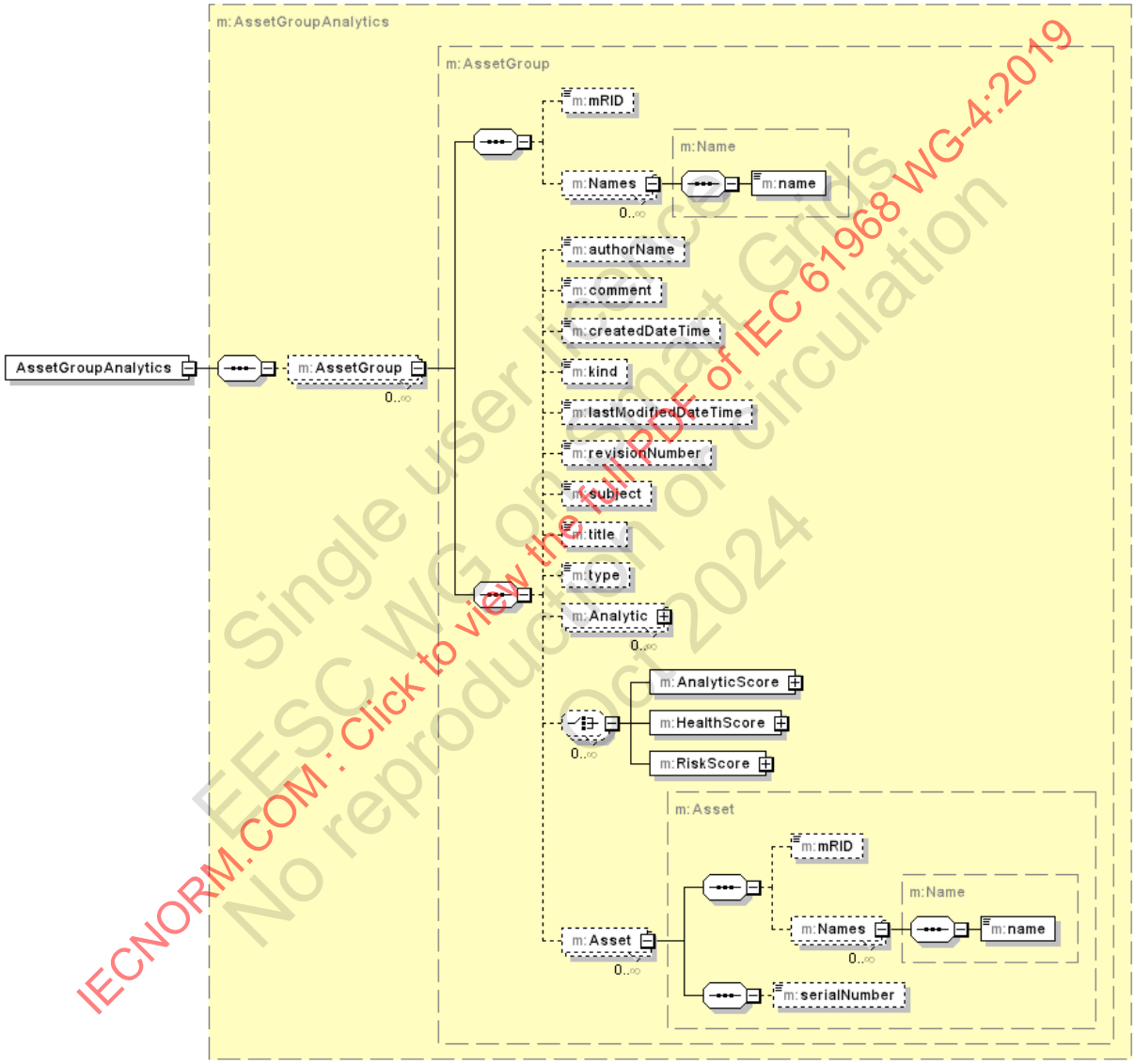


Figure 92 – AssetGroupAnalytics message format

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.

