IEC 61968-3

Edition 3.0 2021-04

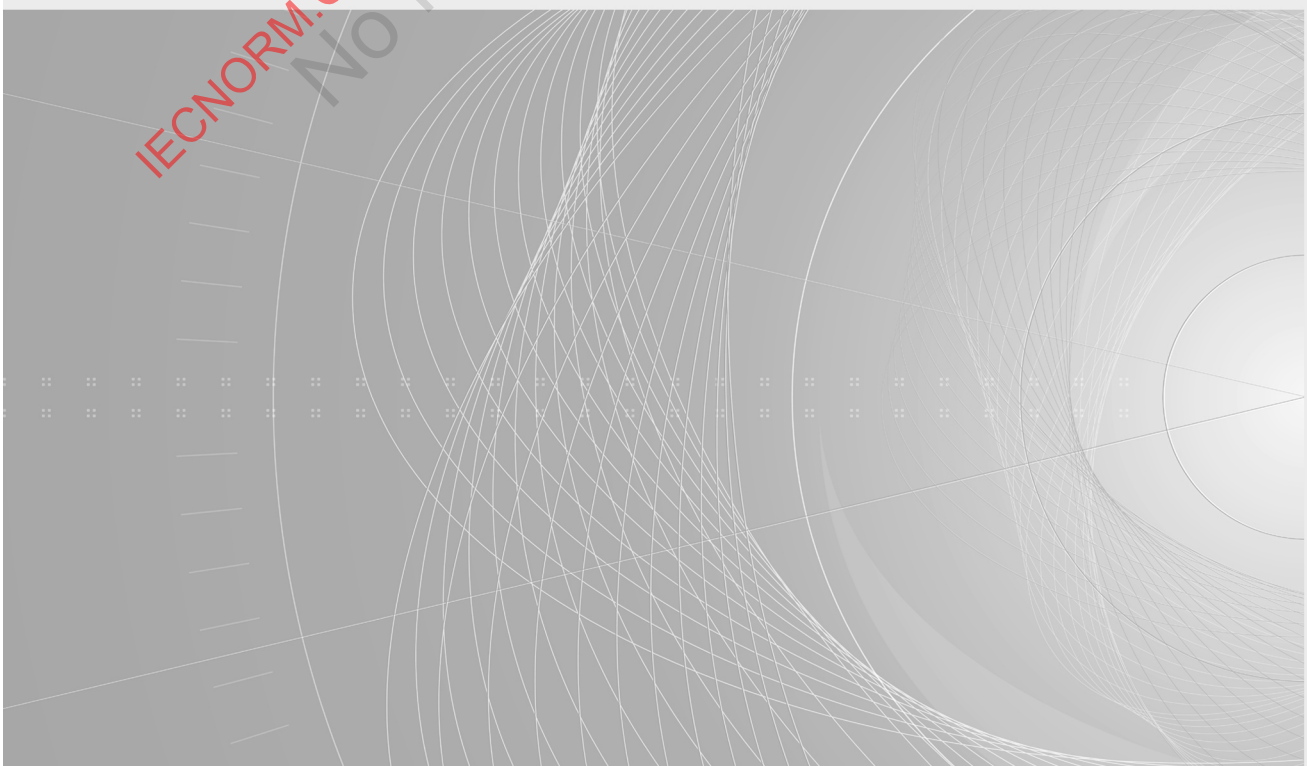
INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Application integration at electric utilities – System interfaces for distribution management –
Part 3: Interface for network operations

Intégration d'applications pour les services électriques – Interfaces système pour la gestion de la distribution –
Partie 3: Interface pour l'exploitation du réseau



IEC 61968-3:2021-04(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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Intégration d'applications pour les services électriques – Interfaces système pour la gestion de la distribution – Partie 3: Interface pour l'exploitation du réseau

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 33.200

ISBN 978-2-8322-9596-0

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 3: Interface for network operations

FOREWORD

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

This third edition cancels and replaces the second edition published in 2017. This edition constitutes a technical revision.

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

a) major rework of Switch Order related profiles and Outage related profiles;
b) documented profiles in more detail as a result of the analysis of end-to-end use cases;
c) separated Measurement and Control profile into two profiles: PSRMeasurements and PSRControls;
d) replaced Temporary Network Change profile with SwitchingEvents profile;

e) added MeasurementAction, ControlAction, GenericAction and VerificationAction to SwitchingPlans profile. Added examples;

f) added SwitchingActions profile to support the coordination of SwitchingPlan execution between control room and the field crew;

g) added ClampAction to SwitchingPlan, SwitchingAction and SwitchingEvent profiles, to allow clamps to be placed and removed independently of jumpers;

h) separated OutagesAndFaults profile into UnplannedOutages, PlannedOutages, EquipmentFaults, LineFaults;

i) added list of energized and de-energized UsagePoints to the UnplannedOutages profile;

j) added PlannedOutages profile;

k) added PlannedOutageNotifications profile;

l) added SwitchingPlanRequest profile to replace OutageSchedules profile;

m) expanded TroubleOrders profile to include UnplannedOutages and TroubleTickets and to allow crews to be scheduled to individual tasks within the TroubleOrder;

n) expanded use cases and sequence diagrams;

o) sequence diagrams updated to use IEC 61968-100 message patterns;

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

q) added example XML for profiles;

r) replaced xsd in Annex with tables to document the profiles in a serialisation-independent form;

s) clarified FLISR use case to include interactions between DSO and TSO per review comments from Edition 2.

t) removed OperationalTags since it is now part of the TagAction in the SwitchingEvents payload

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

Draft	Report on voting
57/2343/FDIS	57/2364/RVD

Full information on the voting for its approval 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 language used for the development of this International Standard is English.

In this standard, the following print types are used:

– **tokens: in arial black type**

A list of all parts of the IEC 61968 series, under the general title: *Application integration at electric utilities – System interfaces for distribution management* can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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 purpose of this part of IEC 61968 is to define a standard for the integration of network operations systems with each other and other systems and business functions within the scope of IEC 61968. The specific details of the communication protocols those systems employ are outside the scope of this part of IEC 61968. Instead, this part of IEC 61968 will recognize and model the general capabilities that can be potentially provided by network operations systems. In this way, this part of IEC 61968 will not be impacted by the specification, development and/or deployment of next generation network operations 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 conversational communication models. Therefore, these inter-application 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.

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

Part 3: Interface for network operations

1 Scope

Per the IEC 61968 Interface Reference Model, the Network Operations function defined in this part of IEC 61968 provides utilities with the means to supervise main substation topology (breaker and switch state), feeder topology and control equipment status through SCADA, AMI and other data sources. It also provides the means for handling network connectivity and loading conditions. Finally, it makes it possible for utilities to locate customer telephone complaints and coordinate activities of field crews with respect to planned and unplanned outages.

IEC 61968-3 specifies the information content of a set of message payloads that can be used to support many of the business functions related to network operations. Typical uses of the message payloads defined in IEC 61968-3 include data acquisition by external systems, fault isolation, fault restoration, trouble management and coordination of the real-time state of the network.

The scope diagram shown in Figure 1 illustrates the possibility of implementing IEC 61968-3 functionality as either a single integrated advanced distribution management system or as a set of separate functions – OMS, DMS and SCADA. Utilities may choose to buy these systems from different vendors and integrate them using the IEC 61968-3 messages. Alternatively, a single vendor could provide two or all of these components as a single integrated system. In the case of more than one system being provided by the same vendor, the vendor may choose to use either extensions of the IEC 61968 messages or a proprietary integration mechanism to provide enhanced functionality over and above what is required/supported by the IEC 61968-3 specification. While this is a possible implementation, Subclause 4.3 defines the scope in terms of business functions that are implemented in common vendor offerings.

Annexes in this document detail integration scenarios or use cases, which are informative examples showing typical ways of using the message payloads defined in this document as well as message payloads to be defined in other parts of the IEC 61968 series.

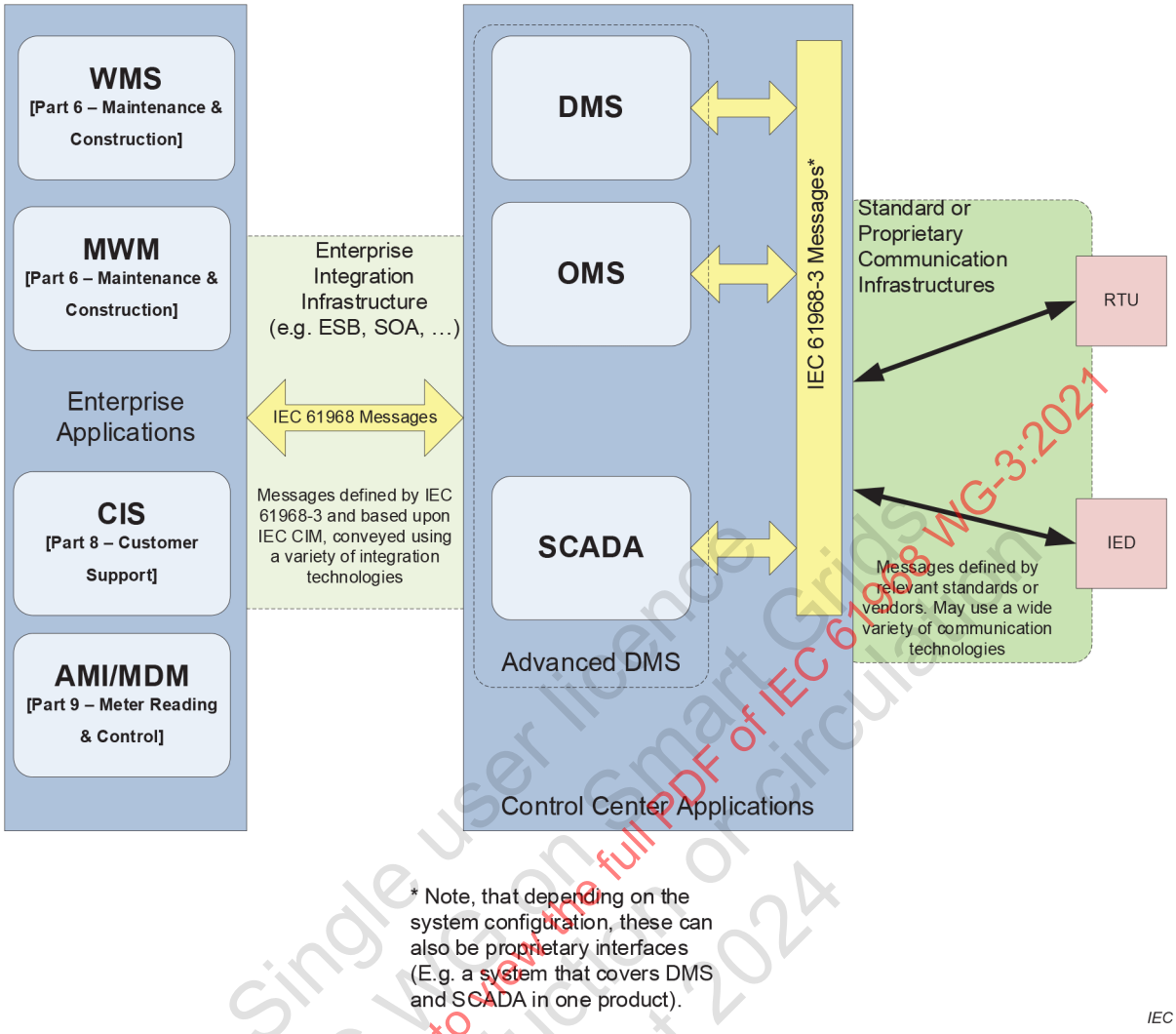

Figure 1 – IEC 61968-3 Scope

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

IEC TS 61968-2, *Application integration at electric utilities – System interfaces for distribution management – Part 2: Glossary*

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

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

3 Terms, definitions and abbreviated terms

3.1 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

3.2 Abbreviated terms

For the purposes of this document, the abbreviations given in IEC 61968-2 as well as the following apply.

NOTE Refer to IEC 60050, *International Electrotechnical Vocabulary*, for general glossary definitions.

FLISR Fault Location, Isolation and Service Restoration

WMS Work Management System

4 Reference and information models

4.1 General approach to network operations

Traditionally there have been two types of systems to manage distribution operations: Distribution Management Systems (DMS) and Outage Management Systems (OMS). Often a DMS has been delivered as an extension to a SCADA system, but some DMS can be delivered as a standalone set of distribution applications with no SCADA.

Outage Management Systems are used extensively in many parts of the world (typically with large service territories and a large amount of primary overhead conductor) to manage their distribution systems. Such distribution systems are typically configured radially and cover large distances. For this reason it has been historically expensive to monitor the status of the distribution system, particularly outside of the substation. In more dense populations the cost of telemetry and automation is lower, and can be justified on a cost per customer basis.

Thus often the only way that a distribution utility knows that there is a problem with the system is when a customer calls to report an outage. The utility then collects a set of outage calls, and from the pattern of calls received, determines the likely location and cause of the outage. A crew is then sent to the location of the outage to investigate further and affect repairs.

Distribution management systems have their roots in transmission SCADA systems. As automation has moved downwards and into distribution substations, there has been an increasing need to provide functionality for distribution applications. Distribution management systems originated as either extensions to the existing transmission SCADA, by adding additional points to cover the feeder breakers, or by adding a standalone distribution SCADA system. Both types of system usually have RTUs, communication front-ends, alarm systems and displays.

What characterizes these systems as distribution management systems is the addition of functions such as the ability to add temporary devices, such as line cuts and jumper lines. Such temporary devices are uncommon in transmission systems, but are very common in distribution systems. Since many distribution systems are operated in a radial configuration, it is often necessary to operate feeder tie switches to reconfigure feeders, either to restore outages or to adjust to different loading situations. This dictates a need for the ability to dynamically color lines according to which direction they are being energized from and also for the ability to color lines according to whether they are energized or not. In addition, in certain parts of the world, such systems can be unbalanced, meaning that each electrical phase is operated independently. Another characteristic of a distribution system is that change is the norm. New residential construction and routine maintenance means that the distribution network model changes frequently. It is not uncommon for 10 000 or even 100 000 changes to occur to a distribution system in a single week.

The thing that both the DMS and OMS have in common is the need for an as operated near real-time network model. Thus this part of IEC 61968 includes the ability to exchange distribution network models between two such systems and to keep them synchronized. Increasingly, vendors are beginning to realize that this integration is non-trivial to implement and maintain, are therefore offering integrated DMS/OMS, and even integrated DMS/OMS/SCADA systems in order to provide reduced total cost of ownership and consistent views of the real-time distribution network. The term ADMS (Advanced Distribution Management System) has been coined to describe such systems.

4.2 Reference model

Figure 2 serves as a reference model and provides examples of the logical components and data flows related to this document. Clause 3 provides references to terms that are defined by the CIM.

The diagram in Figure 2 describes the flows between the components in the reference model. The label for each flow is the name of an IEC 61968 message profile.

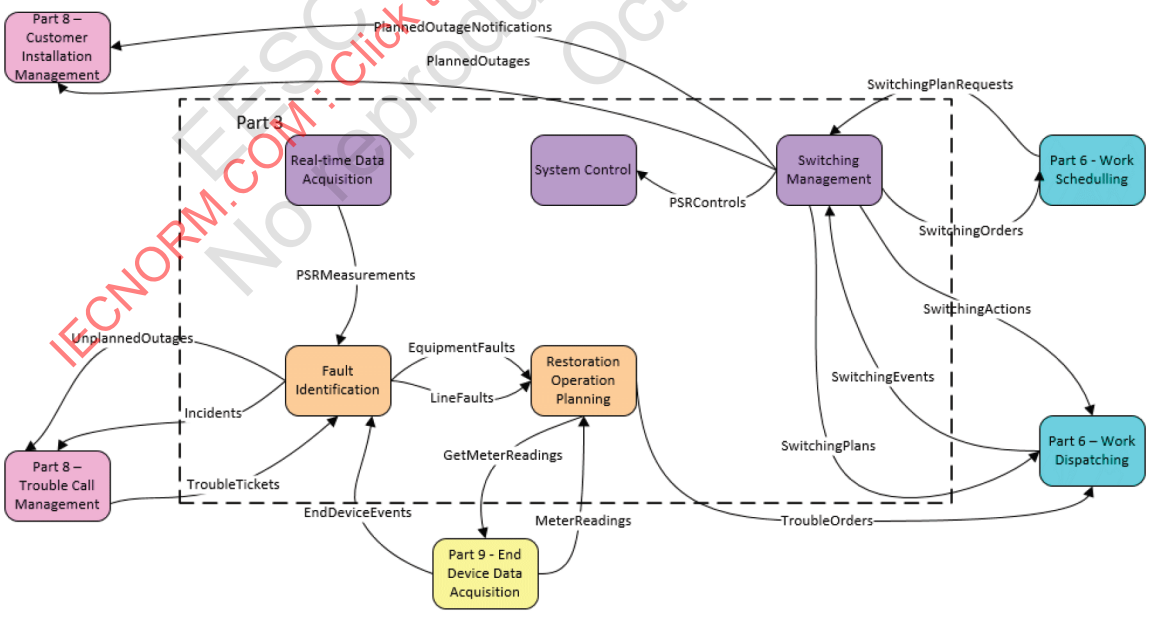

Figure 2 – IEC 61968-3 Reference model

The reference architecture reflects four main logical components (potentially realized as systems or subsystems) related to network operations:

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

IEC 61968-8, *Application integration at electric utilities – System interfaces for distribution management – Part 8: Interfaces for customer operations*

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

IEC 61968-5, *Application integration at electric utilities – System interfaces for distribution management – Part 5: Distributed energy optimization*

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 this part of IEC 61968 and IEC 61968-6, IEC 61968-8 and IEC 61968-9. It does not necessarily mean that compliant software is delivered either as separate modules or as a single system.

IEC 61968-1 describes the interface reference model, while IEC 61968-3 through IEC 61968-9 define the details of the information exchanged for specific types of abstract component.

4.4 Network operations business functions and sub-business functions

It should be noted that the message payloads defined in this document, IEC 61968-3, *Application integration at electric utilities – System interfaces for distribution management – Part 3: Interfaces for Network Operations*, may be sent or received by any type of component within a distribution management system (DMS) or outage management system (OMS).

Table 1 shows these business functions and typical sub-business functions that are expected to be producers of information for these message payloads. This is not intended to be an exhaustive list of business functions and sub-business functions, rather they are examples. Typical consumers of the information include, but are not restricted to, the other business functions as listed in IEC 61968-1.

Table 1 – Business functions and sub-business functions

Business functions	Sub-business functions
Real-time Operation (RTO) The Real-Time Operation (RTO) business function includes the execution of the planned action in regard to changing the network operational state. In addition, it monitors the current state of the network to ensure that the power grid is operating in a secure and balanced state. Predefined and activated remedial action will be executed when the pre-condition is met. That a system is secure and balanced state means that there is balance between supply and demand and that the system can handle pre-defined unanticipated loss of system equipment without violating operational requirements in regard to voltage, frequency, and operational stability limits. Real-Time Data Acquistion (RTDA)	The Real-Time Data Acquisition business function includes the collection and validation of measurements and observations that are used to determent the present state of the system that is under the entities' control. This could include acquisition of measurements and observations that are outside the entity's responsibility, but where the equipment that is defined as relevant to determine the state of the responsible system. The measurements and observations could include: • traditional SCADA points and analogues; • manually collected and entered data; • phasor data; • data generated by other systems, such as: – generating plants; – IEC 61850 systems; – lower or higher-level operations' activities. The common denominator for this data is that it is sampled data treated as raw input, as opposed to a setting or instruction or request received from some other system. In other words, the source of the data is completely ignorant of the acquisition and use of the data. It is not a coordinated integration of peer intelligence.
	Switching Management (SM) The Switching Management business function includes all activity involved in supervising execution of switching orders and outage restoration. • Execution of switching steps can involve remote operations of devices via SCADA and/or modifying settings on system controls. • Execution incorporates critical safety procedures. • Wherever there is concern about the impact of switching on the grid, analytical evaluation of the security of the state that switching will establish is usual. The types of analysis are similar to real-time state evaluation except that power flow or optimal power flow replaces state estimation.
	System Control (SC) The System Control business function includes any activity (other than Switching Management) which issues instructions to field controls in order to change the state of the grid. These controls may be closed loop or man-in-the-loop. Controls can be divided into active and reactive domains and generally use either raw measurements or the evaluated state as the input to control logic, which then develops a proposed change. Such control logic can be quite complex, even involving analyses based on algorithms such as optimal power flow. Control functions also may include follow-up logic to confirm that an issued control was in fact executed in the field and/or to assess whether the impact of the control was as predicted. Controls are important to model in analytical simulations, and a key distinguishing characteristic is whether the control can be represented by standard block diagram components or whether one has to incorporate the control software in order to simulate. Active controls include: • AGC, LFC; • active reserve management; • controllable load management; • remedial action scheme settings; • security constrained dispatch. Reactive controls include: • reactive reserve management; • Volt-VAr optimization; • DER settings; • FLISR.

Business functions	Sub-business functions
Fault Management (FM) The Fault Management (FM) business function receives notifications regarding faults in the electrical network and analyses those notifications in order to estimate the location of the fault. Fault Management tracks the fault through the stages of actual location, minimizing the area impacted by the fault, restoring service to all impacted parts of the network and coordinating permanent repairs. Fault Management ensures that fault durations and restoration times are correctly captured for regulatory reporting purposes.	Fault Identification (FI) The Fault Identification (FI) business function uses a variety of inputs in order to identify where the real fault has occurred. It will also identify the cause of the fault, where known.
	Restoration Operation Planning (ROP) The Restoration Operation Planning (ROP) business function create a plan for handling unplanned or forced outage to recover to an acceptable operation state. It also includes a plan to restore the network to its pre-fault condition after repairs have been made

The use case sequence diagrams presented in this document assume a simplified interpretation of the business functions listed in Table 1. This allows for easier mapping of business functions to systems familiar to the parties implementing the standard.

4.5 Static information model

4.5.1 General

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

The classes are defined in detail in IEC 61968-11, Common Information Model (CIM) Extensions for Distribution or in IEC 61970-301, Energy Management System Application Program Interfaces – Common Information Model Core.

4.5.2 Classes for network operations

Table 2 lists classes used within message types. Usually all the attributes of these classes are defined within a message type. The descriptions provided describe usage within IEC 61968-3.

Classes that are used to specify the network model are defined in IEC 61970.

Classes described as type "Asset" are defined in the IEC 61968/Assets package of the CIM.

Classes described as type "Work" are defined in the IEC 61968/Work package of the CIM.

Classes described as type "Customer" are defined in the IEC 61968/Customers package of the CIM.

Classes described as type "Metering" are defined in the IEC 61968/Metering package of the CIM.

Classes described as type "Profile" are contextual profiles defined for IEC 61968-3 that describe message definitions defined using CIM objects.

Table 2 – Classes for network operations

Class	Type	Description
AreaKind	Class	Enumeration for the type of area defined; e.g., county, state, parish, zipcode, etc.
ClearanceAction	Class	Action on clearance document as a switching step.
ClearanceActionKind	Class	Type of clearance action.
ClearanceDocument	Class	Safety document used to authorise work on conducting equipment in the field. Tagged equipment is not allowed to be operated.
ControlAction	Class	Control executed as a switching step.
CutAction	Class	Action on cut as a switching step.
EnergySourceAction	Class	Action on energy source as a switching step.
ERTConfidenceKind	Class	The estimated time of restoration can have a confidence factor applied such as high or low confidence that the ERT will be accomplished. This confidence factor may be updated as needed during the outage period – just as the actual ERT can be updated.
EstimatedRestorationTime	Class	The Estimated Restoration Time for a single outage
FieldSafetySupervisor	Class	Crew member on work site responsible for all local safety measures for the work crew doing maintenance, construction and repair in a substation or on a power line/cable.
GenericAction	Class	An arbitrary switching step.
GroundAction	Class	Action on ground as a switching step.
Incident	Class	Description of a problem in the field that may be reported in a trouble ticket or come from another source. It may have to do with an outage.
JumperAction	Class	Action on jumper as a switching step.
MeasurementAction	Class	Measurement taken as a switching step.
OperationalTag	Class	Operational tag placed on a power system resource or asset in the context of switching plan execution or other work in the field.
OperationsSafetySupervisor	Class	Operator with responsibility that the work in high voltage installation is executed in a safe manner and according to safety regulation.
Outage	Class	Document describing details of an active or planned outage in a part of the electrical network. A non-planned outage may be created upon: – a breaker trip, – a fault indicator status change, – a meter event indicating customer outage, – a reception of one or more customer trouble calls, or – an operator command, reflecting information obtained from the field crew. Outage restoration may be performed using a switching plan which complements the outage information with detailed switching activities, including the relationship to the crew and work. A planned outage may be created upon: – a request for service, maintenance or construction work in the field, or – an operator-defined outage for what-if/contingency network analysis.
OutageArea	Class	This defines the area covered by the Outage.

Class	Type	Description
OutageCauseKind	Class	This enumeration describes the primary cause of the outage – planned, unplanned, etc.
OutageOrder	Class	Transmits an outage plan to a crew in order for the planned outage to be executed.
OutagePlan	Class	Document containing the definition of planned outages of equipment and/or usage points. It will reference switching plans that are used to execute the planned outage.
OutageStatusKind	Class	This defines if the outage have been predicted or confirmed
PlannedOutage	Class	An outage that is created by the utility that will impact a customer. These may be created to implement a switching plan or energize a new line or device. The customer may or may not be notified in advance.
PlannedOutageNotification	Class	Notifies customers about a planned outage that they will be impacted by.
PSREvent	Class	Event recording the change in operational status of a power system resource; may be for an event that has already occurred or for a planned activity.
PSREventKind	Class	Kind of power system resource event.
SafetyDocument	Class	Document restricting or authorising works on electrical equipment (for example a permit to work, sanction for test, limitation of access, or certificate of isolation), defined based upon organisational practices.
ServicePointOutageSummary	Class	Summary counts of service points affected by an outage. These counts are sometimes referred to as total and critical customer count.
SwitchAction	Class	Action on switch as a switching step.
SwitchActionKind	Class	Kind of action on switch.
SwitchingAction	Class	Atomic switching action.
SwitchingEvent	Class	Event indicating the completion (success or fail) of any switching action (jumper action, cut action, tag action, etc). The switching action may or may not be a consequential event in response to a request to complete the action.
SwitchingOrder	Class	Transmits a switching plan to a crew in order for the plan to be executed.
SwitchingPlan	Class	A sequence of grouped or atomic steps intended to: – de-energise equipment or part of the network for safe work, and/or – bring back in service previously de-energised equipment or part of the network.
SwitchingPlanRequest	Class	A document used to request that a switching plan be created for a particular purpose.
SwitchingStep	Class	Atomic switching step; can be part of a switching step group, or part of a switching plan.
SwitchingStepGroup	Class	A logical step, grouping atomic switching steps that are important to distinguish when they may change topology (e.g. placing a jumper between two cuts).
TagAction	Class	Action on operation tag as a switching step.
TagActionKind	Class	Kind of action on tag.
TempEquipActionKind	Class	Kind of action on temporary equipment (such as cut, jumper, ground, energy source).
TroubleOrder	Class	Trouble order sends an incident to a crew to initiate a response to an unplanned outage.

Class	Type	Description
UnplannedOutage	Class	Document describing the consequence of an unplanned outage in a part of the electrical network. For the purposes of this model, an unplanned outage refers to a state where energy is not delivered; such as, customers out of service, a street light is not served, etc. A unplanned outage may be created upon: – impacts the SAIDI calculation – a breaker trip, – a fault indicator status change, – a meter event indicating customer outage, – a reception of one or more customer trouble calls, or – an operator command, reflecting information obtained from the field crew. Outage restoration may be performed using a switching plan which complements the outage information with detailed switching activities, including the relationship to the crew and work.
VerificationAction	Class	Verification of a switch position or other condition as a switching step

4.5.3 Classes related to network operations

Table 3 lists classes that are commonly associated with network operations classes. Their attributes, or a subset of their attributes, are used in the messages defined in this document. The detailed attributes of those classes are defined in IEC 61968-11.

Table 3 – Classes related to network operations

Related Class	Reference	Description
AccountNotification	Customer	Notifications for move-in, move-out, delinquencies, etc.
Agreement	Common	Formal agreement between two parties defining the terms and conditions for a set of services. The specifics of the services are, in turn, defined via one or more service agreements.
Approver	Common	Person who accepted/signed or rejected the document.
Asset	Asset	Tangible resource of the utility, including power system equipment, various end devices, cabinets, buildings, etc. For electrical network equipment, the role of the asset is defined through PowerSystemResource and its subAssetes, defined mainly in the Wires model (refer to IEC 61970-301 and model package IEC61970::Wires). Asset description places emphasis on the physical characteristics of the equipment fulfilling that role.
AssetContainer	Asset	Asset that is aggregation of other assets such as conductors, transformers, switchgear, land, fences, buildings, equipment, vehicles, etc.
AssetFunction	Asset	Function performed by an asset.
AssetInfo	Asset	Set of attributes of an asset, representing typical datasheet information of a physical device that can be instantiated and shared in different data exchange contexts: – as attributes of an asset instance (installed or in stock) – as attributes of an asset model (product by a manufacturer) – as attributes of a type asset (generic type of an asset as used in designs/extension planning).
AssetKind	Asset	Kinds of assets or asset components.
Author	Common	Person who created document or activity record.
BaseWork	Class	Common representation for work and work tasks.

Related Class	Reference	Description
ConfigurationEvent	Common	Used to report details on creation, change or deletion of an entity or its configuration.
CoordinateSystem	Common	Coordinate reference system.
Crew	Common	Group of people with specific skills, tools, and vehicles.
CrewMember	Common	Member of a crew.
CrewStatusKind	Common	Defines the current status of the Crew – assigned, arrived, etc.
CrewType	Common	Custom description of the type of crew. This may be used to determine the type of work the crew can be assigned to. Examples include repair, tree trimming, switching, etc.
Customer	Customer	Organisation receiving services from service supplier.
CustomerAccount	Customer	Assignment of a group of products and services purchased by the customer through a customer agreement, used as a mechanism for customer billing and payment. It contains common information from the various types of customer agreements to create billings (invoices) for a customer and receive payment.
CustomerAgreement	Customer	Agreement between the customer and the service supplier to pay for service at a specific service location. It records certain billing information about the type of service provided at the service location and is used during charge creation to determine the type of service.
CustomerKind	Customer	Kind of customer.
CustomerNotification	Customer	Conditions for notifying the customer about the changes in the status of their service (e.g., outage restore, estimated restoration time, tariff or service level change, etc.)
Document	Common	Parent class for different groupings of information collected and managed as a part of a business process. It will frequently contain references to other objects, such as assets, people and power system resources.
DocumentPersonRole	Common	Person role with respect to documents.
Editor	Common	Person who modified the document.
ElectronicAddress	Common	Electronic address information.
FieldDispatchHistory	Common	The history of field dispatch statuses for this work.
FieldDispatchStep	Common	Details of the step in the field dispatch history.
Hazard	Common	An object or a condition that is a danger for causing loss or perils to an asset and/or people.
Issuer	Common	Person who issued the document and is responsible for its content.
Location	Common	The place, scene, or point of something where someone or something has been, is, and/or will be at a given moment in time. It can be defined with one or more postition points (coordinates) in a given coordinate system.
NotificationTriggerKind	Customer	Kind of trigger to notify customer.
OperationPersonRole	Common	Person role in the context of utility operations.
Operator	Common	Control room operator.
Organisation	Common	Organisation that might have roles as utility, contractor, supplier, manufacturer, customer, etc.
Ownership	Common	Ownership of e.g. asset.
Person	Common	General purpose information for name and other information to contact people.

Related Class	Reference	Description
PositionPoint	Common	Set of spatial coordinates that determine a point, defined in the coordinate system specified in 'Location.CoordinateSystem'. Use a single position point instance to desribe a point-oriented location. Use a sequence of position points to describe a line-oriented object (physical location of non-point oriented objects like cables or lines), or area of an object (like a substation or a geographical zone – in this case, have first and last position point with the same values).
Priority	Common	Priority definition.
ServiceCategory	Customer	Category of service provided to the customer.
ServiceKind	Customer	Kind of service.
ServiceLocation	Customer	A real estate location, commonly referred to as premises.
Status	Common	Current status information relevant to an entity.
StreetAddress	Common	General purpose street and postal address information.
StreetDetail	Common	Street details, in the context of address.
TelephoneNumber	Common	Telephone number.
TownDetail	Common	Town details, in the context of address.
TroubleCallKind	Customer	Describes the type of Trouble, based on customer input.
TroubleReportingKind	Customer	Kind of trouble reporting.
TroubleTicket	Customer	Customer call to report a problem with their service.
Work	Work	Document used to request, initiate, track and record work.
WorkActivityRecord	Work	Records information about the status of work or work task at a point in time.
WorkAsset	Work	Asset used to perform work.
WorkKind	Work	Kinds of work.
WorkLocation	Work	Information about a particular location for various forms of work.
WorkStatusKind	Work	Kind of status, specific to work.
WorkTask	Work	A task within a set of work.
WorkTaskKind	Work	Kinds of work tasks.

5 Network operations message payloads

5.1 General

The purpose of Clause 5 is to describe the message payloads related to IEC 61968-3. It is important to note that some of these message payloads may also be used by other parts of IEC 61968. The general approach to the realization of message structures and XML schemas for IEC 61968 message payloads is described in IEC 61968-100.

Although they may be represented in sequence diagrams for context and completeness, this document does not describe message formats that are defined by other parts of IEC 61968. The message payload structures defined by this part of IEC 61968 are described in Clause 5.

Message structures are diagrammed within Clause 5. Note that these diagrams are examples and not intended to be exhaustive. The notation convention shows required elements with a solid outline, and optional elements with dashed outlines.

It is also important to note that the use cases and sequence diagrams provided in Annex A are informative in nature, and are intended to provide examples of usage for the normative message payload definitions. There is no intent by this document to standardize specific business processes.

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

– Objects are identified by one of the following:
  - **mRID** inherited from **IdentifiedObject**
  - one or more **Name.name** instances. Transacting systems may use one or both of the attributes to uniquely identify the objects being exchanged.
  - a combination of **mRID** and one or more **Name.name** instances
– Several CIM classes have an attribute called **type** to provide a string description of an instance of the class. Some CIM classes (such as **Asset**) also have an enumerated attribute called "**kind**". This provides for better interoperability. Messages in this document that incorporate such classes include both the "**type**" and "**kind**" attributes. 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 majority of attributes in the message payloads are optional. It is up to the transacting system to implement the logic for any required fields.

5.2 Summary of IEC 61968-3 message profiles

Table 4 shows a summary of all of the messages defined in this document and their purpose.

Table 4 – Summary of IEC 61968-3 message profiles

Profile Name	Purpose
PSRMeasurements	Contains accumulator, analog, discrete and string values from SCADA. Time stamps and quality codes are also included. If applicable, includes a reference to the **PowerSystemResource** that the measurement is associated with.
PSRControls	Request to SCADA to change a value in the field. The change can be an accumulator reset, analog control, command, raise/lower command or a setpoint. If applicable, includes a reference to the **PowerSystemResource** that is associated with the control request.
SwitchingPlanRequests	A **SwitchingPlanRequest** is used to convey a request from work management (or other business function) to network operations that switching needs to be performed (e.g. part of the network needs to be isolated) in order for maintenance or construction work to be performed. The payload includes the type of work to be performed and when it should start. The typical outcome of a **SwitchingPlanRequest** is the creation of a **SwitchingPlan**.
SwitchingPlans	**SwitchingPlans** message payloads are designed to communicate a set of **SwitchingActions** that form a sequence of operations to manage a complete operational task. **SwitchingPlans** may also be created in order to perform emergency switching.
SwitchingOrders	**SwitchingOrders** message payloads are designed to communicate requests for scheduling the execution of a **SwitchingPlan** for emergency or planned switching.
SwitchingActions	**SwitchingActions** are used to coordinate the manual execution of steps within **SwitchingPlans** between the control room and field crews. Automated step execution is coordinated with **PSRControls** messages.
SwitchingEvents	**SwitchingEvents** are used to communicate temporary network changes as a result of the execution of a step in a **SwitchingPlan** that was initiated via a **SwitchingAction. SwitchingEvents** are also used to communicate temporary network changes between enterprise systems. Results of **PSRControls** are coordinated with **PSRMeasurements** messages.

Profile Name	Purpose
PlannedOutageNotifications	**PlannedOutageNotifications** are used to notify customers that they will be impacted by a **PlannedOutage**, prior to the execution of a **SwitchingPlan**. The payload includes scheduled start and end date/time and a list of customers who will be impacted.
PlannedOutages	**PlannedOutages** message payloads are designed to communicate the creation and status changes of **PlannedOutages** once one or more customers become de-energized as a result of planned switching actions. The payload includes: a list of customers affected and the actual start/end time.
UnplannedOutages	**UnplannedOutages** message payloads are designed to communicate the creation and status changes of **UnplannedOutages** once one or more customers become de-energized. This could be as a result of faults, such as short circuit faults and downed lines, switching errors or other causes.
TroubleOrders	**TroubleOrders** message payloads are designed to communicate work requests to field crews to perform work in response to an **Incident**, or an **UnplannedOutage**, and to track the status of the work.
Incidents	**Incidents** message payloads are designed to communicate a problem in the field. Typically, but not always, an **Incident** is associated with an **UnplannedOutage**.
EquipmentFaults	**EquipmentFaults** message payloads, are designed to communicate the detailed fault information as part of **UnplannedOutages** messages. An **EquipmentFault** is a fault applied at the terminal, external to the equipment. This class is not used to specify faults internal to the equipment.
LineFaults	**LineFaults** messages are designed to communicate the detailed fault information as part of **UnplannedOutages** messages. **LineFaults** define all types of faults that occur on AC or DC line segments.

5.3 Config Profiles

5.3.1 General

Config profiles are used to share a subset of the model so as to avoid sharing the entire model and to avoid sending configuration data at run-time. It is envisioned that config messages are exchanged between systems only when required.

For example, a Customer Information System may send **CustomerConfig**, **UsagePointConfig**, and **OperationsDataLinkageConfig** messages to an Outage Management System. By receiving these messages and instantiating the customer information, the usage point information, the association between customers and usage points, and information in its database, the OMS can produce customer contact lists for an outage.

All messages rely on unique identifiers (**mRIDs**) for all objects that are part of the common network model, in this case the common distribution network model which is defined as part of CIM. In order to publish those unique identifiers, the respective system needs either to import that network model or load the necessary identifiers as part of the system's configuration step.

Two mechanisms are supported for message transfer between systems, one is a 'push' model and the other is a 'pull' model. The mechanism selected depends upon the capabilities of the systems involved in the message exchange and the timeliness of the data exchanged. An example of a push message exchange is shown in Figure 3. In this example, a new customer is created in the CIS and the information is sent to OMS.

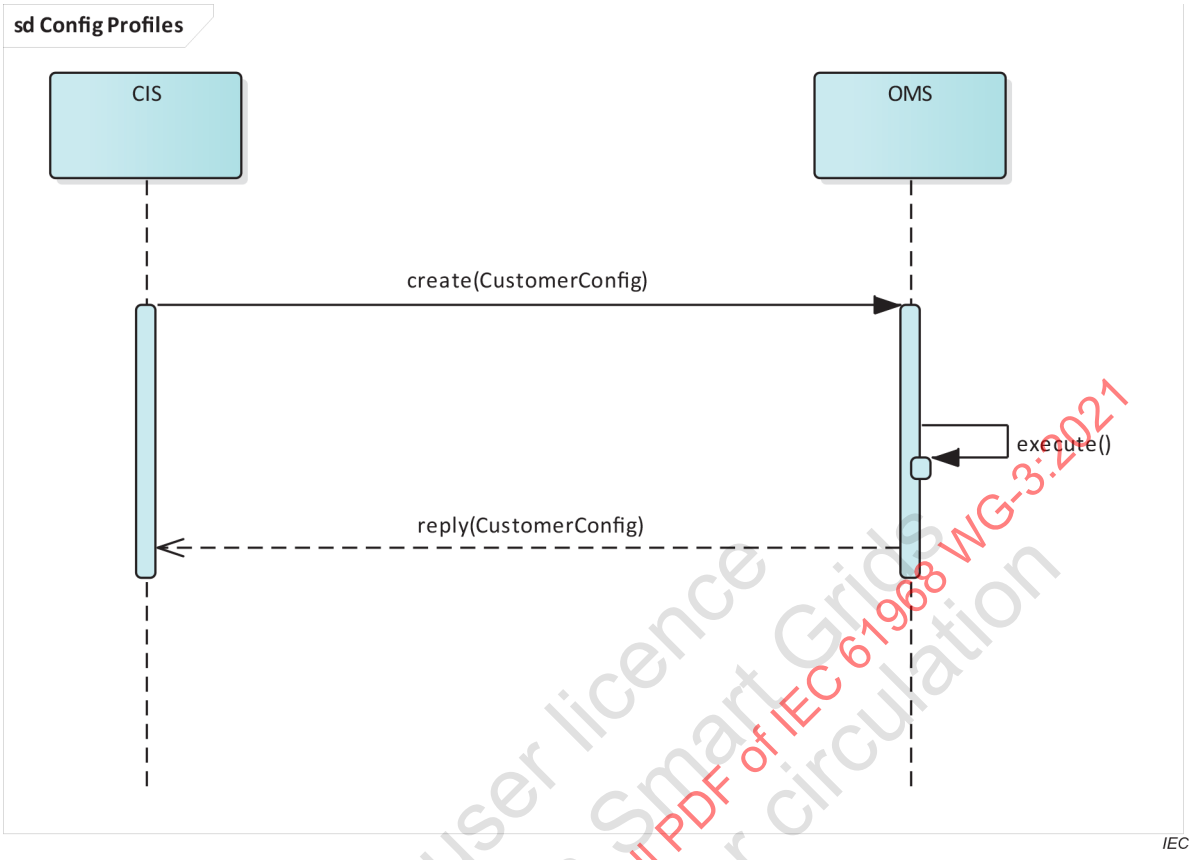

Figure 3 – Example of a Push Message Exchange

An example of a pull message exchange is shown in Figure 4.

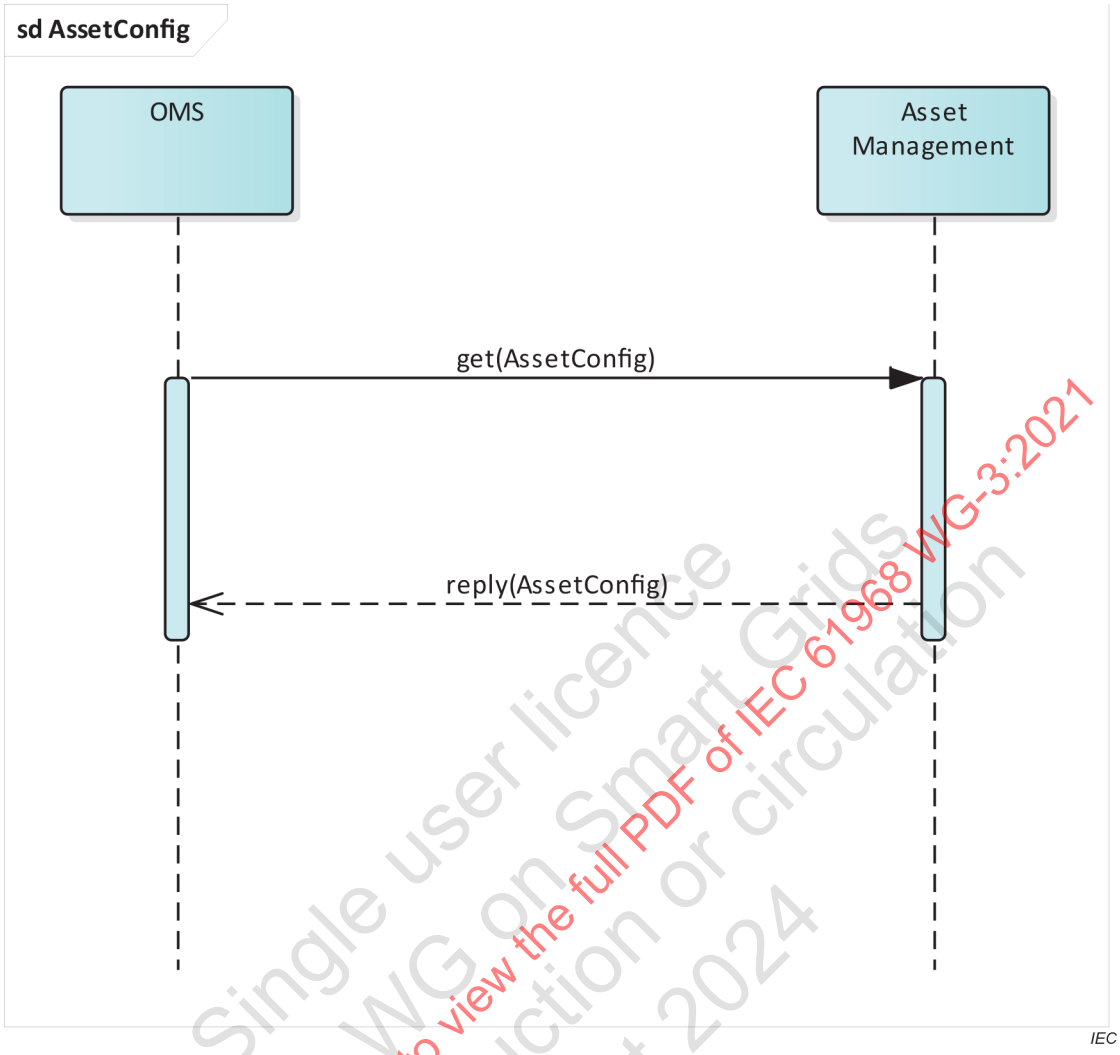

Figure 4 – Example of a Pull Message Exchange

5.3.2 Message payloads

There are multiple Config messages, including:

- **AssetConfig** – see 5.3.3
- **CustomerAgreementConfig** – see D.1
- **CustomerConfig** – see D.2
- **FaultCauseTypeConfig** – see 5.3.4
- **LocationConfig** – see 5.3.5
- **MeterConfig** – see D.3
- **PowerSystemResourceConfig** – see 5.3.6
- **UsagePointConfig** – see D.4
- **UsagePointLocationConfig** – see D.5

The above config messages are associated using the **OperationsDataLinkageConfig** message, to allow relationships between the various config messages to be defined.

5.3.3 **AssetConfig** payload

The **AssetConfig** payload shown in Figure 5 and Figure 6 defines zero, one or many **Asset**s. Important attributes for the purposes of this document are the **mRID** and **Names** since this allows the mapping between the **mRID**, **Names** and the objects themselves in the messages so that the the entire object instance does not need to be sent in the message.

The attributes of the **AssetConfig** profile are described in Table 5.

Table 5 – AssetConfig Profile

AssetConfig				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
AssetConfig	Asset	[1..*]		
Profile Attributes for Asset				
mRID	String	[0..1]	GUID	mRID of the Asset
description	String	[0..1]		Free-form text field that describes the **Asset**
Names	Name	[0..*]	See B.56	Human-readable names for the Asset.
baselineCondition	String	[0..1]		Condition of asset at last baseline. Examples include new, rebuilt, overhaul required, other. Refer to inspection data for information on the most current condition of the asset.
baselineLossOfLife	PerCent	[0..1]		Percentage of initial life expectancy that has been lost as of the last life expectancy baseline. Represents (initial life expectancy – current life expectancy) / initial life expectancy.
critical	Boolean	[0..1]		True if asset is considered critical for some reason (for example, a pole with critical attachments).
inUseState	inUseStateKind	[0..1]	See C.9	Indication of whether asset is currently deployed (in use), ready to be put into use or not available for use.
kind	AssetKind	[0..1]	See C.1	Kind of asset. Used in description of asset components in asset instance templates.
lifecycleState	AssetLifecycleStateKind	[0..1]	See C.2	Current lifecycle state of asset.
lotNumber	String	[0..1]		Lot number for this asset. Even for the same model and version number, many assets are manufactured in lots.
position	String	[0..1]		Position of asset or asset component. May often be in relation to other assets or components.
purchasePrice	Money	[0..1]		Purchase price of asset.
retiredReason	RetiredReasonKind	[0..1]	See C.16	Reason asset retired.
serialNumber	String	[0..1]		Serial number of this asset.

AssetConfig				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
type	String	[0..1]		Utility-specific classification of Asset and its subtypes, according to their corporate standards, practices, and existing IT systems (e.g., for management of assets, maintenance, work, outage, customers, etc.).
utcNumber	String	[0..1]		Uniquely tracked commodity (UTC) number.
ActivityRecords	ActivityRecord	[0..*]	See B.5	
AssetContainer	Choice of: Cabinet DuctBank Pole Structure Tower UndergroundStructure	[0..1]	For Cabinet, see B.14 For DuctBank, see B.30 For Pole, see B.66 For Structure, see B.84 For Tower, see B.91 For UndergroundStructure, see B.96	
AssetFunction	AssetFunction	[0..*]	Reference to AssetFunction in this payload	Contains the mRID or Names.name of the referenced AssetFunction
ConfigurationEvents	ConfigurationEvent	[0..*]	See B.19	All configuration events created for this asset.
electronicAddress	ElectronicAddress	[0..1]	See B.32	Electronic address of this asset, such as a MAC address.
lifecycleDate	LifeCycleDate	[0..1]	See B.50	Lifecycle dates for this asset.
Location	Location	[0..1]	See B.52	Location of this asset
Ownerships	Ownership	[0..1]	See B.64	All ownerships of this asset.
ProductAssetModel	ProductAssetModel	[0..1]	See B.70	The model of this asset.
status	Status	[0..1]	See B.79	Status of this asset.

AssetConfig				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
Profile attributes for AssetFunction				
mRID	String	[0..1]	GUID	mRID of the AssetFunction
description	String	[0..1]		Free-form text field that describes the **AssetFunction**
Names	Name	[0..*]	See B.56	Human-readable names for the AssetFunction.
configID	String	[0..1]		Configuration specified for this function.
firmwareID	String	[0..1]		Firmware version.
hardwareID	String	[0..1]		Hardware version.
password	String	[0..1]		Password needed to access this function.
programID	String	[0..1]		Name of program.