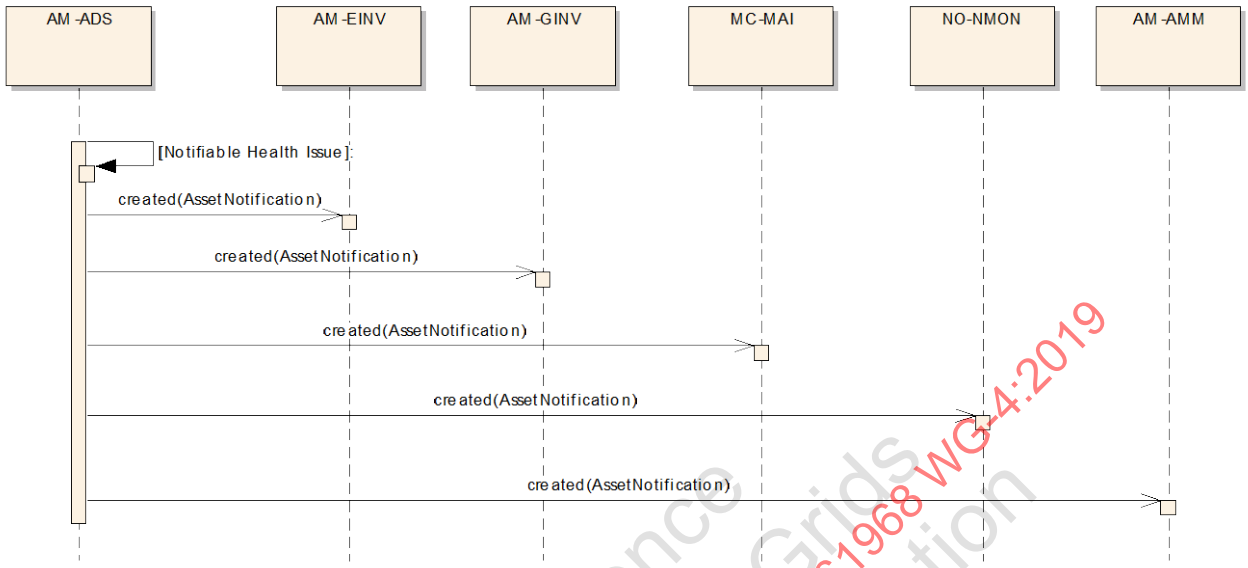


Figure 93 – AssetHealthEvents message exchanges

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.