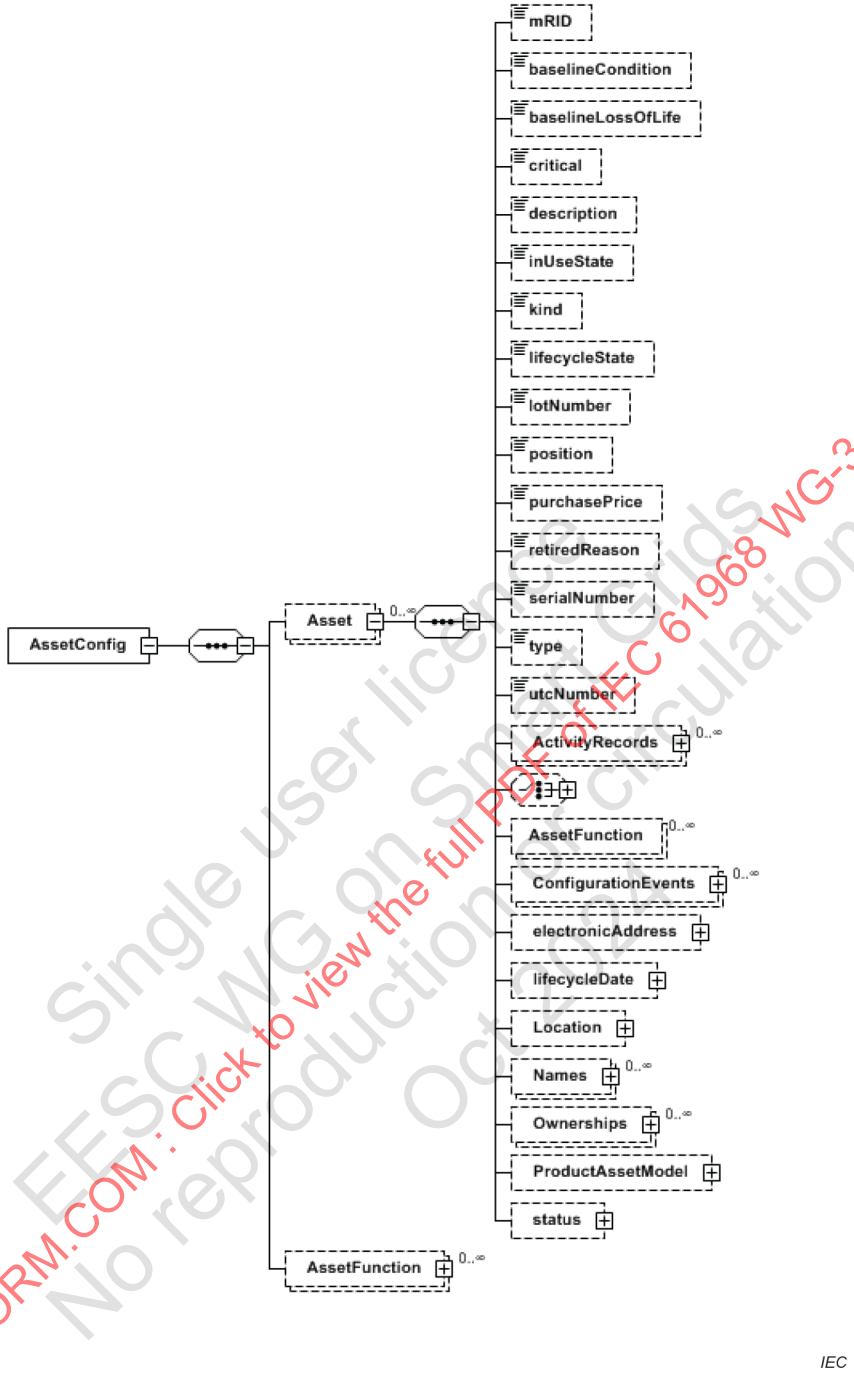

Figure 5 – AssetConfig payload (1)

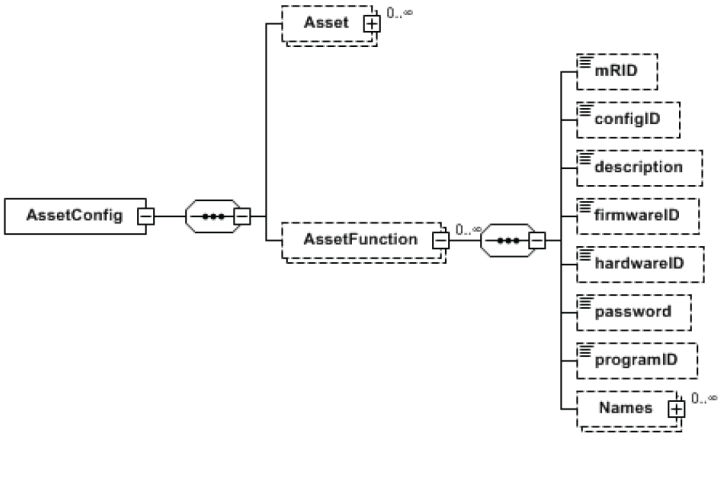

Figure 6 – AssetConfig payload (2)

5.3.4 FaultCauseTypeConfig payload

The **FaultCauseTypeConfig** payload shown in Figure 7 defines zero, one or many **FaultCauseType**s. Important attributes for the purposes of this document are the **mRID** and **Names** since this allows the mapping **between** the **mRID**, **Names** and the objects themselves in the messages so that the the entire object instance does not need to be sent in the message.

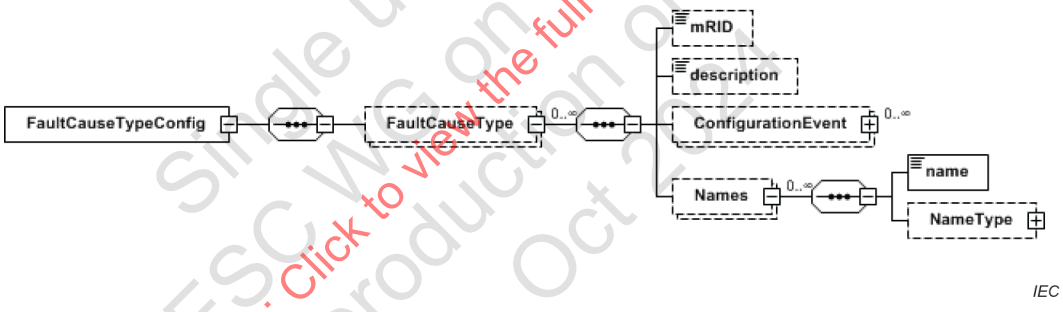

Figure 7 – FaultCauseTypeConfig payload

5.3.5 LocationConfig payload

The **LocationConfig** payload shown in Figure 8 defines zero, one or many **Location**s. Important attributes for the purposes of this document are the **mRID** and **Names** since this allows the mapping **between** the **mRID**, **Names** and the objects themselves in the messages so that the the entire object instance does not need to be sent in the message.

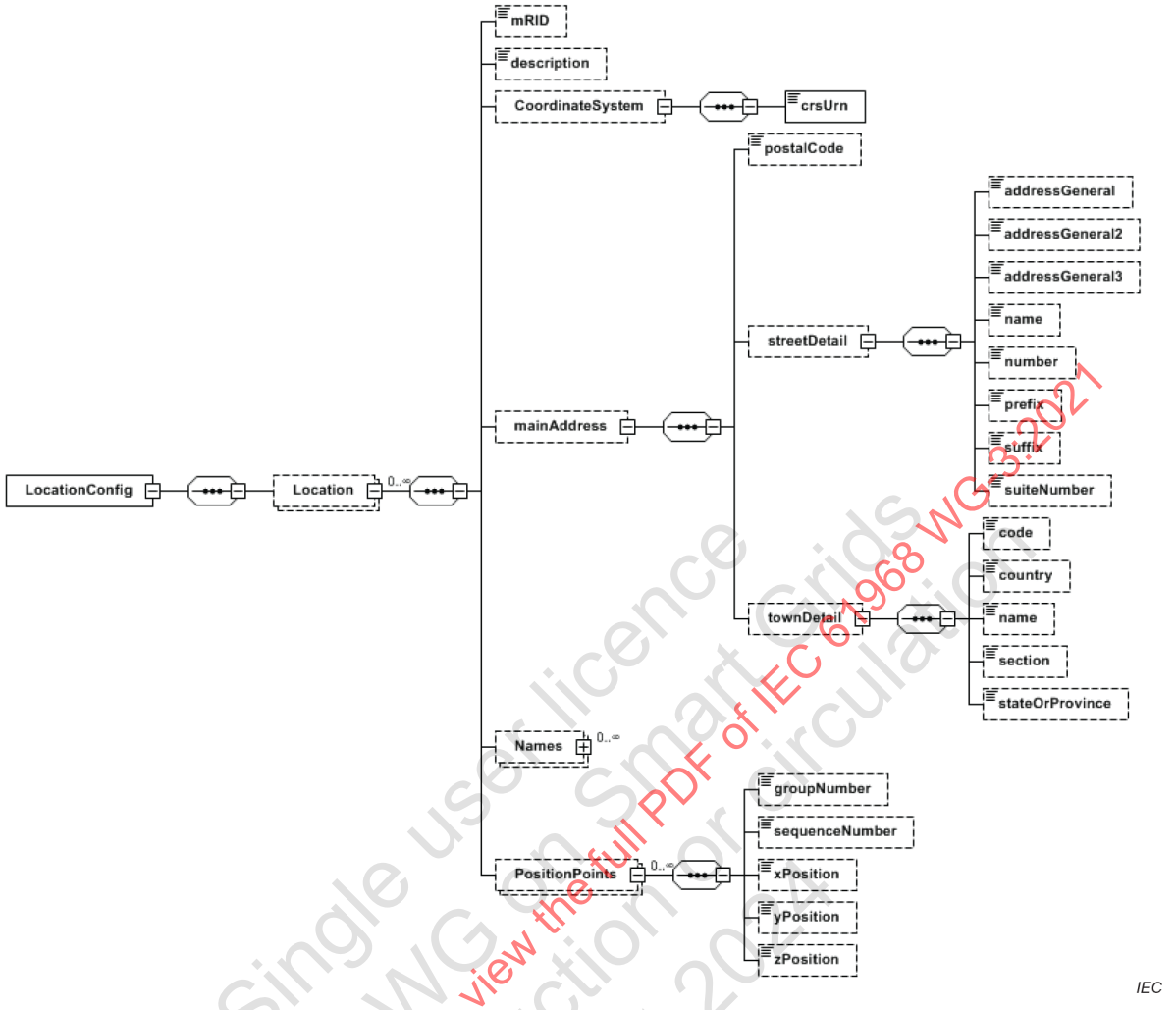

Figure 8 – LocationConfig payload

5.3.6 PowerSystemResourceConfig payload

The **PowerSystemResourceConfig** payload shown in Figure 9 defines zero, one or many **PowerSystemResource**s. Important attributes for the purposes of this document are the **mRID** and **Names** since this allows the mapping **between** the **mRID**, **Names** and the objects themselves in the messages so that the the entire object instance does not need to be sent in the message.

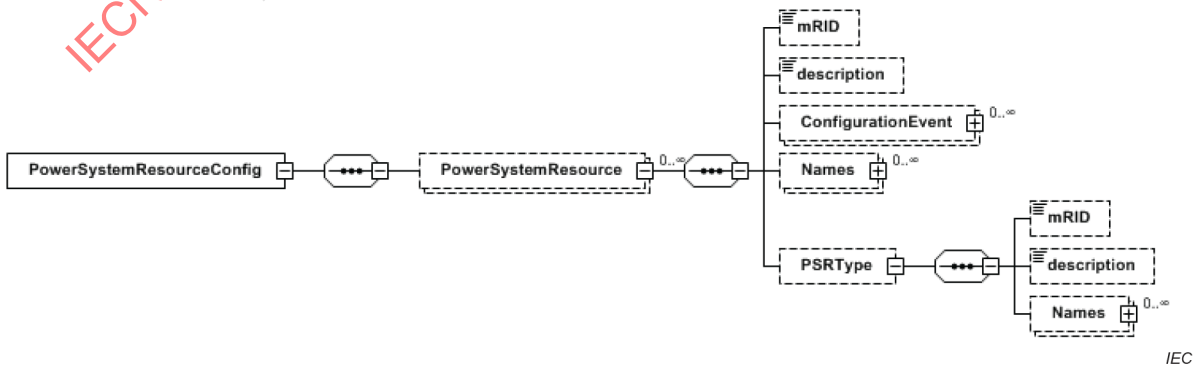

Figure 9 – PowerSystemResourceConfig payload

5.3.7 **OperationsDataLinkageConfig** payload

The **OperationsDataLinkageConfig** payload shown in Figure 10 and Figure 11 defines zero, one or many **OperationsDataLinkage**s. This message links the various objects used in config messages together. In particular it optionally links one or more of the following together:

- Asset
- ConfigurationEvent
- Customer
- CustomerAccount
- CustomerAgreement
- EndDevice
- Location
- Meter
- PowerSystemResourceConfig
- UsagePoint
- UsagePointLocation

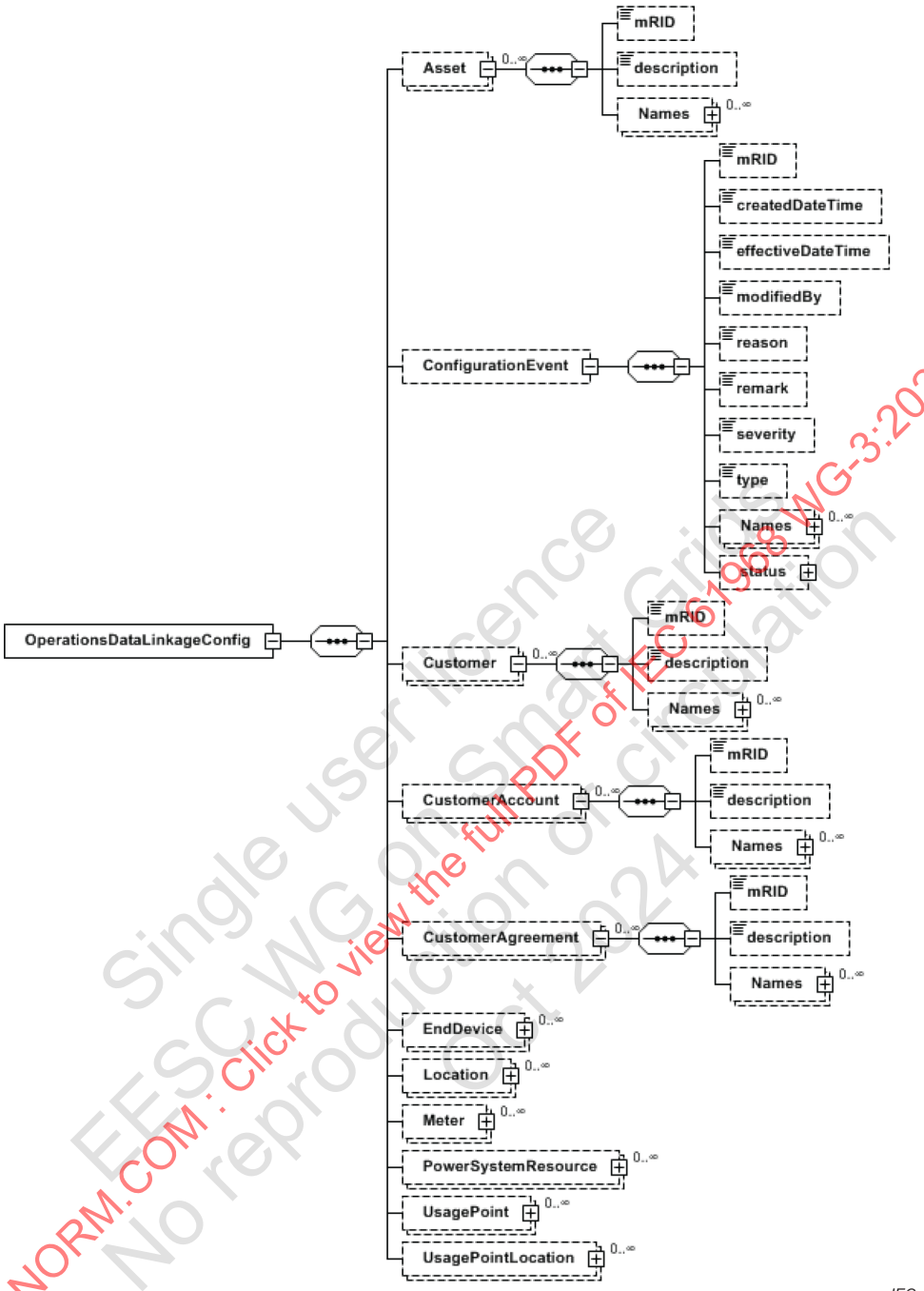

Figure 10 – OperationsDataLinkageConfig payload (1)

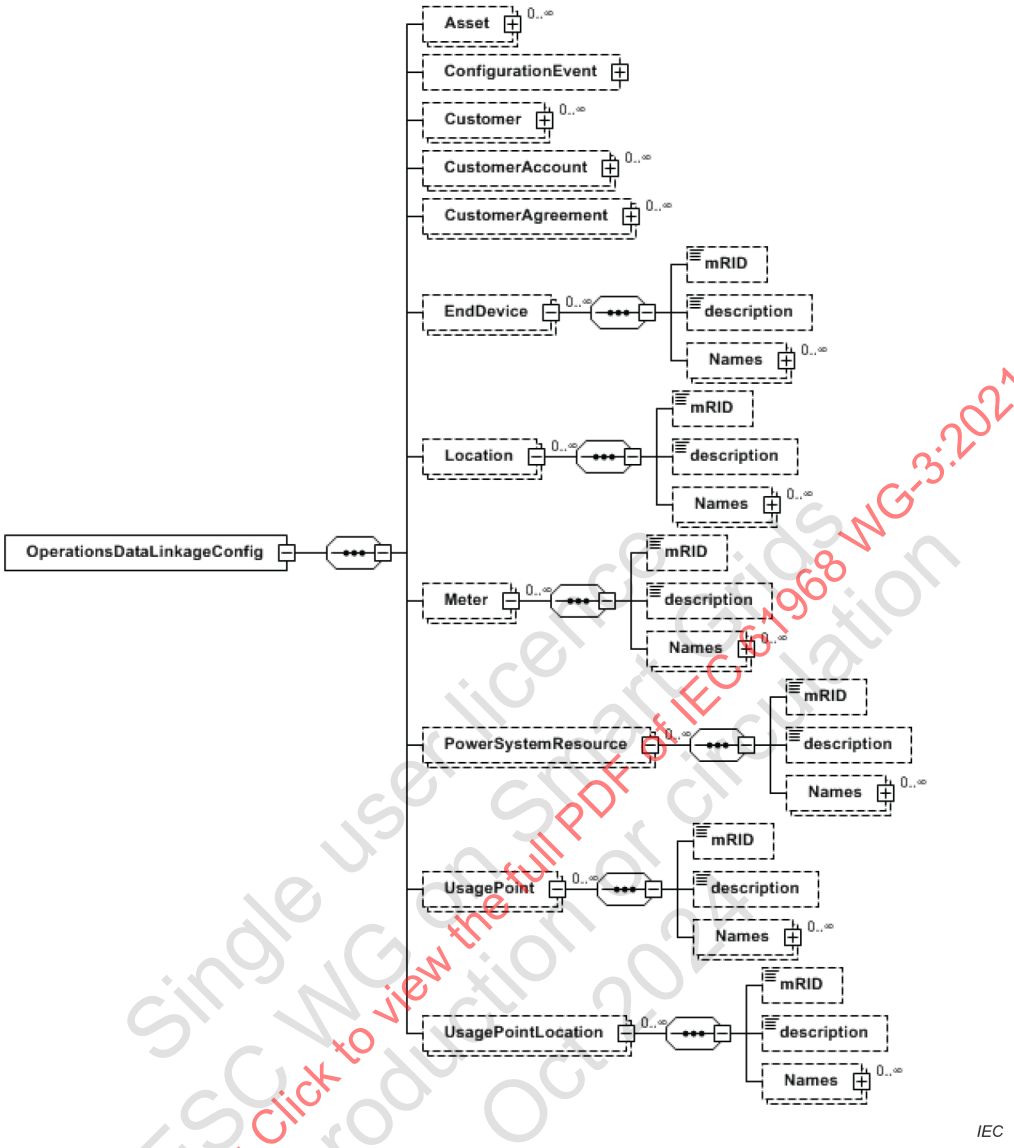

Figure 11 – OperationsDataLinkageConfig payload (2)

Possible use cases for this message include:

- Linking a customer to a meter
- Linking a customer to a power system resource, such as a load (energyConsumer).
- Linking a customer to their customer agreement, to determine participation in a demand response program

5.3.8 Example – linking a Customer to a PowerSystemResource

A common requirement for outage management and distribution management systems is to associate customers with the network. This can be done by associating a **Customer** with an **EnergyConsumer**. In this case, an **OperationsDataLinkageConfig** message could be sent from the system of record (e.g. CIS or GIS) and would contain the **Customer mRID** or **name** and the **PowerSystemResource mRID** or **name**.

In this example, it is not mandatory that a **CustomerConfig** message or a **PowerSystemResourceConfig** message to have been received, as long as the **mRID** or **name** of the **Customer** and **PowerSystemResource** are known to the receiving system. However, sample **CustomerConfig** and **PowerSystemResourceConfig** XML is included.

CustomerConfig sample XML. This defines information for one customer:

```
<?xml version="1.0" encoding="UTF-8"?>
<m:CustomerConfig xmlns:m="http://iec.ch/TC57/2019/CustomerConfig#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/CustomerConfig# CustomerConfig.xsd ">
  <m:Customer>
    <m:mRID>fd393766-f408-4ef8-8d83-d9f17fddf931</m:mRID>
    <m:kind>commercialIndustrial</m:kind>
    <m:locale>m:en</m:locale>
    <m:Names>
      <m:name>Michael B Higgins</m:name>
        <m:NameType>
          <m:name>Customer Name</m:name>
        </m:NameType>
    </m:Names>
    <m:Names>
        <m:name>02100045112314</m:name>
        <m:NameType>
          <m:name>Account Number</m:name>
        </m:NameType>
    </m:Names>
    <m:Organisation>
      <m:electronicAddress>
        <m:email1>michaelbhiggins31427@gmail.com</m:email1>
      </m:electronicAddress>
      <m:Names>
        <m:name>02100045112314</m:name>
        <m:NameType>
          <m:name>Account Number</m:name>
        </m:NameType>
      </m:Names>
      <m:phone1>
        <m:areaCode>919</m:areaCode>
        <m:cityCode>555</m:cityCode>
        <m:localNumber>1212</m:localNumber>
      </m:phone1>
      <m:postalAddress>
        <m:postalCode>27606</m:postalCode>
        <m:streetDetail>
          <m:addressGeneral>Main Campus Drive</m:addressGeneral>
          <m:number>901</m:number>
        </m:streetDetail>
        <m:townDetail>
          <m:name>Raleigh</m:name>
          <m:stateOrProvince>NC</m:stateOrProvince>
        </m:townDetail>
      </m:postalAddress>
      <m:streetAddress>
        <m:postalCode>27606</m:postalCode>
        <m:streetDetail>
          <m:addressGeneral>Main Campus Drive</m:addressGeneral>
          <m:number>901</m:number>
        </m:streetDetail>
        <m:townDetail>
          <m:name>Raleigh</m:name>
          <m:stateOrProvince>NC</m:stateOrProvince>
        </m:townDetail>
      </m:streetAddress>
    </m:Organisation>
  </m:Customer>
</m:CustomerConfig>
```

PowerSystemResourceConfig sample XML. This defines a pad mount transformer that the above customer will be associated with:

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PowerSystemResourceConfig xmlns:m="http://iec.ch/TC57/2019/PowerSystemResourceConfig#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/PowerSystemResourceConfig#
PowerSystemResourceConfig.xsd ">
  <m:PowerSystemResource>
    <m:mRID>ffb7f838-1eef-4297-83b4-59a2e431551d</m:mRID>
  </m:PowerSystemResource>
</m:PowerSystemResourceConfig>
```

OperationsDataLinkage sample XML. This links the customer with the pad mount transformer:

```
<?xml version="1.0" encoding="UTF-8"?>
<m:OperationsDataLinkageConfig xmlns:m="http://iec.ch/TC57/2017/OperationsDataLinkageConfig#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2017/OperationsDataLinkageConfig#
OperationsDataLinkageConfig.xsd ">
  <m:Customer>
    <m:mRID>fd393766-f408-4ef8-8d83-d9f17fddf931</m:mRID>
  </m:Customer>
  <m:PowerSystemResource>
    <m:mRID> ffb7f838-1eef-4297-83b4-59a2e431551d </m:mRID>
  </m:PowerSystemResource>
</m:OperationsDataLinkageConfig>
```

5.4 PSRMeasurements payload

5.4.1 General

Network state is monitored by SCADA or other network monitoring devices/systems and communicated to other systems that need to consider the current network state for further processing and analysis, e.g. an OMS system (for the Fault Management function) or a DMS (for the Network Operations and Monitoring function).

A Measurement in this document is analogous to a MeterReading in IEC 61969-9. In IEC 61968-9, a MeterReading is indeed used to convey a current value of digital (e.g., switch position) or analog (e.g., voltage) information. However, an EndDeviceEvent is used to convey a change in state (e.g., the change from a closed to an open position of a switch). So, for example, if a system receives a MeterReading indicating a switch is open at a particular time, the system must rely on its own prior knowledge of the switch position to determine whether the open state represents a change in state (from closed to open) at that particular time or simply a confirmation that the switch is still open at that particular time. Conversely, if a system receives an EndDeviceEvent indicating a switch opened at a particular time, the system need not have prior knowledge of the state of the switch to understand that the switch had been closed up until that time.

Many legacy measurement systems, such as SCADA, make no similar distinction between states and events. This is because such systems have been designed to receive data from field devices either by periodic polling or by exception. Thus in general, events are not available. This is also true for measurements that are calculated within the SCADA system or by an application such as state estimator or power flow. Thus it is assumed that any business function receiving PSRMeasurements has the capability of determining whether a value has changed since the last time a value was received. In some cases, the receiving function may be looking for a change that exceeds a certain threshold before taking action.

Figure 12 is sequence diagram showing how **PSRMeasurements** are used to communicate values between different actors. It is also possible for an actor to request the current value of a measurement, using the GetPSRMeasurements profile defined in 5.4.7. The sequence diagram is shown in Figure 13.

PSRMeasurements message payloads are designed to communicate network state information such as the current switch status, the state of a fault relay, the current tap position of a transformer or the current value of a voltage measurement. Messages may contain accumulator, analog, discrete and string values from SCADA or other measurement systems. Time stamps and quality codes are also included. The message also includes the phase(s) associated with the measurement, defined by **phases** (of type **PhaseCode**). If no phases are specified, then three phases are assumed. For unganged (single phase) measurements, one **PSRMeasurement** per phase is required. Each **PSRMeasurement** includes a reference to the power system resource that the measurement is associated with.

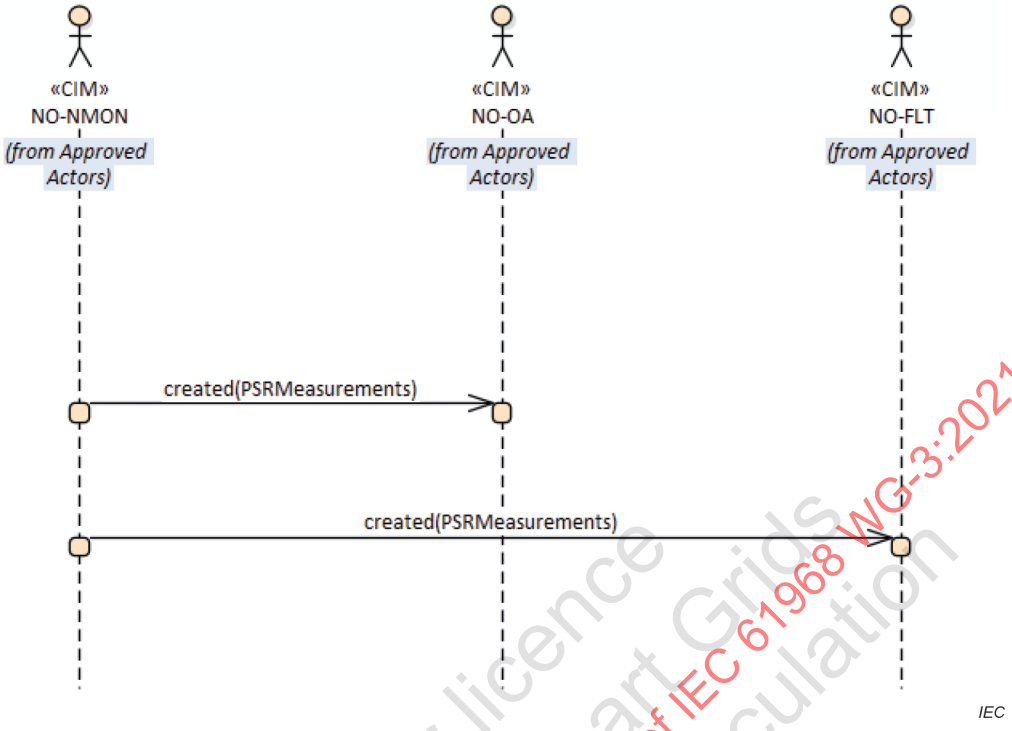

Figure 12 – PSRMeasurements sequence diagram

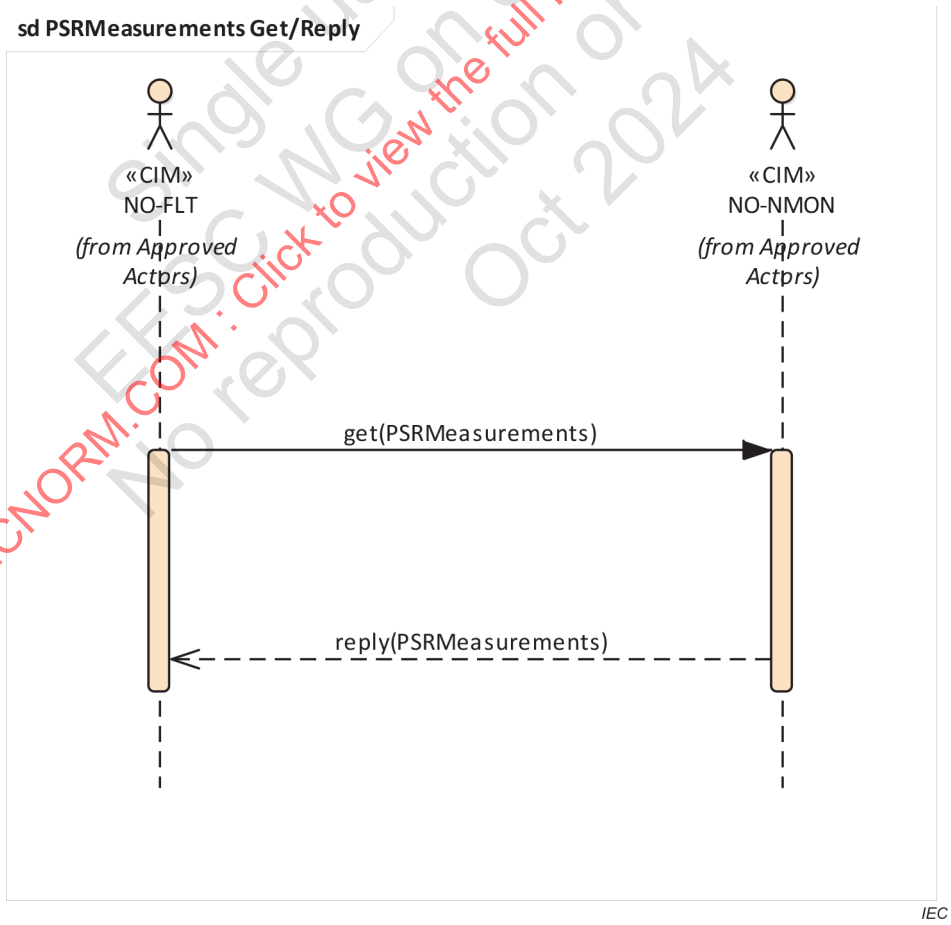

Figure 13 – Get/Reply Message Pattern for PSRMeasurements

5.4.2 Message Payload

PSRMeasurement value objects are the following

- **Accumulator** value
- **Analog** value (for example active and reactive power)
- **Discrete** value (for example status of a breaker)
- **StringMeasurement** value

The attributes of the **PSRMeasurements** profile are described in Table 6.

Table 6 – PSRMeasurements Profile

PSRMeasurements				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
PSRMeasurements	Accumulator	[0..*]	See B.2	Choice depending on the type of measurement
PSRMeasurements	Analog	[0..*]	See B.6	Choice depending on the type of measurement
PSRMeasurements	Discrete	[0..*]	See B.28	Choice depending on the type of measurement
PSRMeasurements	StringMeasurement	[0..*]	See B.82	Choice depending on the type of measurement

5.4.3 PSRMeasurements Payload – Accumulator

Figure 14 shows the message payload for **PSRMeasurements Accumulator**. **Accumulator** represents an accumulated (counted) Measurement, e.g. an energy value.

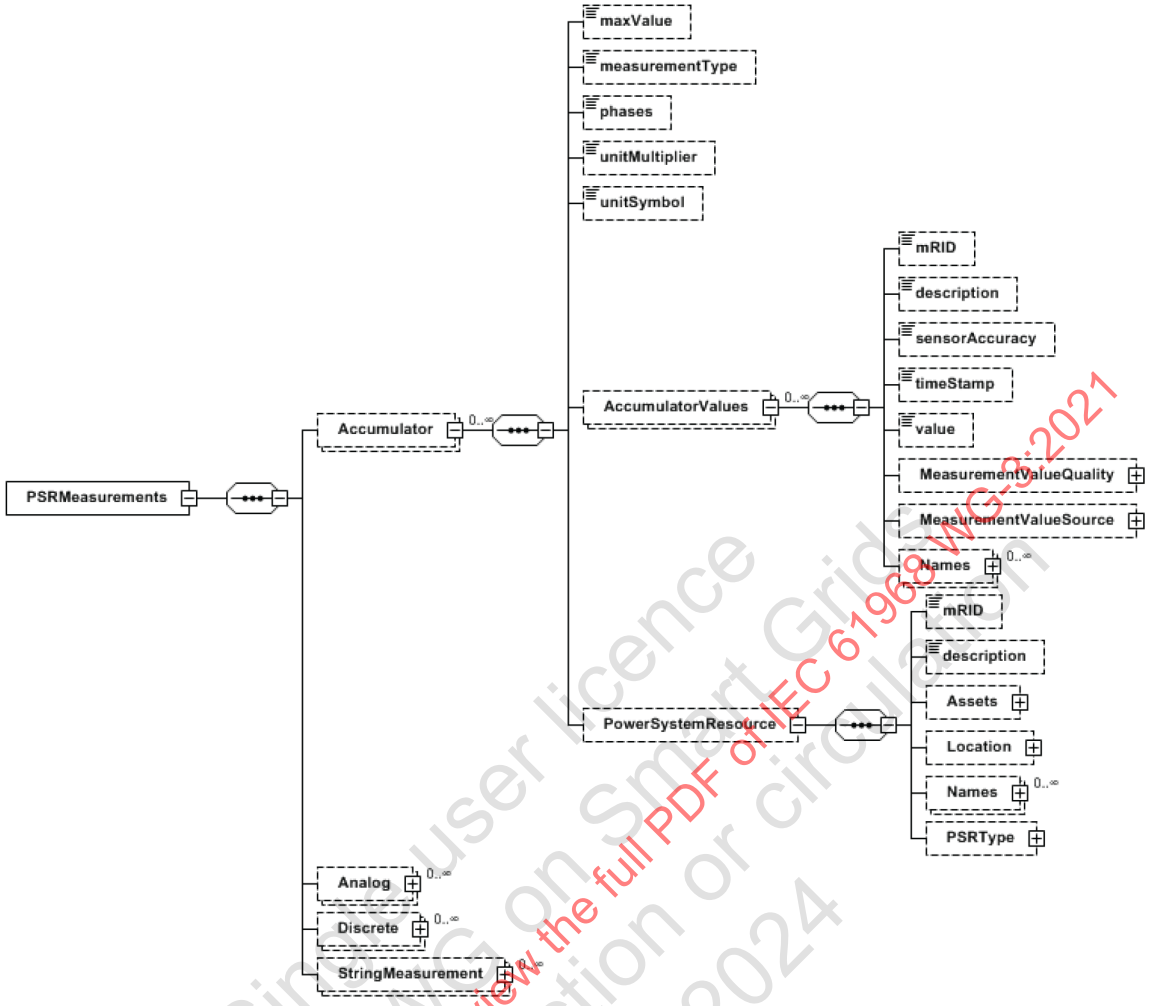

Figure 14 – PSRMeasurements payload – Accumulator

5.4.4 PSRMeasurements Payload – Analog

5.4.4.1 General

Figure 15 shows the message payload for **PSRMeasurements Analog**. **Analog** represents an analog Measurement, i.e. one that has continuous floating point values.

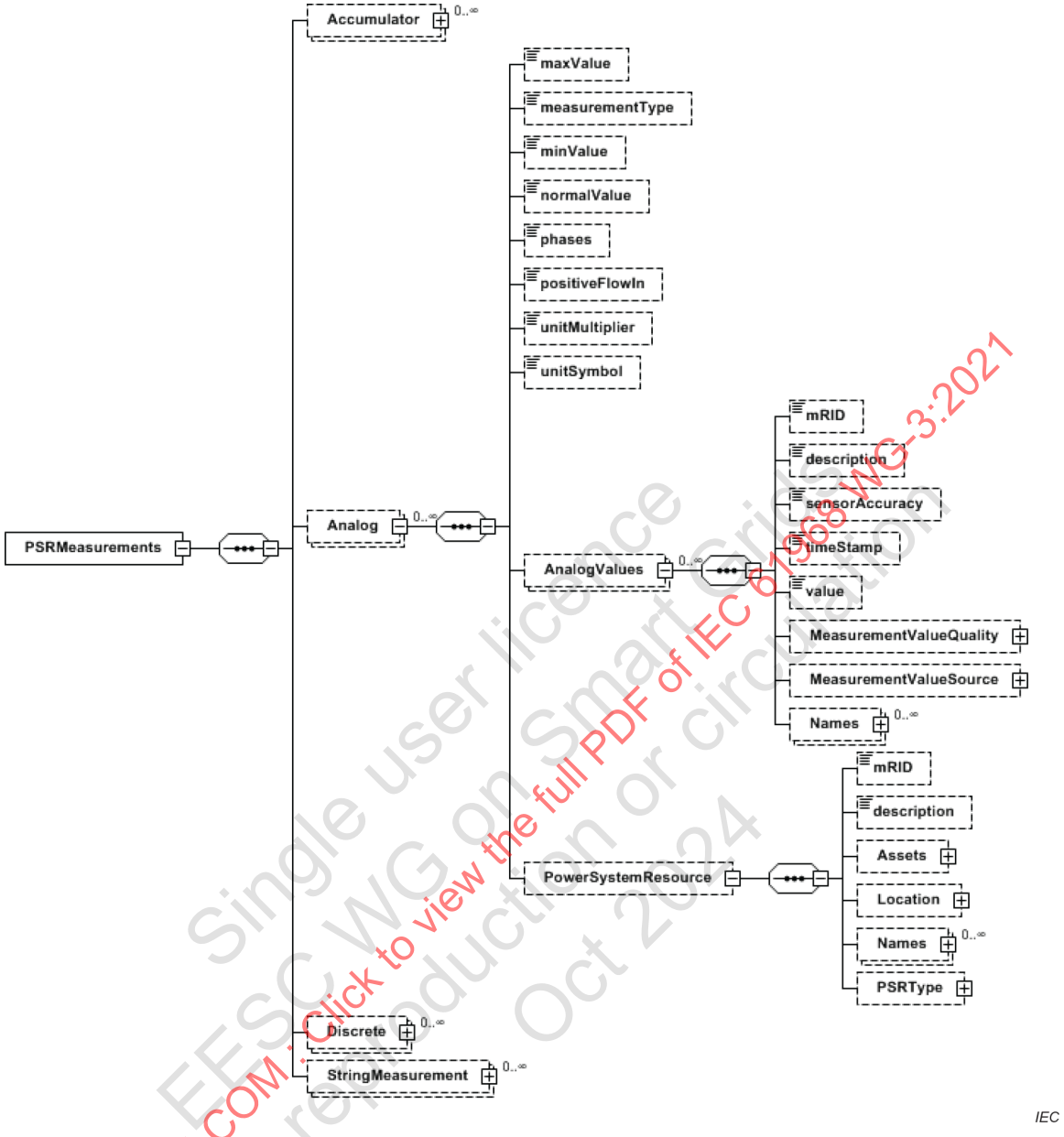

Figure 15 – PSRMeasurements payload – Analog

5.4.4.2 Example XML for Analog Measurement

The example below shows a B-phase Amps measurement that is associated with a line recloser.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PSRMeasurements xmlns:m="http://iec.ch/TC57/2019/PSRMeasurements#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2017/PSRMeasurements# PSRMeasurements.xsd ">
  <m:Analog>
    <m:measurementType>Line Flow</m:measurementType>
    <m:phases>B</m:phases>
    <m:positiveFlowIn>true</m:positiveFlowIn>
    <m:unitMultiplier>none</m:unitMultiplier>
    <m:unitSymbol>A</m:unitSymbol>
    <m:AnalogValues>
      <m:mRID>4d9ae2fa-37c0-42b0-90ca-0cefc141d5e8</m:mRID>
      <m:timeStamp>2019-03-08T12:03:01-06:00</m:timeStamp>
      <m:value>210.14</m:value>
      <m:MeasurementValueQuality>
        <m:badReference>false</m:badReference>
        <m:estimatorReplaced>false</m:estimatorReplaced>
```

```
        <m:failure>false</m:failure>
        <m:oldData>false</m:oldData>
        <m:operatorBlocked>false</m:operatorBlocked>
        <m:oscillatory>false</m:oscillatory>
        <m:outOfRange>false</m:outOfRange>
        <m:overFlow>false</m:overFlow>
        <m:source>SCADA</m:source>
        <m:suspect>false</m:suspect>
        <m:test>true</m:test>
        <m:validity>GOOD</m:validity>
      </m:MeasurementValueQuality>
      <m:Names>
        <m:name> Recloser D102 Phase B Amps </m:name>
      </m:Names>
    </m:AnalogValues>
    <m:PowerSystemResource>
      <m:mRID>4d9ae2fa-37c0-42b0-90ca-0cefc141d5e8</m:mRID>
      <m:description>m:description</m:description>
      <m:Names>
        <m:name> Recloser D102</m:name>
      </m:Names>
      <m:PSRType>
        <m:mRID>75240e31-89b4-40c0-a1eb-27629e726110</m:mRID>
        <m:description> Recloser Unganged 23kV </m:description>
        <m:Names>
          <m:name> Recl Ug 23kV </m:name>
        </m:Names>
      </m:PSRType>
    </m:PowerSystemResource>
  </m:Analog>
</m:PSRMeasurements>
```

5.4.5 **PSRMeasurements** Payload – **Discrete**

5.4.5.1 General

Figure 16 shows the message payload for **PSRMeasurements Discrete**. **Discrete** represents a discrete Measurement, i.e. a Measurement representing discrete values, e.g. a Breaker position.

The valid values for **DiscreteValue.value** are dependent upon the **measurementType** as shown in Table 7.

Table 7 – Valid values for DiscreteValue.value

measurementType	Valid values
Single Point Status	False or open (0), true or closed (1)
Double Point Status	Invalid or transient (0), false or closed (1), true or open (2), invalid (3).
Integer Status	Integer

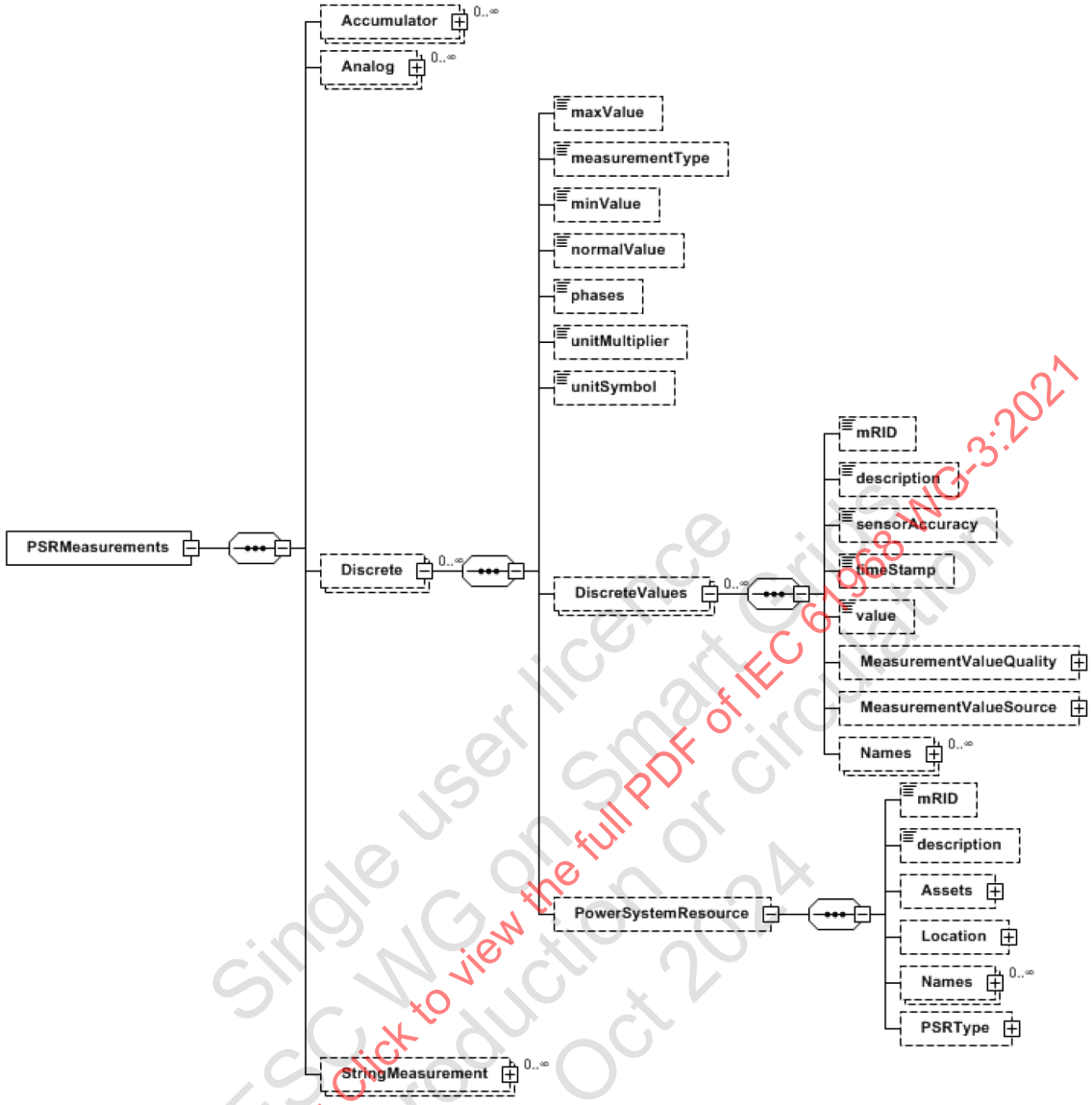

Figure 16 – PSRMeasurements payload – Discrete

5.4.5.2 Example XML for Discrete Measurement

Below is example XML for an unganged recloser status for Phase A.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PSRMeasurements xmlns:m="http://iec.ch/TC57/2019/PSRMeasurements#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2017/PSRMeasurements# PSRMeasurements.xsd ">
<m:Discrete>
    <m:measurementType> Unganged Recloser Status </m:measurementType>
    <m:normalValue>1</m:normalValue>
    <m:phases>A</m:phases>
    <m:DiscreteValues>
      <m:description> Lizard Lick Feeder-324 Recloser 4267 Phase A Status </m:description>
      <m:timeStamp>2019-04-10T12:12:12</m:timeStamp>
      <m:value>1</m:value>
      <m:MeasurementValueQuality>
        <m:estimatorReplaced>false</m:estimatorReplaced>
        <m:validity>GOOD</m:validity>
      </m:MeasurementValueQuality>
      <m:MeasurementValueSource>
        <m:Names>
          <m:name>SCADA</m:name>
        </m:Names>
```

```
      </m:MeasurementValueSource>
      <m:Names>
        <m:name> Lizard Lick-324 R-4267 A Status </m:name>
      </m:Names>
    </m:DiscreteValues>
    <m:PowerSystemResource>
      <m:mRID>7c584905-8c89-4810-98f5-f73d47521cbf </m:mRID>
    </m:PowerSystemResource>
  </m:Discrete>
</m:PSRMeasurements>
```

5.4.6 **PSRMeasurements** Payload – **StringMeasurement**

Figure 17 shows the message payload for **PSRMeasurements** **StringMeasurement**. **StringMeasurement** represents a measurement with values of type string.

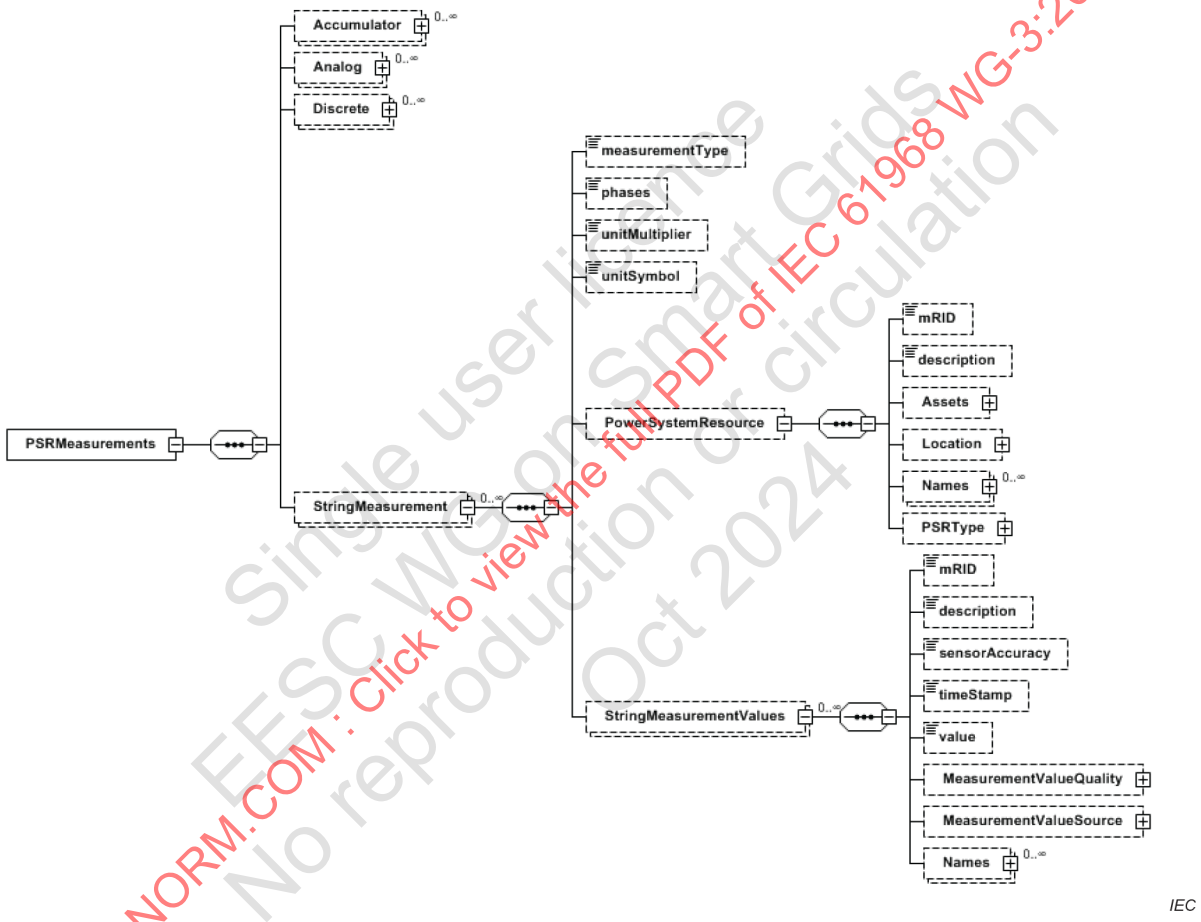

Figure 17 – PSRMeasurements payload – StringMeasurement

5.4.7 **GetPSRMeasurements** payload

The **GetPSRMeasurements** profile is used to request one or more **Measurement**s. The payload is shown graphically in Figure 18.

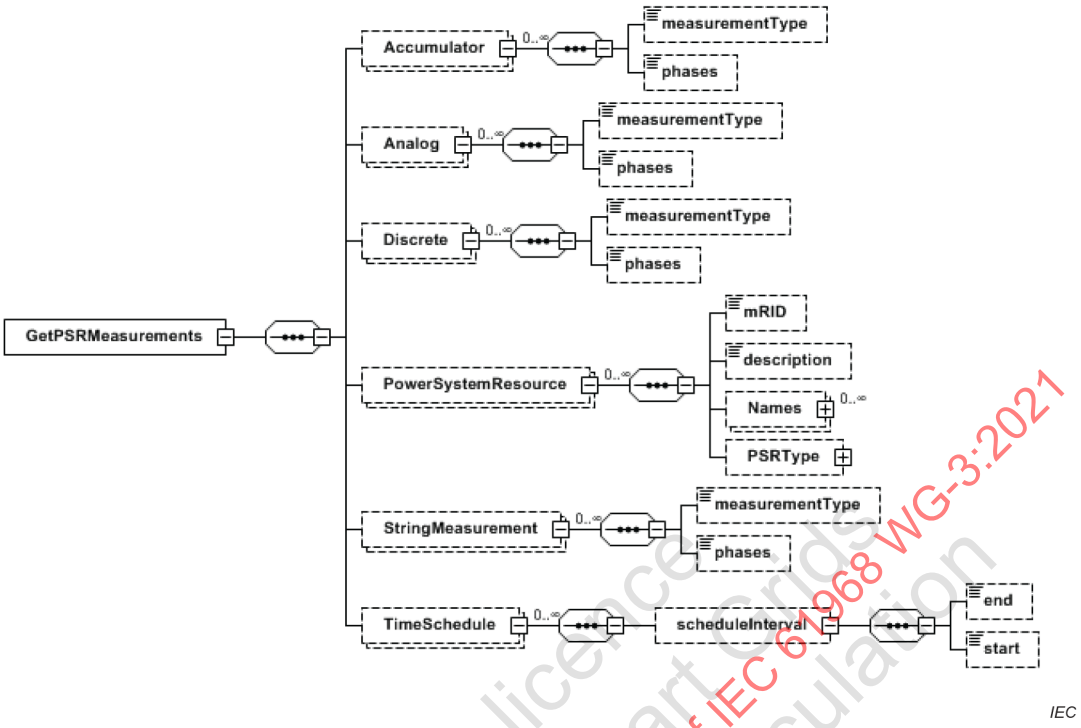

Figure 18 – GetPSRMeasurements payload

The attributes of the **getPSRMeasurements** profile are described in Table 8.

Table 8 – getPSRMeasurements Profile

PSRMeasurements				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
Accumulator	Accumulator	[0..*]	See B.2	measurementType and phases of the requested measurements.
Analog	Analog	[0..*]	See B.6	measurementType and phases of the requested measurements.
Discrete	Discrete	[0..*]	See B.28	measurementType and phases of the requested measurements.
PowerSystemResource	PowerSystemResource	[0..*]	See B.68	The PowerSystemResources for which the measurements are requested.
StringMeasurement	StringMeasurement	[0..*]	See B.82	measurementType and phases of the requested measurements.
TimeSchedule	TimeSchedule	[0..*]	See B.91	Time range of the requested measurements. If no time range is specified, the request is for the latest measurements only.

5.5 **PSRControls** payload

5.5.1 General

PSRControls message payloads are designed to communicate requests to change the network state. The change can be an accumulator reset, analog control, command, raise/lower command or a setpoint. Examples include a request to open or close a switch, control the position of a transformer tap or set a new set point for a local controller. Each **PSRControl** includes a reference to the **PowerSystemResource** that is associated with the control request.

Controls are typically sent from a DMS system to a SCADA system. Figure 19 is a sequence diagram that shows how an actor can request a control to be performed. The diagram also shows a reply that confirms that the control request has been received. It also shows that when the value changes as a result of the control being sent, a **PSRMeasurements** is sent to the requester.

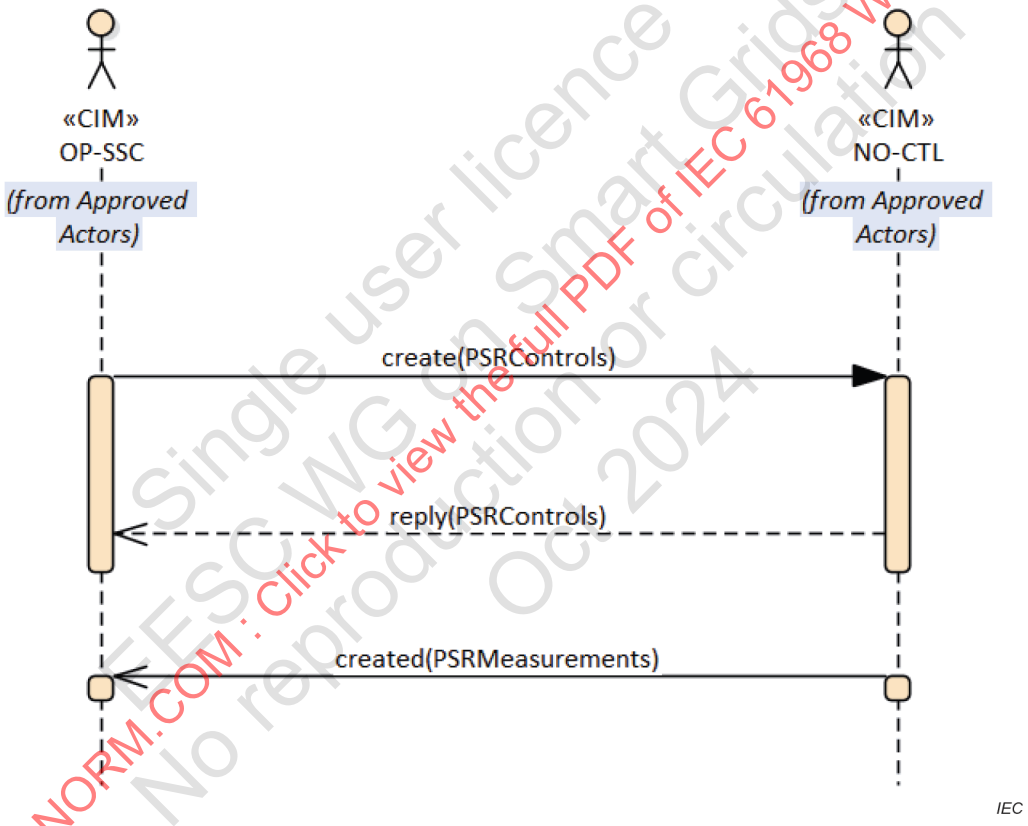

Figure 19 – PSRControls sequence diagram

5.5.2 **PSRControls** Message Payload

This message payload can be used for exchanging control data including 0 to many control objects.

Control objects are the following:

- **AccumulatorReset**
- **AnalogControl**
- **Command** (for example open or close a switch)
- **RaiseLowerCommand** (for example raise or lower a transformers tap position)
- **SetPoint** (for example setpoint for local voltage control)

The attributes of the **PSRControls** profile are described in Table 9.

Table 9 – PSRControls Profile

PSRControls				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
PSRControls	AccumulatorReset	[0..*]	Choice depending on the type of control.	This command resets the counter value to zero.
PSRControls	AnalogControl	[0..*]	Choice depending on the type of control.	An analog control used for supervisory control.
PSRControls	Command	[0..*]	Choice depending on the type of control.	A Command is a discrete control used for supervisory control.
PSRControls	RaiseLowerCommand	[0..*]	Choice depending on the type of control.	An analog control that increase or decrease a set point value with pulses. Unless otherwise specified, one pulse moves the set point by one.
PSRControls	SetPoint	[0..*]	Choice depending on the type of control.	An analog control that issues a set point value.
Profile Attributes for AccumulatorReset				
controlType	String	[0..1]		Specifies the type of Control, e.g. BreakerOn/Off, GeneratorVoltageSetPoint, TieLineFlow etc. The ControlType.name shall be unique among all specified types and describe the type.
operationInProgress	Boolean	[0..1]		Indicates that a client is currently sending control commands that has not completed.
phases	PhaseCode	[0..1]	See C.12	Specifies the phases to be controlled. If no phases are specified, all available phases are assumed. E.g. for a three phase control, three phases are assumed to be controlled..
timeStamp	DateTime	[0..1]		The last time a control output was sent.
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	

PSRControls				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
Profile Attributes for AnalogControl				
controlType	String	[0..1]		Specifies the type of Control, e.g. BreakerOn/Off, GeneratorVoltageSetPoint, TieLineFlow etc. The ControlType.name shall be unique among all specified types and describe the type.
maxValue	Float	[0..1]		Normal value range maximum for any of the Control.value. Used for scaling, e.g. in bar graphs.
minValue	Float	[0..1]		Normal value range minimum for any of the Control.value. Used for scaling, e.g. in bar graphs.
operationInProgress	Boolean	[0..1]		Indicates that a client is currently sending control commands that has not completed.
phases	PhaseCode	[0..1]	See C.12	Specifies the phases to be controlled. If no phases are specified, all available phases are assumed. E.g. for a three phase control, three phases are assumed to be controlled..
timeStamp	DateTime	[0..1]		The last time a control output was sent.
unitMultiplier	UnitMultiplier	[0..1]		The unit multiplier of the measured quantity.
unitSymbol	UnitSymbol	[0..1]		The unit of measure of the measured quantity.
AnalogValue	AnalogValue	[0..*]	See B.7	
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	
Profile Attributes for Command				
controlType	String	[0..1]		
normalValue	Integer	[0..1]		Normal value for Control.value e.g. used for percentage scaling.
operationInProgress	Boolean	[0..1]		Indicates that a client is currently sending control commands that has not completed.
phases	PhaseCode	[0..1]	See C.12	Specifies the phases to be controlled. If no phases are specified, all available phases are assumed. E.g. for a three phase control, three phases are assumed to be controlled.
timeStamp	DateTime	[0..1]		The last time a control output was sent.
unitMultiplier	UnitMultiplier	[0..1]		The unit multiplier of the controlled quantity.
unitSymbol	UnitSymbol	[0..1]		The unit of measure of the controlled quantity.
DiscreteValue	DiscreteValue	[0..*]	See B.29	

PSRControls				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	
Profile Attributes for RaiseLowerCommand				
controlType	String	[0..1]		Values of either 'Raise' or 'Lower'
maxValue	Float	[0..1]		Normal value range maximum for any of the Control.value. Used for scaling, e.g. in bar graphs.
minValue	Float	[0..1]		Normal value range minimum for any of the Control.value. Used for scaling, e.g. in bar graphs.
operationInProgress	Boolean	[0..1]		Indicates that a client is currently sending control commands that has not completed.
phases	PhaseCode	[0..1]	See C.12	Specifies the phases to be controlled. If no phases are specified, all available phases are assumed. E.g. for a three phase control, three phases are assumed to be controlled..
timeStamp	DateTime	[0..1]		The last time a control output was sent.
unitMultiplier	UnitMultiplier	[0..1]		The unit multiplier of the measured quantity.
unitSymbol	UnitSymbol	[0..1]		The unit of measure of the measured quantity.
AnalogValue	AnalogValue	[0..*]	See B.7	AnalogValue.value is used to specify the number of pulses. If not specified, a value of 1 is assumed.
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	

PSRControls				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
Profile Attributes for SetPoint				
controlType	String	[0..1]		Specifies the type of Control, e.g. BreakerOn/Off, GeneratorVoltageSetPoint, TieLineFlow etc. The ControlType.name shall be unique among all specified types and describe the type.
maxValue	Float	[0..1]		Normal value range maximum for any of the Control.value. Used for scaling, e.g. in bar graphs.
minValue	Float	[0..1]		Normal value range minimum for any of the Control.value. Used for scaling, e.g. in bar graphs.
normalValue	Float	[0..1]		Normal value for Control.value e.g. used for percentage scaling.
operationInProgress	Boolean	[0..1]		Indicates that a client is currently sending control commands that has not completed.
phases	PhaseCode	[0..1]	See C.12	Specifies the phases to be controlled. If no phases are specified, all available phases are assumed. E.g. for a three phase control, three phases are assumed to be controlled.
timeStamp	DateTime	[0..1]		The last time a control output was sent.
unitMultiplier	UnitMultiplier	[0..1]		The unit multiplier of the measured quantity.
unitSymbol	UnitSymbol	[0..1]		The unit of measure of the measured quantity.
AnalogValue	AnalogValue	[0..*]	See B.7	AnalogValue.value is used to specify the desired analog value that the controlled device should be set to. For example, for a voltage regulator, the desired voltage should be specified.
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	

5.5.3 PSRControls payload – AccumulatorReset

5.5.3.1 General

Figure 20 shows the **AccumulatorReset** control message payload. This command resets the counter value to zero.

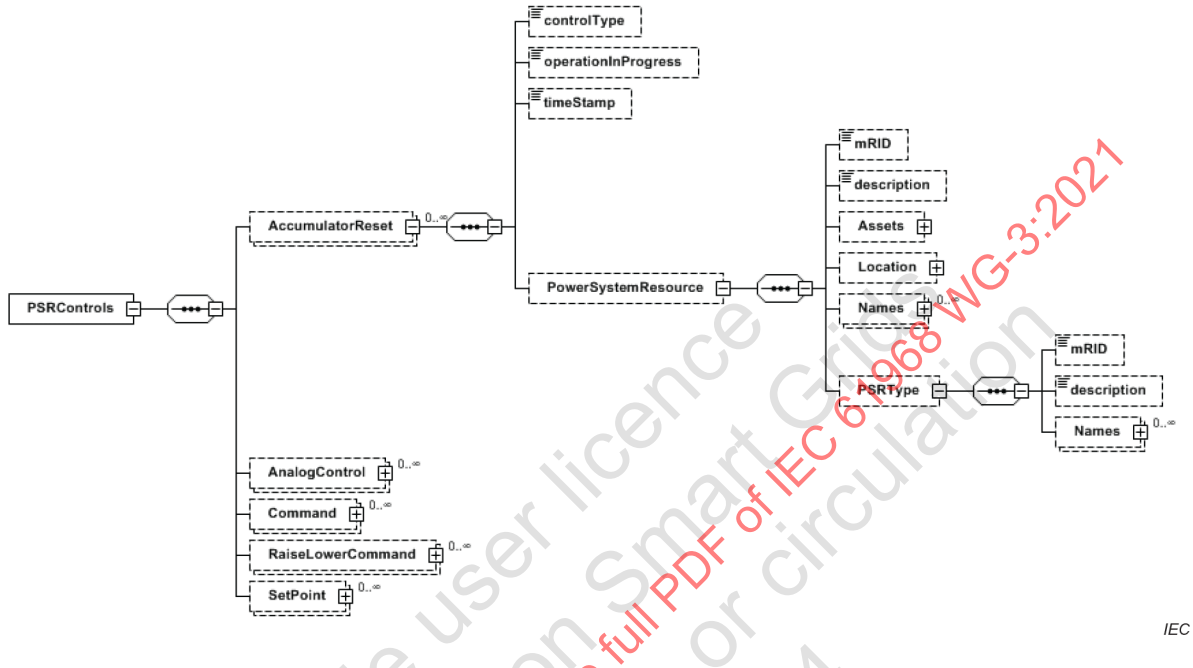

Figure 20 – PSRControls payload – AccumulatorReset

5.5.3.2 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PSRControls xmlns:m="http://iec.ch/TC57/2019/PSRControls#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/PSRControls# PSRControls.xsd ">
  <m:AccumulatorReset>
    <m:controlType>Accumulator Reset</m:controlType>
    <m:phases>ABC</m:phases>
    <m:timeStamp>2019-06-03T09:00:00</m:timeStamp>
    <m:PowerSystemResource>
      <m:mRID>d7380450-a5ec-472b-bc74-11aaf22af7fd</m:mRID>
    </m:PowerSystemResource>
  </m:AccumulatorReset>
</m:PSRControls>
```

5.5.4 PSRControls payload – AnalogControl

5.5.4.1 General

Figure 21 shows the **AnalogControl** control message payload. This command is an analog control used for supervisory control.

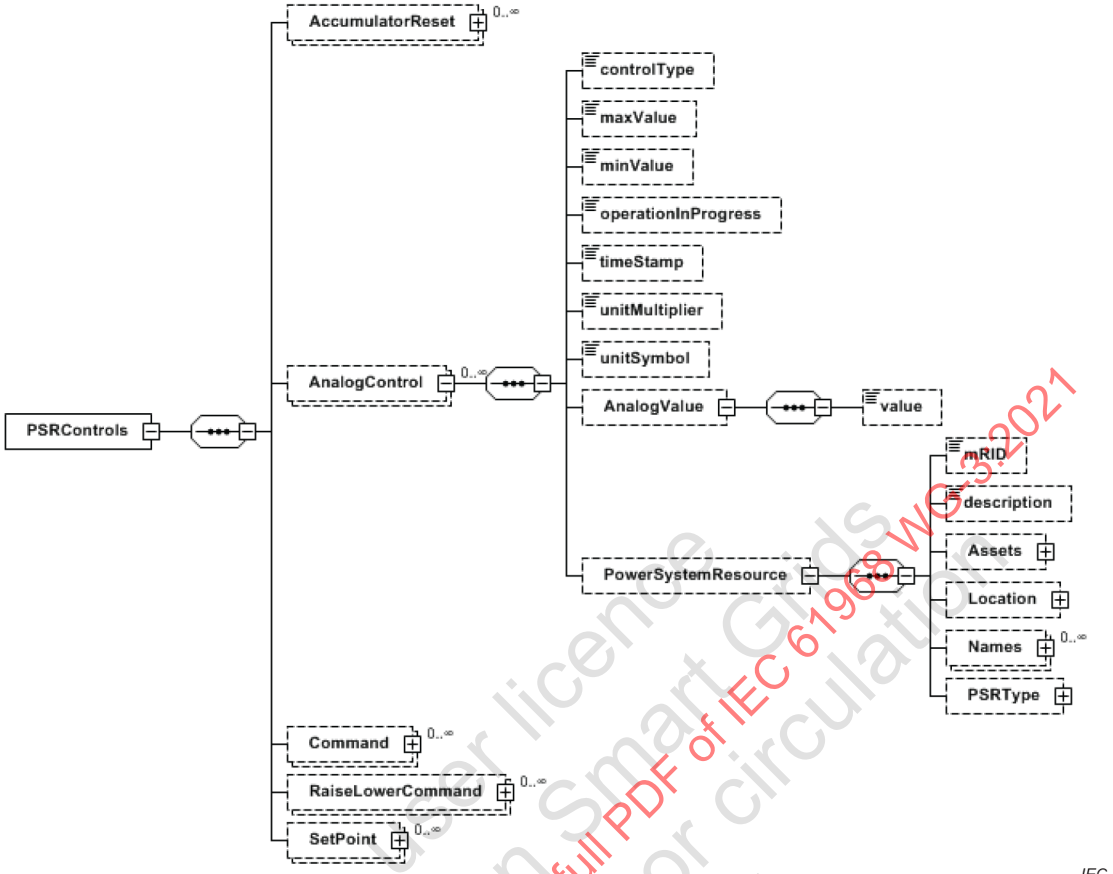

Figure 21 – PSRControls payload – AnalogControl

5.5.4.2 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PSRControls xmlns:m="http://iec.ch/TC57/2019/PSRControls#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/PSRControls# PSRControls.xsd ">
  <m:AnalogControl>
    <m:controlType>Analog Output</m:controlType>
    <m:timeStamp>2019-06-03T09:47:00</m:timeStamp>
    <m:AnalogValue>
      <m:value>0.0</m:value>
    </m:AnalogValue>
    <m:PowerSystemResource>
      <m:mRID>6093b77b-0e82-4a9c-9a8d-aa79bd926972</m:mRID>
    </m:PowerSystemResource>
  </m:AnalogControl>
</m:PSRControls>
```

5.5.5 PSRControls payload – Command

5.5.5.1 General

Figure 22 shows the **Command** control message payload. Command is a discrete control used for supervisory control.

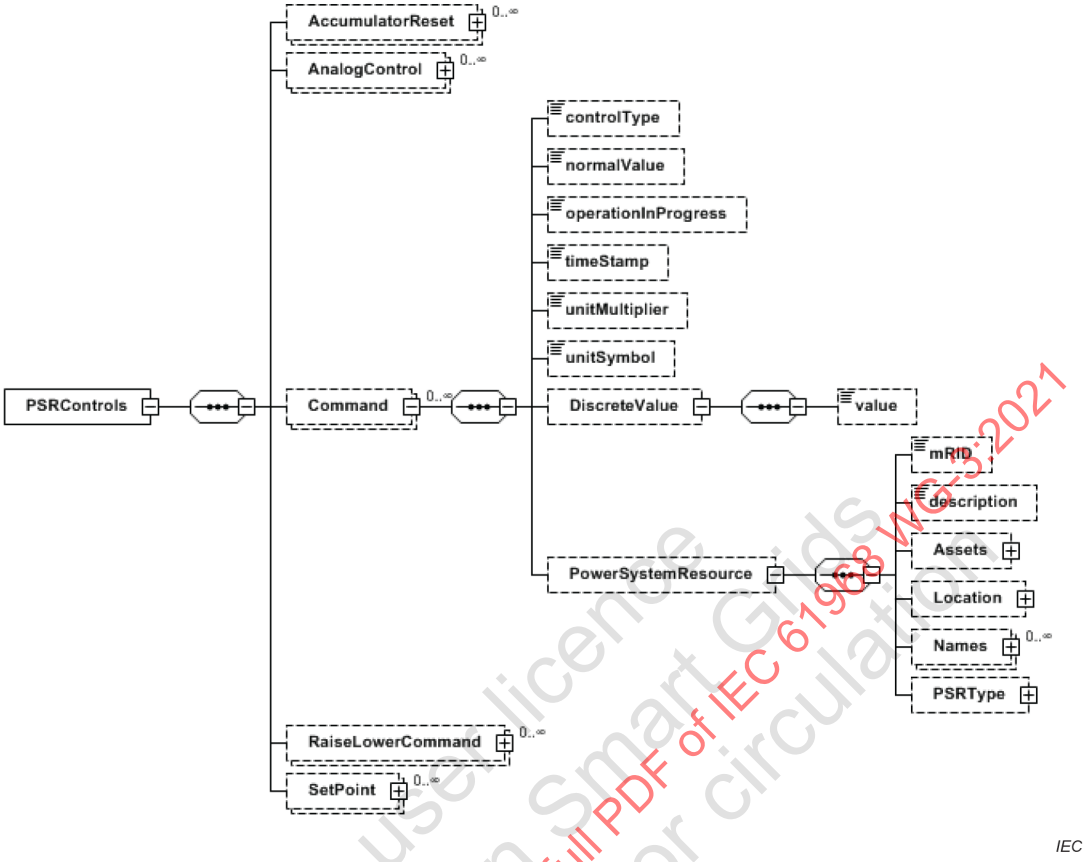

Figure 22 – PSRControls payload – Command

5.5.5.2 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PSRControls xmlns:m="http://iec.ch/TC57/2019/PSRControls#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/PSRControls# PSRControls.xsd ">
  <m:Command>
    <m:controlType>Breaker Open/Close</m:controlType>
    <m:phases>A</m:phases>
    <m:timeStamp>2019-06-03T09:54:00</m:timeStamp>
    <m:DiscreteValue>
      <m:value>01</m:value>
    </m:DiscreteValue>
    <m:PowerSystemResource>
      <m:mRID>d1e7a6fe-9270-4f33-8f7e-04a00965b4e4</m:mRID>
      <m:Assets>
        <m:description>Wicker 12kV Substation Feeder 02 Breaker</m:description>
        <m:Names>
          <m:name>Wick F-02 CB</m:name>
        </m:Names>
      </m:Assets>
      <m:Names>
        <m:name>Wick F-02 CB</m:name>
      </m:Names>
      <m:PSRType>
        <m:Names>
          <m:name>12kV Circuit Breaker</m:name>
        </m:Names>
      </m:PSRType>
    </m:PowerSystemResource>
  </m:Command>
</m:PSRControls>
```

5.5.6 PSRControls payload – RaiseLowerCommand

5.5.6.1 General

Figure 23 shows the **RaiseLowerCommand** control message payload. An analog control that increase or decrease a set point value with pulses.

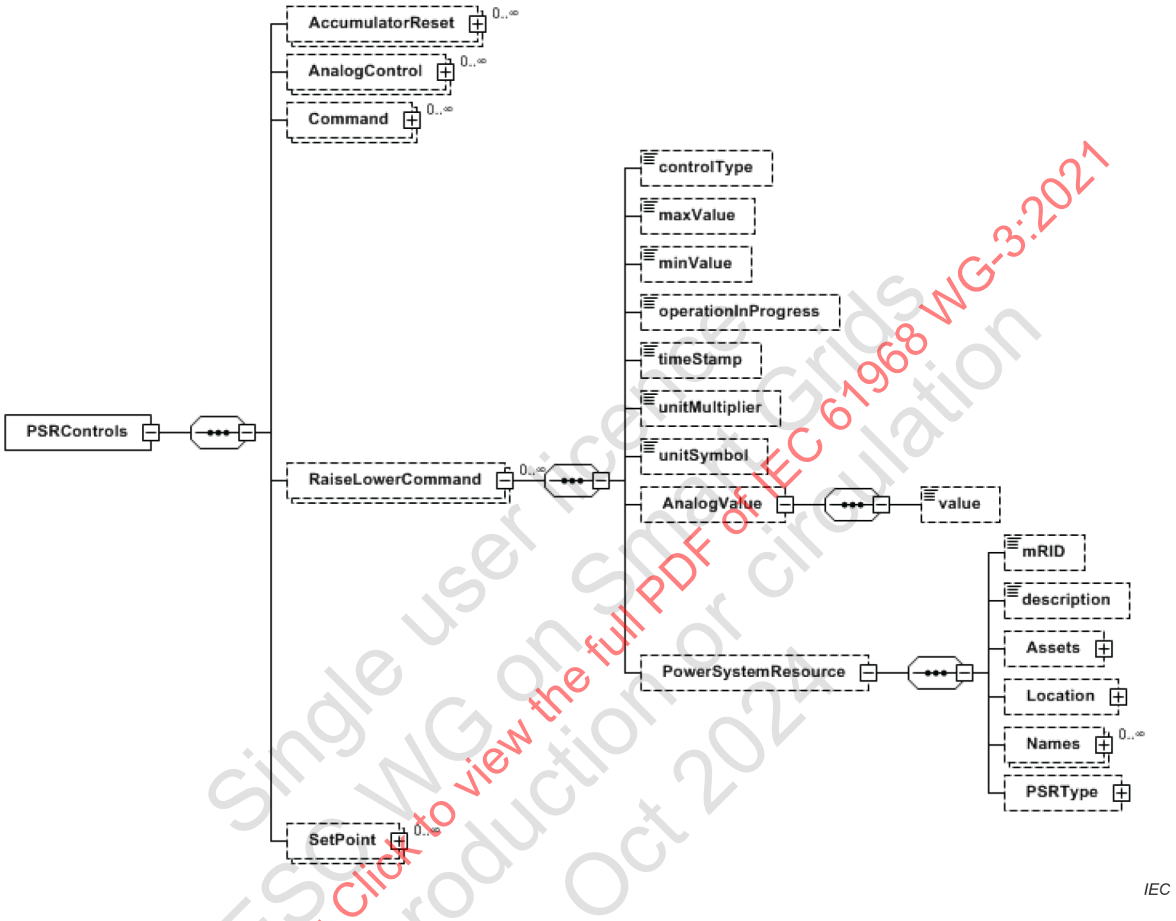

Figure 23 – PSRControls payload RaiseLowerCommand

5.5.6.2 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PSRControls xmlns:m="http://iec.ch/TC57/2019/PSRControls#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/PSRControls# PSRControls.xsd ">
  <m:RaiseLowerCommand>
    <m:controlType>Load Tap Changer Control</m:controlType>
    <m:maxValue>16</m:maxValue>
    <m:minValue>-16</m:minValue>
    <m:phases>ABC</m:phases>
    <m:timeStamp>2019-06-03T10:00:00</m:timeStamp>
    <m:AnalogValue>
      <m:value>8.0</m:value>
    </m:AnalogValue>
    <m:PowerSystemResource>
      <m:mRID>b50d893b-b44e-4895-8924-658c862ee75f</m:mRID>
      <m:Assets>
        <m:Names>
          <m:name>Wick 12kV Substation Transformer Bank 01 LTC</m:name>
        </m:Names>
      </m:Assets>
      <m:Names>
        <m:name> Wick 12kV Substation Transformer Bank 01 LTC </m:name>
      </m:Names>
      <m:PSRType>
        <m:Names>
```

```
          <m:name>Load Tap Changer</m:name>
        </m:Names>
      </m:PSRType>
    </m:PowerSystemResource>
  </m:RaiseLowerCommand>
</m:PSRControls>
```

5.5.7 PSRControls payload – SetPoint

5.5.7.1 General

Figure 24 shows the **SetPoint** control message payload. A **SetPoint** is an analog control that issues a target value that a controller must set a controlled variable to.

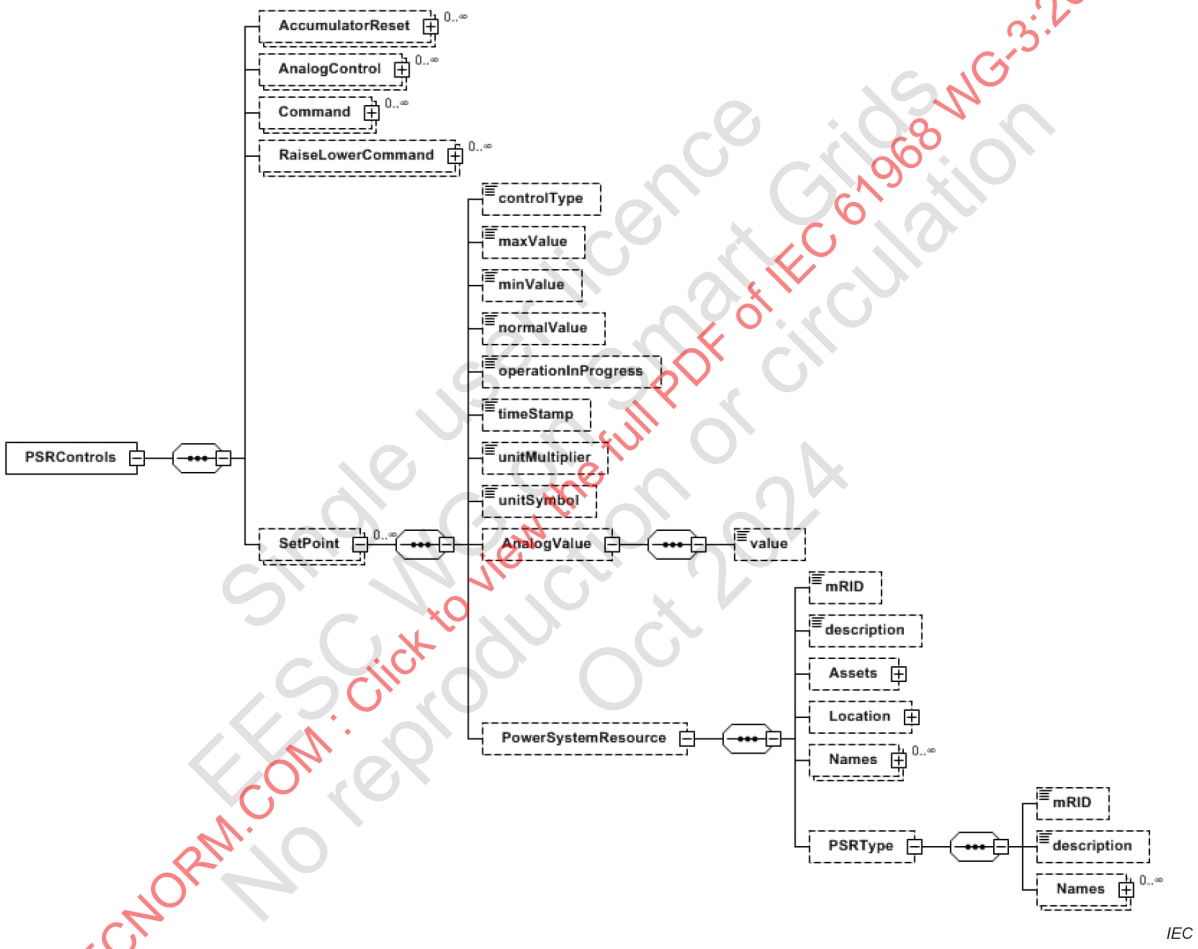

Figure 24 – PSRControls payload SetPoint

5.5.7.2 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PSRControls xmlns:m="http://iec.ch/TC57/2019/PSRControls#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/PSRControls# PSRControls.xsd ">
  <m:SetPoint>
    <m:controlType>Single Phase Voltage Setpoint, Per Unit</m:controlType>
    <m:maxValue>1.05</m:maxValue>
    <m:minValue>0.95</m:minValue>
    <m:normalValue>1.0</m:normalValue>
    <m:phases>B</m:phases>
    <m:timeStamp>2019-06-03T10:05:00</m:timeStamp>
    <m:unitMultiplier>none</m:unitMultiplier>
    <m:AnalogValue>
      <m:value>1.02</m:value>
    </m:AnalogValue>
    <m:PowerSystemResource>
      <m:mRID>13dd1b33-71fe-48e7-859c-887edf017399</m:mRID>
      <m:Assets>
        <m:description>Wick 12kV F02 VREG-1029</m:description>
        <m:Names>
          <m:name>VREG-1029</m:name>
        </m:Names>
      </m:Assets>
      <m:Names>
        <m:name>Wick 12-F02 VREG-1029</m:name>
      </m:Names>
      <m:PSRType>
        <m:Names>
          <m:name>Voltage regulator PU tap</m:name>
        </m:Names>
      </m:PSRType>
    </m:PowerSystemResource>
  </m:SetPoint>
</m:PSRControls>
```

5.6 SwitchingPlanRequests payload

5.6.1 General

Figure 25 is a sequence diagram that is an example of the interaction between work management and switch order scheduling.

In this example, the sequence starts with a **SwitchingPlanRequest**, which is used to convey a request from work management (or other business function) to network operations that switching needs to be performed. This could be a request to isolate part of the network in order for maintenance or construction work to be performed. The payload includes the type of work to be performed and when it should start. The typical outcome of a **SwitchingPlanRequest** is the creation of a **SwitchingPlan**. A **SwitchingPlan** is a sequence of pre-defined steps that typically perform operations to change the state of the network, such as a sequence of switch open and close operations.

Switch Action Scheduling (OP-SSC) acknowledges receipt of the request with a reply message. The **SwitchingPlan** is then developed by creating steps, either manually or automatically.

During its development, the **SwitchingPlan** goes through various review and approval processes within the Switch Action Scheduling function. Upon completion of the development of an approved **SwitchingPlan**, Switch Action Scheduling makes a request to Work Scheduling and Dispatching (MC-SCHD) to create a **SwitchingOrder** using the **SwitchingOrders** message. The **SwitchingPlan** is not yet communicated outside of the Switch Action Scheduling function. An example of this communication is described in Subclause 5.10.

The **SwitchingOrder** is scheduled within Work Scheduling and Dispatching. Once it has been scheduled, Work Scheduling and Dispatching replies with a **SwitchingOrders** message, to indicate that the **SwitchingOrder** has been scheduled.

Finally, if the switching will result in customer outages, Customer Service is notified of the planned outage via a **PlannedOutageNotification** message.

Please note that the actual scheduling and coordination of SwitchingPlanRequests (Predictive Operational Condition Planning as defined in IEC 61968-1) is not included in the scope of this document.

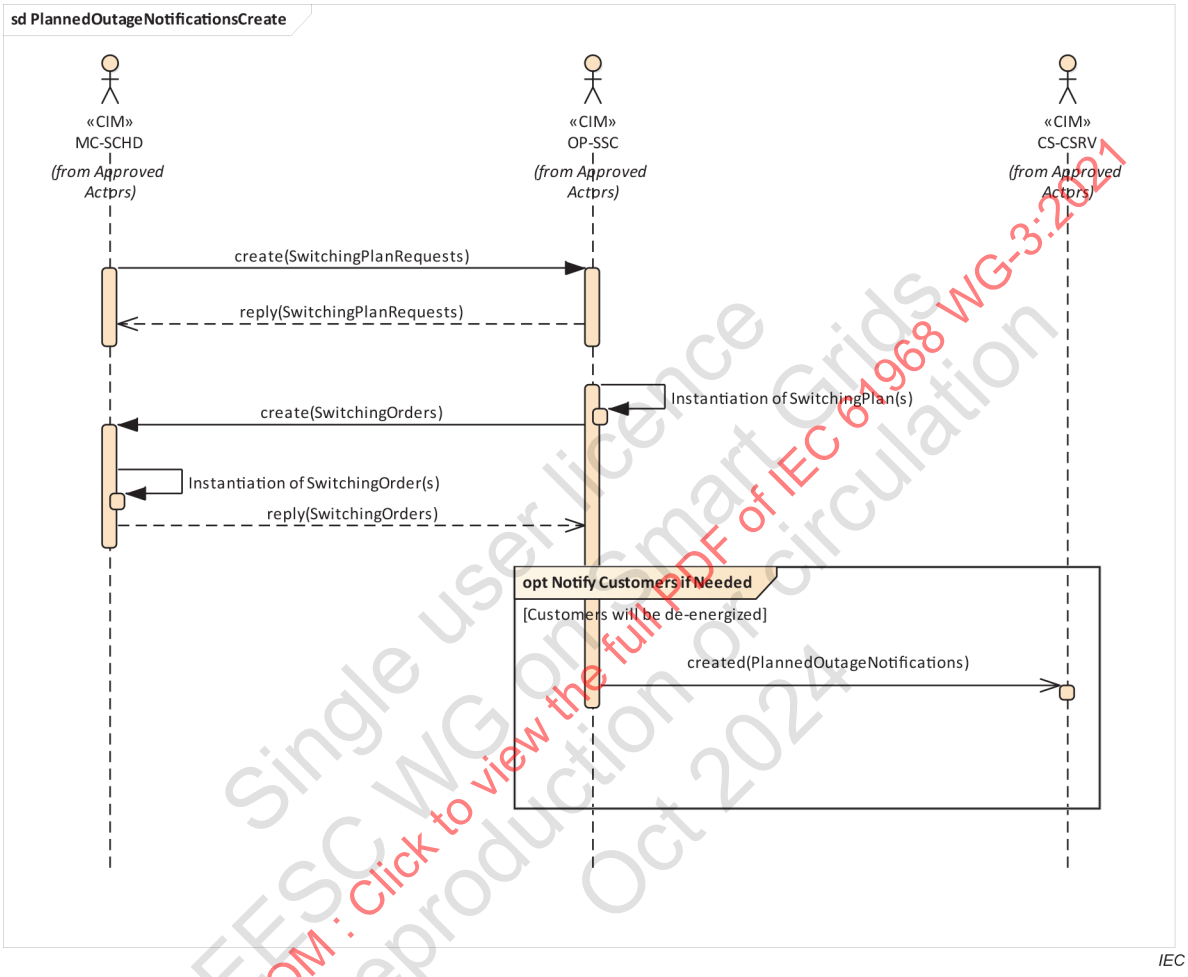

Figure 25 – SwitchingPlanRequests Sequence Diagram

5.6.2 Message Payload

The attributes of the **SwitchingPlanRequests** profile are described in Table 10 and shown graphically in Figure 26 and Figure 27.

Table 10 – SwitchingPlanRequests Profile

SwitchingPlanRequests				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
SwitchingPlanRequests	SwitchingPlanRequest	[1..*]		
Profile Attributes				
mRID	String	[0..1]	GUID	
description	String	[0..1]		Free-form text field that describes the **SwitchingPlanRequest**
Names	Name	[0..*]	See B.56	Can be used to provide additional information such as internal request number.
comment	String	[0..1]		Requester comments
createdDateTime	DateTime	[0..1]		DateTime that the SwitchingPlanRequest was initially created.
equipmentToBeIsolated	String	[0..1]		List of equipment to be isolated, free-form text
groundingPoints	String	[0..1]		List of potential grounding points, free-form text
isolationArea	String	[0..1]		The location of the area to be isolated, free-form text
isolationPoints	String	[0..1]		List of potential isolation points, free-form text
lastModifiedDateTime	DateTime	[0..1]		DateTime that the SwitchingPlanRequest was last changed.
purpose	String	[0..1]		The purpose of the switching request
revisionNumber	String	[0..1]		Revision number of switching request. Used to track changes.
subject	String	[0..1]		Free-form text
switchingRequestDetails	String	[0..1]		Free-form text
title	String	[0..1]		Free-form text
type	String	[0..1]		Type of switching request
Author	Author	[0..1]	See B.13	Author of the SwitchingPlanRequest
docStatus	Status	[0..1]	See B.79	docStatus.value is used to specify the overall status of the SwitchingPlanRequest document, such as draft, in review, approved, cancelled, etc.
forwardSwitchingDateTimeInterval	DateTimeInterval	[0..1]		Forward switching start and end date – time and date when the switching starts and ends to take the equipment out of service
outageDateTimeInterval	DateTimeInterval	[0..1]		Outage start and end date – time and date when customers are scheduled to be de-energized and then energized.
RequestingOrganization	Organisation	[0..1]	See B.62	The name and contact information of the organisation making the switching request
reverseSwitchingDateTimeInterval	DateTimeInterval	[0..1]		Reverse switching start and end date – time and date when the switching starts and ends to put the equipment back in service

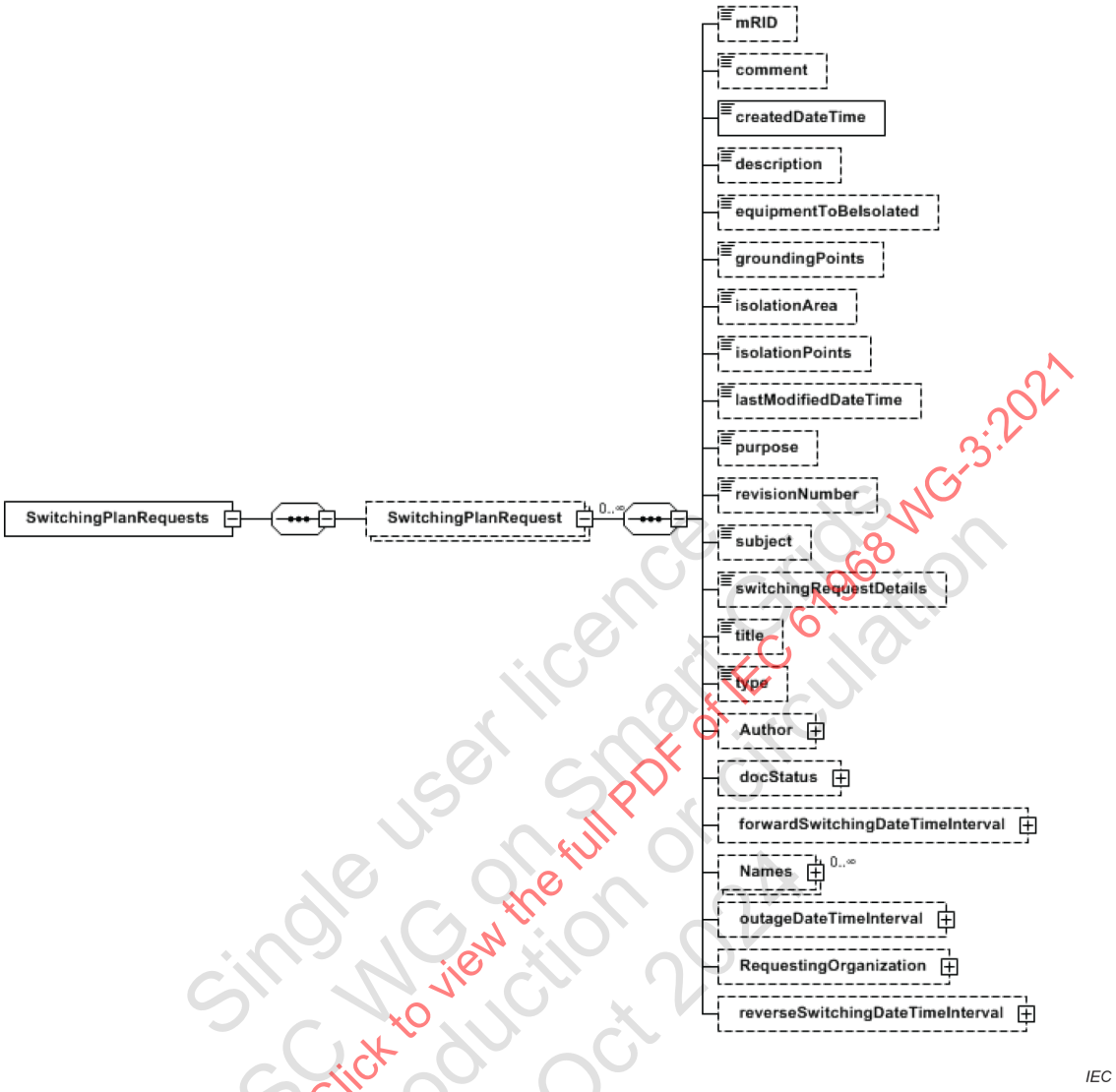

Figure 26 – SwitchingPlanRequests payload (Part 1)