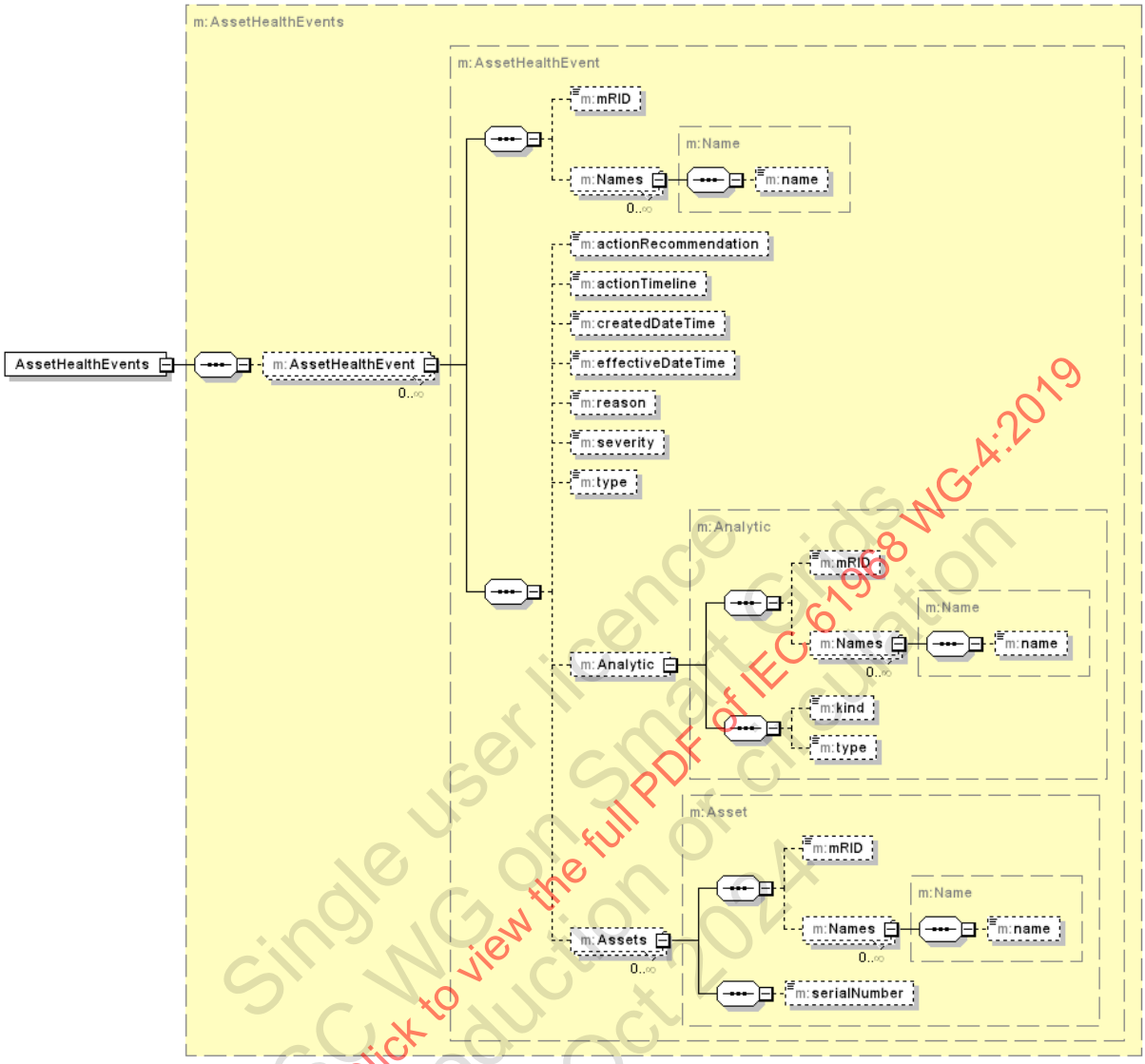


Figure 94 – AssetHealthEvents message format

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.