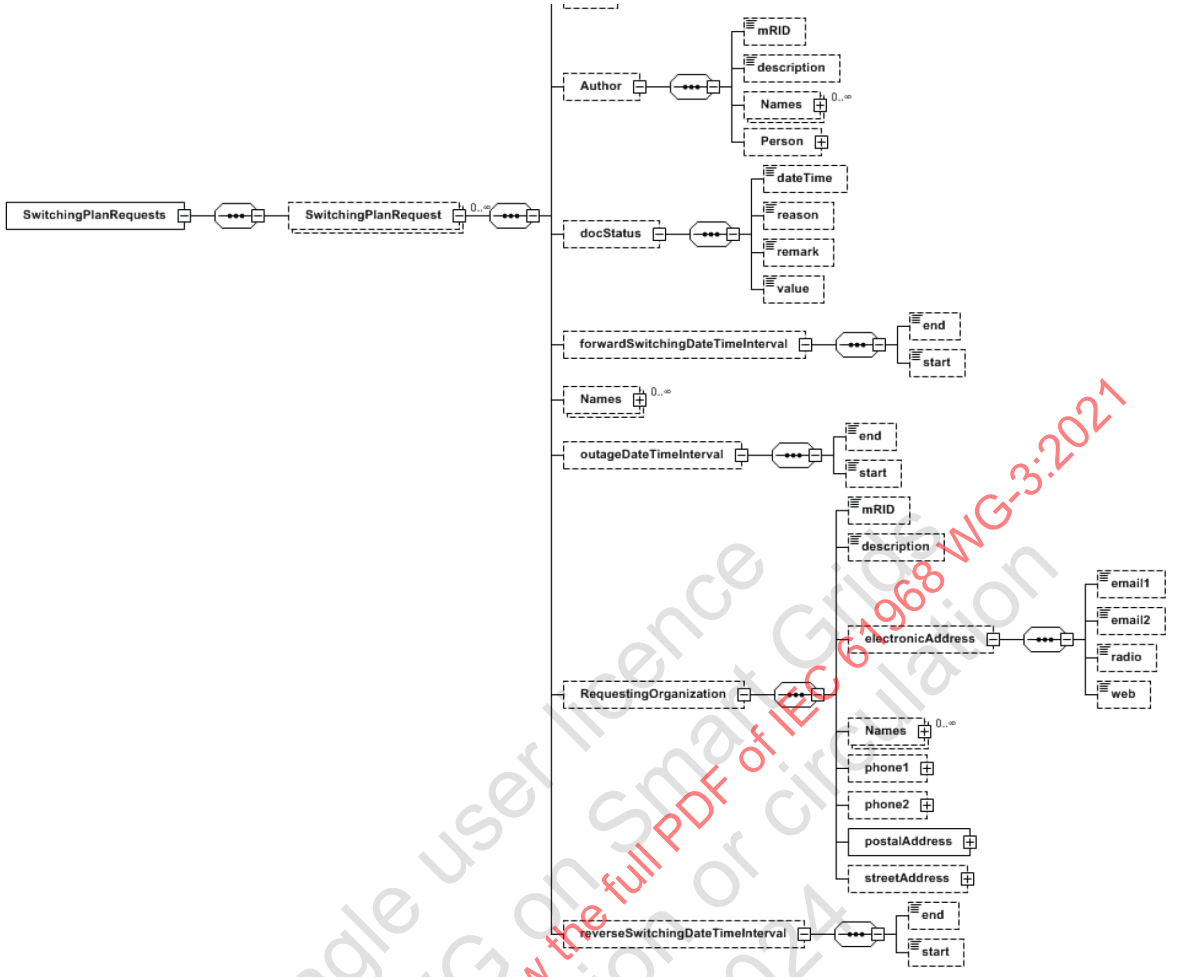

Figure 27 – SwitchingPlanRequests payload (Part 2)

5.6.3 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:SwitchingPlanRequests xmlns:m="http://iec.ch/TC57/2018/SwitchingPlanRequests#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/SwitchingPlanRequests# SwitchingPlanRequests.xsd
">
  <m:SwitchingPlanRequest>
    <m:mRID>2050a0b-0422-4184-8cfe-b9fdfc433509</m:mRID>
    <m:comment>Line extension on 13 kV line at Bonkers Creek</m:comment>
    <m:createdDateTime>2019-04-01T12:12:12</m:createdDateTime>
    <m:description>Isolate line section between Cotter's Grove Lane and Snarly Brook
Street</m:description>
    <m:equipmentToBeIsolated> Switch SW-13423, Recloser R-4267</m:equipmentToBeIsolated>
    <m:groundingPoints>Ground switches GS-73456, GS-76721, manual grounds at SW-13423, R-
4267</m:groundingPoints>
    <m:isolationArea>Area bounded by SW-12113 to the North and SW-13211 to the
South</m:isolationArea>
    <m:isolationPoints> SW-12113, SW-13211</m:isolationPoints>
    <m:lastModifiedDateTime>2019-04-13T12:12:12</m:lastModifiedDateTime>
    <m:purpose>New construction</m:purpose>
    <m:revisionNumber>A</m:revisionNumber>
    <m:subject>Switching Plan Request</m:subject>
    <m:switchingRequestDetails> Capital expenditure project #14122-
A</m:switchingRequestDetails>
    <m:title>Substation: Lizard Lick; Feeder: 321</m:title>
    <m:type>Construction</m:type>
    <m:Author>
      <m:Person>
        <m:firstName>Mick</m:firstName>
        <m:lastName>Jagger</m:lastName>
        <m:electronicAddress>
          <m:email1>mickj@abc-utility.com</m:email1>
```

```
        </m:electronicAddress>
        <m:mobilePhone>
          <m:areaCode>919</m:areaCode>
          <m:cityCode>555</m:cityCode>
          <m:localNumber>1212</m:localNumber>
        </m:mobilePhone>
      </m:Person>
    </m:Author>
    <m:docStatus>
      <m:dateTime>2019-04-01T12:12:12</m:dateTime>
      <m:remark>Created</m:remark>
      <m:value>New</m:value>
    </m:docStatus>
    <m:forwardSwitchingDateTimeInterval>
      <m:end>2019-05-01T09:00:00</m:end>
      <m:start>2019-05-01T08:00:00</m:start>
    </m:forwardSwitchingDateTimeInterval>
    <m:Names>
      <m:name>Switching Request 2019-04-142</m:name>
    </m:Names>
    <m:outageDateTimeInterval>
      <m:end>2019-05-01T10:30:00</m:end>
      <m:start>2012-12-13T09:45:00</m:start>
    </m:outageDateTimeInterval>
    <m:RequestingOrganization>
      <m:electronicAddress>
        <m:email1>maint@abc-utility.com</m:email1>
      </m:electronicAddress>
      <m:Names>
        <m:name>Maintenance and Construction</m:name>
      </m:Names>
      <m:phone1>
        <m:areaCode>919</m:areaCode>
        <m:cityCode>555</m:cityCode>
        <m:localNumber>1234</m:localNumber>
      </m:phone1>
    </m:RequestingOrganization>
    <m:reverseSwitchingDateTimeInterval>
      <m:end>2019-05-01T12:00:00</m:end>
      <m:start>2019-05-01T11:30:00</m:start>
    </m:reverseSwitchingDateTimeInterval>
  </m:SwitchingPlanRequest>
</m:SwitchingPlanRequests>
```


5.7 SwitchingPlan Definition and Execution

The actual operational steps for a **SwitchingPlan** are defined using the **SwitchingPlans** profile. Operational steps can comprise different **SwitchingActions** that determine what operation is to be performed and on what network component. At the time that the **SwitchingPlan** is executed, different profiles are used to coordinate the execution between the control room, field crews and SCADA. It is possible for a **SwitchingPlan** to consist solely of operational steps that are performed by a field crew or solely operational steps that are performed automatically via SCADA, or a combination of the two.

Table 11 shows which actions are coordinated with which messages. With the exception of the SCADA enabled **MeasurementAction**, all interactions follow the consequential event pattern defined in IEC 61968-100. The SCADA enabled **MeasurementAction** follows the request/response pattern defined in IEC 61968-100. The first column shows what action is defined in the **SwitchingPlans** profile as a **SwitchingPlanStep**. The second column shows which action and profile is used to send a request to a field crew or SCADA to execute a **SwitchingPlanStep**. The third column shows what action and profile is used to confirm that the step has been executed.

Table 11 – Messages used to coordinate different types of SwitchingSteps

Action defined in SwitchingPlan	Instruction to execute	Confirmation of execute
ClearanceAction	**SwitchingAction - ClearanceAction** sent to field crew	**SwitchingEvent - ClearanceAction** received from field crew
ControlAction (manual, no telemetry)	**SwitchingAction** – **ControlAction** sent to field crew	**SwitchingEvent** – **ControlAction** received from field crew
ControlAction (automatic via SCADA, if there is telemetry)	**PSRControls** sent to SCADA	**PSRMeasurements** received from SCADA
CutAction	**SwitchingAction** – **CutAction** sent to field crew	**SwitchingEvent** – **CutAction** received from field crew
EnergySourceAction	**SwitchingAction - EnergySourceAction** sent to field crew	**SwitchingEvent - EnergySourceAction** received from field crew
GenericAction	**SwitchingAction - GenericAction** sent to field crew	**SwitchingEvent - GenericAction** received from field crew
GroundAction	**SwitchingAction - GroundAction** sent to field crew	**SwitchingEvent - GroundAction** received from field crew
JumperAction	**SwitchingAction - JumperAction** sent to field crew	**SwitchingEvent - JumperAction** received from field crew
MeasurementAction (manual, no telemetry)	**SwitchingAction - MeasurementAction** sent to field crew	**SwitchingEvent** – **MeasurementAction** received from field crew
MeasurementAction (automatic via SCADA, if there is telemetry)	**GetPSRMeasurements** sent to SCADA	**PSRMeasurements** received from SCADA
SwitchAction	**SwitchingAction - SwitchAction** sent to field crew	**SwitchingEvent - SwitchAction** received from field crew
TagAction	**SwitchingAction** – **TagAction** sent to field crew	**SwitchingEvent** – **TagAction** received from field crew
VerificationAction	**SwitchingAction - VerificationAction** sent to field crew	**SwitchingEvent - VerificationAction** received from field crew

5.8 SwitchingPlans payload

5.8.1 General

SwitchingPlans message payloads are designed to communicate a set of **SwitchingActions** that form a sequence of operations to manage a complete operational task. **SwitchingPlans** payloads define the sequence of steps that will be executed, while other messages are used to coordinate the execution of the **SwitchingPlan**. Figure 25 is a sequence diagram that illustrates the instantiation of a **SwitchingPlan** in the context of planned maintenance, while Figure 28 shows the communication of **SwitchingPlans** to field crews. **SwitchingPlans** may also be created in order to perform emergency switching.

Additional use cases include:

- Fault Management proposes one or more switching plans as alternative solutions for fault or work area isolations and/or service restoration.

- Network optimization applications such as Volt/Var control, optimal feeder reconfiguration, etc. propose one or more switching plans as alternative solutions to optimize the entire distribution grid or selected parts of the distribution grid.
- A request to generate a switching plan may be result of a user interaction or issued from an application as part of a complete workflow like fault location, isolation and restoration.

A switching plan may include non-network actions such as placement or removal of tags, placement or removal of temporary elements, or general instructions to a field crew or operator.

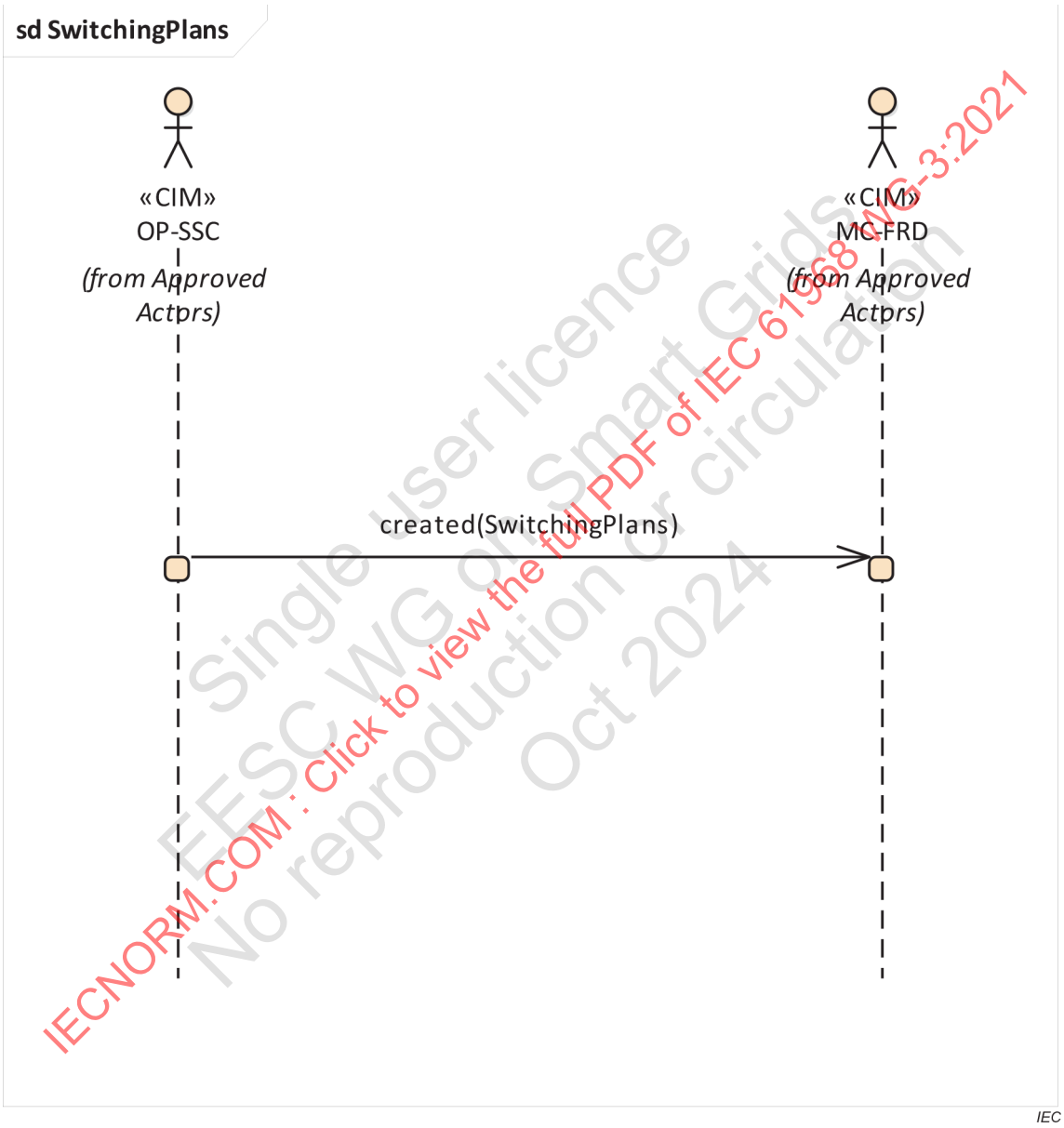

Figure 28 – SwitchingPlans sequence diagram

5.8.2 Message payload

The attributes of the **SwitchingPlans** profile are described in Table 12.

Table 12 – SwitchingPlans Profile

SwitchingPlans					
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**	**Profiles Used In, in addition to this profile.**
SwitchingPlans	SwitchingPlan	[1..*]			
Profile Attributes					
mRID	String	[0..1]	GUID	mRID of this SwitchingPlan	PlannedOutageNotifications, PlannedOutages, TroubleOrders
description	String	[0..1]		Free-form text field that describes the **SwitchingPlan**	PlannedOutageNotifications, PlannedOutages, TroubleOrders
Names	Name	[0..*]	See B.56	List of human-readable names for the SwitchingPlan	PlannedOutageNotifications, PlannedOutages, TroubleOrders
approvedDateTime	DateTime	[0..1]		DateTime that the SwitchingPlan was approved.	
cancelledDateTime	DateTime	[0..1]		DateTime that the SwitchingPlan was cancelled.	
comment	String	[0..1]		Comments associated with the SwitchingPlan	
createdDateTime	DateTime	[0..1]		DateTime that the SwitchingPlan was initially created.	
lastModifiedDateTime	DateTime	[0..1]		DateTime that the SwitchingPlan was last changed.	
purpose	String	[0..1]		The purpose of the switching plan	
rank	Integer	[0..1]		Priority of this SwitchingPlan relative to other SwitchingPlans	
revisionNumber	String	[0..1]		Revision number of the **SwitchingPlan**. Typically this would be used to track changes after the SwitchingPlan has been approved, but it could also be used to track changes during the development and review cycle.	
title	String	[0..1]		Title of the SwitchingPlan	

SwitchingPlans					
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**	**Profiles Used In, in addition to this profile.**
type	String	[0..1]		Type of the SwitchingPlan	
Approver	Approver	[0..1]	See B.8	Person who approved the **SwitchingPlan**	
Author	Author	[0..1]	See B.13	Person who wrote the SwitchingPlan	
docStatus	Status	[0..1]	See B.79	docStatus.value is used to specify the overall status of the SwitchingPlan document, such as draft, in review, approved, cancelled, etc.	
plannedPeriod	DateTimeInterval	[0..1]		Planned start and end dates for the SwitchingPlan	
SafetyDocuments	SafetyDocument	[0..*]	See B.75	List of SafetyDocuments associated with the SwitchingPlan.	
SwitchingPlanRequest	SwitchingPlanRequest	[0..1]	See 5.7	Reference to the SwitchingPlanRequest that resulted in the creation of this SwitchingPlan, identified by its mRID, description and Names. The SwitchingPlanRequest contains more detailed information about the SwitchingPlan, including where it originated and its purpose.	
SwitchingStepGroups	SwitchingStepGroup	[0..1]	See 5.8.3	Detailed instructions on what switching is to be performed.	

Since the **SwitchingPlans** message is large, the payload description is broken up into a series of subclauses in this document in order to assist the reader's understanding of the payload.

This message payload, shown at its highest level in the diagrams in Figure 29, Figure 30 and Figure 31, can be used for exchanging 0 to many **SwitchingPlans**.

Figure 29 shows the high level part of a **SwitchingPlan.**

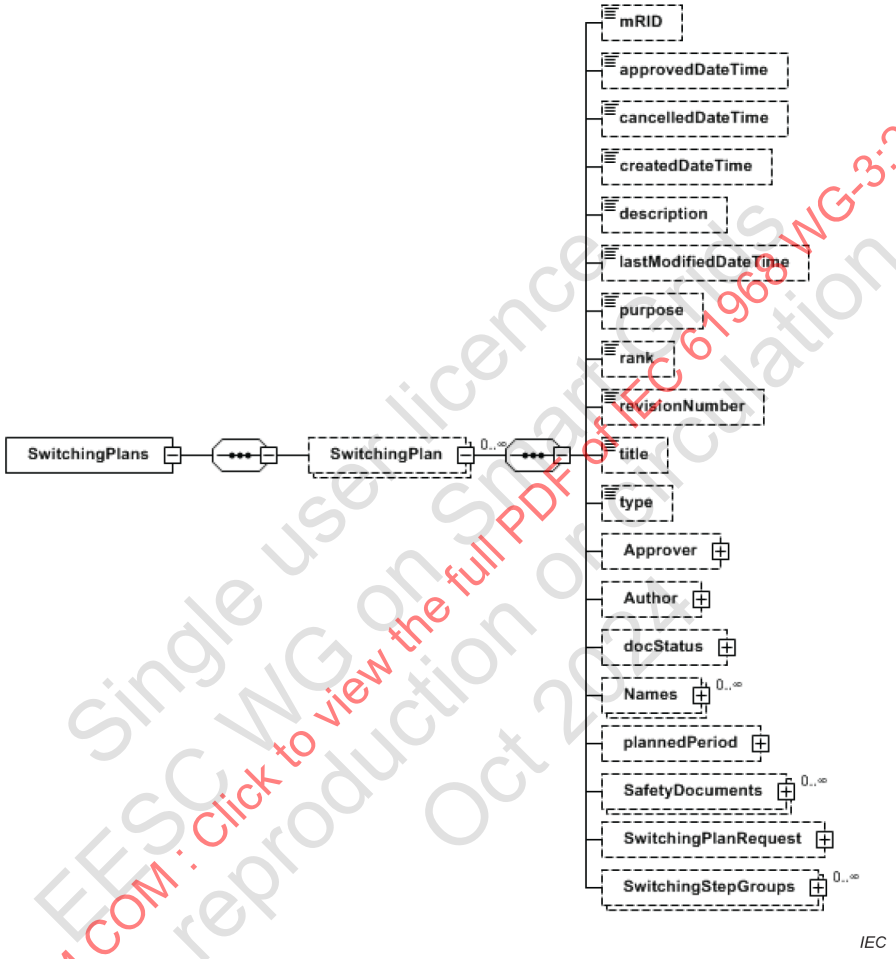

Figure 29 – SwitchingPlans message payload top level

Figure 30 shows an optional set of **SafetyDocument**s that are associated with managing the safety aspects of the **SwitchingPlan**. **SafetyDocument**s are used to track handoffs between different parties to ensure safe operation of the electric network. At the **SwitchingPlan** level, **SafetyDocuments** are used to control access to a part of the network. **SafteyDocument**s may also appear as specific steps in a **SwitchingPlan**, where they are referred to as **ClearanceAction**s.

It is possible to have a **SwitchingPlan** that has no switching steps but has one or more **SafetyDocuments**. Examples of this include safety documents to allow access to a substation or to allow access to customer equipment where no switching is involved.

The attributes of the **SafetyDocument** payload fragment are described in Subclause B.75.

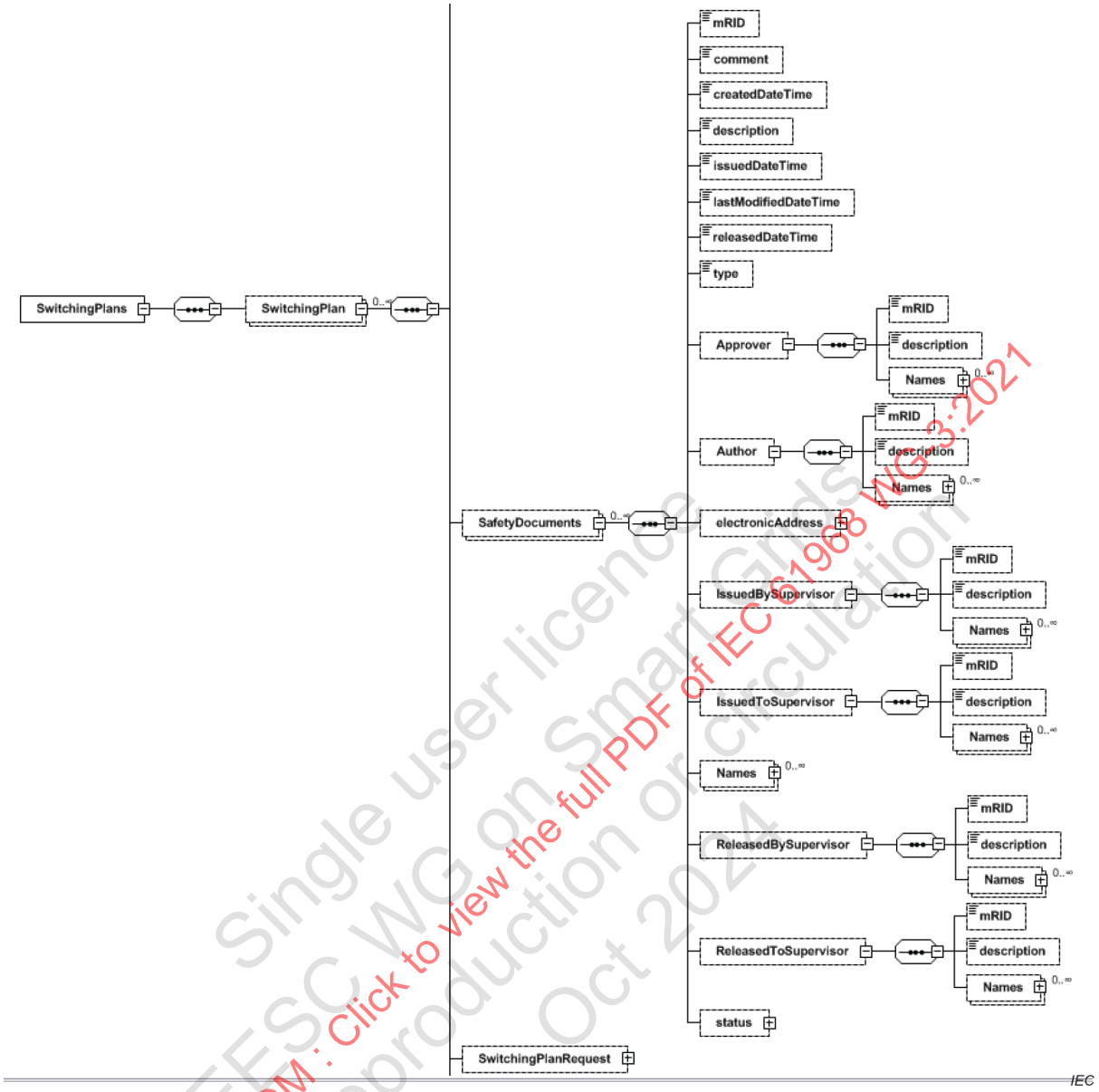

Figure 30 – SwitchingPlans message – SafetyDocuments payload fragment

5.8.3 SwitchingPlans payload – SwitchingStepGroups fragment

The attributes of **SwitchingStepGroups** that are used in this profile are shown in Table 13. As shown in Figure 31, each **SwitchingPlan** may include 0 to many **SwitchingStepGroups**. **SwitchingStepGroups** are used to define the sequence (order) for groups of actions. See also Subclause 5.8.5 for further information on the order of execution.

Table 13 – SwitchingPlans – SwitchingStepGroups payload fragment

Operations: SwitchingStepGroup				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
purpose	String	[0..1]		Comments or free-form instructions
description	String	[0..1]		Comments or free-form instructions
sequenceNumber	Integer	[0..1]		Defines the order in which step groups appear in the **SwitchingPlan** and, in conjunction with isFreeSequence, defines the sequence in which step groups are to be executed in the **SwitchingPlan.** See Subclause 5.8.5 for further details. The first **SwitchingStepGroup** in a given SwitchingPlan has a sequenceNumber of 1. Successsive **sequenceNumbers** increment by 1.
isFreeSequence	Boolean	[0..1]		See Subclause 5.8.5 for further details regarding isFreeSequence and the order in which SwitchingStepGroups and SwitchingSteps may be executed.
SwitchingStep	SwitchingStep	[0..*]	See 5.8.4	

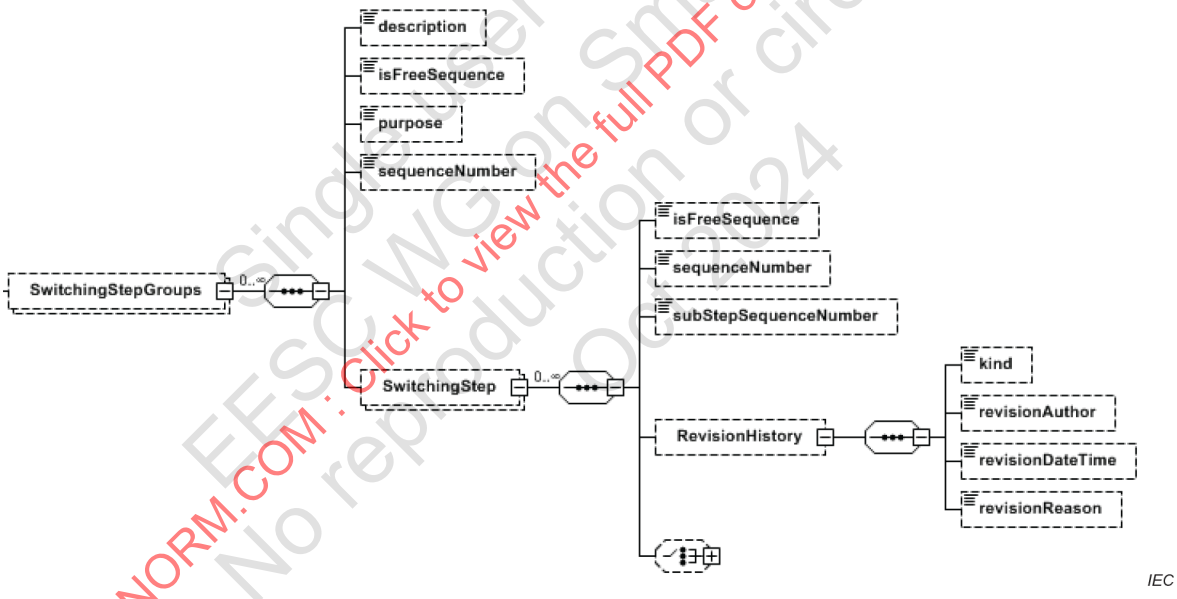

Figure 31 – SwitchingPlans message payload – SwitchingStepGroups

5.8.4 SwitchingPlans payload – SwitchingStep fragment

The attributes of **SwitchingStep** that are used in this profile are shown in Table 14.

Table 14 – SwitchingPlans – SwitchingStep payload fragment

Operations: SwitchingStep				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
sequenceNumber	Integer	[0..1]		Determines the execution sequence within the SwitchingStep. The first **SwitchingStep** in a given **SwitchingPlan** has a **sequenceNumber** of 1. Successsive **sequenceNumbers** increment by 1, regardless of which **SwitchingStepGroup** the **SwitchingStep** appears in.
isFreeSequence	Boolean	[0..1]		See subclause 5.8.5 for further details regarding **isFreeSequence** and the order in which **SwitchingStepGroups** and **SwitchingSteps** may be executed.
RevisionHistory	RevisionHistory	[0..1]	See B.74	The revision history of the step. Used to indicate whether the step has been added or deleted (voided) from the plan after it has been approved,
subStepSequenceNumber	Integer	[0..1]		Allows a second level of steps to be defined for each SwitchingStep. **subStepSequenceNumber**s always start numbering at 1 within a given SwitchingStep. Sub steps are uniquely identified by their **SwitchingStep sequenceNumber** and their **subStepSequenceNumber**. Substeps that have been inserted after the switching plan has been approved will have a **RevisionHistory**.
		[1..1]		Choice of one action as shown below
Actions				
ClampAction	ClampAction		See 5.8.6	
ClearanceAction	ClearanceAction		See 5.8.7	
ControlAction	ControlAction		See 5.8.8	
CutAction	CutAction		See 5.8.9	
EnergyConsumerAction	EnergyConsumerAction		See 5.8.10	
EnergySourceAction	EnergySourceAction		See 5.8.11	
GenericAction	GenericAction		See 5.8.12	
GroundAction	GroundAction		See 5.8.13	
JumperAction	JumperAction		See 5.8.14	
MeasurementAction	MeasurementAction		See 5.8.15	
ShuntCompensatorAction	ShuntCompensatorAction		See 5.8.16	
SwitchAction	SwitchAction		See 5.8.17	
TagAction	TagAction		See 5.8.18	
VerificationAction	VerificationAction		See 5.8.19	

This allows a switching plan to be constructed of any combination of action steps as well as comment or header steps. It also allows a complex step to be defined as a combination of action steps. For example, a complex step could consist of a single numbered step to 'open and place do not operate tag'. This would be represented as a **SwitchingStep** with a **SwitchAction** (**subStepSequenceNumber** = 1) and a **TagAction** (**subStepSequenceNumber** = 2). Sub steps must be executed in strict **subStepSequenceNumber** order.

Each **SwitchingStep** consists of a choice of actions, as shown in Figure 32.

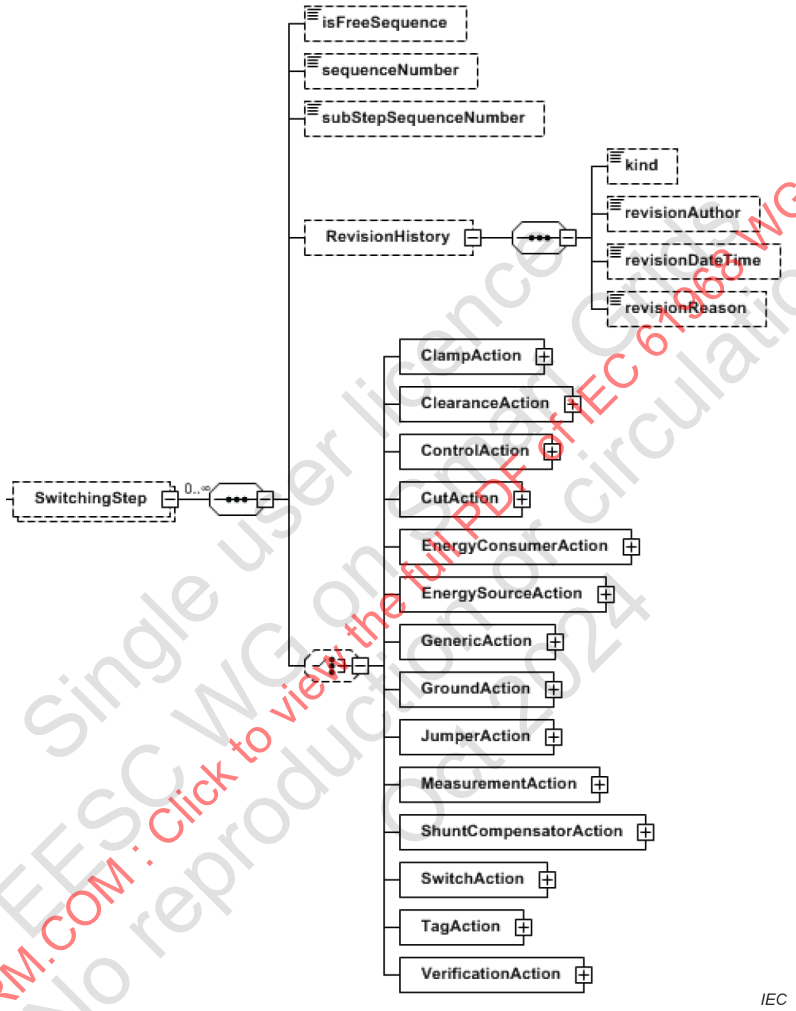

Figure 32 – SwitchingStep actions

5.8.5 Specifying Order of Step Execution

It is possible to define the order of execution of both **SwitchingStepGroup**s and **SwitchingStep**s within a **SwitchingStepGroup**. Both the **SwitchingStepGroup** and the **SwitchingStep**s have a Boolean attribute, **isFreeSequence**.

For a step, if **isFreeSequence** is set to false or is not specified, all of the steps in the group must be executed in the order defined by the **sequenceNumber** attribute. The **sequenceNumber** for a step has a different meaning when there are two or more sequential steps that have the **isFreeSequence** attribute set to true. Execution must still be performed in **sequenceNumber** order until a set of two or more steps that have **isFreeSequence** set to true is encountered. In this case, these steps can be executed in any sequence, until a step is encountered that has **isFreeSequence** set to false. All of the steps preceding this step must be executed before the step can be executed.

An example is shown in Table 15. If **isFreeSequence** were set to false for all of the steps, the steps would have to be executed in order of **sequenceNumber**, starting at 1. However, it is set to true for steps 4, 5 and 6. The modified sequence is therefore to start at step 1, followed by step 2 and step 3. Steps 4, 5 and 6 can be executed in any order but must all be executed before step 7 can be executed.

Table 15 – Example of Switching Step Execution Order

Step	Attributes	Comments
SwitchingStep 1	sequenceNumber: 1 isFreeSequence: false	Must be executed first
SwitchingStep 2	sequenceNumber: 2 isFreeSequence: false	Must be executed after step 1.
SwitchingStep 3	sequenceNumber: 3 isFreeSequence: false	Must be executed after step 2
SwitchingStep 4	sequenceNumber: 4 isFreeSequence: true	Can be executed any time after step 3 has been executed.
SwitchingStep 5	sequenceNumber: 5 isFreeSequence: true	Can be executed any time after step 3 has been executed.
SwitchingStep 6	sequenceNumber: 6 isFreeSequence: true	Can be executed any time after step 3 has been executed.
SwitchingStep 7	sequenceNumber: 7 isFreeSequence: false	Can only be executed after steps 4, 5 and 6 have been executed.

Similar logic applies to a **SwitchingStepGroup**.

If a **SwitchingStep** has sub steps, all sub steps within a step must be executed in the order defined by **subStepSequenceNumber**.

Figure 33 is an example and shows steps that must be run sequentially and switching step groups that can be run in parallel. In the example, **SwitchingStepGroup** 1 must be run before Group 2, Group 3 and Group 4. Once Group 1 has been executed, Groups 2 and 3 can be executed in parallel or in any order. Group 4 cannot be executed until Groups 2 and 3 have been executed.

Also shown is that steps within Groups 1, 2 and 4 must be executed in sequence within their group, while steps 5 and 6 within Group 3 can be executed in any sequence. Step 7 in Group 3 must be executed after steps 5 and 6.

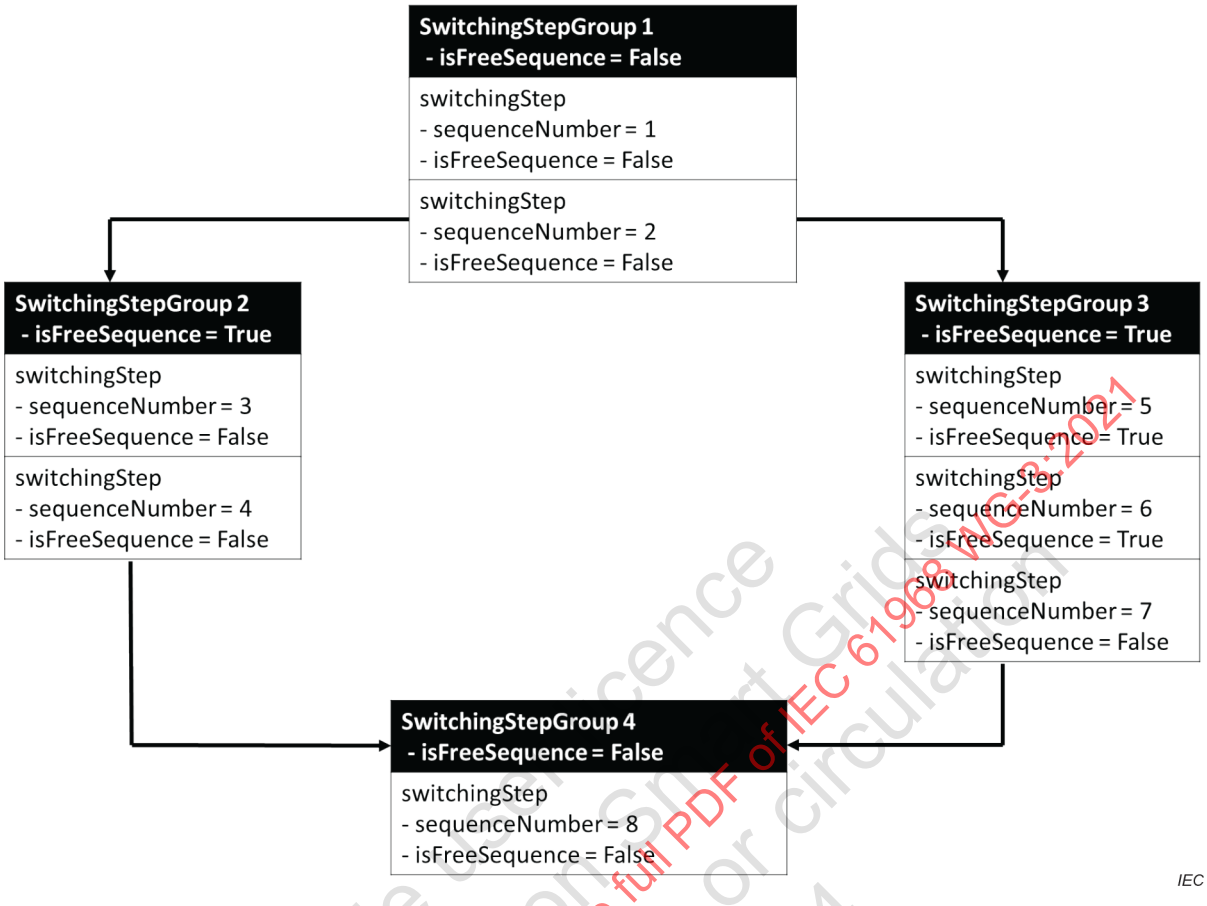

Figure 33 – SwitchingStepGroup and SwitchingStep Execution Order

5.8.6 SwitchingPlans payload – ClampAction

The **ClampAction** part of a **SwitchingPlan** is shown in Figure 34.

A **ClampAction** is a kind of step in a **SwitchingPlan** that involves placing a temporary **Clamp** on a conductor (**ACLineSegment**).

A **Clamp** is a galvanic connection at a line segment where other equipment is connected. A **Clamp** does not cut the line segment. A **Clamp** is **ConductingEquipment** and has one **Terminal** which is associated with a **ConnectivityNode**. A terminal of any other **ConductingEquipment** can be associated with the same **ConnectivityNode**.

Clamps are typically used to connect **jumpers** to an **ACLineSegment** in the case where the **jumper** is to be connected part way along an **ACLineSegment**. If the **jumper** is to be connected at either end of an **ACLineSegment**, then a **clamp** is not required.

The attributes of **ClampAction** that are used in this profile are shown in Table 16.

Table 16 – ClampAction payload fragment for SwitchingPlans

Operations: ClampAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	**mRID of the ClampAction**
description	String	[0..1]		**Free form description**
Names	Name	[0..*]	See Annex B.56	Names for the ClampAction
kind	TempEquipActionKind	[0..1]	See Annex C.22	Determines whether the clamp is placed or removed. Enumeration with possible values place, remove.
Clamp	Clamp	[0..1]	See Annex B.14	Defines the actual clamp that is to be placed or removed.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See Annex B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See Annex B.59	This will be blank until the action is sent to the crew..

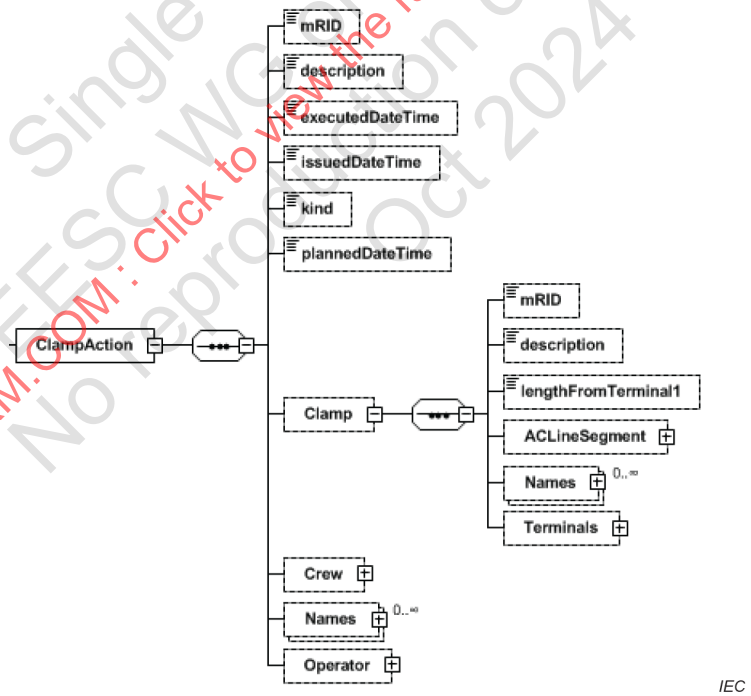

Figure 34 – SwitchingPlans – ClampAction

5.8.7 SwitchingPlans payload – ClearanceAction

The **ClearanceAction** part of a **SwitchingPlan** is shown in Figure 35.

A **ClearanceAction** is a kind of step in a **SwitchingPlan** that involves the transfer of control of a defined part of the electrical network after that part of the network is declared safe for field personnel to work.

The **ClearanceAction** can be used in a **SwitchingPlan** to define the transfer of control between a control room and field personnel when field work is ready to start. This is accomplished by defining a **ClearanceAction** with a **ClearanceAction.kind** of **issue**.

Control is passed back from the field to a control room after the field work is complete. This is accomplished by defining a **ClearanceAction** in the **SwitchingPlan** with a **ClearanceAction.kind** of **release**.

A **ClearanceAction.kind** of **update** in a **SwitchingPlan** can be used to change the list of **TaggedPSRs** when the **SwitchingPlan** requires the clearance scope to be expanded or contracted, or other attributes related to responsibilities.

The fields for a **ClearanceAction** are shown in Figure 35.

The attributes of **ClearanceAction** that are used in this profile are shown in Table 17.

Table 17 – ClearanceAction payload fragment for SwitchingPlans

Operations: ClearanceAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the ClearanceAction
description	String	[0..1]		Free form description of the ClearanceAction
Names	Name	[0..*]	See B.56	Human-readble names for the ClearanceAction
kind	ClearanceActionKind	[0..1]	See C.4	Whether to issue, update or release the Clearance.
Clearance	Clearance	[0..1]	See B.16	Defines the actual Clearance to be issued, updated or released.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

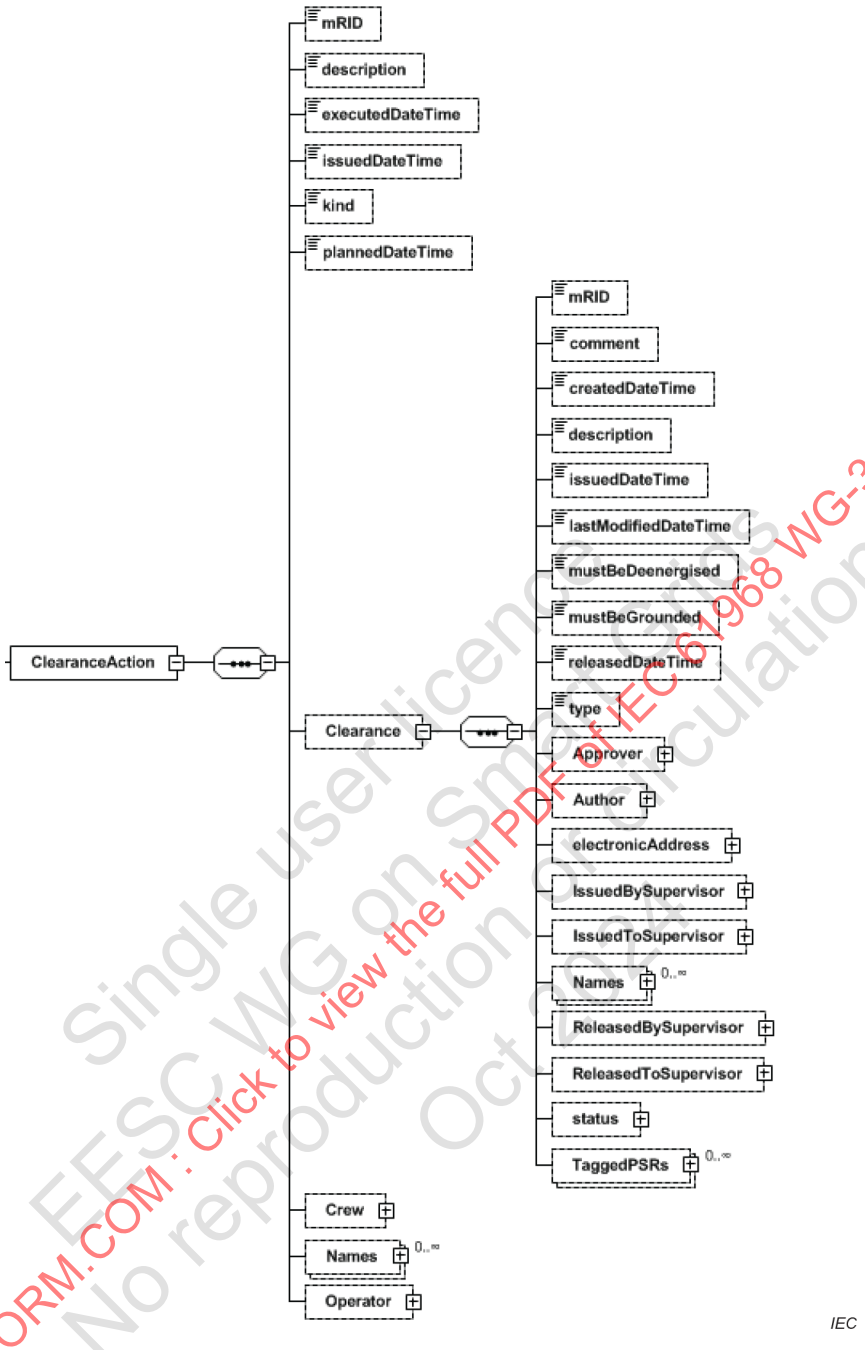

Figure 35 – SwitchingPlans – ClearanceAction

5.8.8 SwitchingPlans Payload – ControlAction

The **ControlAction** part of the **SwitchingPlans** payload is shown in Figure 36. The fields that are unique to a **ControlAction** are a choice of different types of control actions:

- **AccumulatorReset** – see Subclause 5.5.3
- **AnalogControl** – see Subclause 5.5.3.2
- **Command** – see Subclause 5.5.4.2
- **RaiseLowerCommand** – see Subclause 5.5.5.2
- **SetPoint** – see Subclause 5.5.6.2

A **ControlAction** is a **SwitchingPlan** step to change the state of equipment in the field. This may be accomplished either through a **SwitchingActions** message (manual) or a PSRControls message (automated). See 5.7 for further details.

The attributes of **ControlAction** that are used in this profile are shown in Table 18.

Table 18 – ControlAction payload fragment for SwitchingPlans

Operations: ControlAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of this ControlAction.
description	String	[0..1]		Free-form description of this ControlAction
Names	Name	[0..*]	See B.56	Human-readable names for this ControlAction
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See Annex B.59	This will be blank until the action is sent to the crew.
Choice of Controls		[1..1]		
Choice of one of the following				
AccumulatorReset	AccumulatorReset		See 5.6.4	
AnalogControl	AnalogControl		See 5.6.5	
Command	Command		See 5.6.6	
RaiseLowerCommand	RaiseLowerCommand		See 5.6.7	
SetPoint	SetPoint		See 5.6.8	

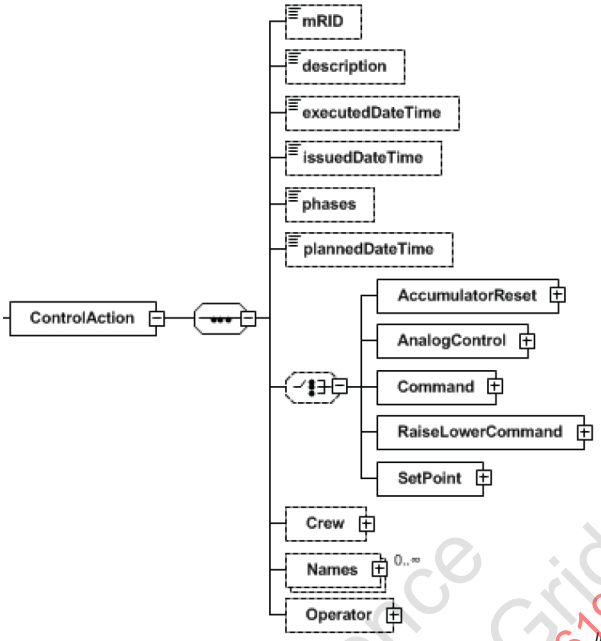

Figure 36 – SwitchingPlans – ControlAction

The **ControlAction** is required to be part of the **SwitchingPlan** so that manual control actions can be captured as part of the **SwitchingPlan**. A 'manual control' action is a request for the field crew to perform control actions using the local controls of a field device, such as changing a setpoint or changing a voltage regulator tap position. During execution of the SwitchingPlan, requests to the field crew are issued using a **SwitchingAction**.**ControlAction** and results are returned from the field with a **SwitchingEvent**.**ControlAction**.

If there is remote control capability available then the **SwitchingPlan** still defines a step of type **ControlAction**. However, during execution of the **SwitchingPlan**, requests for controls are sent to SCADA. Remote **ControlActions** are performed using **PSRControls** and **PSRMeasurements** as shown in the sequence diagram in Figure 19 and as described in Subclause 5.7.

5.8.9 SwitchingPlans Payload – CutAction

A **CutAction** is used to specify a switching step to add or remove a **Cut** to/from a conductor (**ACLineSegment**).

The **CutAction** part of the **SwitchingPlans** payload is shown in Figure 37.

The attributes of **CutAction** that are used in this profile are shown in Table 19. The **Cut** payload contents are described in B.18.

Table 19 – CutAction payload fragment for SwitchingPlans

Operations: CutAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of this CutAction.
description	String	[0..1]		Free-form description of this CutAction
Names	Name	[0..*]	See B.56	Human-readable names for this CutAction
kind	TempEquipActionKind	[0..1]	See C.20	Indicates whether the cut should be placed or removed.
Cut	Cut	[0..1]	See B.18	The cut that is to be placed or removed.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field.
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

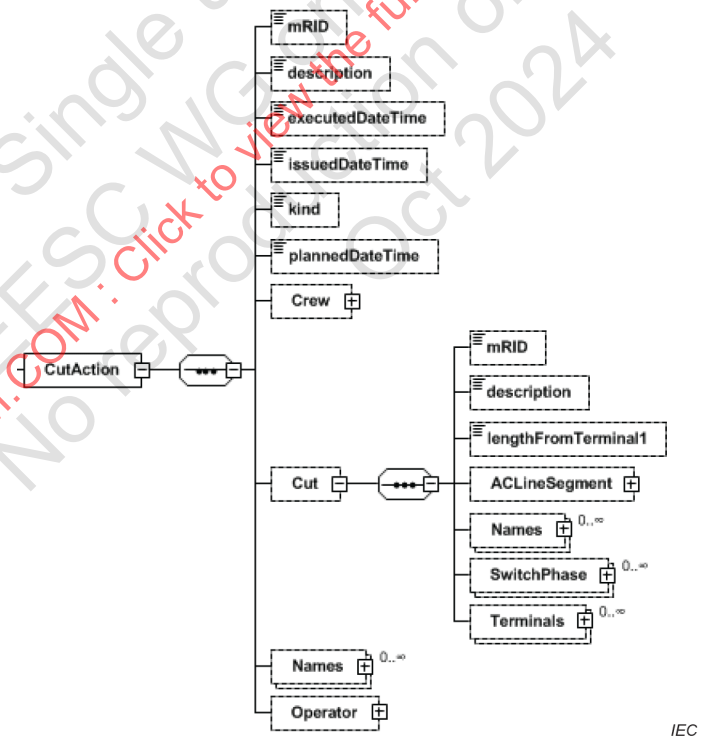

Figure 37 – SwitchingPlans – CutAction

A full description of a **Cut** and an example is given in IEC 61970-301.

5.8.10 SwitchingPlans payload – EnergyConsumerAction

The **EnergyConsumerAction** of the **SwitchingPlans** payload is shown in Figure 38.

An **EnergyConsumerAction** is used to specify a switching step to temporarily disconnect or connect a permanent **EnergyConsumer** from its terminals. **TempEquipAction.kind** defines whether to disconnect or connect the **EnergyConsumer** and can have values of **disconnect** or **connect**.

The attributes of **EnergyConsumerAction** that are used in this profile are shown in Table 20.

Table 20 – EnergyConsumerAction payload fragment for SwitchingPlans

Operations: EnergyConsumerAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the EnergyConsumerAction
description	String	[0..1]		Free form description of EnergyConsumerAction
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TempEquipActionKind	[0..1]	See C.20	Defines whether to disconnect or connect the energy consumer.
phases	PhaseCode	[0..1]	See C.12	Phases to perform the action on.
EnergyConsumer	EnergyConsumer	[0..1]	See B.34	EnergyConsumer to disconnect or connect.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew.
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

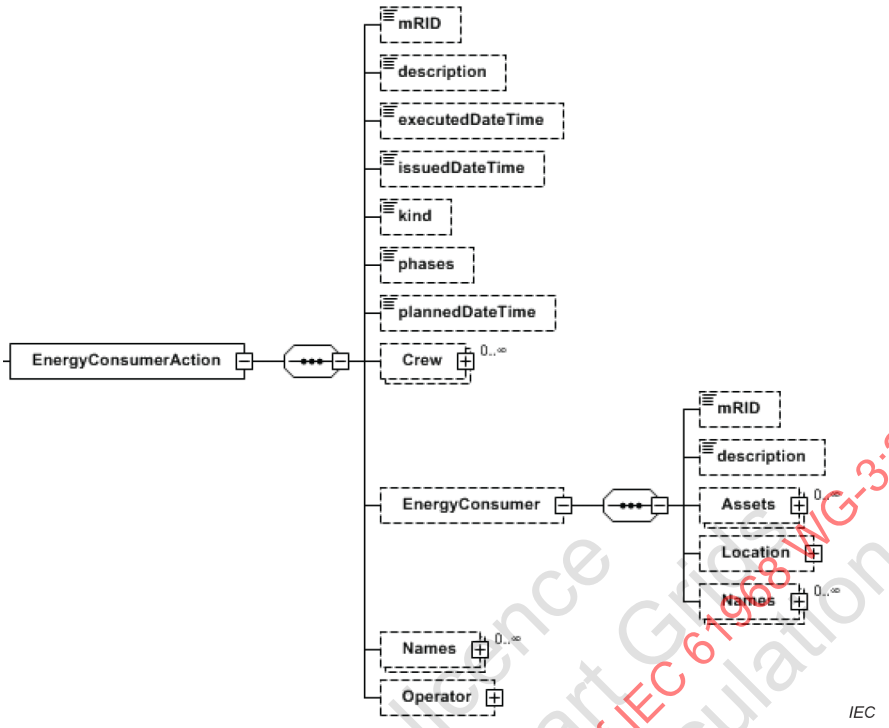

Figure 38 – SwitchingPlans – EnergyConsumerAction

5.8.11 SwitchingPlans payload – EnergySourceAction

The **EnergySourceAction** of the **SwitchingPlans** payload is shown in Figure 39.

An **EnergySourceAction** is used to specify a switching step to add or remove a temporary **EnergySource**. **TempEquipAction.kind** defines whether to add or remove the **EnergySource** and can have values of **place** or **remove**. In addition, an **EnergySourceAction** is used to specify a switching step to temporarily disconnect or connect a permanent **EnergySource** from its terminals. **EnergySourceAction.kind** defines whether to disconnect or connect the **EnergySource** and can have values of **disconnect** or **connect**.

The attributes of **EnergySourceAction** that are used in this profile are shown in Table 21.

Table 21 – EnergySourceAction payload fragment for SwitchingPlans

Operations: EnergySourceAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the EnergySourceAction
description	String	[0..1]		Free form description of EnergySourceAction
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TempEquipActionKind	[0..1]	See C.20	Defines whether to place, remove, disconnect or connect the energy source.
EnergySource	EnergySource	[0..1]	See B.35	EnergySource to place, remove, disconnect or connect
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew.
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

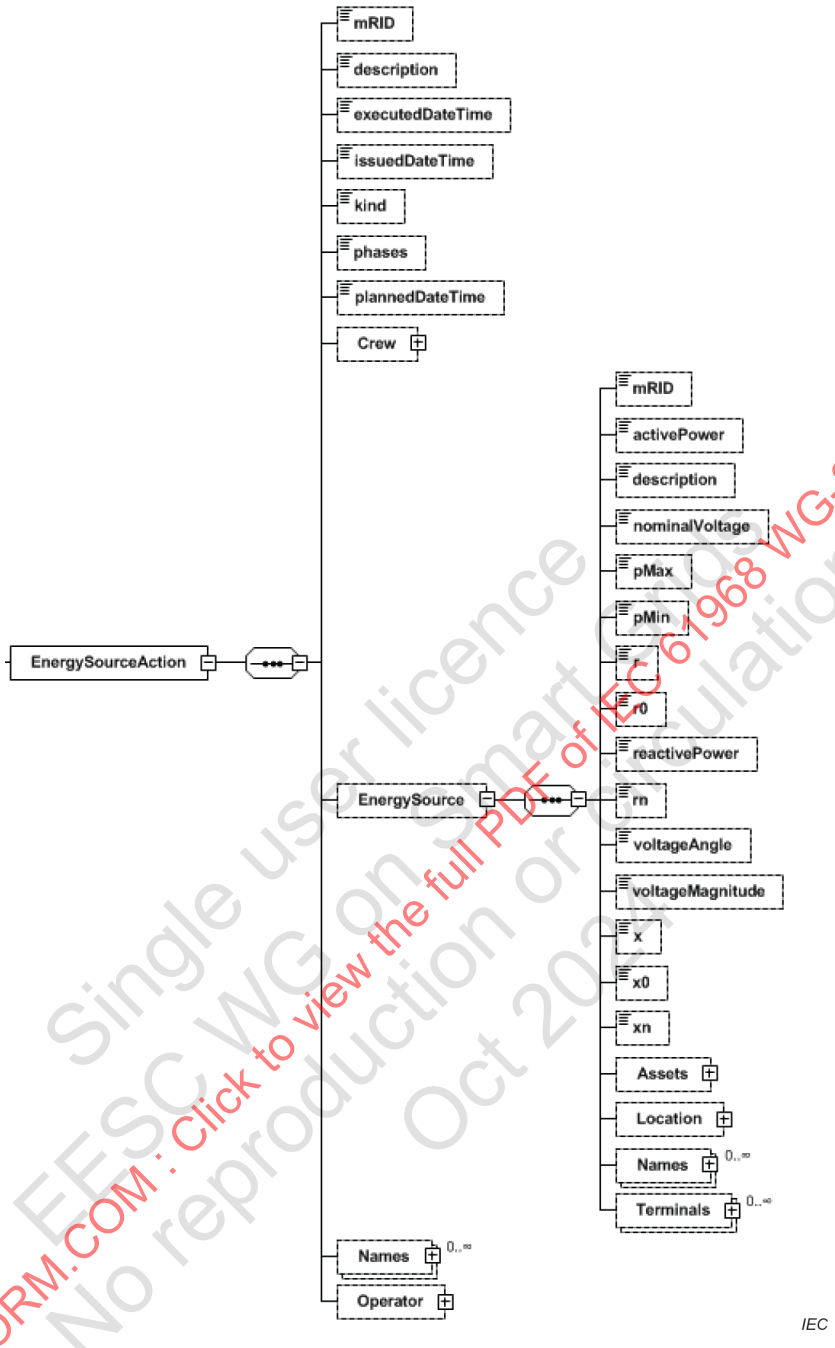

Figure 39 – SwitchingPlans – EnergySourceAction

5.8.12 SwitchingPlans payload – GenericAction

The **GenericAction** part of the **SwitchingPlans** payload is shown in Figure 40.

Generic actions within a **SwitchingPlan** define the set of actions that are performed as a switching step that do not impact the state of the network or to perform an action on a part of the network that is not modelled.

An example of an action that does not impact the state of the network is manually changing the mode of a device (e.g. place in manual when the mode is not remotely controllable) to be recorded as a switching step. In this case, the **description** is used to define the action, e.g. “Place in manual” and the **PowerSystemResource** would define the network component to place in manual.

An example of an action on a part of the network that is not modelled would be operating customer-owned equipment that is operated by the utility but not owned by them. In this case, the **description** is used to define what is to be done, and all parts of the **PowerSystemResource** are blank, other than the **Location**, which is used to define the geographic **Location** of where the action is to be performed.

The attributes of **GenericAction** that are used in this profile are shown in Table 22.

Table 22 – GenericAction payload fragment for SwitchingPlans

Operations: GenericAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of this GenericAction.
description	String	[0..1]		Free-form description of this GenericAction
Names	Name	[0..*]	See B.56	Human-readable names for this GenericAction
phases	PhaseCode	[0..1]	See C.12	Phases to be operated by this action.
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	Defines the PowerSystemResource to perform the GenericAction on.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

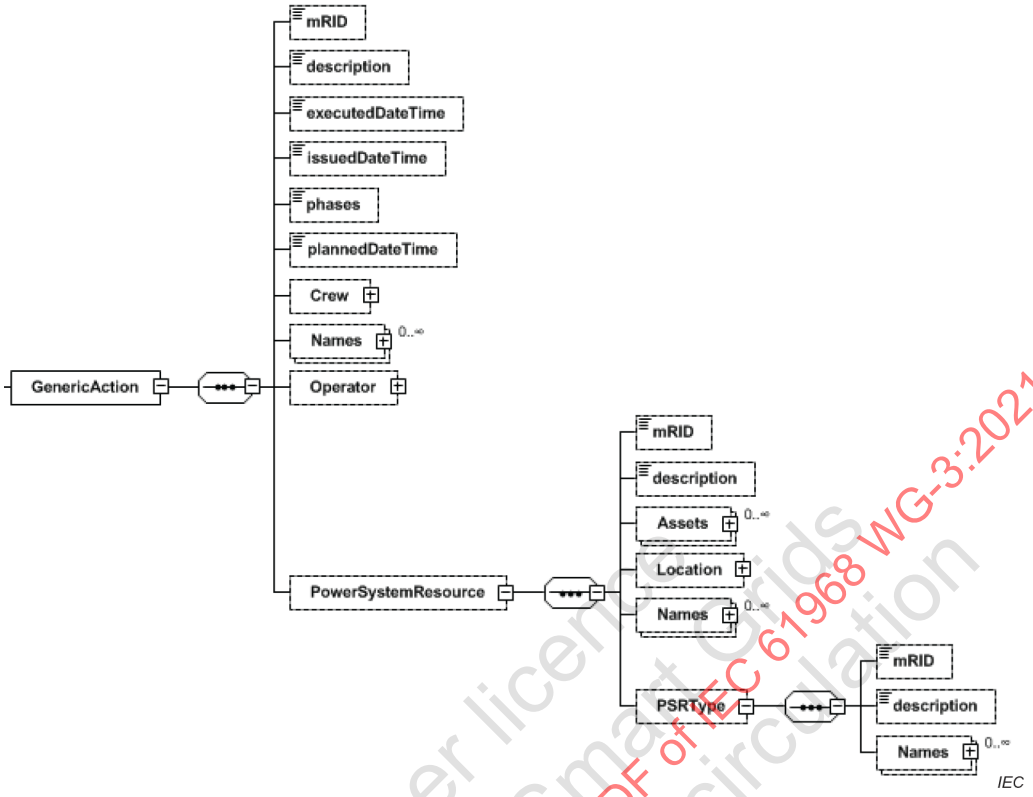

Figure 40 – SwitchingPlans – GenericAction

5.8.13 SwitchingPlans payload – GroundAction

A **GroundAction** is used to specify a switching step to place or remove a **Ground** to/from a conductor or equipment, as defined by **GroundAction.kind**.

A **Ground** is a point where the system is grounded. It is used for connecting conducting equipment to ground. The power system model can have any number of **Ground**s.

The **Ground** may be placed on one of the terminals of an **ACLineSegment** or may be placed on one of the terminals of **ConductingEquipment**. If the **Ground** needs to be placed part way along an **ACLineSegment**, then the **Ground** must be placed on the terminal of a **Clamp**. The **Clamp** must already have been placed. It is important to make sure that the ground is attached to the correct terminal of a component that has more than one terminal. For example, if attaching a ground to an open switch that is energized on one side, the ground should be attached to the terminal that is expected to be de-energized.

If the ground is to be placed on less than all of the available phases, the phase is specified by **Ground.Terminal.phases**. This is shown in Figure 42.

The **GroundAction** part of the **SwitchingPlans** payload is shown in Figure 41.

The attributes of **GroundAction** that are used in this profile are shown in Table 23.

Table 23 – GroundAction payload fragment for SwitchingPlans

Operations: GroundAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID for the GroundAction
description	String	[0..1]		free-form description of the GroundAction
Names	Name	[0..*]	See B.56	Human-readable names for this GroundAction.
kind	TempEquipActionKind	[0..1]	See C.22	Defines the action to be performed, either place the ground or remove the ground
Ground	Ground	[0..1]	See B.44	Ground to place or remove.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.
Choice of one of the following				
ACLineSegment	ACLineSegment		See B.4	Conductor where the ground is to be placed.
Clamp	Clamp		See B.14	Clamp where the ground is to be placed, if the ground is to be placed part way along a conductor
ConductingEquipment	ConductingEquipment		See B.14	ConductingEquipment where the ground is to be placed.

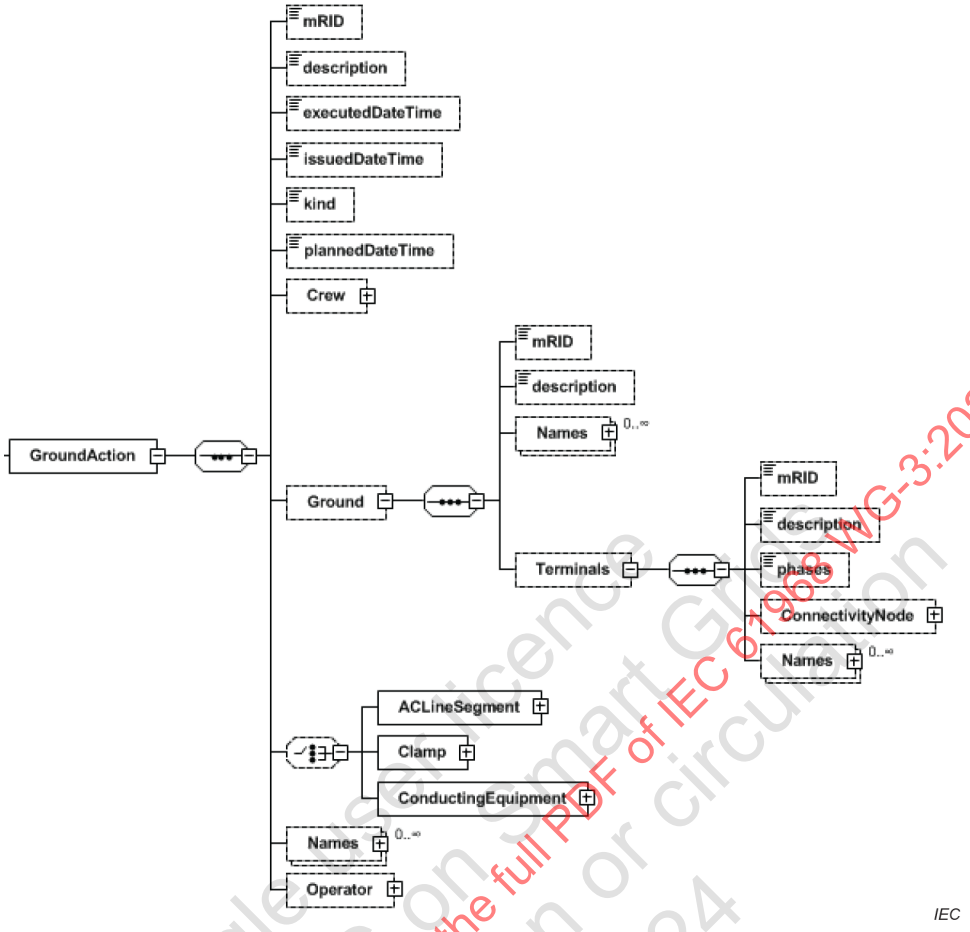

Figure 41 – SwitchingPlans – GroundAction

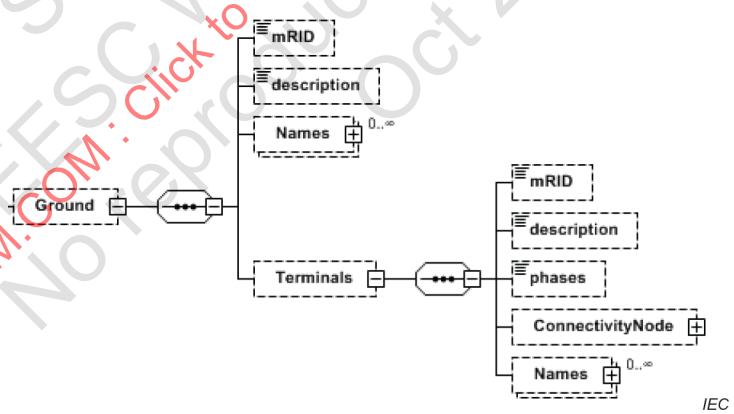

Figure 42 – SwitchingPlans – GroundAction – Ground

The ground can be placed at one of three possible choices. The terminal associated with the ground is connected to the terminal defined in each of the possible choices. For ConductingEquipment that has more than one terminal, the ground is attached to the terminal defined in the payload. Figure 43 shows the payload fragment for the **ACLineSegment** choice.

ACLineSegment fields are defined in Clause B.4.

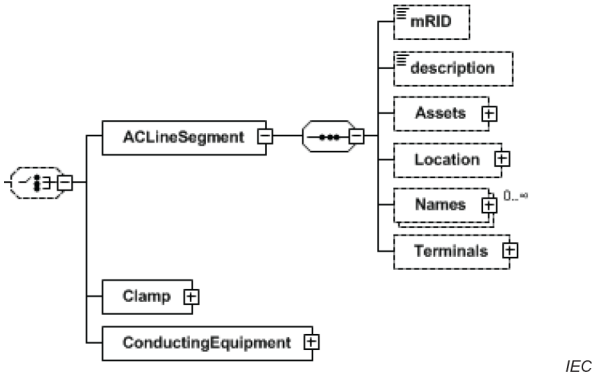

Figure 43 – ACLineSegment choice for connecting ground

Figure 44 shows the payload fragment for the **Clamp** choice.

Clamp fields are defined in Clause B.14.

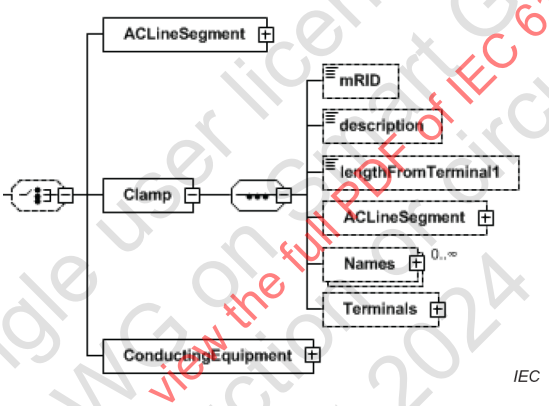

Figure 44 – Clamp choice for connecting ground

Figure 45 shows the payload fragment for the **ConductingEquipment** choice.

ConductingEquipment fields are defined in Clause B.17.

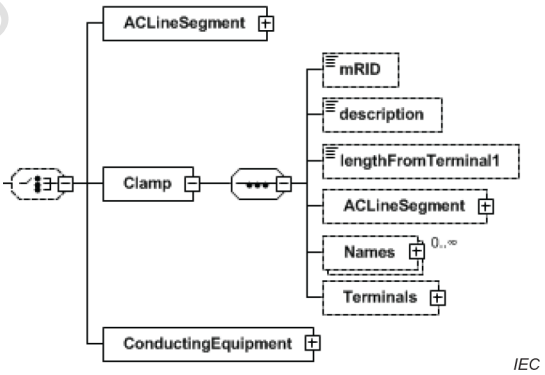

Figure 45 – ConductingEquipment choice for connecting ground

5.8.14 **SwitchingPlans** payload – **JumperAction**

A **JumperAction** is used to specify a switching step to add or remove a **Jumper**. A **Jumper** is a temporary conductor that is used to energize the network and has negligible impedance. In CIM, a **Jumper** inherits from **Switch** and therefore has two **Terminals** and can be open or closed.

Depending on the type of the network (balanced / unbalanced), a **JumperAction** may affect either three phases, two phases or a single phase. In the case of creating a single or two phase jumper, this jumper may connect two or three different phases of the respective field resources (cross phase jumper).

Jumpers must be placed between two **terminals**. Each **terminal** may be one of the following:

- One of the **terminals** of an **ACLineSegment**
- The **terminal** of a **clamp**
- One of the **terminals** of a **ConductingEquipment**.

If used, the **clamp**(s) must already have been placed before the **jumper** can be placed. When the **jumper** is removed, the **clamp**(s) shall remain and must be explicitly removed by a **ClampAction**.

In order to ensure that the correct side of the jumper is placed at the correct terminal, the **ConnectivityNode** in each pair of **terminals** to be connected must be the same in the payload. In other words, the **ConnectivityNode** for the **terminal** with sequence number 1 in the **jumper** must be the same as the **ConnectivityNode** for the terminal of the **ACLineSegment**, **Clamp** or **ConductingEquipment** that side 1 of the **jumper** connects to. The same applies for side 2 of the **jumper**.

The **JumperAction** part of the **SwitchingPlans** payload is graphically shown in Figure 46.

The attributes of **JumperAction** that are used in this profile are shown in Table 24.

Table 24 – JumperAction payload fragment for SwitchingPlans

Operations: JumperAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of this ControlAction.
description	String	[0..1]		Free-form description of this ControlAction
Names	Name	[0..*]	See B.56	Human-readable names for this ControlAction
kind	TempEquipActionKind	[0..1]	See C.20	Indicates whether the jumper should be placed or removed.
ACLineSegment	ACLineSegment	[0..*]	See B.4	There could be zero, one or two ACLineSegments in the payload, depending on where the jumper is to be attached. Each ACLineSegment defines where one end of the jumper is to be placed.
Clamp	Clamp	[0..*]	See B.14	There could be zero, one or two Clamps in the payload, depending on where the jumper is to be attached. Each clamp defines where one end of the jumper is attached to

Operations: JumperAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
JumpedEquipments	ConductingEquipment	[0..*]	See B.14	There could be zero, one or two JumpedEquipments in the payload, depending on where the jumper is to be attached. Each JumpedEquipments defines the ConductingEquipment that one end of the jumper is attached to.
Jumper	Jumper	[0..1]	See B.35	The jumper that is to be placed or removed.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

The **Jumper** part of the payload is defined in Clause B.35.

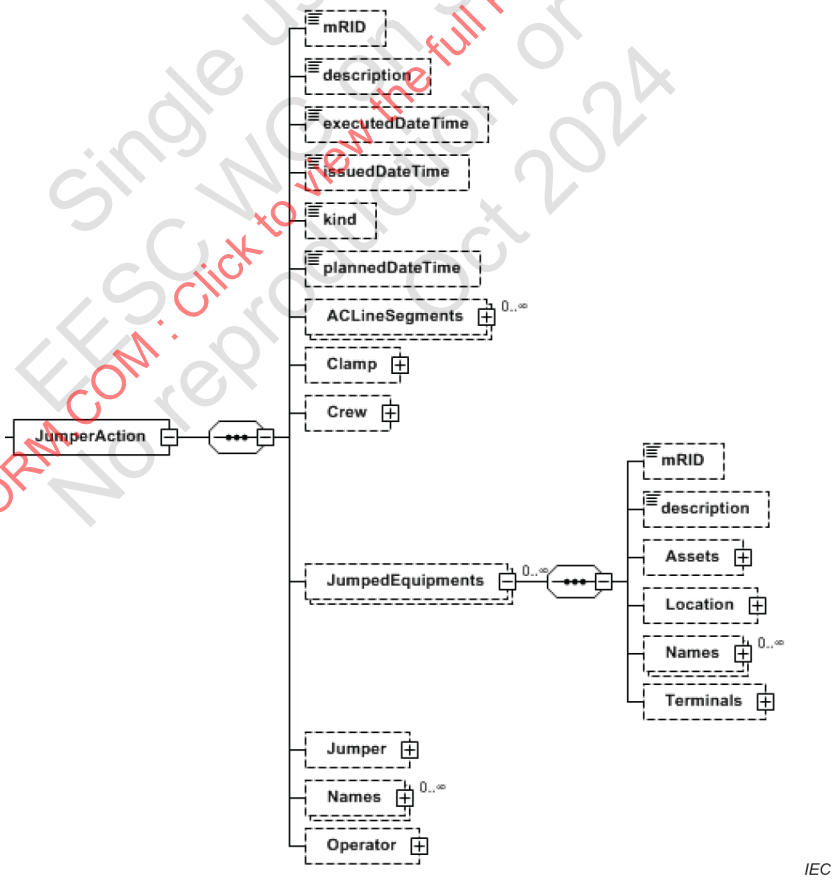

Figure 46 – SwitchingPlans – JumperAction

The payload fragment for **Jumper** is shown in Figure 47.

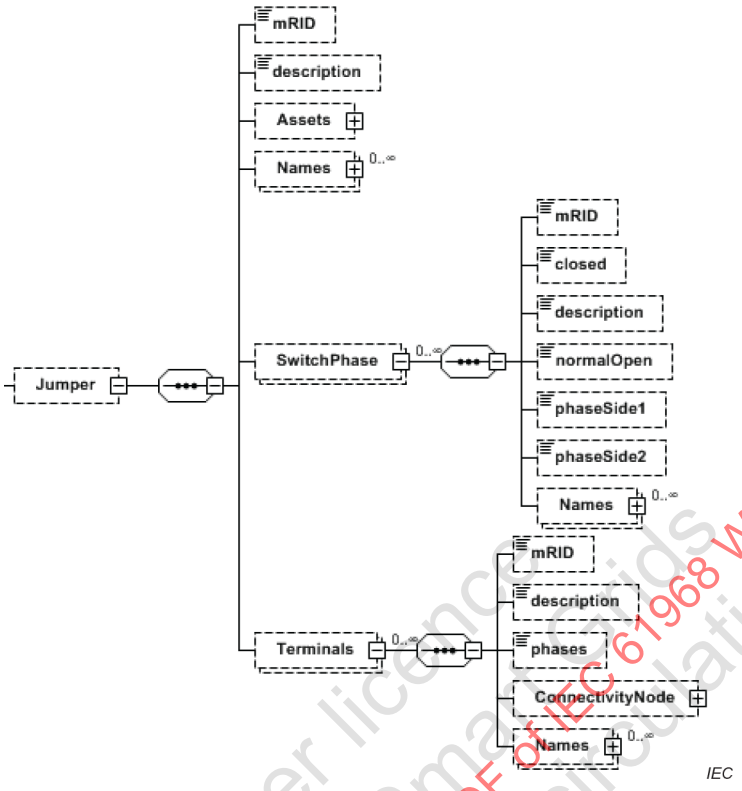

Figure 47 – SwitchingPlans – Jumper payload fragment

5.8.15 SwitchingPlans payload – MeasurementAction

Figure 48 shows the **MeasurementAction** field in the **SwitchingPlans** message payload.

The attributes of **MeasurementAction** that are used in this profile are shown in Table 25.

A **MeasurementAction** within a **SwitchingPlan** defines a measurement associated with a power system resource that must be manually recorded as part of the **SwitchingStep**. For example, an Amps measurement may be taken prior to closing a switch and then a second measurement is taken after the switch is closed, in order to confirm that the switch has actually closed. These measurements form a permanent record of the switching that was performed. Please see Subclause 5.4 for a description of the **GetPSRMeasurements** and **PSRMeasurements** profiles that can be used to obtain measurements electronically.

Table 25 – MeasurementAction payload fragment for SwitchingPlans

Operations: MeasurementAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of this MeasurementAction.
description	String	[0..1]		Free-form description of this MeasurementAction
Names	Name	[0..*]	See B.56	Human-readable names for this MeasurementAction
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.
Choice of one of the following				
Accumulator	Accumulator		See B.2	
Analog	Analog		See B.6	
Discrete	Discrete		See B.28	
StringMeasurement	StringMeasurement		See B.82	

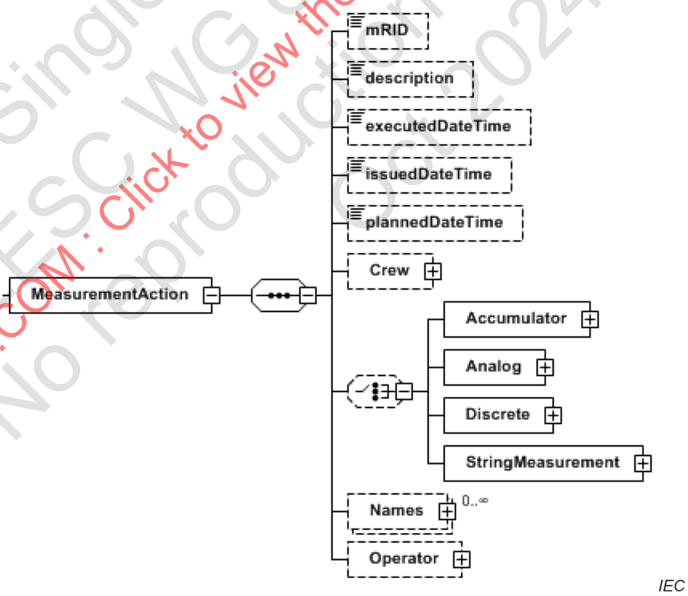

Figure 48 – SwitchingPlans – MeasurementAction

The **MeasurementAction** is included in the **SwitchingPlan** payload so that manual measurements can be captured as part of the **SwitchingPlan**. During execution of the **SwitchingPlan**, requests to the field crew are issued using a **SwitchingAction.MeasurementAction** and results are returned from the field with a **SwitchingEvent.MeasurementAction**. Please see the sequence diagram in Figure 59 that shows **SwitchingEvents** and **SwitchingActions**.

If there is telemetry available then the **SwitchingPlan** can also define a step of type **MeasurementAction**. In this case, during execution of the **SwitchingPlan**, requests for measurements are sent to SCADA using **PSRMeasurements** as shown in Figure 49. In the diagram there is a request to get a **PSRMeasurements**, and then the actual measurements being sent back as a reply **PSRMeasurements**. Please refer to IEC 61968-100 for a description on the usage of get profiles.

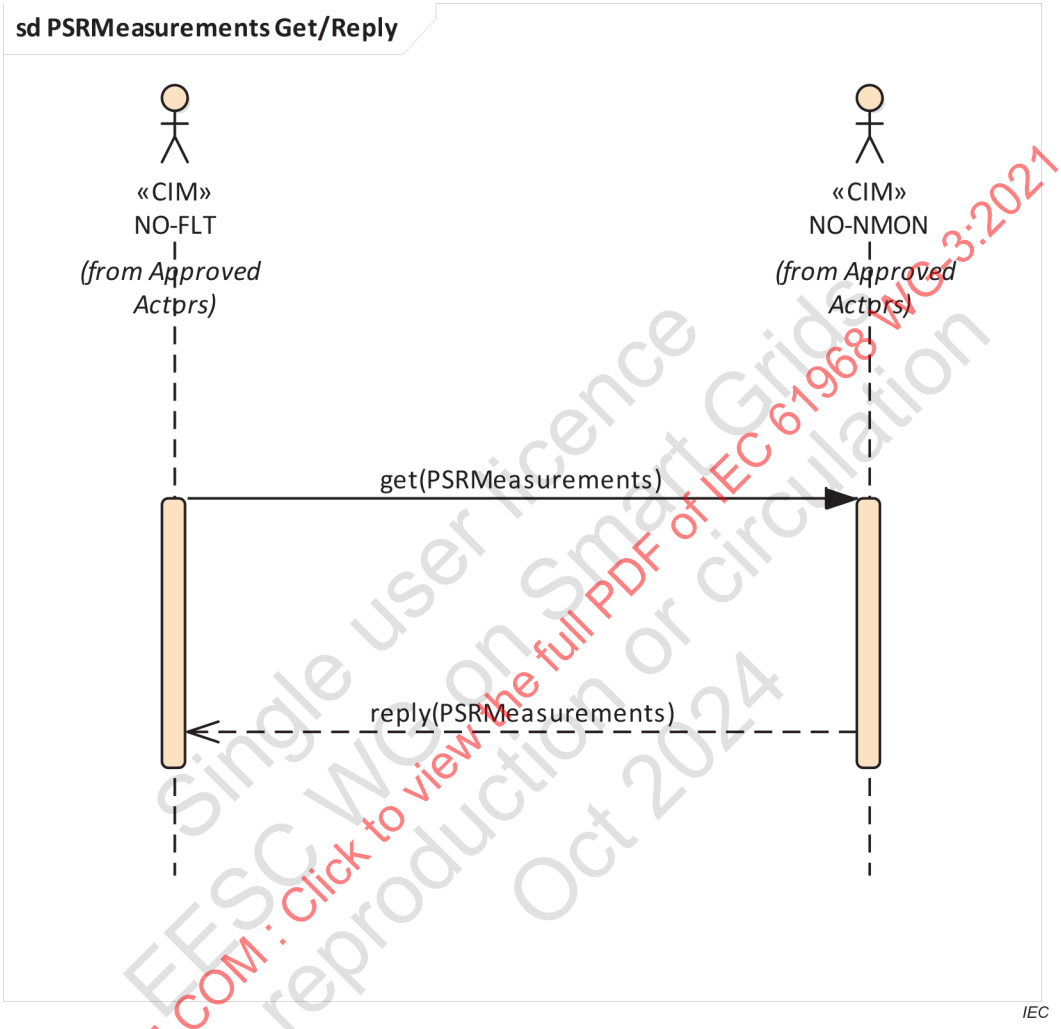

Figure 49 – Execution of a SwitchingStep with a MeasurementAction and the quantity is telemetered

5.8.16 SwitchingPlans payload – ShuntCompensatorAction

The **ShuntCompensatorAction** of the **SwitchingPlans** payload is shown in Figure 50.

A **ShuntCompensatorAction** is used to specify a switching step to temporarily disconnect or connect a permanent **ShuntCompensator** from its terminals. **kind** defines whether to disconnect or connect the **ShuntCompensator** and can have values of **disconnect** or **connect**.

The attributes of **ShuntCompensatorAction** that are used in this profile are shown in Table 26.

Table 26 – ShuntCompensatorAction payload fragment for SwitchingPlans

Operations: ShuntCompensatorAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the ShuntCompensatorAction
description	String	[0..1]		Free form description of ShuntCompensatorAction
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TempEquipActionKind	[0..1]	See C.20	Defines whether to disconnect or connect the shunt compensator.
phases	PhaseCode	[0..1]	See C.12	Phases to perform the action on.
ShuntCompensator	ShuntCompensator	[0..1]	See B.78	ShuntCompensator to disconnect or connect.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew.
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

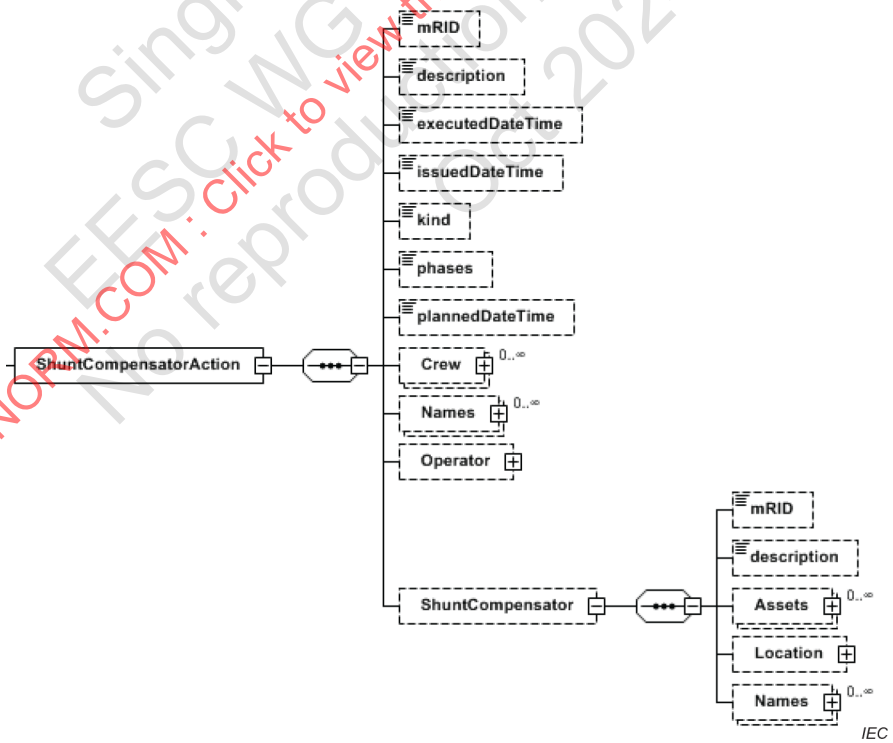

Figure 50 – SwitchingPlans – ShuntCompensatorAction

5.8.17 **SwitchingPlans** payload – **SwitchAction**

The **SwitchAction** part of the **SwitchingPlans** payload is shown in Figure 51. **SwitchAction** is used to specify a switching step to open or close one or more phases of an **OperatedSwitch**. If some phases on a multi-phase switch are to be opened, and some are to be closed, two separate **SwitchAction**s, each specifying the particular **SwitchPhase,** are required. This is because **SwitchAction.kind** applies to the switch as a whole..

The attributes of **SwitchAction** that are used in this profile are shown in Table 27.

Table 27 – SwitchAction payload fragment for SwitchingPlans

Operations: SwitchAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the action
description	String	[0..1]		Free form description of the action
Names	Name	[0..*]	See B.56	Human-readable names for the SwitchAction.
kind	SwitchActionKind	[0..1]	See C.20	Switching action to perform – open, close, disableReclosing, enableReclosing
OperatedSwitch	Switch	[0..1]	See B.86	Switch to operate.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

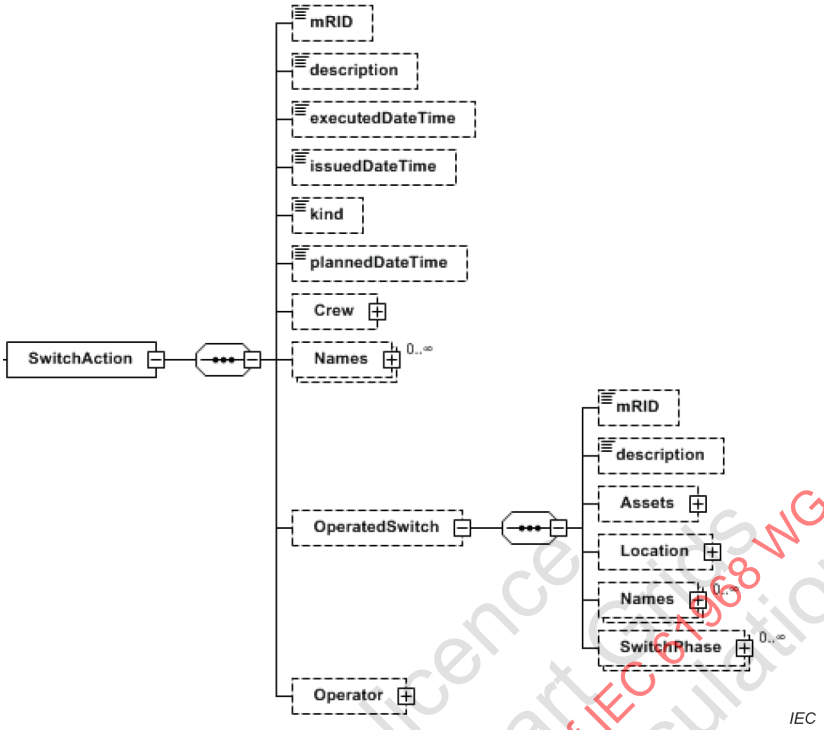

Figure 51 – SwitchingPlans – SwitchAction

5.8.18 SwitchingPlans payload – TagAction

The **SwitchingPlans TagAction** payload is shown in Figure 52. The **TagAction** is used to specify a switching step to **place**, **remove** or **verify** an **OperationalTag**, as defined by **TagAction.kind**. The function that the tag performs, such as do not operate, do not close, etc, is defined by **TagAction.OperationalTag.type**. If not all of the available phases are to be tagged, the **phases** attribute specifies which phase(s) are to be tagged.

The allowable values of **TagAction.OperationalTag.type** are not defined in this document.

The attributes of **TagAction** that are used in this profile are shown in Table 28.

Table 28 – TagAction payload fragment for SwitchingPlans

Operations: TagAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of this TaglAction.
description	String	[0..1]		Free-form description of this TagAction.
Names	Name	[0..*]	See B.56	Human-readable names for this TagAction.
kind	TagActionKind	[0..1]	See C.21	Operation to be performed on the Tag – place, remove, verify.
OperationalTag	OperationalTag	[0..1]	See B.59	The actual tag that is to be placed, removed or verified.
phases	PhaseCode	[0..1]	See C.12	Phases on which the tag is to be placed,. e.g. A, AB, AC, ABC, etc.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

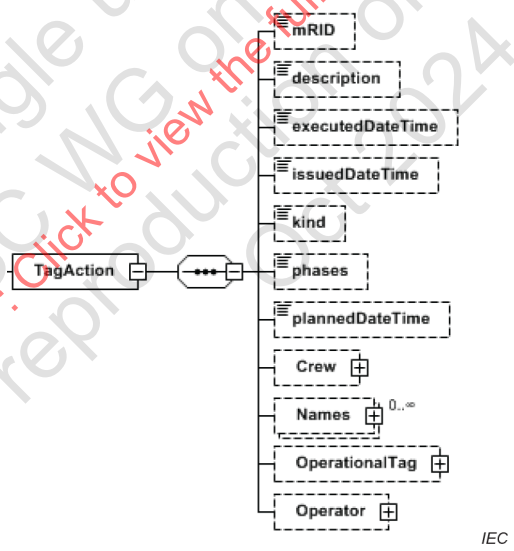

Figure 52 – SwitchingPlans – TagAction payload

The payload for the **OperationalTag** part of the **TagAction** is shown in Figure 53. Its contents are defined in Clause B.59.

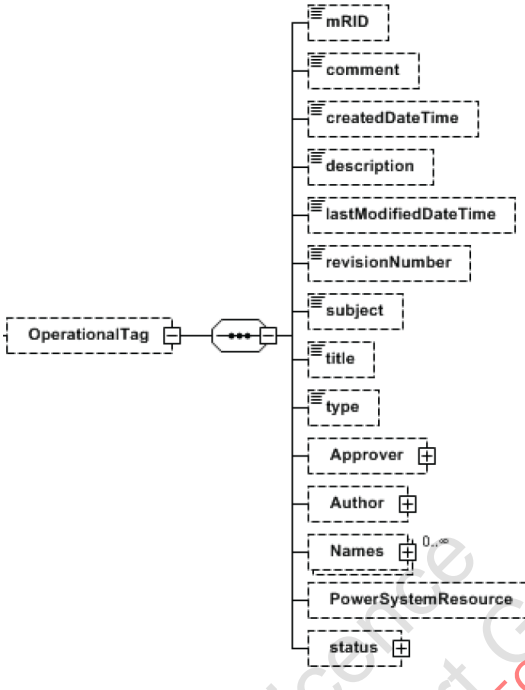

Figure 53 – SwitchingPlans – OperationalTag payload fragment

5.8.19 SwitchingPlans payload – VerificationAction

The **SwitchingPlans VerificationAction** payload fragment is shown in Figure 54. The **VerificationAction** is used to specify a switching step to verify that the **PowerSystemResource** is in an expected state, such as checking that a switch is open.

The attributes of **VerificationAction** that are used in this profile are shown in Table 29.

Table 29 – VerificationAction payload fragment for SwitchingPlans

Operations: VerificationAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of this VerificationAction.
description	String	[0..1]		Free-form description of this VerificationAction
Names	Name	[0..*]	See B.56	Human-readable names for this VerificationAction
phases	PhaseCode	[0..1]	See C.12	Phases to perform the action on, e.g. A, AB, AC, ABC, etc.
verificationCondition	String	[0..1]		Free from text string describing the condition to verify, e.g. check open, disable reclosing, put into manual mode, etc.
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	PowerSystemResource to perform the verification action on.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		Date and time of when the step is planned to be executed

Operations: VerificationAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
Crew	Crew	[0..1]	See B.22	Crew assigned to the step. A Crew can be pre-assigned to perform the step.
Operator	Operator	[0..1]	See B.59	This will be blank until the action is sent to the crew.

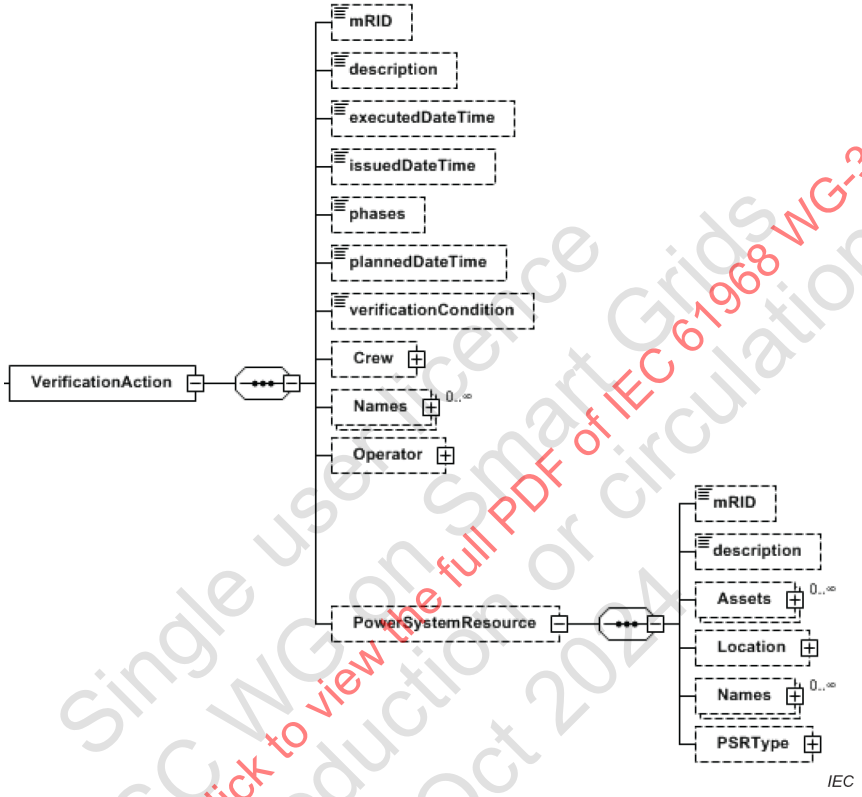

Figure 54 – SwitchingPlans – VerificationAction payload

5.8.20 Example SwitchingPlan

Table 30 shows example switching plan steps and their mapping to CIM objects. The Step Number column and Operation column are what would be shown in a typical real-world switching plan. The explanation and mapping columns are provided to describe what the purpose of each step is and how it maps to the CIM. In this example there is only one **SwitchingStepGroup.**

Table 30 – Example of a switching plan

Step Number	Operation	Explanation	Mapping
	Isolate and Place Tags	Heading step that is not numbered and is not executable	**SwitchingStepGroup** with a **sequenceNumber** of 1 and a **description** of “Isolate and Place Tags” No **SwitchingStep**
1	Contact aluminium plant to tell them their planned outage is about to start	Executable comment step to tell the control room to do something that is not related to the network	**SwitchingStep** with a **sequenceNumber** of 1 and a **GenericAction** that has a **description** of “Contact aluminium plant to tell them their planned outage is about to start”
2	Open switch 12345	Executable step that changes the network	**SwitchingStep** with a **sequenceNumber** of 2 and a **SwitchAction**.
3	Place do not operate tag on switch 12345	Executable tag step	**SwitchingStep** with a **sequenceNumber** of 3 and a **TagAction**.
4	Check open switch 6789 and place do not operate tag	Executable compound step made up of a verification step and a tag step	**SwitchingStep** with a **sequenceNumber** of 4, a **subStepSequenceNumber** of 1 and a **VerificationAction**. **SwitchingStep** with a **sequenceNumber** of 4 a **subStepSequenceNumber** of 2 and a **TagAction**.
5	Issue clearance number 99 to crew Joe Blow using do not operate tag on switch 12345 and do not operate tag on switch 6789	Executable clearance action step	**SwitchingStep** with a **sequenceNumber** of 5 and a **ClearanceAction**.
	Return to Normal	Heading step that is not numbered and is not executable	**SwitchingStepGroup** with a **sequenceNumber** of 2 and a description of “Return to Normal” No **SwitchingStep**
6	Release clearance number 99 from crew Joe Blow using do not operate tag on switch 12345 and do not operate tag on switch 6789	Executable clearance action step	**SwitchingStep** with a **sequenceNumber** of 6 and a **ClearanceAction**.
7	Remove do not operate tag from switch 6789	Executable tag step	**SwitchingStep** with a **sequenceNumber** of 7 and a **TagAction**.
8	Remove do not operate tag from switch 12345	Executable tag step	**SwitchingStep** with a **sequenceNumber** of 8 and a **TagAction**.
9	Close switch 12345	Executable step that changes the network	**SwitchingStep** with a **sequenceNumber** of 9 and a **SwitchAction**.
10	Contact aluminium plant to tell them their planned outage is over	Executable comment step to tell the control room to do something that is not related to the network	**SwitchingStep** with a **sequenceNumber** of 10 and a **GenericAction** that has a **description** of “Contact aluminium plant to tell them their planned outage is over”

Sample XML for the steps of the above switching plan is shown in Figure 55. Note: this is a fragment, not a complete SwitchingPlan.