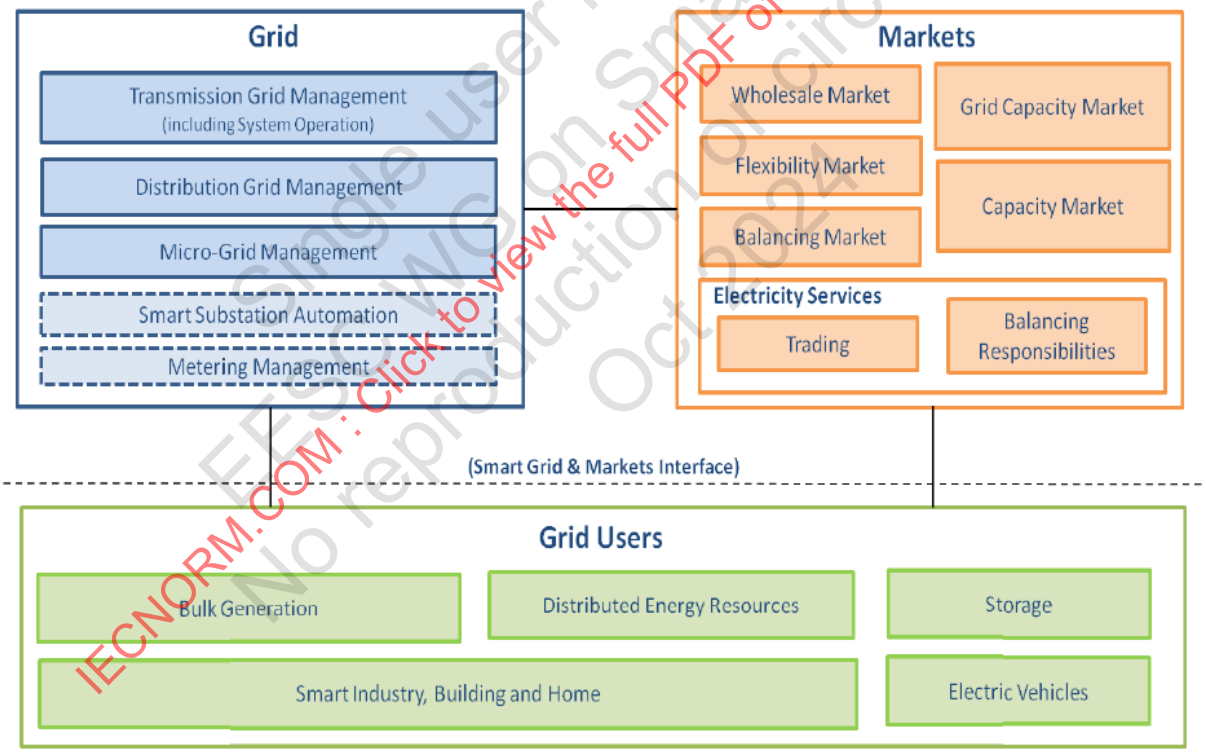


Figure B.1 – IEC 62913 Conceptual model (source: IEC 62913-1)

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

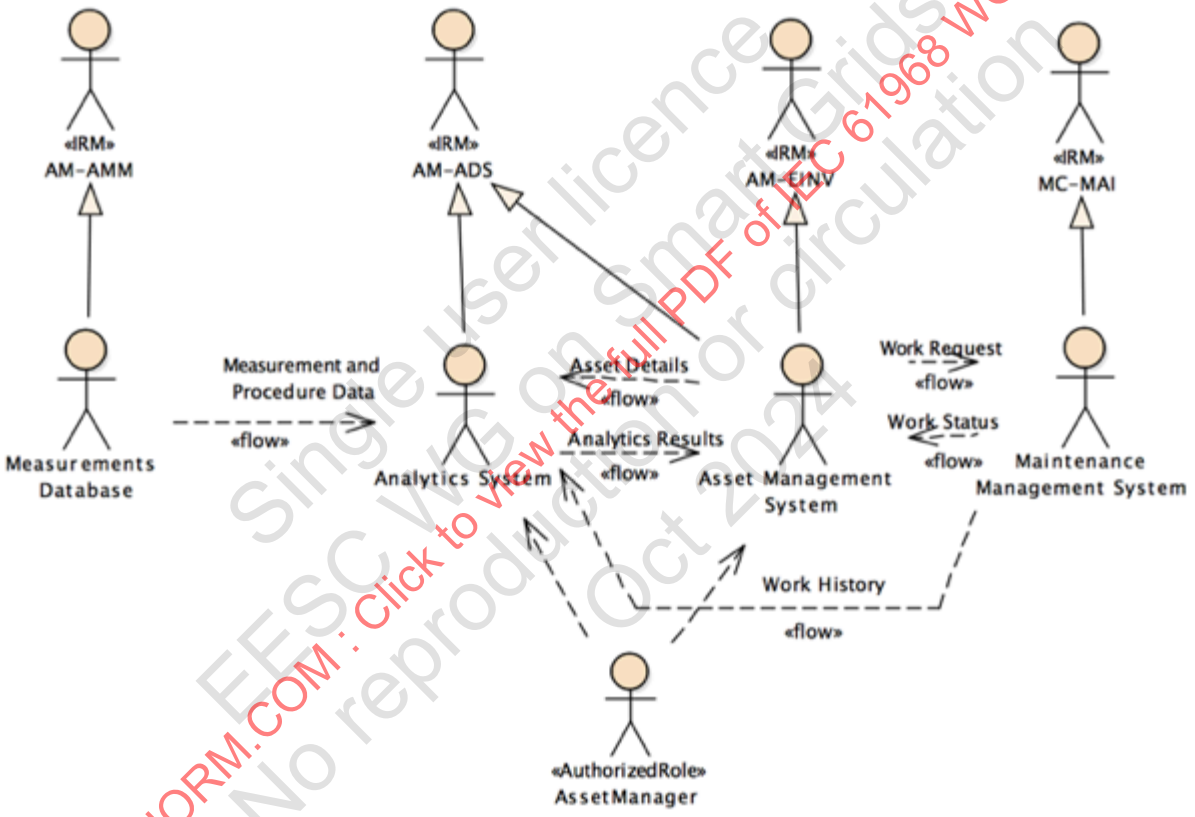
Version management changes / version	Date	Name Author(s) or Committee	Area of expertise / domain / role	Title	Approval status draft, for comments, for voting, final
1	2016.11.01	IEC TC57 WG14 Part 4 Team	Asset Management	Replace a failed asset	Draft