```
<SwitchingPlans>
   <SwitchingPlan>
        <SwitchingStepGroups>
            <sequenceNumber>1</sequenceNumber>
            <Description>Isolate and Place Tags</Description>
            <SwitchingStep>
                <sequenceNumber>1</sequenceNumber>
                    <GenericAction>
                    <description>Contact Aluminum plant to tell them that their planned outage
is about to start</description>
                    </GenericAction>
            </SwitchingStep>
            <SwitchingStep>
                <sequenceNumber>2</sequenceNumber>
                <SwitchAction>
                    <OperatedSwitch>
                        <Name>switch 12345</Name>
                        <SwitchPhase>
                            <Names>ABC</names>
                            <closed>0</closed>
                        </SwitchPhase>
                    </OperatedSwitch>
                </SwitchAction>
            </SwitchingStep>
            <SwitchingStep>
                <sequenceNumber>3</sequenceNumber>
                <TagAction>
                    <kind>place</kind>
                    <OperationalTag>
                        <PowerSystemResource>
                            <Names>switch 12345</Names>
                        </PowerSystemResource>
                    </OperationalTag>
                </TagAction>
            </SwitchingStep>
            <SwitchingStep>
                <sequenceNumber>4</sequenceNumber>
                <subStepSequenceNumber>1</subStepSequenceNumber>
                <VerificationAction>
                    <VerificationCondition>check open</VerificationCondition>
                    <PowerSystemResource>
                        <Names>switch 6789</Names>
                    </PowerSystemResource>
                </VerificationAction>
                <sequenceNumber>4</sequenceNumber>
                <subStepSequenceNumber>2</subStepSequenceNumber>
                <TagAction>
                    <kind>place</kind>
                    <OperationalTag>
                        <PowerSystemResource>
                            <Names>switch 6789</Names>
                        </PowerSystemResource>
                    </OperationalTag>
                </TagAction>
            </SwitchingStep>
            <SwitchingStep>
                <sequenceNumber>5</sequenceNumber>
                <ClearanceAction>
                    <Kind>issue</Kind>
                    <Clearance>
                        <TaggedPSRs>
                            <Names>switch 6789</Names>
                            <Names>switch 12345</Names>
                        </TaggedPSRs>
                    </Clearance>
                </ClearanceAction>
            </SwitchingStep>
        </SwitchingStepGroups>
        <SwitchingStepGroups>
            <sequenceNumber>2</sequenceNumber>
            <Description>Return to Normal</Description>
            <SwitchingStep>
                <sequenceNumber>6</sequenceNumber>
                <ClearanceAction>
                    <Kind>release</Kind>
                    <Clearance>
                        <TaggedPSRs>
                            <Names>switch 6789</Names>
```

```
                        <Names>switch 12345</Names>
                    </TaggedPSRs>
                </Clearance>
            </ClearanceAction>
        </SwitchingStep>
        <SwitchingStep>
            <sequenceNumber>7</sequenceNumber>
            <TagAction>
                <kind>remove</kind>
                <OperationalTag>
                    <PowerSystemResource>
                        <Names>switch 6789</Names>
                    </PowerSystemResource>
                </OperationalTag>
            </TagAction>
        </SwitchingStep>
        <SwitchingStep>
            <sequenceNumber>8</sequenceNumber>
            <TagAction>
                <kind>remove</kind>
                <OperationalTag>
                    <PowerSystemResource>
                        <Names>switch 12345</Names>
                    </PowerSystemResource>
                </OperationalTag>
            </TagAction>
        </SwitchingStep>
        <SwitchingStep>
            <sequenceNumber>9</sequenceNumber>
            <SwitchAction>
                <OperatedSwitch>
                    <Name>switch 12345</Name>
                    <SwitchPhase>
                        <Names>ABC</names>
                        <closed>1</closed>
                    </SwitchPhase>
                </OperatedSwitch>
            </SwitchAction>
        </SwitchingStep>
        <SwitchingStep>
            <sequenceNumber>10</sequenceNumber>
                <GenericAction>
                <description>Contact Aluminum plant to tell them that their planned outage
is over</description>
                </GenericAction>
        </SwitchingStep>
    </SwitchingStepGroups>
  </SwitchingPlan>
</SwitchingPlans>
```

Figure 55 – Sample XML for SwitchingPlans

5.8.21 Example XML for a complete SwitchingPlan

The example below shows a SwitchingPlan complete with a header and a single SwitchingAction. It is intended to illustrate the XML structure rather than be a real-world example of a SwitchingPlan.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:SwitchingPlans xmlns:m="http://iec.ch/TC57/2019/SwitchingPlans#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/SwitchingPlans# SwitchingPlans.xsd ">
  <m:SwitchingPlan>
    <m:mRID>6571f4c4-acee-4024-8d1f-6c4a0398e5fa</m:mRID>
    <m:approvedDateTime>2019-04-10T14:14:14</m:approvedDateTime>
    <m:createdDateTime>2019-04-01T09:15:00</m:createdDateTime>
    <m:description>Example switching plan</m:description>
    <m:lastModifiedDateTime>2019-04-23T10:46:22</m:lastModifiedDateTime>
    <m:purpose>New Construction</m:purpose>
    <m:revisionNumber>C</m:revisionNumber>
    <m:Approver>
      <m:Names>
        <m:name>Keith Richards</m:name>
      </m:Names>
    </m:Approver>
    <m:Author>
```

```
  <m:Names>
    <m:name>Mick Jagger</m:name>
  </m:Names>
</m:Author>
<m:Names>
  <m:name>Switching Plan PO-2019-04-142</m:name>
</m:Names>
<m:plannedPeriod>
  <m:end>2019-05-01T12:00:00</m:end>
  <m:start>2019-01-01T08:00:00</m:start>
</m:plannedPeriod>
<m:SafetyDocuments>
  <m:mRID> 0f8aca59-1d58-4054-ac22-8d00487e91ee </m:mRID>
  <m:comment>Clearance #1 for Switching Plan PO-2019-04-142</m:comment>
  <m:createdDateTime>2019-04-05T11:11:11</m:createdDateTime>
  <m:description>Isolate using SW-13231 and SW-131542</m:description>
  <m:issuedDateTime>2019-05-01T10:12:00</m:issuedDateTime>
  <m:lastModifiedDateTime>2019-04-23T15:09:00</m:lastModifiedDateTime>
  <m:releasedDateTime></m:releasedDateTime>
  <m:type>Clearance</m:type>
  <m:Approver>
    <m:Names>
      <m:name>Keith Richards</m:name>
    </m:Names>
  </m:Approver>
  <m:Author>
    <m:Names>
      <m:name>Mick Jagger</m:name>
    </m:Names>
  </m:Author>
  <m:IssuedBySupervisor>
    <m:Names>
      <m:name>Samuel Adams</m:name>
    </m:Names>
  </m:IssuedBySupervisor>
  <m:IssuedToSupervisor>
    <m:Names>
      <m:name>Billy Scruggs</m:name>
      <m:NameType>
        <m:name>Contractor</m:name>
        <m:NameTypeAuthority>
          <m:name>XYZ Electrical Services LLC</m:name>
        </m:NameTypeAuthority>
      </m:NameType>
    </m:Names>
  </m:IssuedToSupervisor>
  <m:Names>
    <m:name>Clearance PO-2019-04-142-1</m:name>
  </m:Names>
  <m:ReleasedBySupervisor>
    <m:Names>
      <m:name>Billy Scruggs</m:name>
      <m:NameType>
        <m:name>Contractor</m:name>
        <m:NameTypeAuthority>
          <m:name>XYZ Electrical Services LLC</m:name>
        </m:NameTypeAuthority>
      </m:NameType>
    </m:Names>
  </m:ReleasedBySupervisor>
  <m:ReleasedToSupervisor>
    <m:Names>
      <m:name>Samuel Adams</m:name>
    </m:Names>
  </m:ReleasedToSupervisor>
  <m:status>
    <m:dateTime>2019-05-01T10:31:42</m:dateTime>
    <m:reason>Status change</m:reason>
    <m:remark>Issued to Billy Scruggs</m:remark>
    <m:value>Issued</m:value>
  </m:status>
</m:SafetyDocuments>
<m:status>
  <m:dateTime>2019-05-01T07:12:19</m:dateTime>
  <m:reason>State Change</m:reason>
  <m:remark>Approved and ready to execute. Checked in study mode this morning</m:remark>
  <m:value>Approved</m:value>
</m:status>
```

```
    <m:SwitchingPlanRequest>
      <m:mRID>205c0a0b-0422-4184-8cfe-b9fdfc433509 </m:mRID>
      <m:description>Isolate line section between Cotter's Grove Lane and Snarly Brook
Street</m:description>
      <m:Names>
        <m:name>Switching Request 2019-04-142</m:name>
      </m:Names>
    </m:SwitchingPlanRequest>
    <m:SwitchingStepGroups>
      <m:description>First and only group</m:description>
      <m:isFreeSequence>false</m:isFreeSequence>
      <m:purpose>First group of the switching plan</m:purpose>
      <m:sequenceNumber>1</m:sequenceNumber>
      <m:SwitchingStep>
        <m:isFreeSequence>false</m:isFreeSequence>
        <m:sequenceNumber>1</m:sequenceNumber>
        <m:subStepSequenceNumber>1</m:subStepSequenceNumber>
        <m:ClampAction>
          <m:description>Place clamp on feeder 179-01</m:description>
          <m:kind>place</m:kind>
          <m:Clamp>
            <m:description>13.8 kV clamp</m:description>
            <m:lengthFromTerminal1>120</m:lengthFromTerminal1>
            <m:ACLineSegment>
              <m:mRID>69bdf28b-b4d2-4d05-91f4-ee7f9815b481</m:mRID>
              <m:description>13.8 kV 2ACSR</m:description>
              <m:Location>
                <m:direction>Two blocks south of Highway 27 at Crows Feet Street<m:direction>
                <m:mainAddress>
                  <m:townDetail>
                    <m:name>Bloomsbury</m:name>
                    <m:stateOrProvince>North Carolina</m:stateOrProvince>
                  </m:townDetail>
                </m:mainAddress>
                <m:PositionPoints>
                  <m:groupNumber>0</m:groupNumber>
                  <m:sequenceNumber>0</m:sequenceNumber>
                  <m:xPosition>35.7718409</m:xPosition>
                  <m:yPosition>-78.6801357</m:yPosition>
                </m:PositionPoints>
              </m:Location>
              <m:Names>
                <m:name>13.8 kV line</m:name>
              </m:Names>
            </m:ACLineSegment>
            <m:Names>
              <m:name>Clampy Mc Clamp Face</m:name>
            </m:Names>
            <m:Terminals>
              <m:mRID>6a8a6da5-bb10-49de-a682-710d9a6ee3e9</m:mRID>
              <m:description>New terminal associated with the clamp</m:description>
              <m:phases>ABC</m:phases>
            </m:Terminals>
          </m:Clamp>
        </m:ClampAction>
      </m:SwitchingStep>
    </m:SwitchingStepGroups>
  </m:SwitchingPlan>
</m:SwitchingPlans>
```


5.9 SwitchingOrders payload

5.9.1 General

SwitchingOrders message payloads are designed to communicate requests for scheduling the execution of a **SwitchingPlan** for emergency or planned switching. An example of how a **SwitchingOrder** may be communicated between different parties during its life cycle as shown in Figure 56.

- A request to schedule a **SwitchingPlan** is made through a request to create a **SwitchingOrder**
- The **SwitchingPlan** is scheduled within work management, resulting in the creation of a **SwitchingOrder**

- The schedule is communicated to Switch Order Scheduling through a **SwitchingOrder** reply

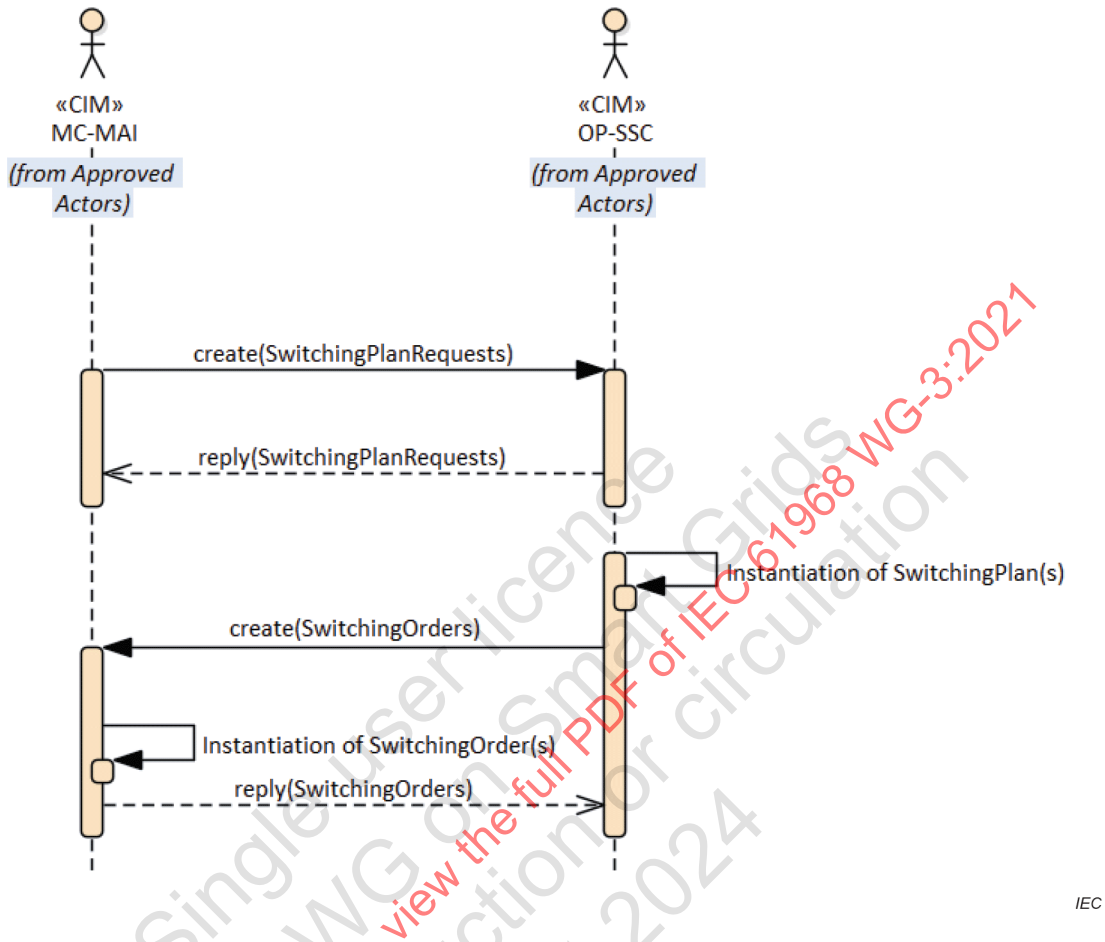

Figure 56 – SwitchingOrders sequence diagram

5.9.2 Message payload

The **SwitchingOrders** payload is shown in Figure 57.

The attributes of the **SwitchingOrders** profile are described in Table 31.

Table 31 – SwitchingOrders Profile

SwitchingOrders				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
SwitchingOrders	SwitchingOrder	[0..*]		
Profile Attributes				
mRID	String	[0..1]	GUID	mRID for the SwitchingOrder.
description	String	[0..1]		Free-form text field that describes the **SwitchingOrder**
Names	Name	[0..*]	See B.56	List of human-readable names for the SwitchingOrder
comment	String	[0..1]		Free-form text
createdDateTime	DateTime	[0..1]		DateTime that the SwitchingOrder was initially created.
lastModifiedDateTime	DateTime	[0..1]		DateTime that the SwitchingOrder was last changed.
revisionNumber	String	[0..1]		Revision number of the **SwitchingOrder**. Typically this would be used to track changes after the SwitchingOrder has been approved and scheduled.
subject	String	[0..1]		Free-form text
Title	String	[0..1]		Free-form text
Type	String	[0..1]		Free-form text
Approver	Approver	[0..1]	See B.8	Person who approved the **SwitchingOrder**
electronicAddress	ElectronicAddress	[0..1]		Email address of person who should be contacted regarding the SwitchingOrder.
Issuer	DateTimeInterval	[0..1]		Person who issued the SwitchingOrder (e.g. the person who sent the SwitchingOrder to be scheduled)
Location	Location	[0..*]	See B.52	Location(s) of the SwitchingOrder. Location includes the CrewType required at each Location. This defines the skill set and quantity of each crew type required at each Location.
plannedExecutionInterval	DateTimeInterval	[0..1]		Requested start time/date and end time/date
status	Status	[0..1]	See B.79	Status.value is used to specify the overall status of the SwitchingOrder, such as draft, in review, approved, cancelled, etc.
SwitchingPlan	SwitchingPlan	[0..1]	See 5.8.2	mRID, description and Names of associated SwitchingPlan.

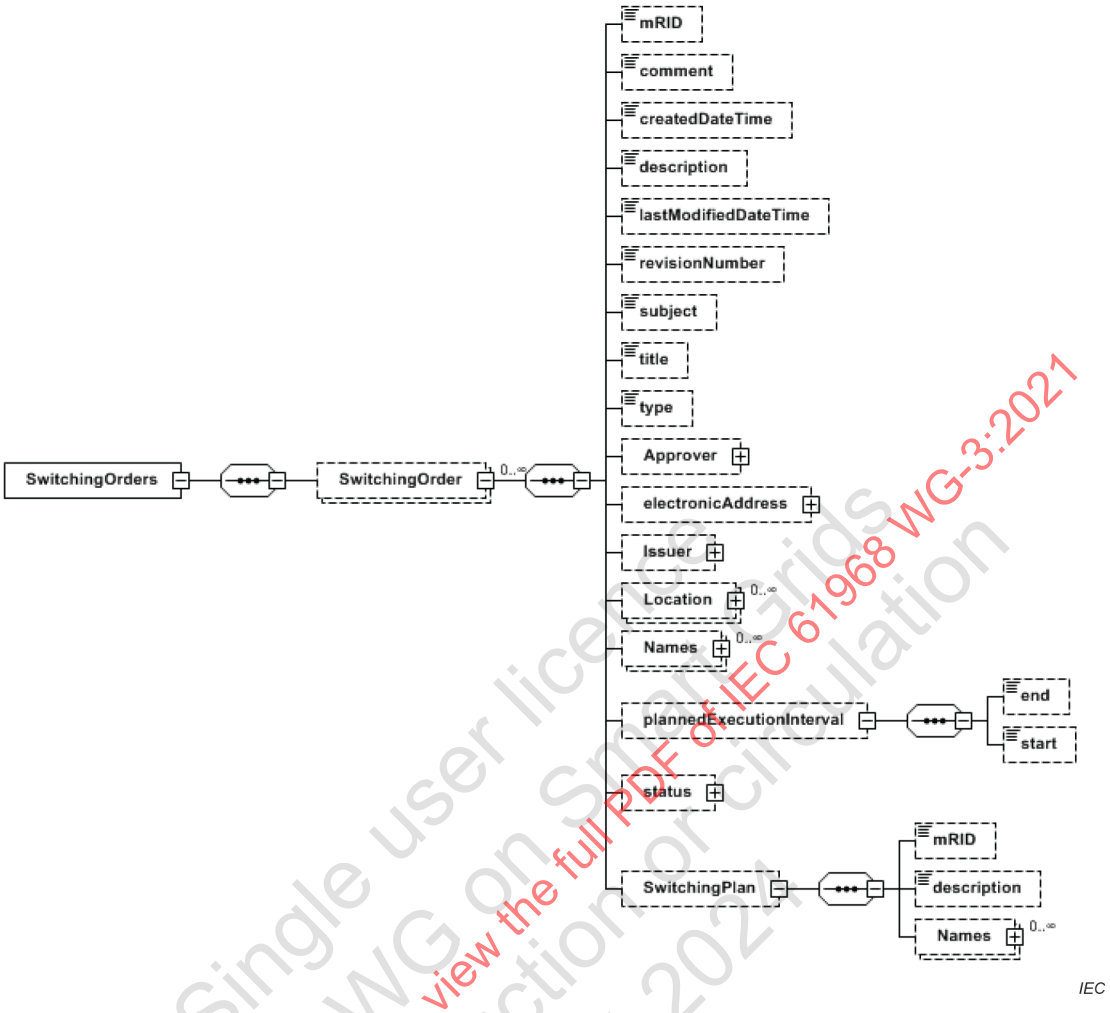

Figure 57 – SwitchingOrders message payload

The Location part of this payload is shown in Figure 58. It allows the requesting system to specify a number of **CrewType**(s) that are required at each Location, in order to have the work scheduled. In the reply, the actual **CrewType**(s) and **Names** and/or **CrewMembers** should be returned.

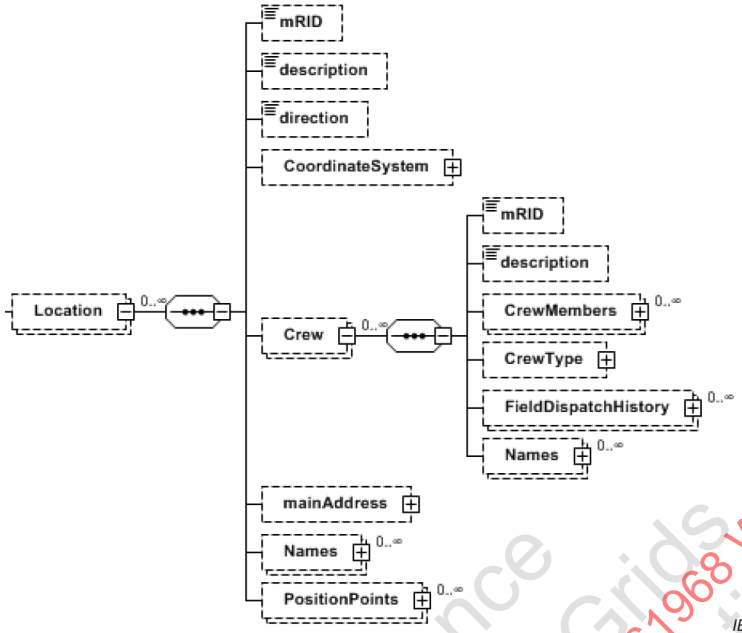

Figure 58 – SwitchingOrders – Location fragment

5.9.3 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:SwitchingOrders xmlns:m="http://iec.ch/TC57/2019/SwitchingOrders#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/SwitchingOrders# SwitchingOrders.xsd ">
  <m:SwitchingOrder>
    <m:mRID>m:mRID</m:mRID>
    <m:comment>Line extension on 13 kV line at Bonkers Creek</m:comment>
    <m:createdDateTime>2019-05-31T12:01:11</m:createdDateTime>
    <m:description> Isolate line section between Cotter's Grove Lane and Snarly Brook Street
</m:description>
    <m:lastModifiedDateTime>2019-05-31T12:01:11</m:lastModifiedDateTime>
    <m:revisionNumber>B</m:revisionNumber>
    <m:subject>Switching Order</m:subject>
    <m:title>Substation: Lizard Lick; Feeder: 321</m:title>
    <m:type>Construction</m:type>
    <m:Approver>
      <m:Names>
        <m:name>James T Kirk</m:name>
      </m:Names>
    </m:Approver>
    <m:electronicAddress>
      <m:email1>jtkirk@enterprise.gov</m:email1>
    </m:electronicAddress>
    <m:Issuer>
      <m:Names>
        <m:name>John Snow</m:name>
      </m:Names>
    </m:Issuer>
    <m:Location>
      <m:description>Area bounded by SW-12113 to the North and SW-13211 to the
South</m:description>
      <m:direction>Highway 27 2 blocks South</m:direction>
        <m:CrewType>
          <m:Names>
            <m:name>Switchman Level 2</m:name>
          </m:Names>
        </m:CrewType>
        <m:CrewType>
          <m:Names>
            <m:name>Switchman Level 2</m:name>
          </m:Names>
        </m:CrewType>
      </m:Crew>
    </m:Location>
    <m:Names>
```

```
      <m:name>Switching Order PO-2019-04-142</m:name>
    </m:Names>
    <m:plannedExecutionInterval>
      <m:end>2001-05-01T12:00:00</m:end>
      <m:start>2019-05-01T08:00:00</m:start>
    </m:plannedExecutionInterval>
    <m:SwitchingPlan>
      <m:mRID>6571f4c4-acee-4024-8d1f-6c4a0398e5fa</m:mRID>
      <m:description>Example switching plan</m:description>
      <m:Names>
        <m:name>Switching Plan PO-2019-04-142</m:name>
      </m:Names>
    </m:SwitchingPlan>
  </m:SwitchingOrder>
</m:SwitchingOrders>
```


5.10 **SwitchingActions** payload

5.10.1 General

SwitchingActions are used to coordinate the manual execution of steps within **SwitchingPlans** between the control room and field crews. It is also possible to use **SwitchingActions** to communicate requests to perform switching outside of a **SwitchingPlan**. Automated step execution is coordinated with **PSRControls** messages.

Figure 59 gives an example of how a switching step could be sent from the control room to a field crew by using a **SwitchingActions** message. Even though the field crew may already have a complete copy of the **SwitchingPlan**, this message can be used to request the field crew to execute the specific step referenced in the message. The message exchange utilizes the consequential event message pattern defined in IEC 61968-100.

The reply indicates that the field crew has received the instruction to execute a switching step and whether the request is valid. If the request passes initial validation (or no validation has been performed), the Reply section of the IEC 61968-100 response shall indicate success. If the request fails initial validation, e.g. if the request refers to an unknown **SwitchingPlan**, then the Reply section of the response shall indicate failure. If the request was completed successfully, the **SwitchingEvents** message (see Subclause 5.11) is a confirmation that the switching step has been executed.

If the request was accepted, an attempt to execute the **SwitchingAction** shall be made. If the **SwitchingAction** could not be performed successfully, e.g. because the requested device could not be physically accessed, then a second reply shall communicate the failure and the reason for failure using the Reply section of the IEC 61968-100 response message. In this case no **SwitchingEvents** message shall be returned.

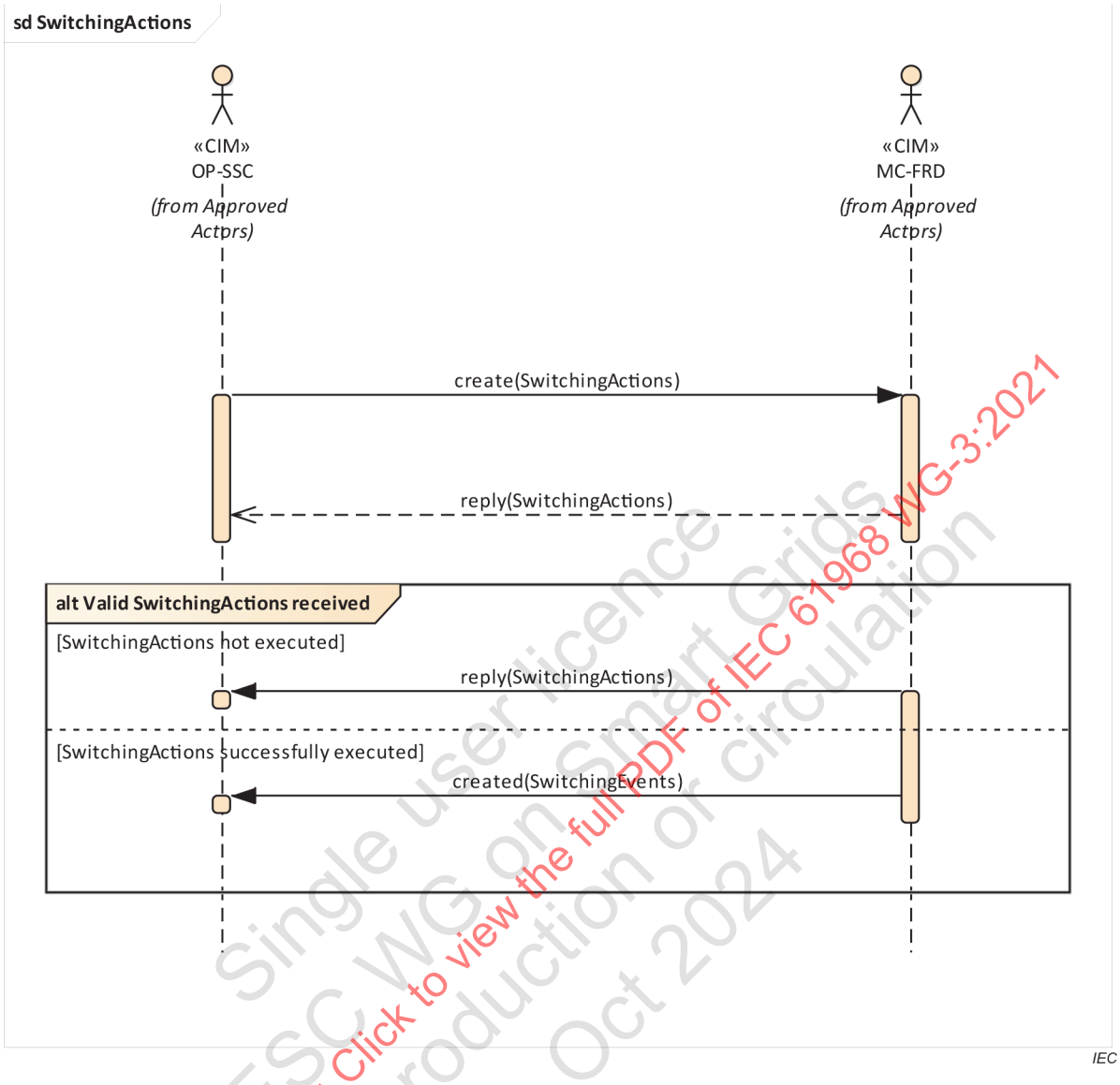

Figure 59 – Sequence Diagram of Switching Step Execution

5.10.2 Message Payload

The top level payload for **SwitchingActions** is shown graphically in Figure 60. The attributes of the **SwitchingActions** profile are described in Table 32.

The message consists of a choice of zero, one or many actions. Multiple actions of different types can be sent in a single payload. This is necessary when a **SwitchingStep** is made up of several sub-steps that are part of the same step in the same **SwitchingPlan**. Each action must only contain one **SwitchingStep** or sub-step.

Please note that the actions for **SwitchingActions** have a different structure to those for **SwitchingPlans**.

Table 32 – SwitchingActions Profile

SwitchingActions				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
SwitchingActions	SwitchingAction	[0..*]		Choice of actions as shown below
Actions				
ClampAction	ClampAction		See 5.10.6	
ClearanceAction	ClearanceAction		See 5.10.7	
ControlAction	ControlAction		See 5.10.8	
CutAction	CutAction		See 5.10.9	
EnergyConsumerAction	EnergyConsumerAction		See 5.10.10	
EnergySourceAction	EnergySourceAction		See 5.10.11	
GenericAction	GenericAction		See 5.10.12	
GroundAction	GroundAction		See 5.10.13	
JumperAction	JumperAction		See 5.10.14	
MeasurementAction	MeasurementAction		See 5.10.15	
ShuntCompensatorAction	ShuntCompensatorAction		See 5.10.16	
SwitchAction	SwitchAction		See 5.10.17	
TagAction	TagAction		See 5.10.18	
VerificationAction	VerificationAction		See 5.10.19	

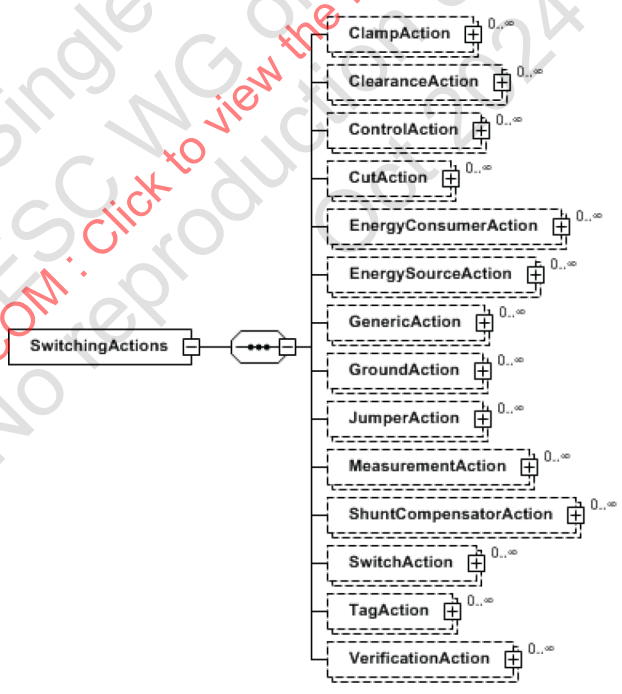

Figure 60 – SwitchingActions top level payload

5.10.3 SwitchingActions payload – SwitchingStep fragment

The **SwitchingStep** fragment is shown in Table 33 and graphically in Figure 61.

This fragment is common to every action within the **SwitchingAction**.

Table 33 – SwitchingStep payload fragment for SwitchingActions

Operations: SwitchingStep				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
isFreeSequence	Boolean	[0..*]		When there are multiple SwitchingSteps in the SwitchingAction, this is used to determine the sequence of execution. See subclause 5.9.3.1 for further details.
sequenceNumber	Integer	[0..1]		Sequence number that identifies the SwitchingSstep within theSwitchingPlan.
subStepSequenceNumber	Integer	[0..1]		SequenceNumber of the SwitchingStepSubStep
RevisionHistory	RevisionHistory	[0..1]	See B.74	Indicates whether the step has been added or voided.

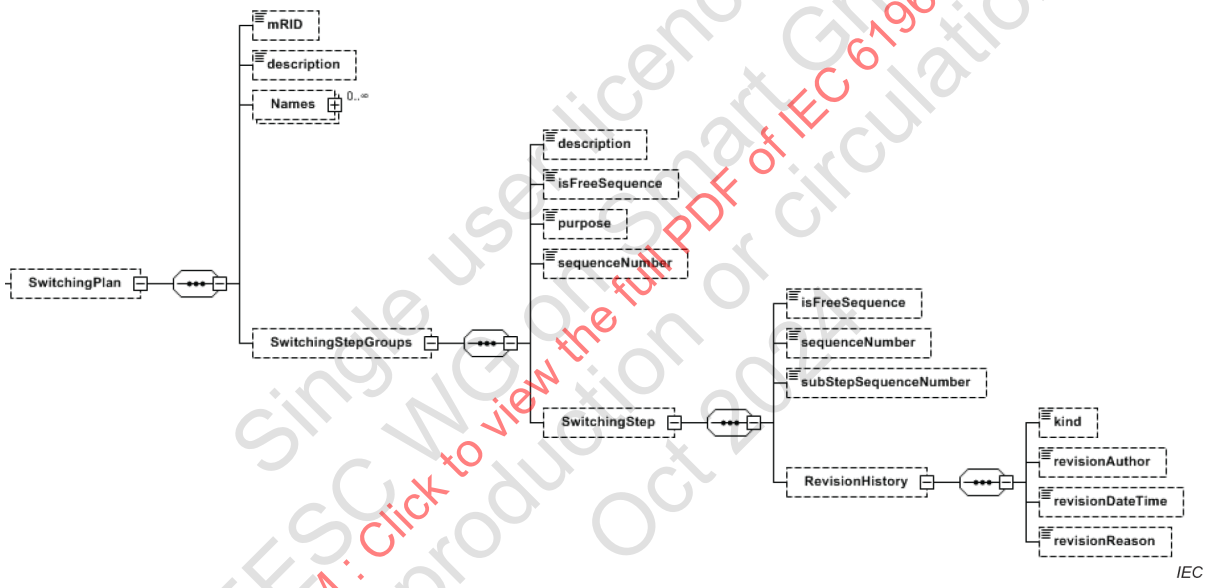

Figure 61 – SwitchingActions – SwitchingPlan fragment

5.10.4 SwitchingActions payload – SwitchingStepGroups fragment

The **SwitchingStepGroups** fragment is shown in Table 34 and graphically in Figure 61.

This fragment is common to every action within the **SwitchingAction**.

Table 34 – SwitchingStepGroup payload fragment for SwitchingActions

Operations: SwitchingStepGroups				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
description	String	[0..1]		Free form text that describes the SwitchingStepGroup
isFreeSequence	Boolean	[0..*]		When there are multiple SwitchingStepGroups in the SwitchingAction, this is used to determine the sequence of execution. See subclause 5.9.3.1 for further details.
purpose	String	[0..1]		Free form text that describes the purpose of the SwitchingStepGroup
sequenceNumber	Integer	[0..1]		Sequence number that identifies the SwitchingStepGroup within the SwitchingPlan.
SwitchingStep	SwitchingStep	[0..1]	See 5.10.3	SwitchingStep that is associated with this SwitchingStepGroup

5.10.5 SwitchingActions payload – SwitchingPlan fragment

The **SwitchingPlan** fragment is shown in Table 35 and graphically in Figure 61.

This fragment is common to every action within the **SwitchingAction**.

Table 35 – SwitchingPlan payload fragment for SwitchingActions

Operations: SwitchingPlan				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	
description	String	[0..1]		Free form text that describes the SwitchingPlan
Names	Name	[0..*]	See B.56	
purpose	String	[0..1]		Free form text that describes the purpose of the SwitchingStepGroup
sequenceNumber	Integer	[0..1]		Sequence number that identifies the switching step group within the switching plan.
SwitchingStepGroups	SwitchingStepGroup	[0..1]	See 5.10.4	SwitchingStepGroup that is associated with this SwitchingAction

5.10.6 SwitchingActions payload – ClampAction

The attributes of **ClampAction** that are used in this profile are shown in Table 36 and graphically in Figure 62.

Table 36 – ClampAction payload fragment for SwitchingActions

Operations: ClampAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the ClampAction
description	String	[0..1]		Free form description of the action.
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the ClampAction
kind		[0..1]		Determines whether the clamp is placed or removed. Enumeration with possible values place, remove.
Clamp	Clamp	[0..1]	See B.14	The details of the actual clamp that is to be placed or removed.
executedDateTime	DateTime	[0..1]		This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed.
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

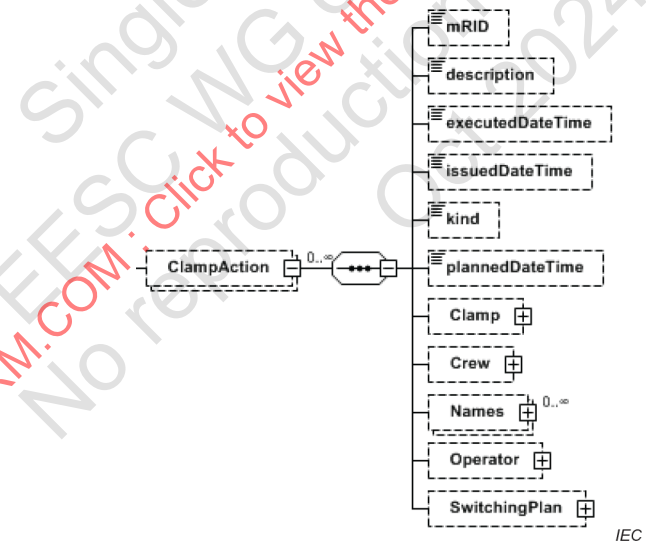

Figure 62 – SwitchingAction – ClampAction fragment

5.10.7 SwitchingActions payload – ClearanceAction

The attributes of **ClearanceAction** that are used in this profile are shown in Table 37 and graphically in Figure 63.

Table 37 – ClearanceAction payload fragment for SwitchingActions

Operations: ClearanceAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the ClearanceAction
description	String	[0..1]		Free form description of the ClearanceAction
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	ClearanceActionKind	[0..1]	See C.4	The ClearanceAction can be used in a SwitchingPlan to define the transfer of control between the control room and field personnel when field work is ready to start. This is accomplished by defining a ClearanceAction with a ClearanceAction.kind of issue. Control is passed back from the field to the control room after the field work is complete. This is accomplished by defining a ClearanceAction in the SwitchingPlan with a ClearanceAction.kind of release. A ClearanceAction.kind of update in a SwitchingPlan can be used to change the list of TaggedPSRs or other attributes.
Clearance	Clearance	[0..1]	See B.16	This defines the actual Clearance that is part of this action.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew. This will be blank until the action is sent to the crew
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

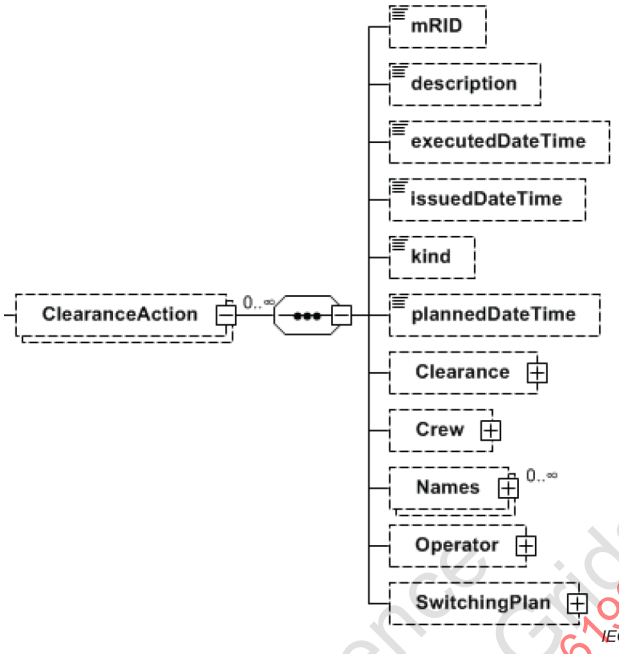

Figure 63 – SwitchingActions – ClearanceAction fragment

5.10.8 SwitchingActions payload – ControlAction

The attributes of **ControlAction** that are used in this profile are shown in Table 38 and graphically in Figure 64.

Table 38 – ControlAction payload fragment

Operations: ControlAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID for this ControlAction
description	String	[0..1]		Free form description of the action.
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
phases	PhaseCode	[0..1]	See C.12	Phases to be controlled.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

Operations: ControlAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
Choice of one of the following Controls				
AccumulatorReset	AccumulatorReset		See 5.6.4	
AnalogControl	AnalogControl		See 5.6.5	
Command	Command		See 5.6.6	
RaiseLowerCommand	RaiseLowerCommand		See 5.6.7	
SetPoint	SetPoint		See 5.6.8	

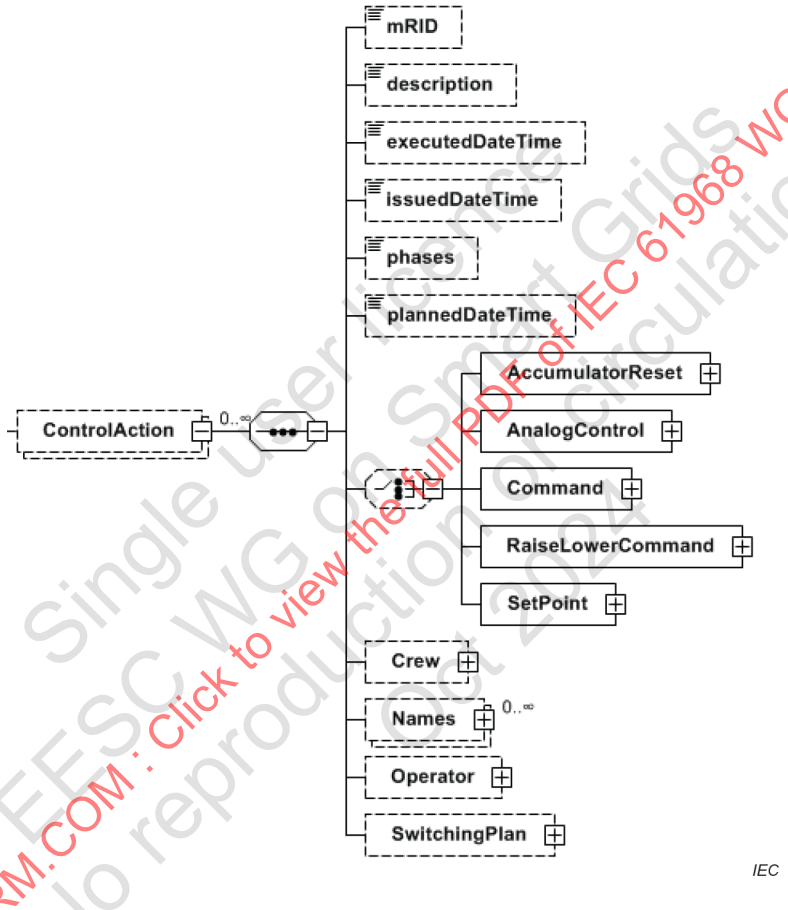

Figure 64 – SwitchingActions – ControlAction fragment

5.10.9 SwitchingActions Payload – CutAction

The attributes of **CutAction** that are used in this profile are shown in Table 39 and graphically in Figure 65.

Table 39 – CutAction payload fragment for SwitchingActions

Operations: CutAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of this CutAction
description	String	[0..1]		Free form description of the action.
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TempEquipActionKind	[0..1]	See C.20	Indicates whether the cut should be placed or removed.
Cut	Cut	[0..1]	See B.18	The cut that is to be placed or removed.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

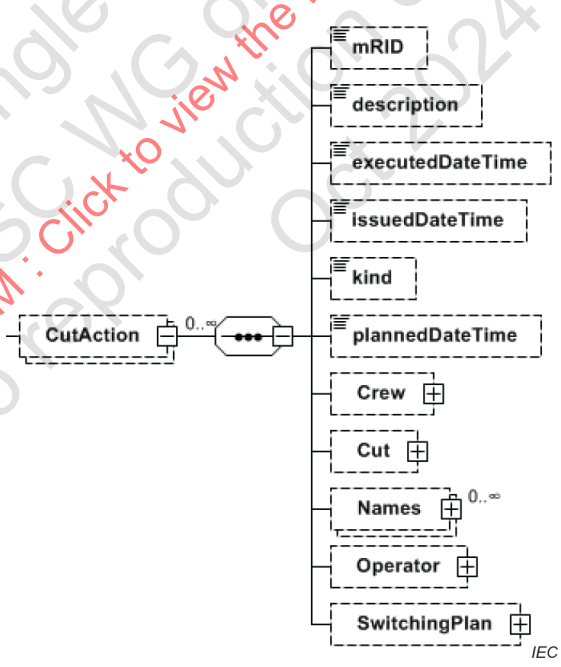

Figure 65 – SwitchingActions – CutAction fragment

5.10.10 SwitchingActions payload – EnergyConsumerAction

The attributes of **EnergyConsumerAction** that are used in this profile are shown in Table 40 and graphically in Figure 66.

Table 40 – EnergyConsumerAction payload fragment for SwitchingActions

Operations: EnergyConsumerAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the EnergyConsumerAction
description	String	[0..1]		Free form description of EnergyConsumerAction
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TempEquipActionKind	[0..1]	See C.20	Defines whether to disconnect or connect the energy consumer from/to its terminals.
phases	PhaseCode	[0..1]	See C.12	Phases to perform the action on.
EnergyConsumer	EnergyConsumer	[0..1]	See B.34	EnergyConsumer to connect or disconnect.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

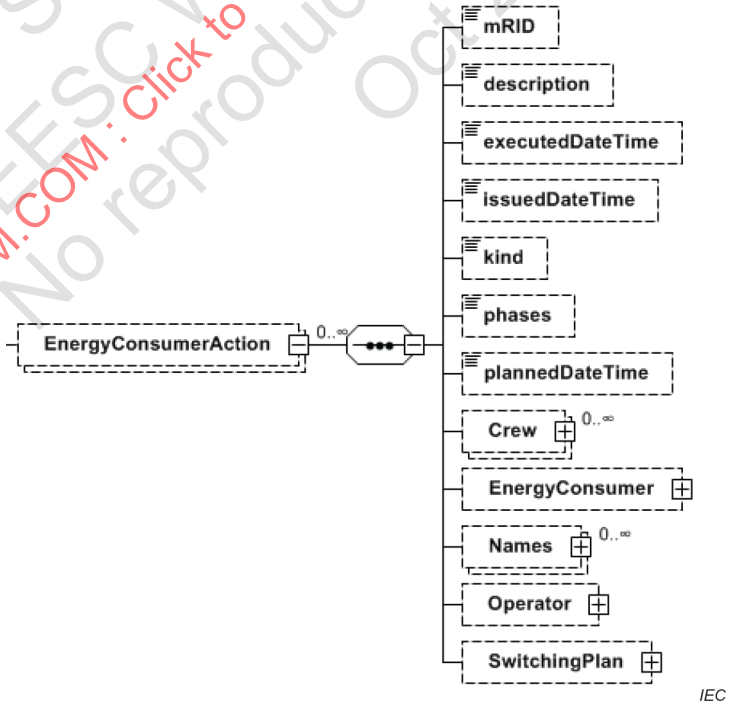

Figure 66 – SwitchingActions – EnergyConsumerAction fragment

5.10.11 **SwitchingActions** payload – **EnergySourceAction**

The attributes of **EnergySourceAction** that are used in this profile are shown in Table 41 and graphically in Figure 67.

Table 41 – EnergySourceAction payload fragment for SwitchingActions

Operations: EnergySourceAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the EnergySourceAction
description	String	[0..1]		Free form description of EnergySourceAction
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TempEquipActionKind	[0..1]	See C.20	Defines whether to place or remove the energy source.
phases	PhaseCode	[0..1]	See C.12	Phases to perform the action on.
EnergySource	EnergySource	[0..1]	See B.35	EnergySource to place or remove.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

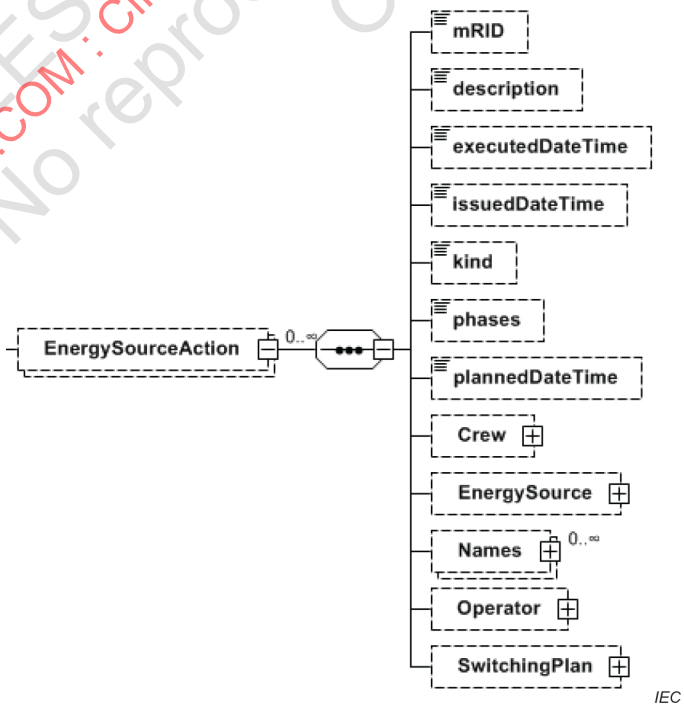

Figure 67 – SwitchingActions – EnergySourceAction fragment

5.10.12 **SwitchingActions** payload – **GenericAction**

The attributes of **GenericAction** that are used in this profile are shown in Table 42 and graphically in Figure 68.

Table 42 – GenericAction payload fragment for SwitchingActions

Operations: GenericAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of this GenericAction
description	String	[0..1]		Free form description of the action.
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
phases	PhaseCode	[0..1]	See C.12	Phases to be operated by this action.
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	Defines the PowerSystemResource to perform the GenericAction on.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
phases	PhaseCode	[0..1]	See C.12	Phases to operate.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

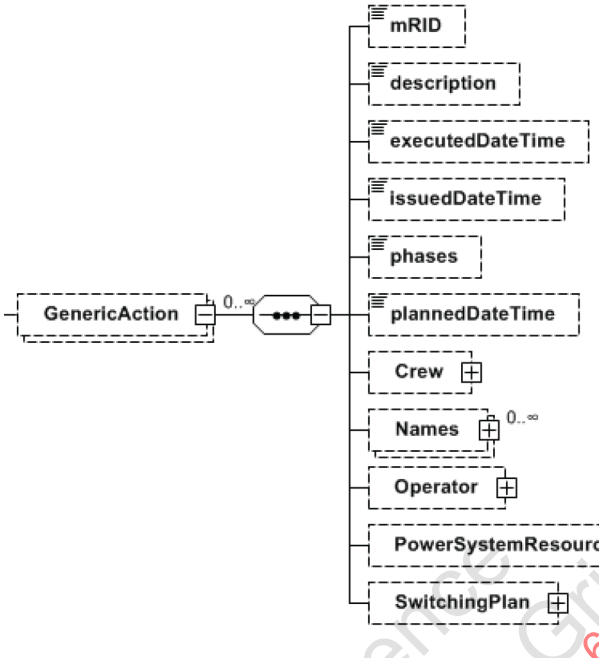

Figure 68 – SwitchingActions – GenericAction fragment

5.10.13 SwitchingActions payload – GroundAction

The attributes of **GroundAction** that are used in this profile are shown in Table 43 and graphically in Figure 69.

See 5.8.13 for a more detailed description of the **GroundAction**, although the payload is slightly different.

Table 43 – GroundAction payload fragment for SwitchingActions

Operations: GroundAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID for the GroundAction
description	String	[0..1]		Free-form description of the GroundAction
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TempEquipActionKind	[0..1]	See C.22	Defines the action to be performed, either place the ground or remove the ground
Ground	Ground	[0..1]	See B.44	Ground to place or remove.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

Choice of one of the following				
ACLineSegment	ACLineSegment		See B.4	Conductor where the ground is to be placed.
Clamp	Clamp		See B.14	Clamp where the ground is to be placed, if the ground is to be placed part way along a conductor
ConductingEquipment	ConductingEquipment		See B.14	ConductingEquipment where the ground is to be placed.

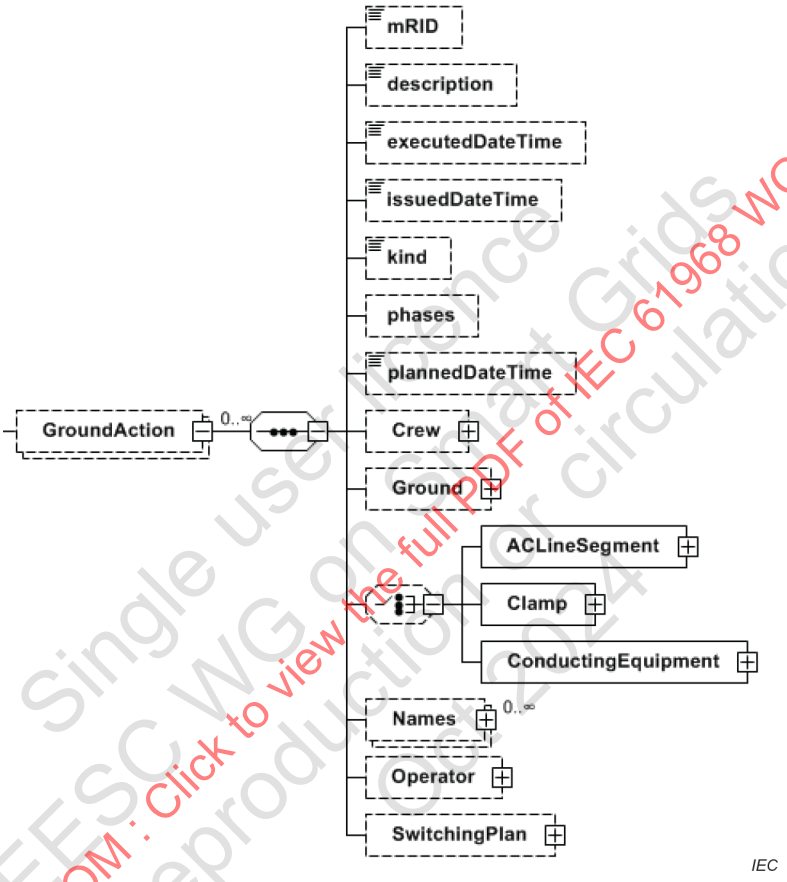

Figure 69 – SwitchingActions – GroundAction fragment

5.10.14 SwitchingActions payload – JumperAction

The attributes of **JumperAction** that are used in IEC 61968-3 profiles are shown in Table 44 and graphically in Figure 70.

Table 44 – JumperAction payload fragment for SwitchingActions

Operations: JumperAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	
description	String	[0..1]		Free form description of the action.
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TempEquipActionKind	[0..1]	See C.20	Indicates whether the jumper should be placed or removed.
ACLineSegment	ACLineSegment	[0..*]	See B.4	There could be zero, one or two ACLineSegments in the payload, depending on where the jumper is to be attached. Each ACLineSegment defines where one end of the jumper is to be placed.
Clamp	Clamp	[0..*]	See B.14	There could be zero, one or two Clamps in the payload, depending on where the jumper is to be attached. Each clamp defines where one end of the jumper is attached to
JumpedEquipments	ConductingEquipment	[0..*]	See B.14	There could be zero, one or two JumpedEquipments in the payload, depending on where the jumper is to be attached. Each JumpedEquipments defines the ConductingEquipment that one end of the jumper is attached to.
Jumper	Jumper	[0..1]	See B.35	The jumper that is to be placed or removed.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

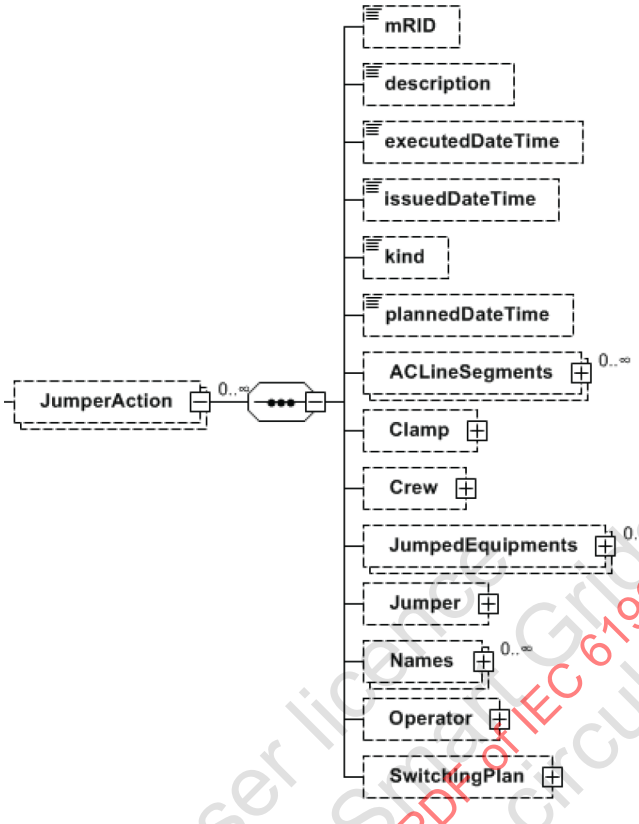

Figure 70 – SwitchingActions – JumperAction fragment

5.10.15 SwitchingActions payload – MeasurementAction

The attributes of **MeasurementAction** that are used in this profile are shown in Table 45 and graphically in Figure 71.

Table 45 – MeasurementAction payload fragment for SwitchingActions

Operations: MeasurementAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	
description	String	[0..1]		Free form description of the action.
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
phases	PhaseCode	[0..1]	See C.12	
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.
Choice of one of the following				
Accumulator	Accumulator		See 5.4.2	
Analog	Analog		See 5.4.2	
Discrete	Discrete		See 5.4.2	
StringMeasurement	StringMeasurement		See 5.4.2	

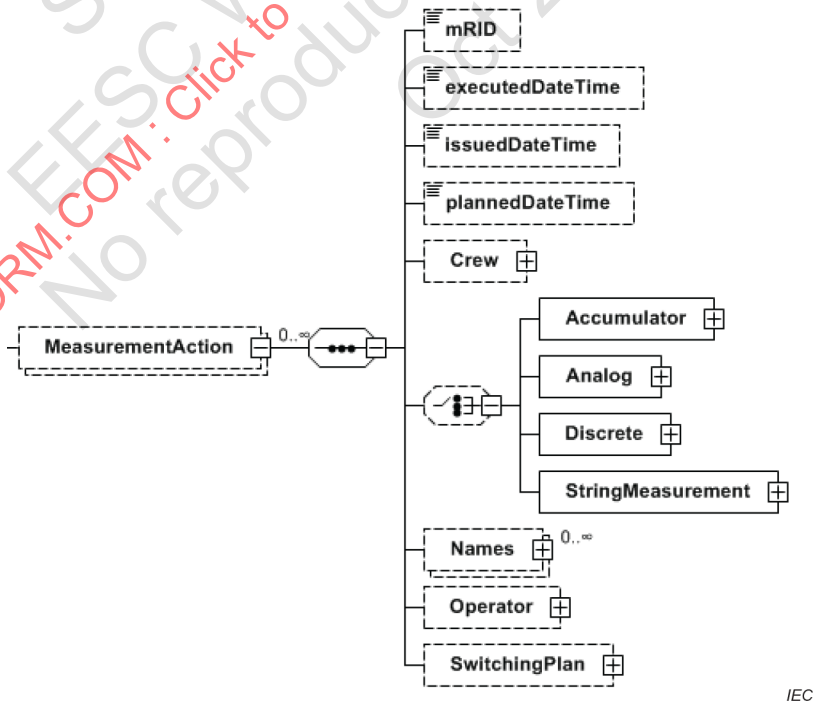

Figure 71 – SwitchingActions – MeasurementAction fragment

5.10.16 **SwitchingActions** payload – **ShuntCompensatorAction**

The attributes of **ShuntCompensatorAction** that are used in this profile are shown in Table 46 and graphically in Figure 72.

Table 46 – ShuntCompensatorAction payload fragment for SwitchingActions

Operations: ShuntCompensatorAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the action
description	String	[0..1]		Free form description of the action
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TempEquipActionKind	[0..1]	See C.20	Action to perform – disconnect or connect
phases	PhaseCode	[0..1]	See C.12	Phases to disconnect or connect.
ShuntCompensator	ShuntCompensator	[0..1]	See B.78	ShuntCompensator to perform action on.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

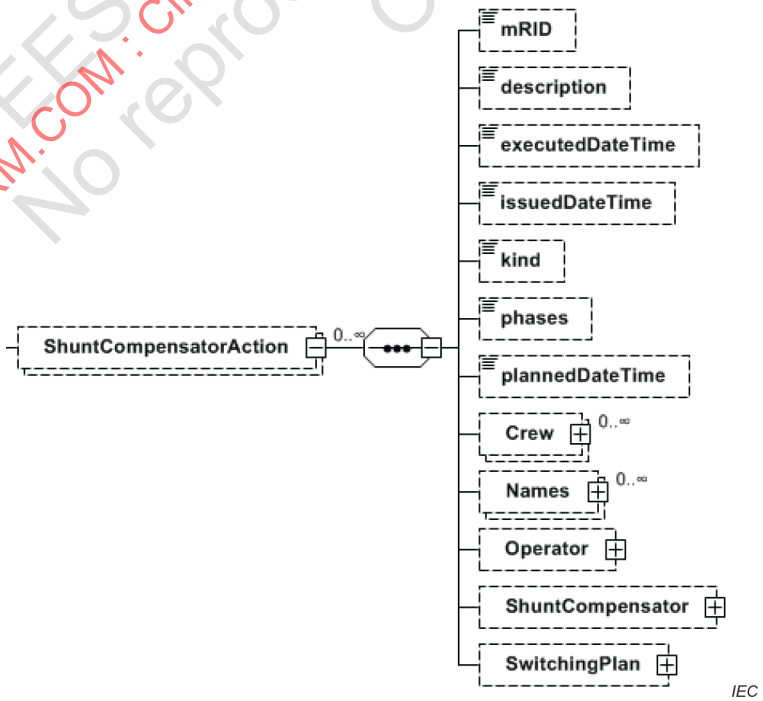

Figure 72 – SwitchingActions – ShuntCompensatorAction fragment

5.10.17 **SwitchingActions** payload – **SwitchAction**

The attributes of **SwitchAction** that are used in this profile are shown in Table 47 and graphically in Figure 73.

Table 47 – SwitchAction payload fragment for SwitchingActions

Operations: SwitchAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the action
description	String	[0..1]		Free form description of the action
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	SwitchActionKind	[0..1]	See C.20	Switching action to perform – open, close, disableReclosing, enableReclosing
OperatedSwitch	Switch	[0..1]	See B.86	Switch to operate.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

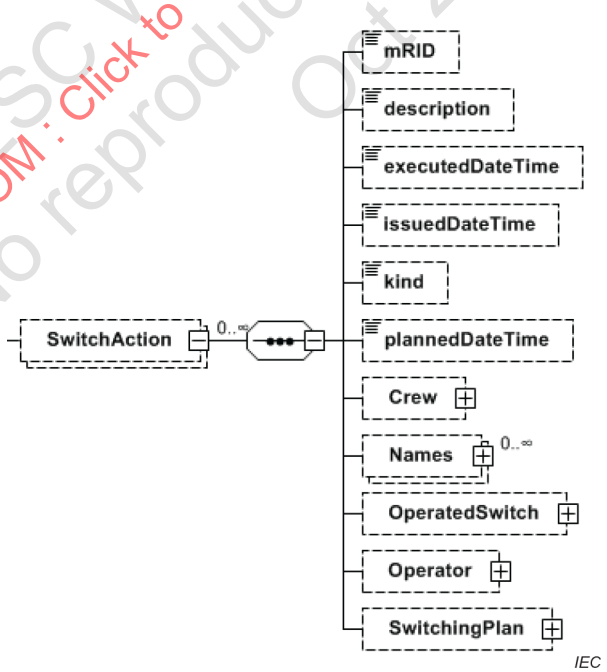

Figure 73 – SwitchingActions – SwitchAction fragment

5.10.18 **SwitchingActions** payload – **TagAction**

The attributes of **TagAction** that are used in this profile are shown in Table 48 and graphically in Figure 74.

Table 48 – TagAction payload fragment for SwitchingActions

Operations: TagAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	
description	String	[0..1]		Free form description of the action.
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
kind	TagActionKind	[0..1]	See C.21	Operation to be performed on the Tag – place, remove, verify
OperationalTag	OperationalTag	[0..1]	See B.59	The actual tag that is to be placed, removed or verified.
phases	PhaseCode	[0..1]	See C.12	Phases on which the tag is to be placed, e.g. A, B, AC, ABC
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

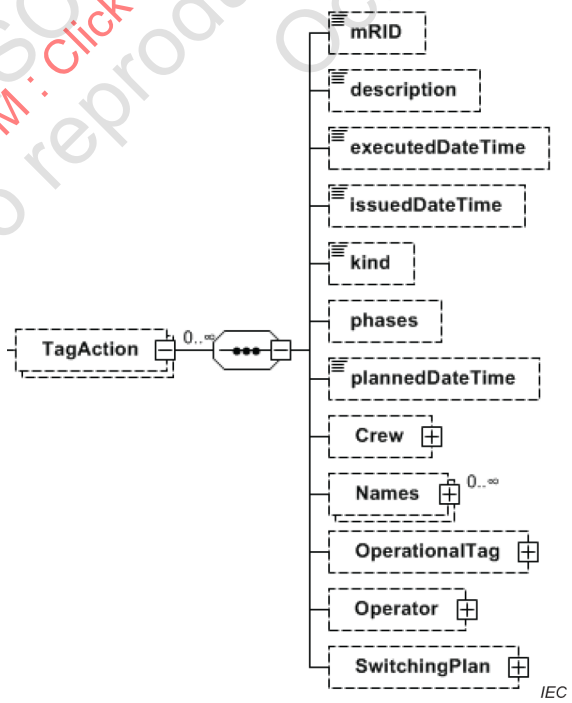

Figure 74 – SwitchingActions – TagAction fragment

5.10.19 **SwitchingActions** payload – **VerificationAction**

The attributes of **VerificationAction** that are used in this profile are shown in Table 49 and graphically in Figure 75.

Table 49 – VerificationAction payload fragment for SwitchingActions

Operations: VerificationAction				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	
description	String	[0..1]		Free form description of the action.
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the action.
phases	PhaseCode	[0..1]	See C.12	Phases to perform the action on, e.g. A, AB, AC, ABC, etc.
verificationCondition	String	[0..1]		Free from text string describing the condition to verify, e.g. check open, disable reclosing, put into manual mode, etc.
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	PowerSystemResource to perform the verification action on.
executedDateTime	DateTime	[0..1]		DateTime of when the action was executed. This will be blank until the action is executed in the field
issuedDateTime	DateTime	[0..1]		DateTime of when the action was sent to the crew.
phases	PhaseCode	[0..1]	See C.12	
plannedDateTime	DateTime	[0..1]		DateTime of when the action is planned to be executed
Crew	Crew	[0..1]	See B.22	Crew that has been given the action to execute
Operator	Operator	[0..1]	See B.60	Operator who has given the crew this action to execute
SwitchingPlan	SwitchingPlan	[0..1]	See 5.10.3	SwitchingPlan that this action is associated with.

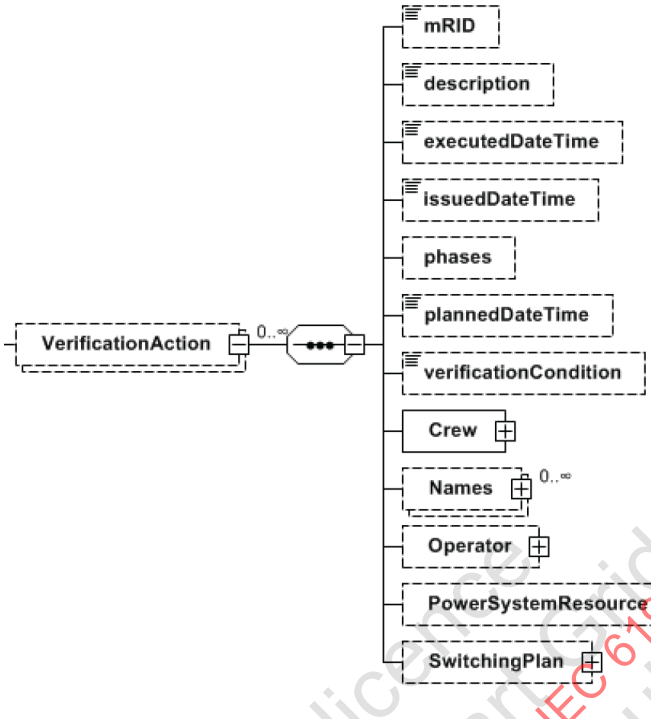

Figure 75 – SwitchingActions – VerificationAction fragment

5.10.20 Example XML

The example shows one of the possible choices of actions, in this case a **SwitchAction**.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:SwitchingActions xmlns:m="http://iec.ch/TC57/2019/SwitchingActions#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/SwitchingActions# SwitchingActions.xsd ">
  <m:SwitchAction>
    <m:mRID>4dcc0e34-de05-4836-83ff-2afa11a6c8c4</m:mRID>
    <m:description>Request to close Switch 1083</m:description>
    <m:issuedDateTime>2019-06-01T08:00:00</m:issuedDateTime>
    <m:kind>close</m:kind>
    <m:Crew>
      <m:Names>
        <m:name>James Smedley IV</m:name>
      </m:Names>
    </m:Crew>
    <m:OperatedSwitch>
      <m:mRID>0738a0bd-0f26-499d-9c44-e2e8ce87a065</m:mRID>
      <m:Assets>
        <m:Names>
          <m:name>Switch 1083</m:name>
        </m:Names>
      </m:Assets>
      <m:Location>
        <m:direction>W Side 25th Ave N of Linden Ave Southbury</m:direction>
      </m:Location>
      <m:Names>
        <m:name>Switch 1083</m:name>
      </m:Names>
      <m:SwitchPhase>
        <m:closed>false</m:closed>
        <m:normalOpen>false</m:normalOpen>
        <m:phaseSide1>ABC</m:phaseSide1>
        <m:phaseSide2>ABC</m:phaseSide2>
      </m:SwitchPhase>
    </m:OperatedSwitch>
    <m:Operator>
      <m:Names>
        <m:name>Horatio Hornblower</m:name>
      </m:Names>
    </m:Operator>
    <m:SwitchingPlan>
      <m:mRID>6571f4c4-acee-4024-8d1f-6c4a0398e5fa</m:mRID>
      <m:description>Example switching plan</m:description>
      <m:Names>
        <m:name>Switching Plan PO-2019-04-142</m:name>
      </m:Names>
      <m:SwitchingStepGroups>
        <m:description>m:First Group</m:description>
        <m:isFreeSequence>false</m:isFreeSequence>
        <m:purpose>m:Close the switch</m:purpose>
        <m:sequenceNumber>1</m:sequenceNumber>
        <m:SwitchingStep>
          <m:isFreeSequence>false</m:isFreeSequence>
          <m:sequenceNumber>1</m:sequenceNumber>
          <m:subStepSequenceNumber>1</m:subStepSequenceNumber>
        </m:SwitchingStep>
      </m:SwitchingStepGroups>
    </m:SwitchingPlan>
  </m:SwitchAction>
</m:SwitchingActions>
```


5.11 SwitchingEvents payload

5.11.1 General

SwitchingEvents are used to communicate temporary network changes that have been made either as the result of the execution of a switching plan step or as a result of network operations outside of a switching plan.

SwitchingEvents are used to communicate temporary network changes that have been made as the result of the execution of a **SwitchingPlanStep** (see Subclause 5.8) in a **SwitchingPlan** that was initiated via a **SwitchingAction.**

The results of executing a **SwitchingPlanStep** that is a **ControlAction** are coordinated with **PSRControls** and **PSRMeasurements** messages, rather than **SwitchingEvents**.

SwitchingEvents are also used to communicate temporary network changes between enterprise systems that have been made outside of a **SwitchingPlan**. Temporary network changes are of special importance in the case of network construction, during outages caused by severe weather or other disaster, or as emergency backup during maintenance of the network or power plants. In those scenarios, the power utilities are forced to still maintain the balance between generation and consumption as well as to re-supply affected customers as fast as possible. Temporary network changes such as jumpers, cuts and grounds, are used to temporarily reconfigure the respective part of the network.

Figure 76 shows how a change in the network is communicated from one actor to another, in this case DMS communicates a network change to OMS and there is no **SwitchingPlan** involved.

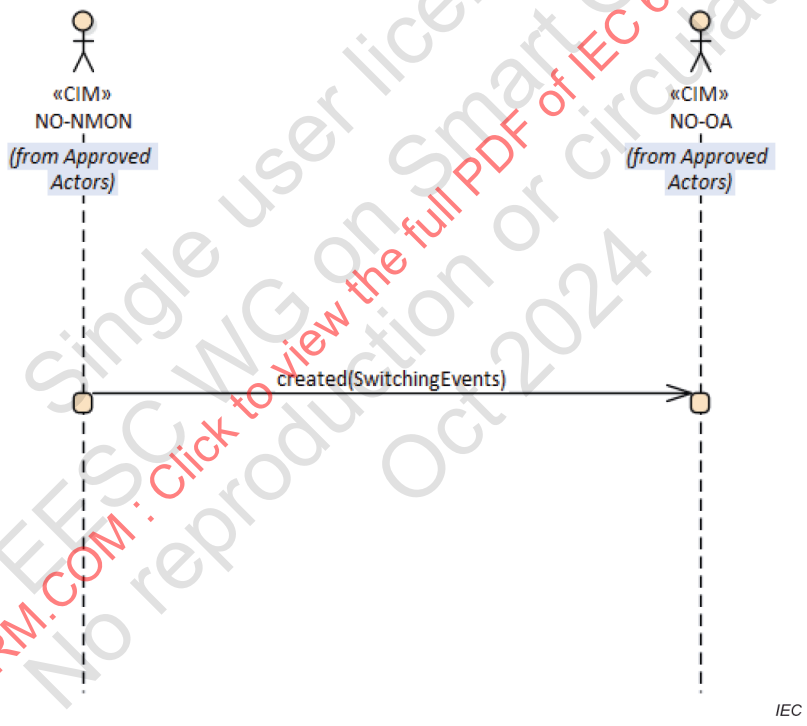

Figure 76 – SwitchingEvents sequence diagram for a notification

5.11.2 Message payload

Figure 77 shows the top level payload for **SwitchingEvents** in graphical form; Table 50 defines the attributes in detail.

Table 50 – SwitchingEvents Profile

SwitchingEvents				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
SwitchingEvents	SwitchingEvent	[0..*]		
mRID	String	[0..1]	GUID	mRID of this SwitchingEvent
description	String	[0..1]		Free-form description of this SwitchingEvent
Names	Name	[0..*]	See B.56	Human-readable names for this SwitchingEvent
reason	String	[0..1]		Free text reason for the **SwitchingEvent**
severity	String	[0..1]		Severity of this event
type	String	[0..1]		Free-form text
		[0..*]		Choice of actions as shown below
Actions				
ClampAction	ClampAction		See 5.10.6	
ClearanceAction	ClearanceAction		See 5.10.7	
ControlAction	ControlAction		See 5.10.8	
CutAction	CutAction		See 5.10.9	
EnergyConsumerAction	EnergyConsumerAction		See 5.10.10	
EnergySourceAction	EnergySourceAction		See 5.10.11	
GenericAction	GenericAction		See 5.10.12	
GroundAction	GroundAction		See 5.10.13	
JumperAction	JumperAction		See 5.10.14	
MeasurementAction	MeasurementAction		See 5.10.15	
ShuntCompensatorAction	ShuntCompensatorAction		See 5.10.16	
SwitchAction	SwitchAction		See 5.10.17	
TagAction	TagAction		See 5.10.18	
VerificationAction	VerificationAction		See 5.10.19	

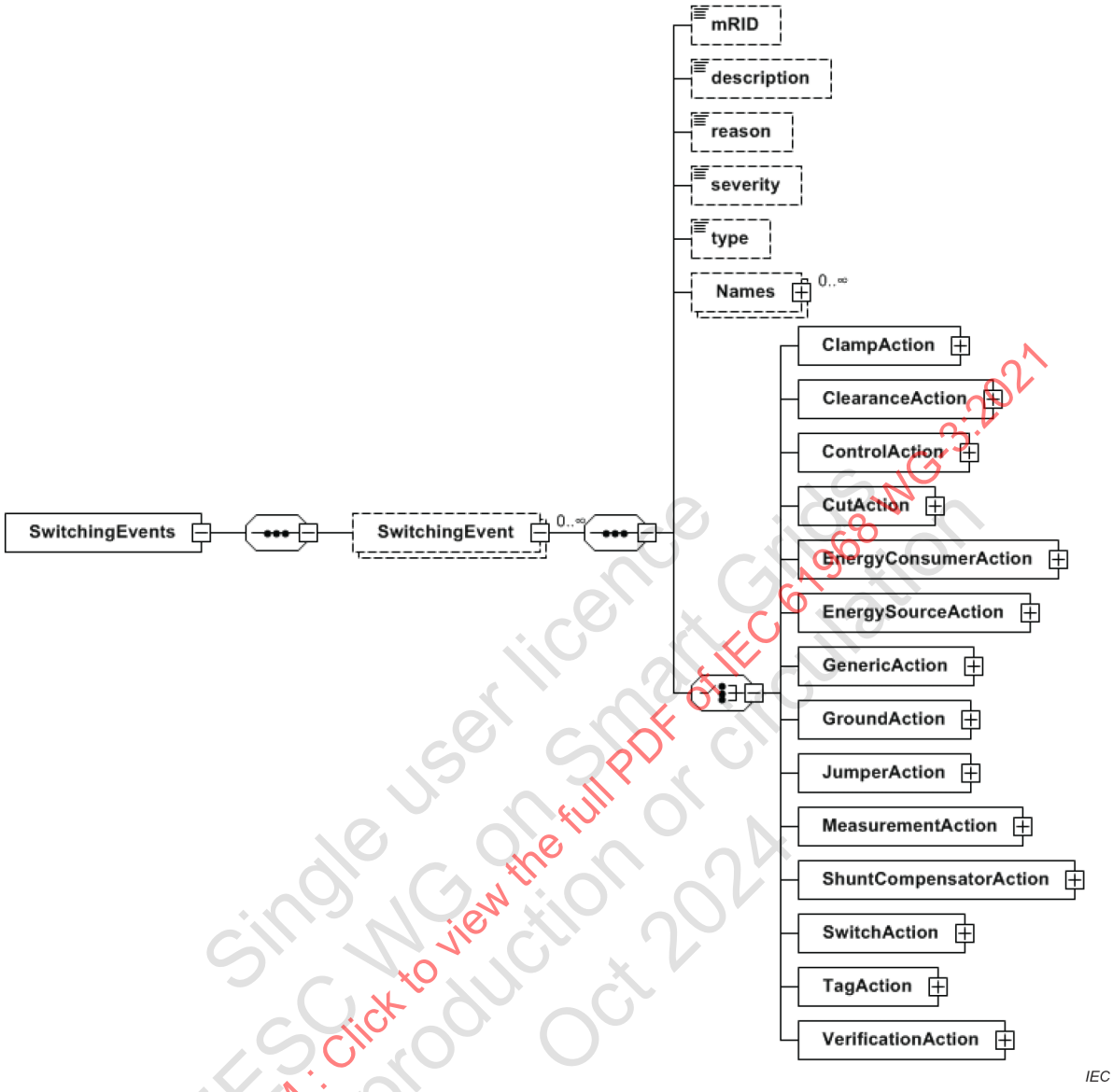

Figure 77 – SwitchingEvents top level payload

The most important part of the payload is a choice of one of the possible actions that was performed on the network. The actions are the same as those in the **SwitchingActions** payload, although as shown in the sequence diagram, the **SwitchingEvents** does not need to be a response to a **SwitchingActions**.

5.11.3 SwitchingEvents payload – ClampAction

The **ClampAction** payload fragment in the **SwitchingEvents** message payload is the same as the **ClampAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.6

5.11.4 SwitchingEvents payload – ClearanceAction

The **ClearanceAction** payload fragment in the **SwitchingEvents** message payload is the same as the **ClearanceAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.7.

5.11.5 SwitchingEvents payload – ControlAction

The **ControlAction** payload fragment in the **SwitchingEvents** message payload is the same as the **ControlAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.8.

5.11.6 SwitchingEvents Payload – CutAction

The **CutAction** payload fragment in the **SwitchingEvents** message payload is the same as the **CutAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.9.

5.11.7 SwitchingEvents payload – EnergyConsumerAction

The **EnergyConsumerAction** payload fragment in the **SwitchingEvents** message payload is the same as the **EnergyConsumerAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.10.

5.11.8 SwitchingEvents payload – EnergySourceAction

The **EnergySourceAction** payload fragment in the **SwitchingEvents** message payload is the same as the **EnergySourceAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.11.

5.11.9 SwitchingEvents payload – GenericAction

The **GenericAction** payload fragment in the **SwitchingEvents** message payload is the same as the **GenericAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.12.

5.11.10 SwitchingEvents payload – GroundAction

The **GenericAction** payload fragment in the **SwitchingEvents** message payload is the same as the **GenericAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.13.

5.11.11 SwitchingEvents payload – JumperAction

The **JumperAction** payload fragment in the **SwitchingEvents** message payload is the same as the **JumperAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.14.

5.11.12 SwitchingEvents payload – MeasurementAction

The **MeasurementAction** payload fragment in the **SwitchingEvents** message payload is the same as the **MeasurementAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.15.

5.11.13 SwitchingEvents payload – ShuntCompensatorAction

The **ShuntCompensatorAction** payload fragment in the **SwitchingEvents** message payload is the same as the **ShuntCompensatorAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.16.

5.11.14 SwitchingEvents payload – SwitchAction

The **SwitchAction** payload fragment in the **SwitchingEvents** message payload is the same as the **SwitchAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.17.

5.11.15 SwitchingEvents payload – TagAction

The **TagAction** payload fragment in the **SwitchingEvents** message payload is the same as the **TagAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.18.

5.11.16 **SwitchingEvents** payload – **VerificationAction**

The **TagAction** payload fragment in the **SwitchingEvents** message payload is the same as the **TagAction** payload fragment in the **SwitchingActions** message. See Subclause 5.10.19.

5.11.17 Example XML

The example below is a consequential response to the example **SwitchingAction** in 5.10.20, using the same switch, with a successful completion.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:SwitchingEvents xmlns:m="http://iec.ch/TC57/2019/SwitchingEvents#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/SwitchingEvents# Copy of SwitchingEvents.xsd ">
  <m:SwitchingEvent>
    <m:mRID>0575495a-2767-4875-9134-11fd46045b95</m:mRID>
    <m:description>Response to request to close Switch 1083</m:description>
    <m:reason>Execution through switching plan</m:reason>
    <m:SwitchAction>
      <m:mRID>4dcc0e34-de05-4836-83ff-2afa11a6c8c4</m:mRID>
      <m:description>Request to close Switch 1083</m:description>
      <m:executedDateTime>2019-06-01T08:02:48</m:executedDateTime>
      <m:issuedDateTime>2019-06-01T08:00:00</m:issuedDateTime>
      <m:Crew>
        <m:Names>
          <m:name>James Smedley IV</m:name>
        </m:Names>
      </m:Crew>
      <m:OperatedSwitch>
        <m:mRID>0738a0bd-0f26-499d-9c44-e2e8ce87a065</m:mRID>
        <m:Names>
          <m:name>Switch 1083</m:name>
        </m:Names>
        <m:SwitchPhase>
          <m:closed>true</m:closed>
          <m:phaseSide1>ABC</m:phaseSide1>
          <m:phaseSide2>ABC</m:phaseSide2>
        </m:SwitchPhase>
      </m:OperatedSwitch>
      <m:Operator>
        <m:Names>
          <m:name> Horatio Hornblower </m:name>
        </m:Names>
      </m:Operator>
     <m:SwitchingPlan>
       <m:mRID>6571f4c4-asee-4024-8d1f-6c4a0398e5fa</m:mRID>
       <m:description>Example switching plan</m:description>
       <m:Names>
        <m:name>Switching Plan PO-2019-04-142</m:name>
       </m:Names>
       <m:SwitchingStepGroups>
         <m:description>m:First Group</m:description>
         <m:sequenceNumber>1</m:sequenceNumber>
         <m:SwitchingStep>
          <m:sequenceNumber>1</m:sequenceNumber>
           <m:subStepSequenceNumber>1</m:subStepSequenceNumber>
         </m:SwitchingStep>
       </m:SwitchingStepGroups>
     </m:SwitchingPlan>
    </m:SwitchAction>
  </m:SwitchingEvent>
</m:SwitchingEvents>
```


5.12 **PlannedOutageNotification** payload

5.12.1 General

NOTE the distinction between and **PlannedOutageNotification** and a **PlannedOutage** is that the **PlannedOutageNotification** is created prior to customers being taken out of service, while the **PlannedOutage** is created once switching has started and customers are out of service.

PlannedOutageNotifications are used to notify a customer system that **UsagePoint**s will be impacted by a **SwitchingPlan**, prior to the execution of the **SwitchingPlan**.

A sequence diagram showing an example of the creation of **PlannedOutageNotification** is shown in Figure 78.

Firstly, a **SwitchingPlanRequest** is used to initiate the creation of a **SwitchingPlan**. The **SwitchingPlanRequest** identifies at a high level that work needs to be done, on a particular part of the network, and at what time and date. A **SwitchingPlan Author** will look at the requirements in the **SwitchingPlanRequest** and write a detailed **SwitchingPlan** to be associated with the **SwitchingPlanRequest**.

Once the **SwitchingPlan** has been created and approved, a request to create a **SwitchingOrder** is issued. The **SwitchingOrder** is used to schedule field crews to the work.

When the **SwitchingOrder** is created, it defines the time and date that the work will be performed and by whom. This provides the schedule information necessary to create a **PlannedOutageNotification**. The **PlannedOutageNotification** includes the scheduled start date/time and a list of customers to notify prior to the **SwitchingPlan** being executed.

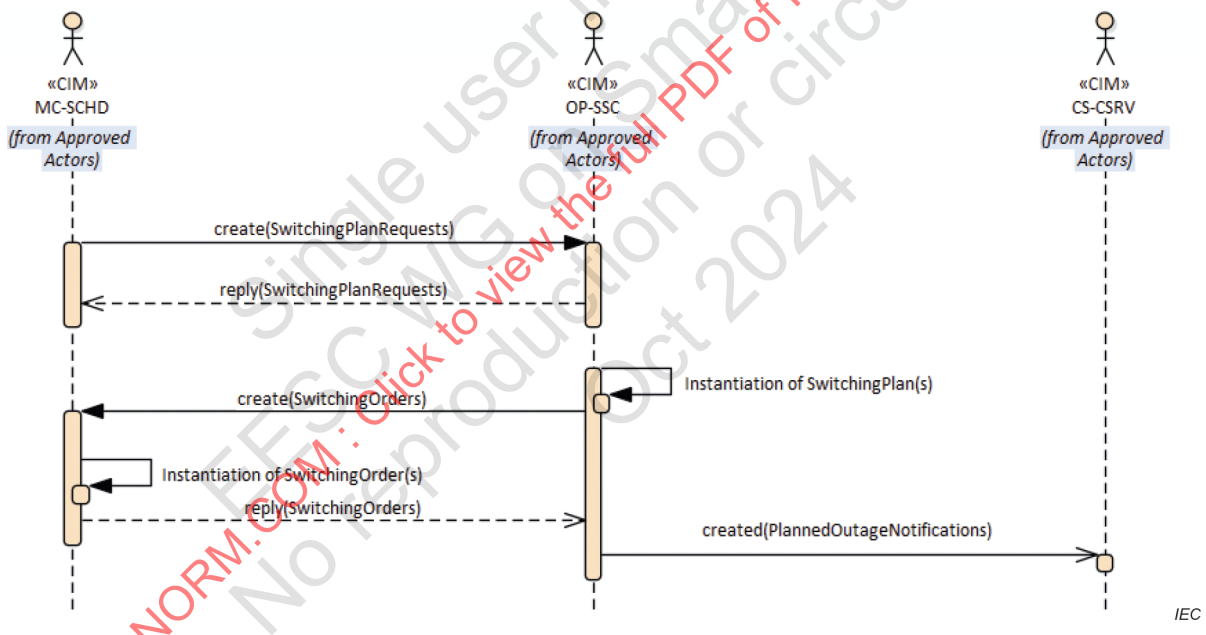

Figure 78 – PlannedOutageNotifications sequence diagram

PlannedOutageNotifications can be changed if the related **SwitchingOrder** is changed such that it either affects which **UsagePoint**s will be affected or if the scheduled time/date of execution changes. The **SwitchingOrder** can also be canceled. Changing **SwitchingOrders** and the consequent change to the **PlannedOutageNotification** is shown in Figure 79.

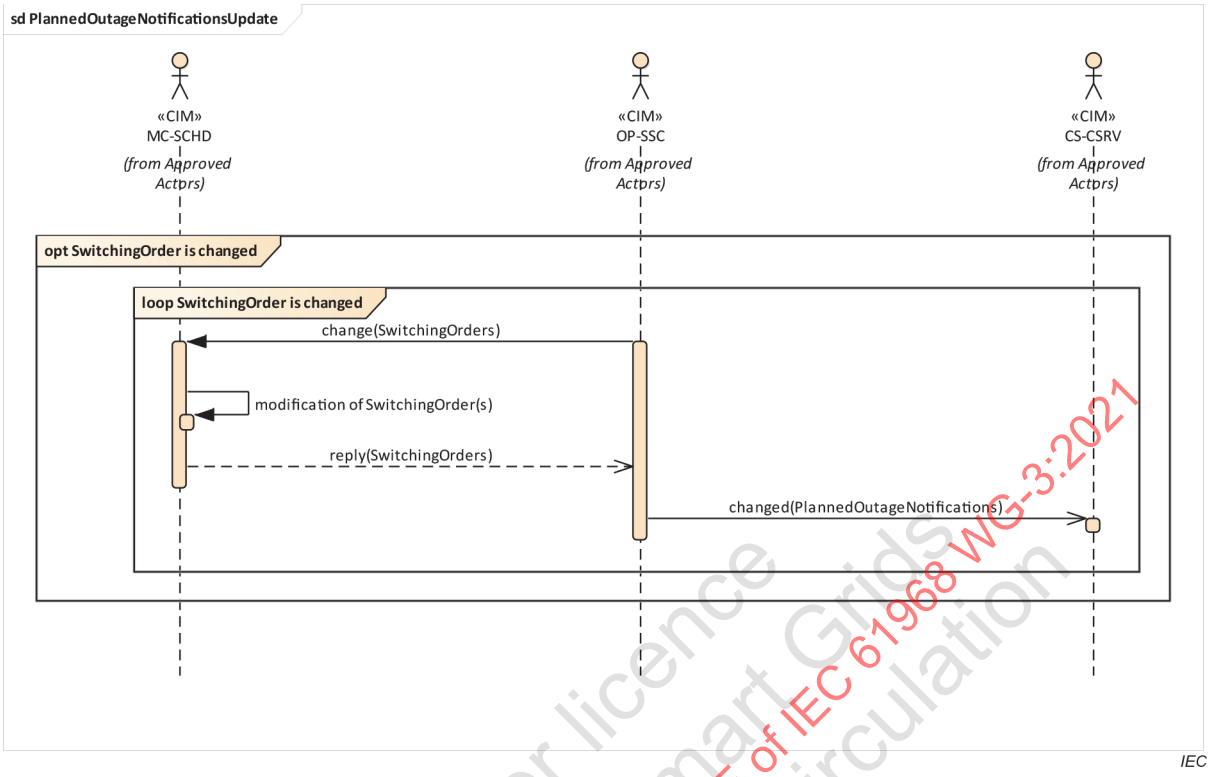

Figure 79 – change PlannedOutageNotifications sequence diagram

5.12.2 Message payload

Figure 80 shows the top level message payload for **PlannedOutageNotifications** in graphical form, while Table 51 shows the attributes in detail.

Table 51 – PlannedOutageNotifications Profile

PlannedOutageNotifications				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
PlannedOutageNotifications	PlannedOutageNotification	[1..*]		
Profile Attributes				
mRID	String	[0..1]	GUID	
description	String	[0..1]		Free-form text field that describes the **PlannedOutageNotification**
Names	Name	[0..1]	See B.56	Human-readable names associated with the PlannedOutageNotification
comment	String	[0..1]		Free-form text
createdDateTime	DateTime	[0..1]		DateTime that the PlannedOutageNotification was initially created.
lastModifiedDateTime	DateTime	[0..1]		DateTime that the PlannedOutageNotification was last modified.
revisionNumber	String	[0..1]		Revision number of this PlannedOutageNotification
subject	String	[0..1]		Free-form text.
title	String	[0..1]		Title of this PlannedOutageNotification. Free-form text
UsagePoint	UsagePoint	[0..*]	See B.97	UsagePoints that will be de-energized as a result of executing this SwitchingPlan.
SwitchingPlan	SwitchingPlan	[0..1]	See 5.8.2	Includes the start and end date/time of the SwitchingPlan.

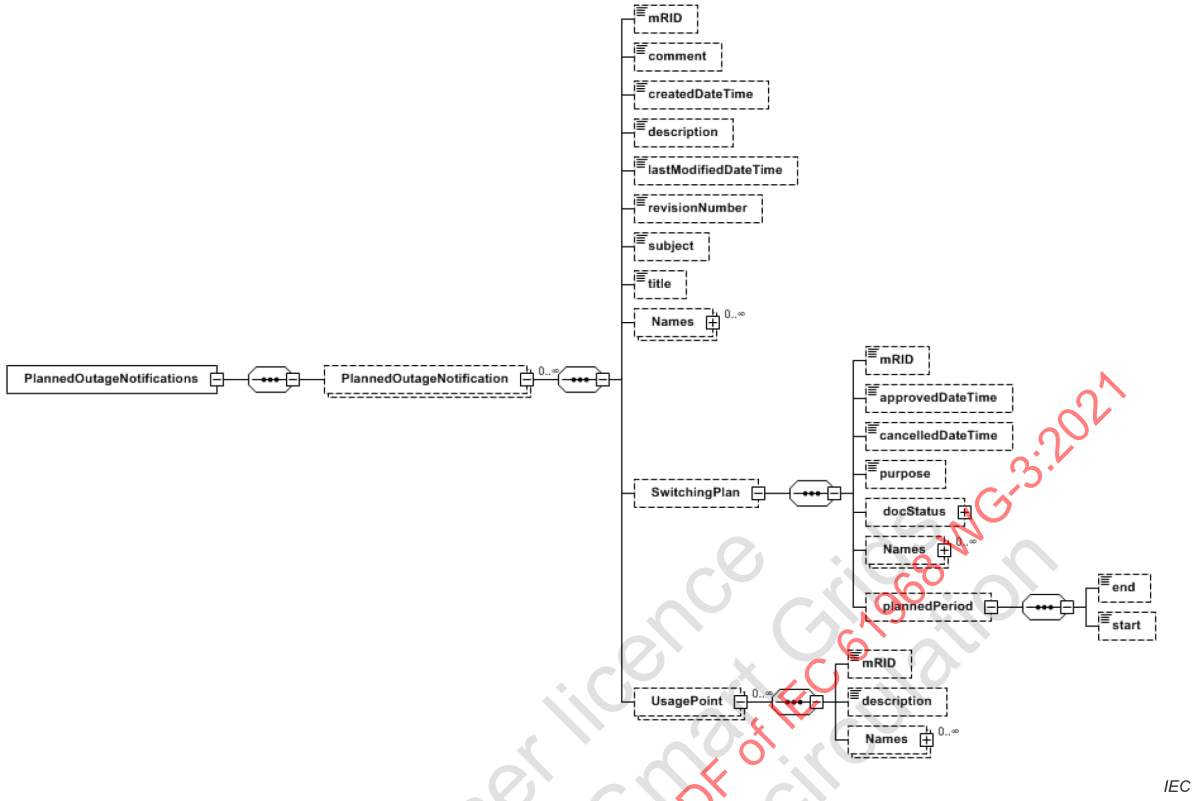

Figure 80 – PlannedOutageNotifications message payload

Attributes of the **SwitchingPlan** include the start and end date (**plannedPeriod.start**, **plannedPeriod.end**) as well as the status of the **SwitchingPlan**.

5.12.3 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PlannedOutageNotifications xmlns:m="http://iec.ch/TC57/2019/PlannedOutageNotifications#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/PlannedOutageNotifications#
PlannedOutageNotifications.xsd ">
  <m:PlannedOutageNotification>
    <m:mRID>a52a3bb6-d05d-43db-8d46-ee629bc09ff6</m:mRID>
    <m:comment>Notification of planned outage</m:comment>
    <m:createdDateTime>2019-05-22T09:30:00</m:createdDateTime>
    <m:description>Notification for example switching plan</m:description>
    <m:lastModifiedDateTime>2019-05-25T16:45:00</m:lastModifiedDateTime>
    <m:revisionNumber>B</m:revisionNumber>
    <m:subject>Revised to exclude Our Lady of Mercy Hospital</m:subject>
    <m:title>New Construction</m:title>
    <m:UsagePoint>
      <m:mRID>326bc1f5-0c97-4ef9-b266-77be10f72fc8</m:mRID>
    </m:UsagePoint>
    <m:UsagePoint>
      <m:mRID>ec035307-40ee-4605-86eb-e1dc4985010a</m:mRID>
    </m:UsagePoint>
    <m:Names>
      <m:name>Planned Outage notification for Switching Plan PO-2019-04-142</m:name>>
    </m:Names>
    <m:SwitchingPlan>
      <m:mRID>6571f4c4-acee-4024-8d1f-6c4a0398e5fa </m:mRID>
      <m:approvedDateTime>2019-04-10T14:14:14</m:approvedDateTime>
      <m:purpose>New Construction</m:purpose>
      <m:docStatus>
        <m:dateTime>2019-05-25T16:45:00</m:dateTime>
        <m:reason>Revised</m:reason>
        <m:value>Approved</m:value>
      </m:docStatus>
      <m:Names>
        <m:name>Switching Plan PO-2019-04-142</m:name>
```

```
      </m:Names>
      <m:plannedPeriod>
        <m:end>2019-05-01T12:00:00</m:end>
        <m:start>2019-01-01T08:00:00</m:start>
      </m:plannedPeriod>
    </m:SwitchingPlan>
  </m:PlannedOutageNotification>
</m:PlannedOutageNotifications>
```

5.13 **PlannedOutages** payload

5.13.1 General

PlannedOutages message payloads, shown in Figure 82, communicate **PlannedOutages** to ensure that other parts of the utility are aware that there is a planned outage in progress.