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

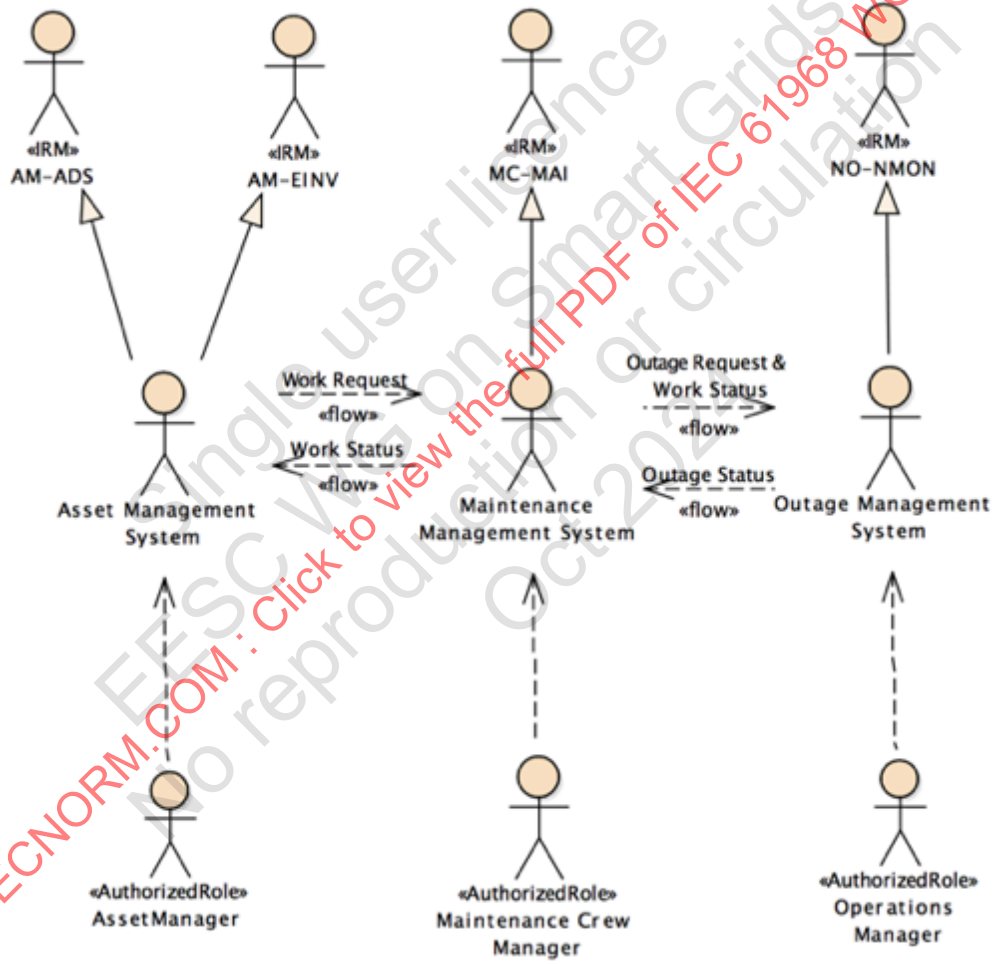
Version management changes / version	Date	Name Author(s) or Committee	Area of expertise / Domain / Role	Title	Approval status draft, for comments, for voting, final
1	2016.11.01	IEC TC57 WG14 Part 4 Team	Asset Management	Replace a failed asset	Draft

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
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Actors		
Grouping (community)		**Group description**
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Actor name see Actor list	**Actor type see Actor list**	**Actor description see Actor list**
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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**