- A **PlannedOutage** is created and changes as shown in the sequence diagram, Figure 81. The **PlannedOutage** is created when steps in a **SwitchingPlan** are executed, either by a field crew or remotely by SCADA and the first customer(s) is de-energized. This is indicated by the number of **DeEnergizedUsagePoints** changing from zero to non-zero.
- A **PlannedOutage** changes when the **SwitchingPlan** continues executing and the number of customers impacted changes, or the estimated restoration time changes, for example. The diagram shows the number of impacted customers changing as the number of **DeEnergizedUsagePoints** changes from a non-zero value to another value. This can include going from non-zero to zero.

NOTE the distinction between a **PlannnedOutageNotification** and a **PlannedOutage** is that the **PlannedOutageNotification** is created prior to customers being taken out of service, while the **PlannedOutage** is created once switching has started and the first customer(s) are out of service.

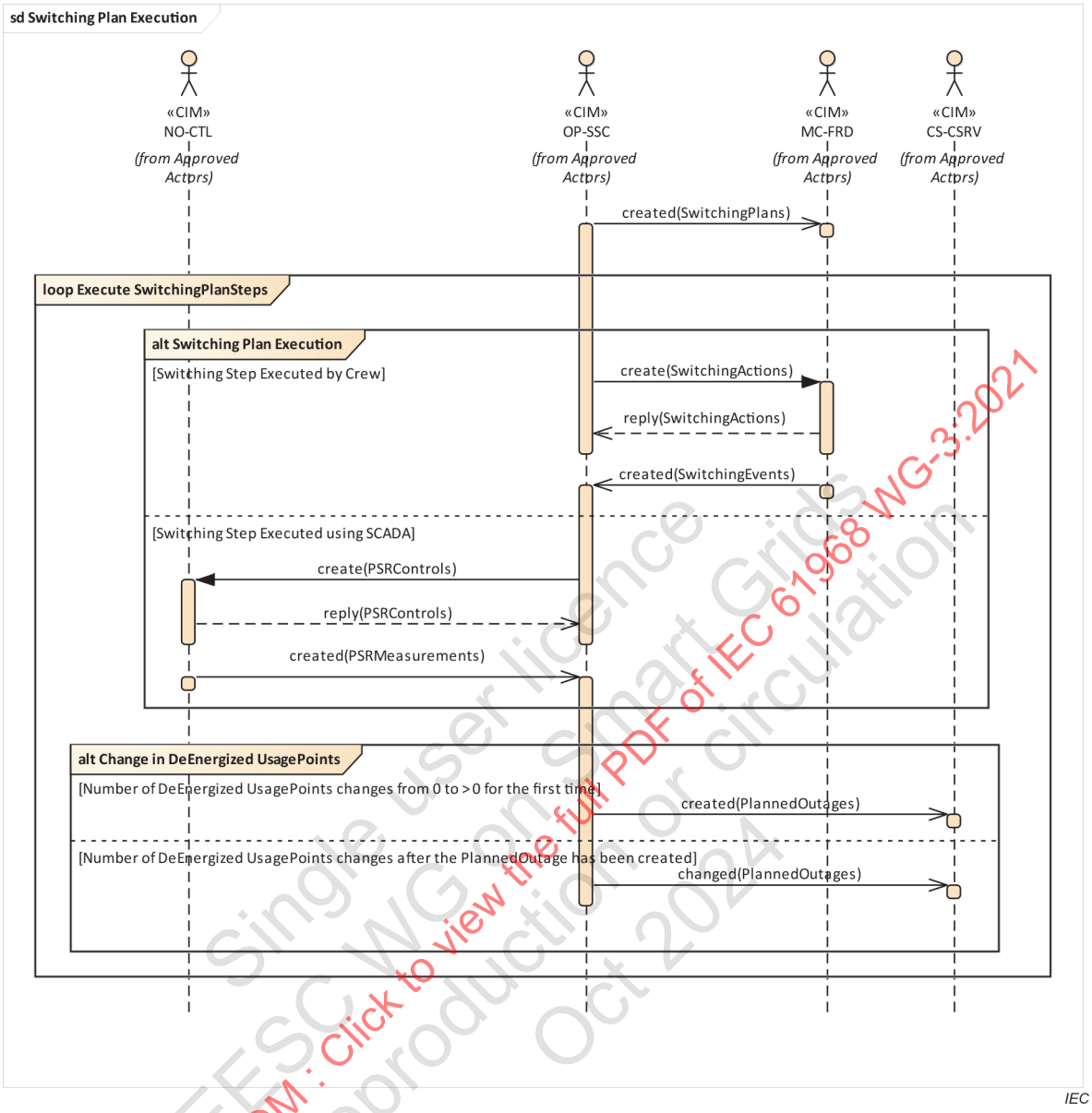

Figure 81 – PlannedOutages – sequence diagram

PlannedOutage information may be used by different applications depending on the type and cause of the **PlannedOutage**. During the lifecycle of those **PlannedOutage**s, the outage information is updated, including changed outage state (outage is in effect, outage is completed, customers are partially or completely restored to power, etc.).

5.13.2 Message payload

The attributes for the **PlannedOutages** profile are shown in Table 52.

Table 52 – PlannedOutages Profile

PlannedOutages				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
PlannedOutages	PlannedOutage	[1..*]		
Profile Attributes				
description	String	[0..1]		Free-form text field that describes the **PlannedOutage**
mRID	String	[0..1]	GUID	**mRID** of the **PlannedOutage**
Names	Name	[0..*]	See B.56	Can be used to provide additional information such as internal outage number.
communityDescriptor	String	[0..1]		A name to denote the community – this could be a name or a code of some kind.
createdDateTime	DateTime	[0..1]		DateTime that the PlannedOutage was initially created.
customersRestored	Integer	[0..1]		Number of customers that have been restored in the area.
metersAffected	Integer	[0..1]		The updated number of meters affected by the outage as reported by the OMS within the utility. It is assumed this number will be updated repeatedly until the full outage is resolved.
originalCustomersServed	Integer	[0..1]		The total number of customers that are served in the area (both outaged and not outaged).
originalMetersAffected	Integer	[0..1]		The original number of meters that were affected as reported by the OMS within the utility. That is, this is the total number of meters that were out at the beginning of the outage.
outageKind	OutageStatusKind	[0..1]	Enumeration. See C.11	For a PlannedOutage, should only be confirmed, restored or closed.
reason	String	[0..1]		Reason for the PlannedOutage
statusKind	CrewStatusKind	[0..1]	Enumeration. See C.1	Defines the status of the crew as in dispatched or arrived, etc. If there are multiple crews assigned to the PlannedOutage at the same time, then the statusKind shall be the highest priority status as defined in Table 57. The dispatch status of individual crews is available in the FieldDispatchHistory part of the Crew payload fragment in this profile. See B.22
subject	String	[0..1]		String that describes the outage
type	String	[0..1]		String that describes the extent of the outage, e.g. customer, distribution transformer, fuse, recloser, circuit breaker, etc.

PlannedOutages				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
utilityDisclaimer	String	[0..1]		This contains an disclaimers the utility would like to place on the data provided to any stakeholder. This may be different for different stakeholders. This should possibly be an attribute under the Organization class but it is placed here for now.
actualPeriod	DateTimeInterval	[0..1]		Actual outage period; end of the period corresponds to the actual restoration time.
Crew	Crew	[0..*]	See B.22	Crews assigned to this PlannedOutage.
DeEnergizedUsagePoint	UsagePoint	[0..*]	See B.27	List of usage points that are currently de-energized by this outage.
EnergizedUsagePoint	UsagePoint	[0..*]	See B.35	List of usage points that were previously de-energized by this outage but are now energized.
EstimatedPeriod	DateTimeInterval	[0..1]		Estimated duration of the PlannedOutage
EstimatedRestorationTime	EstimatedRestorationTime	[0..1]	See B.38	The Estimated Restoration Time for a single outage
Summary	ServicePointOutageSummary	[0..1]	See B.77	Summary of how many customers are out.
SwitchingPlans	SwitchingPlan	[0..*]	mRID, description and Names only. See 5.8.2	List of SwitchingPlans associated with this PlannedOutage.

A **PlannedOutage** includes

- Customers affected counts
- Actual start/end time
- Crew
- Lists of usage points (energized and de-energized) – see Clauses B.27 and B.35
- Estimated start/end time
- List of incidents. Usually an incident is associated with an unplanned outage. However, this is needed in the event that a planned outage needs to be created as a result of restoring an unplanned outage.
- Reference to **SwitchingPlan**
- Summary of customers out

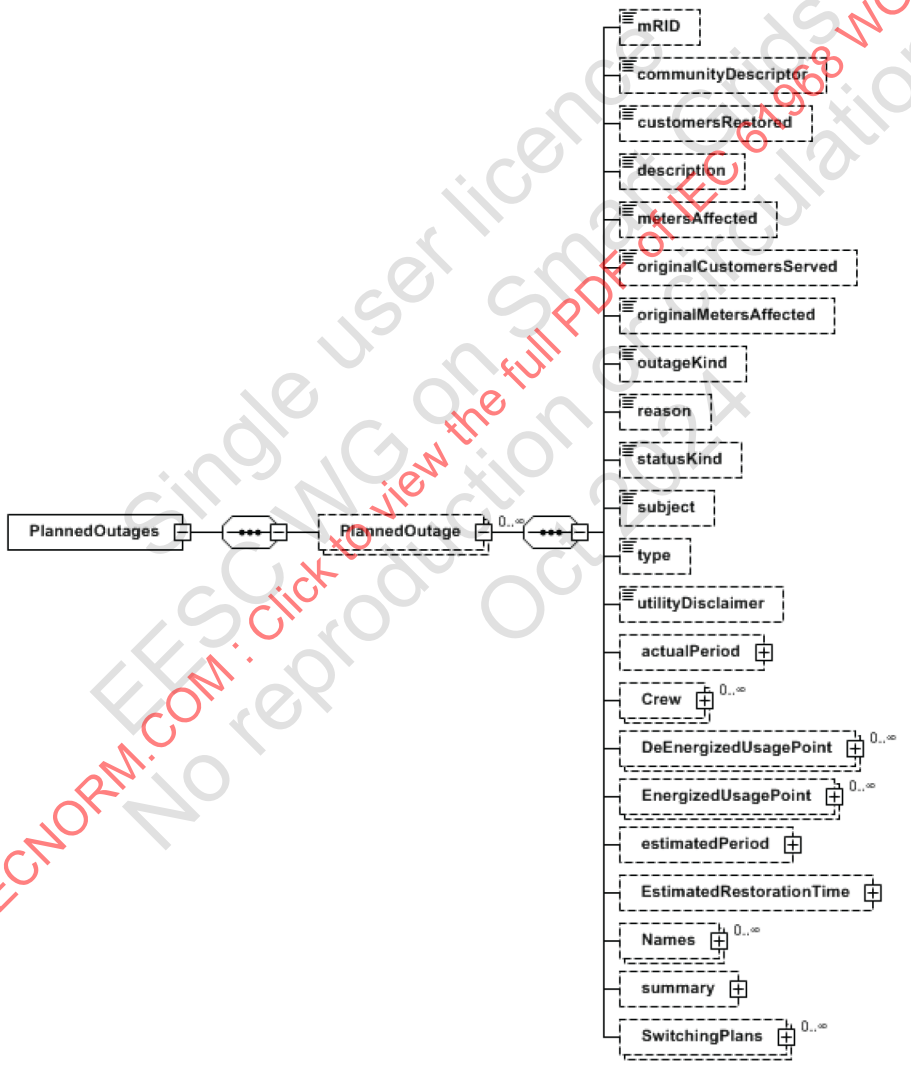

Figure 82 – PlannedOutages message payload

5.13.3 Example XML

In this example, the latitude/longtitude of the planned outage is passed in the **DeEnergizedUsagePoints**. Only one **DeEnergizedUsagePoint** is shown, but in practice there will be one for each UsagePoint that is part of the planned outage. This information can be used to show the outage extent on a geographic map.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:PlannedOutages xmlns:m="http://iec.ch/TC57/2019/PlannedOutages/#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/PlannedOutages/# PlannedOutages.xsd ">
  <m:PlannedOutage>
    <m:mRID>0aa85c42-2cb4-46e4-ae4d-380523b8a65c</m:mRID>
    <m:customersRestored>0</m:customersRestored>
    <m:description>Planned Outage in progress for example switching plan</m:description>
    <m:metersAffected>105</m:metersAffected>
    <m:outageKind>confirmed</m:outageKind>
    <m:reason>Planned Outage</m:reason>
    <m:statusKind>arrived</m:statusKind>
    <m:subject>Planned Outage In Progress</m:subject>
    <m:type>Planned</m:type>
    <m:Crew>
      <m:Names>
        <m:name>James Smedley IV</m:name>
      </m:Names>
    </m:Crew>
    <m:DeEnergizedUsagePoint>
      <m:mRID>cf6ca9ee-44c0-4e5e-8539-806042820bf6</m:mRID>
      <m:Names>
        <m:name>UP-121-AA-54343-CAB</m:name>
      </m:Names>
      <m:UsagePointLocation>
        <m:PositionPoints>
          <m:xPosition>55.103921:xPosition</m:xPosition>
          <m:yPosition>-90.203928</m:yPosition>
        </m:PositionPoints>
      </m:UsagePointLocation>
    </m:DeEnergizedUsagePoint>
    <m:estimatedPeriod>
      <m:end>2019-06-03T12:00:00</m:end>
      <m:start>2019-06-03T10:00:00</m:start>
    </m:estimatedPeriod>
    <m:Names>
      <m:name>PO-2019-04-142</m:name>
    </m:Names>
    <m:SwitchingPlans>
      <m:mRID>6571f4c4-acee-4024-8d1f-6c4a0398e5fa</m:mRID>
      <m:description>Example switching plan </m:description>
      <m:Names>
        <m:name>Switching Plan PO-2019-04-142</m:name>
      </m:Names>
    </m:SwitchingPlans>
  </m:PlannedOutage>
</m:PlannedOutages>
```


5.14 TroubleTickets payload

TroubleTickets are IEC 61968-8 messages that are used by this document to communicate customer reported incidents, outages and related information through the lifecycle of a trouble call. Typically Trouble Call Management (TCM) receives new outage information reported by customers. OMS and DMS may use this information for outage/fault analysis. After the outage is identified, an **UnplannedOutage** is created to track and respond to the outage. Figure 83 shows an example sequence for creating a **TroubleTicket**, changing a **TroubleTicket**, creating an **UnplannedOutage** and changing an **UnplannedOutage**. Further examples are given in Annex A.

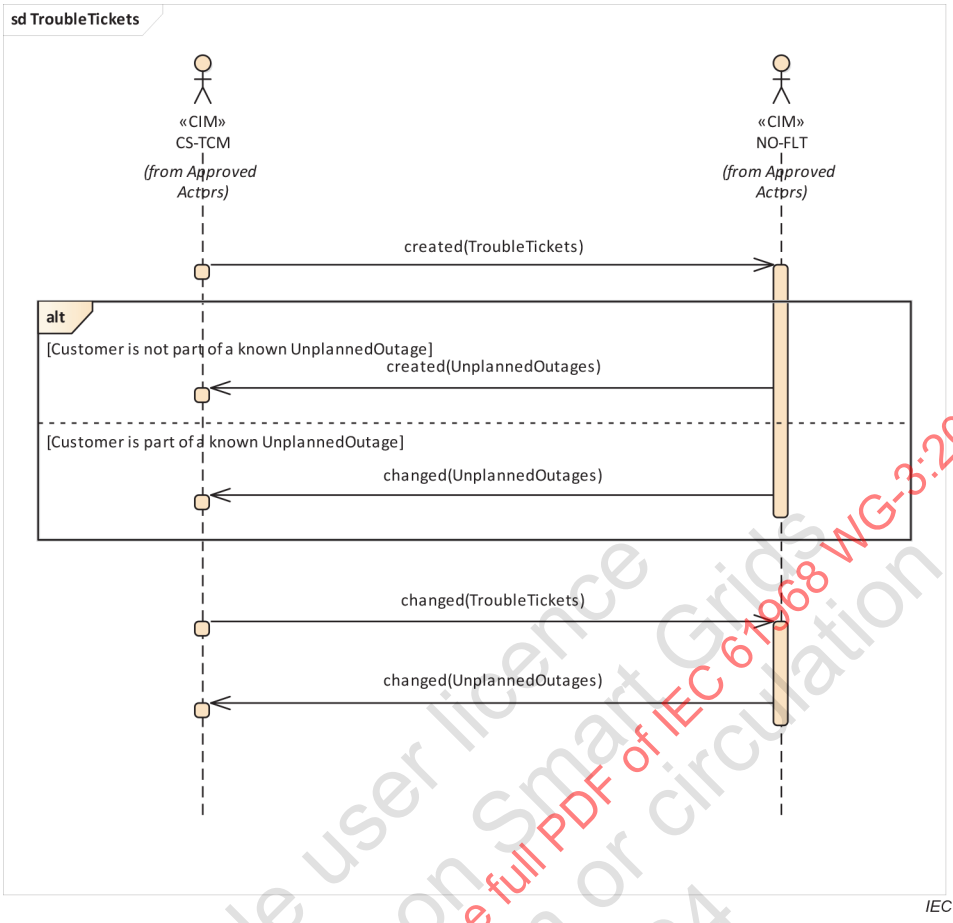

Figure 83 – TroubleTickets sequence diagram

For further details regarding the **TroubleTickets** payload, see IEC 61968-8.

5.15 Incidents payload

5.15.1 General

An **Incident** is a description of an occurrence in the field that impacts or may impact the network. An incident may be reported in a trouble ticket or come from another source. It may or may not be associated with an outage. An example of where an incident is not associated with an outage is where a wire down is reported, but it is a cable television wire and does not create an outage. An example of where an incident will be associated with an unplanned outage is if a car hits a pole and de-energizes customers.

Figure 84 is a sequence diagram that shows an example of the lifecycle of an **Incident**. In this example, Fault Management creates an **Incident** as a result of receiving a **TroubleTicket** that does not report any outage symptoms. In this example, a car hits a pole and customers, passers-by or emergency personnel call the utility's call center to report the **Incident**.

A complete description of the use case is provided in Clause A.8.

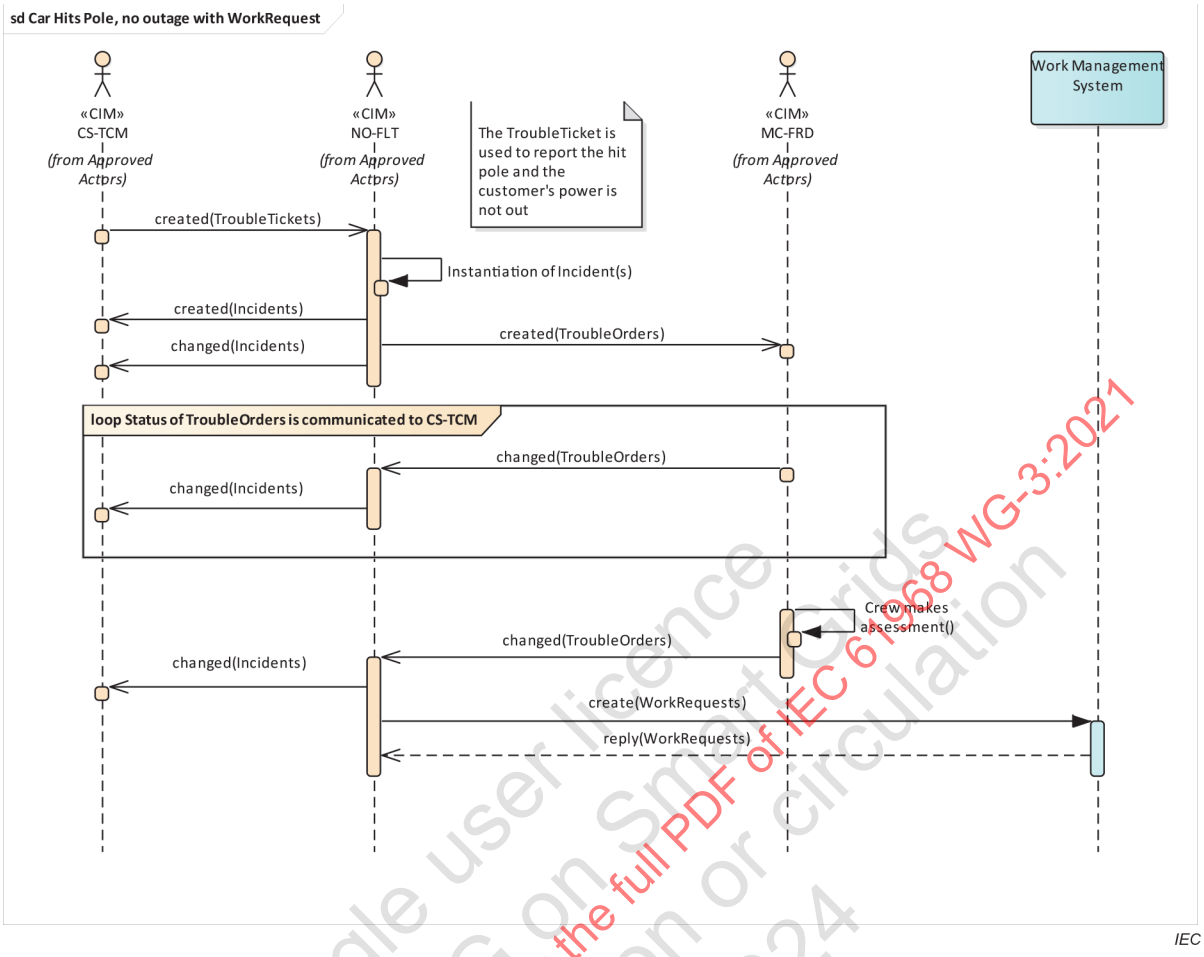

Figure 84 – Sequence diagram showing lifecycle of Incident

An **Incident** can be associated with an **UnplannedOutage** during the lifecycle of the **Incident**. This can happen for example when additional information regarding the **Incident** is received and an **UnplannedOutage** is created as a result. Subsequently, either a user or an automatic system associates the **Incident** with the **UnplannedOutage**.

An example is shown in Figure 85, where an **Incident** is initially created and there is no known outage. Then additional information is received from either another **TroubleTicket**, an **EndDeviceEvent** from AMI indicating that a meter has reported loss of power or a **PSRMeasurement** from SCADA indicating that a breaker has operated.

As a result of these inputs, NO-FLT creates an **UnplannedOutage**. Either an automated process in NO-FLT, or a user, associates the **Incident** with the **UnplannedOutage**. The result is that the **Incident** is associated with the **UnplannedOutage** and a **changed** notification for the **UnplannedOutage** is sent to CS-TCM. This exemplaray diagram does not show an explicit changed(**Incidents**) once the **Incident** has been associated with the **UnplannedOutage**, since it is assuming that the receiver will make the association on their side of the interface and track the **Incident** along with the **UnplannedOutage**.

A complete description of the use case is given in Clause A.9.

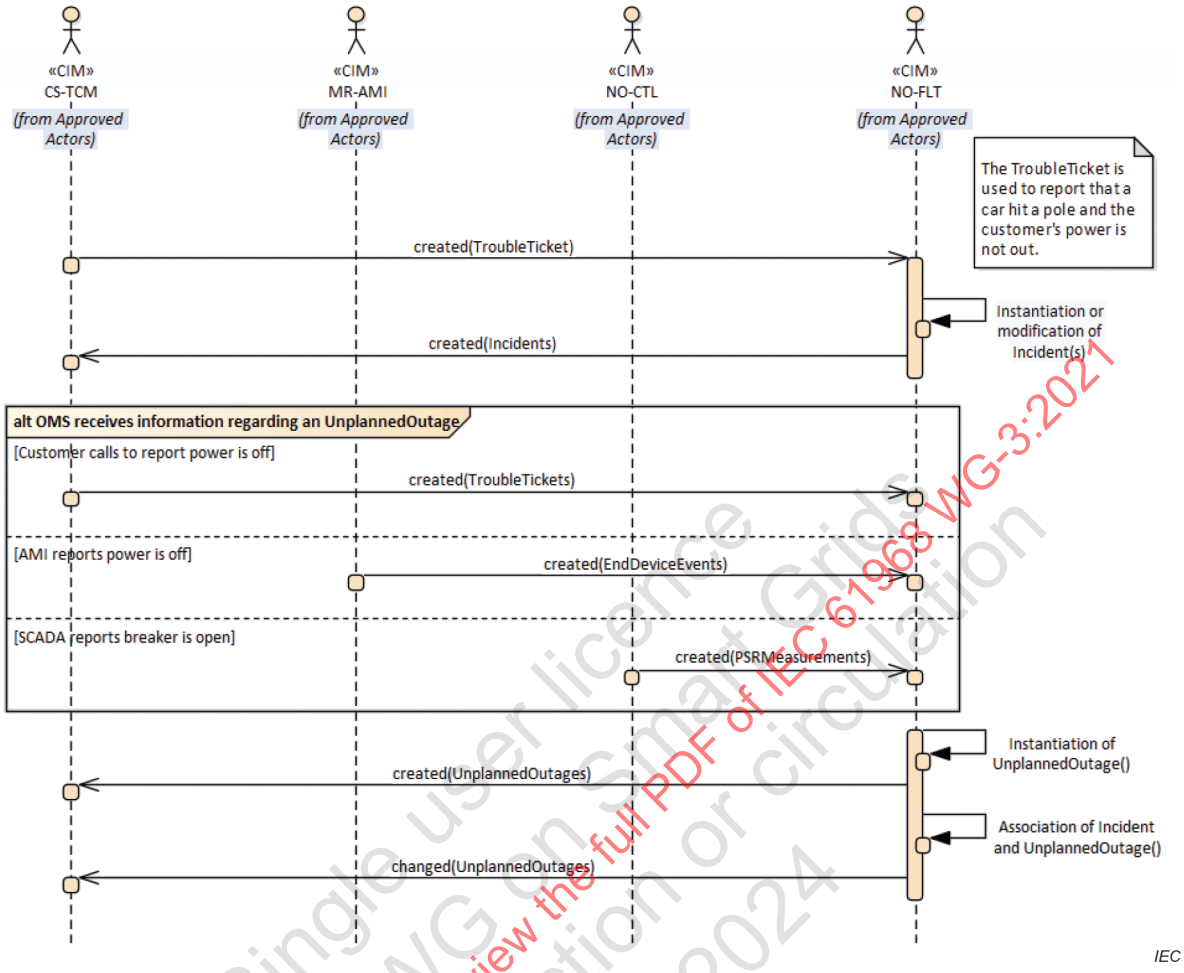

Figure 85 – Sequence diagram showing association of Incident with UnplannedOutage

5.15.2 Message payload

The message payload for **Incidents** is shown in Figure 86. An **Incident** can be associated with zero, one or many **TroubleTickets** (see subclause 5.14) and zero, one or many **Hazard** (see Subclause B.46) and zero or one **UnplannedOutage** (see Subclause 5.17.3).

The attributes of the **Incidents** profile are described in Table 53.

Table 53 – Incidents Profile

Incidents					
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**	**Profiles Used In, in addition to this profile.**
Incidents	Incident	[1..*]			
Profile Attributes					
description	String	[0..1]		Free-form text field that describes the **Incident**	TroubleOrders UnplannedOutages
mRID	String	[0..1]	GUID	mRID of the Incident.	TroubleOrders UnplannedOutages
Names	Name	[0..*]	See B.56	Can be used to provide additional information such as internal incident number.	TroubleOrders UnplannedOutages
cause	String	[0..1]		May not be known early in the lifecycle of the **Incident** but can be populated once the information is known.	TroubleOrders
createdDateTime	DateTime	[0..1]		DateTime that the Incident was initially created.	TroubleOrders
lastModifiedDateTime	DateTime	[0..1]		DateTime that the Incident was last changed.	TroubleOrders
Assets	Asset	[0..*]	See B.9	List of **Assets** associated with this Incident, if any. Even if there are no **Assets**, the association can be used to identify the **PowerSystemResource**(s) associated with the **Incident** and to the **Feeder** and **Substation** if required.	
Hazard	Hazard	[0..*]	See B.46	Hazardous conditions associated with this Incident, if any.	TroubleOrders UnplannedOutages
Location	Location	[0..1]	See B.52	Provides more precise geographic location information than the description alone.	
status	Status	[0..1]	See B.79	Used to indicate whether the **Incident** is open or closed.	TroubleOrders
TroubleTickets	TroubleTicket	[0..*]	See 5.14	mRID, description and Names only.	
UnplannedOutage	UnplannedOutage	[0..1]	See 5.17.3	mRID, description and Names only.	

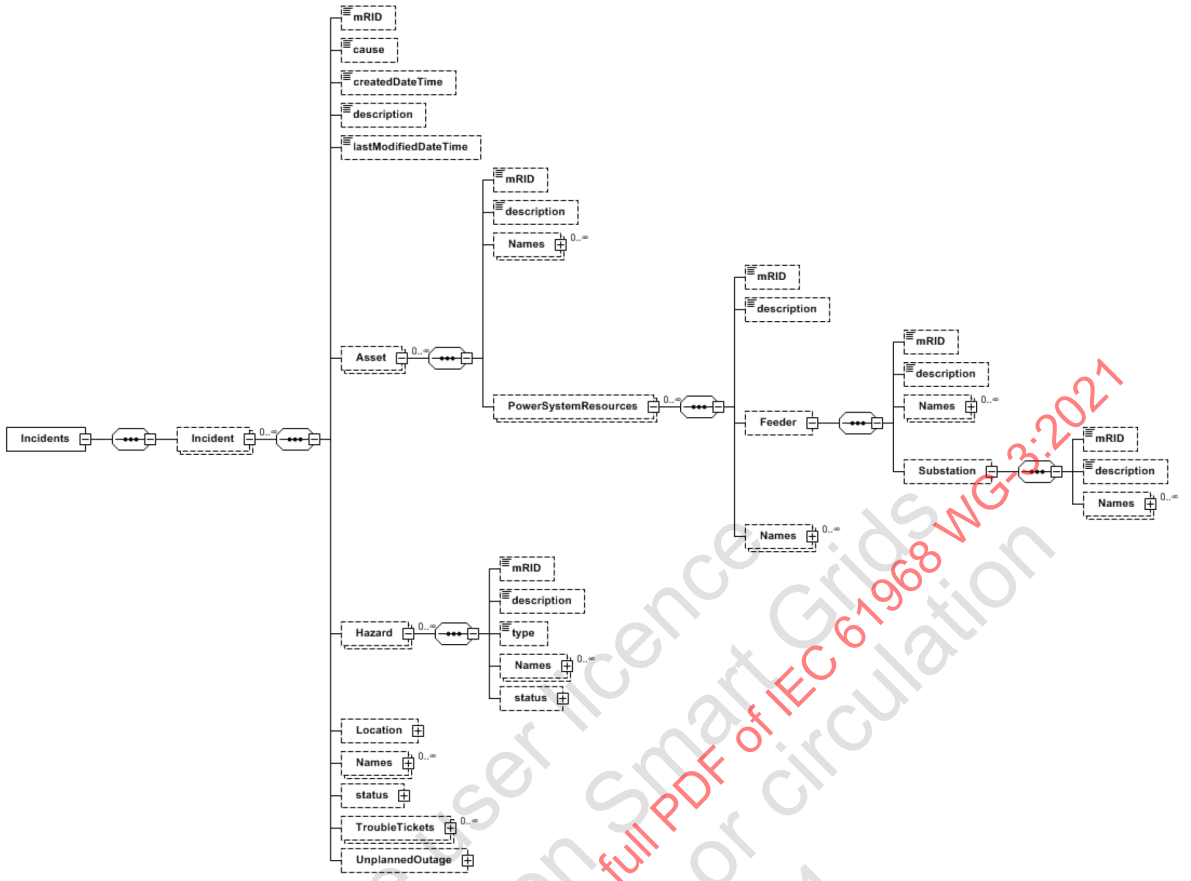

Figure 86 – Incident message payload

5.15.3 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:Incidents xmlns:m="http://iec.ch/TC57/2019/Incidents#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/Incidents# Incidents.xsd ">
  <m:Incident>
    <m:mRID>a80f0cb3-5e58-401d-8f26-1e4d6011d07a</m:mRID>
    <m:cause>Car Hit Pole</m:cause>
    <m:createdDateTime>2019-06-03T11:25:00</m:createdDateTime>
    <m:description>Car hit pole at 17 Station Road in Sidcup, South of Police
Station</m:description>
    <m:lastModifiedDateTime>2019-06-03T11:26:00</m:lastModifiedDateTime>
    <m:Hazard>
      <m:type>Car hit pole; pole burning</m:type>
      <m:status>
        <m:dateTime>2019-06-03T11:27:00</m:dateTime>
        <m:reason>New</m:reason>
        <m:value>Unresolved</m:value>
      </m:status>
    </m:Hazard>
    <m:Location>
      <m:direction>17 Station Road in Sidcup, South of Police Station</m:direction>
      <m:mainAddress>
        <m:postalCode>DA17 6BW</m:postalCode>
        <m:streetDetail>
          <m:addressGeneral>Station Road</m:addressGeneral>
          <m:number>17</m:number>
        </m:streetDetail>
        <m:townDetail>
          <m:name>Sidcup</m:name>
        </m:townDetail>
      </m:mainAddress>
    </m:Location>
    <m:Names>
      <m:name>Incident #890911</m:name>
```

```
    </m:Names>
    <m:status>
      <m:dateTime>2019-06-03T11:31:00</m:dateTime>
      <m:reason>New</m:reason>
      <m:value>Unresolved</m:value>
    </m:status>
    <m:TroubleTickets>
      <m:mRID>c95251c5-bf5f-4657-a9fb-0178fdff3f70</m:mRID>
      <m:description>Car hit pole at 17 Station Road</m:description>
      <m:Names>
        <m:name>Ticket # 4398402</m:name>
      </m:Names>
    </m:TroubleTickets>
  </m:Incident>
</m:Incidents>
```

5.16 **EquipmentFaults** payload

5.16.1 General

An **EquipmentFault** is a fault applied at the terminal, external to the equipment. This class is not used to specify faults internal to the equipment.

EquipmentFaults message payloads, shown in Figure 89, communicate the detailed fault information as part of **UnplannedOutages** messages. **EquipmentFaults** define all types of faults that occur on conducting equipment, with the exception of lines, which are covered by **LineFaults** (see 5.17). This information is added as soon the fault is located and confirmed by a crew. The equipment fault is identified by the concerned conducting equipment and may have a reference to the corresponding asset.

A sequence diagram that shows a possible way of associating an **EquipmentFault** to an **UnplannedOutage** is shown in Figure 87 (the events that trigger the instantiation and creation of the **UnplannedOutage** are omitted for the sake of brevity).

The diagram shows the creation of an **UnplannedOutages** and the subsequent creation of a **TroubleOrders** that is sent to a field crew. The field crew then identifies the root cause of the unplanned outage and this information is sent in an **EquipmentFaults** message to the control room. It is also possible to use the **EquipmentFaults** element in the **TroubleOrders**.**UnplannedOutage** payload (see 5.21.2.3) to achieve the same goal.

The diagram also shows an alternate, where a **LineFaults** is sent instead of an **EquipmentFaults** (see 5.17).

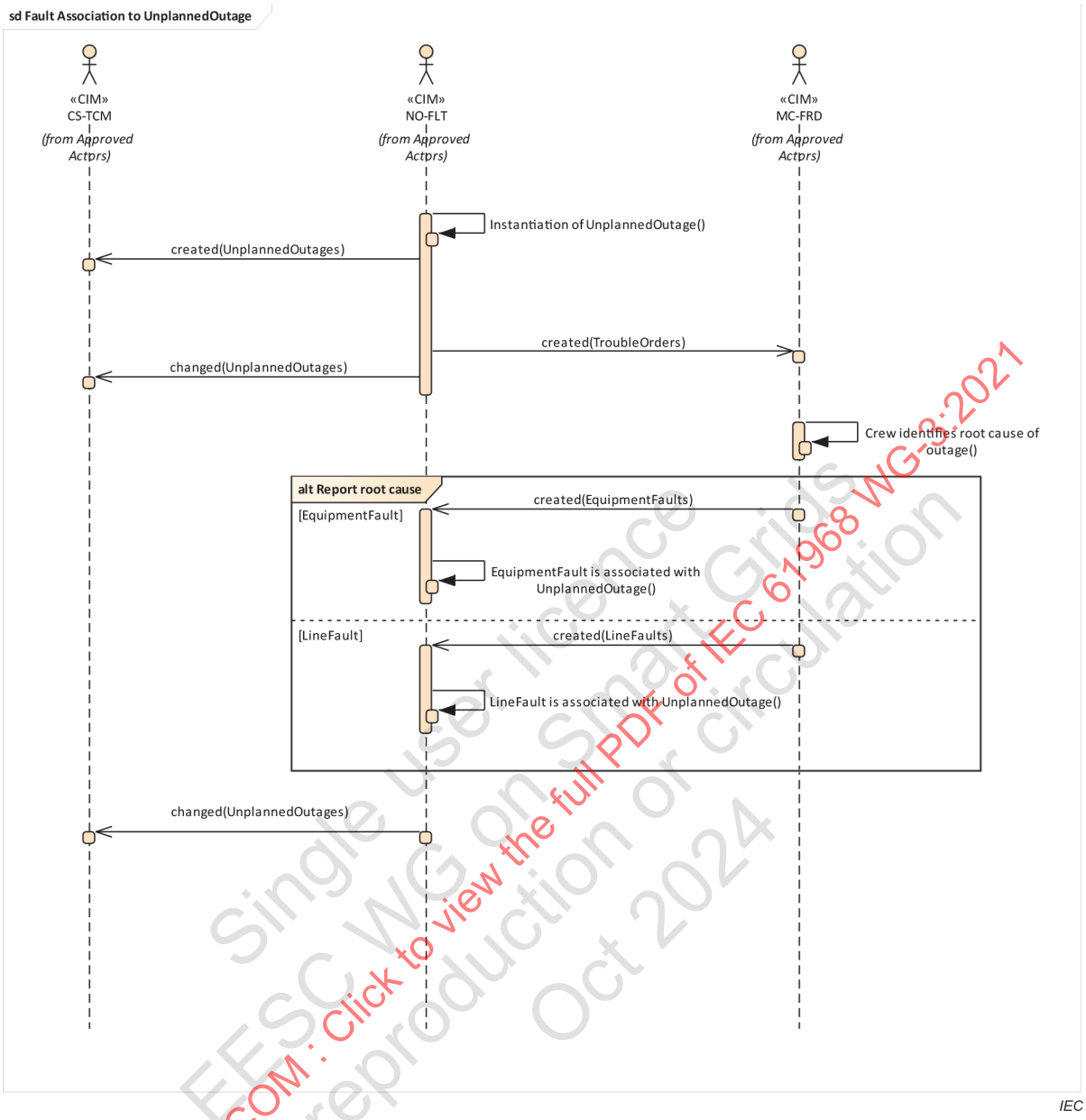

Figure 87 – Association of LineFaults/EquipmentFaults to UnplannedOutage

EquipmentFaults messages payloads may also be used to communicate fault information, e.g. for reporting use cases.

Another example of creating an **EquipmentFault** is shown in Figure 88. This could be used in the case where the FLISR function resides in a different system to the outage management system, and the **EquipmentFault** information needs to be communicated between the two systems.

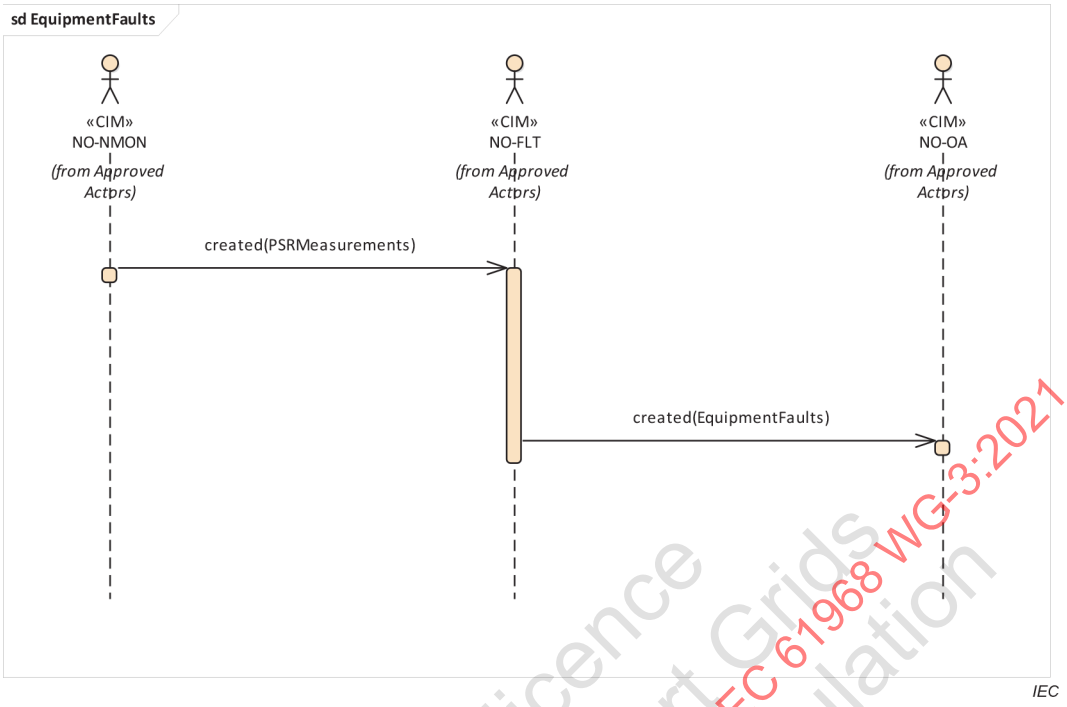

Figure 88 – EquipmentFaults sequence diagram

5.16.2 Message payload

The message payload for **EquipmentFaults** is shown in graphical form in Figure 89. The attributes are described in Table 54.

Table 54 – EquipmentFaults payload

Faults: LineFaults				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
EquipmentFaults	EquipmentFault	[1..*]		
Profile Attributes				
description	String	[0..1]		Free-form text field that describes the **EquipmentFault.**
mRID	String	[0..1]	GUID	mRID of the EquipmentFault.
Names	Name	[0..*]	See B.56	Human-readable names for the EquipmentFault.
kind	PhaseConnectedFaultKind	[0..1]	See C.13	The kind of phase fault.
occuredDateTime	DateTime	[0..1]		The date and time at which the fault occurred.
phases	PhaseCode	[0..1]	See C.12	The phases participating in the fault. The fault connections into these phases are further specified by the type of fault.
FaultCauseTypes	FaultCauseType	[0..*]	See B.40	Type of cause of the fault. There can be zero, one or many causes of the fault, e.g. weather and an equipment failure.
FaultyEquipment	Equipment	[0..1]	See B.37	The equipment that carries the fault.
Location	Location	[0..1]	See B.52	Geographic location of the fault.
Terminal	Terminal	[0..1]	See B.90	The terminal connecting to the bus to which the fault is applied.

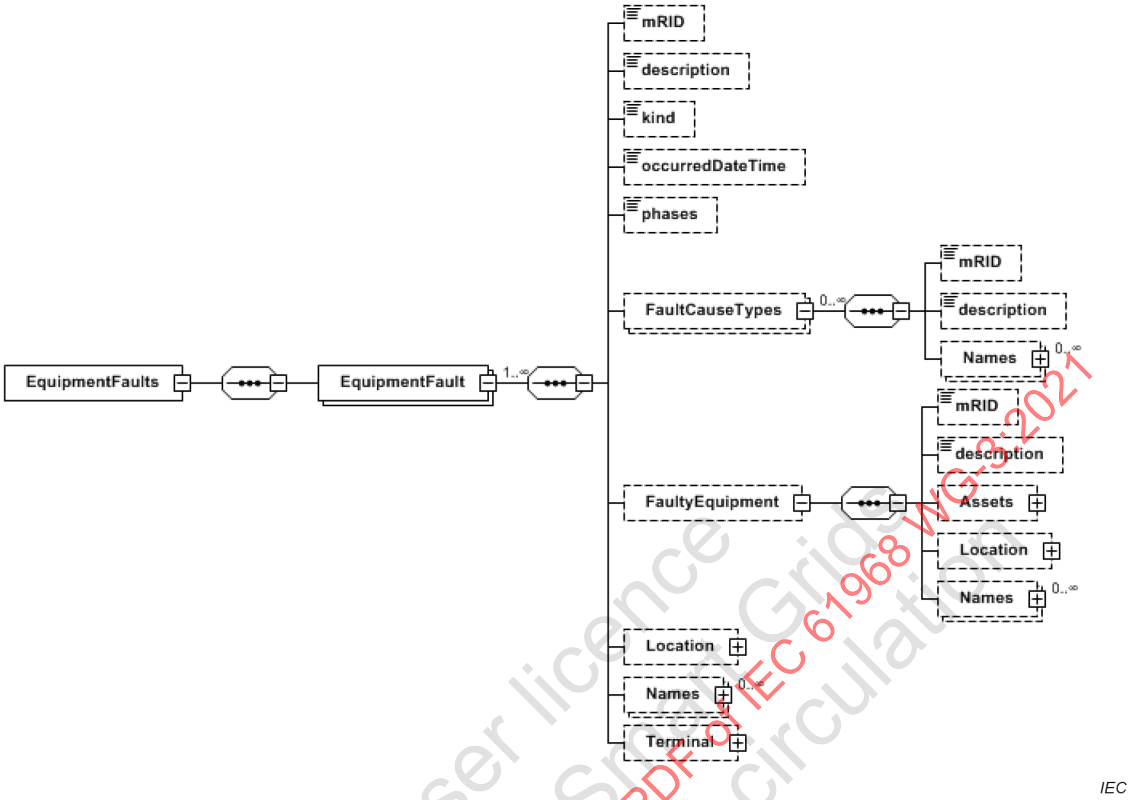

Figure 89 – **EquipmentFaults** message payload

5.16.3 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:EquipmentFaults xmlns:m="http://iec.ch/TC57/2019/EquipmentFaults#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/EquipmentFaults# EquipmentFaults.xsd ">
  <m:EquipmentFault>
    <m:mRID>d1e0d296-9bc5-4c3d-b383-e9bf93c20ac9</m:mRID>
    <m:occurredDateTime>2019-06-03T11:49:00</m:occurredDateTime>
    <m:phases>A</m:phases>
    <m:FaultCauseTypes>
      <m:Names>
        <m:name>Over current</m:name>
      </m:Names>
    </m:FaultCauseTypes>
    <m:FaultyEquipment>
      <m:mRID>445ebf37-a17a-4820-b450-b939c5769a12</m:mRID>
      <m:Assets>
        <m:Names>
          <m:name>Furman 34kV F06 R-066</m:name>
        </m:Names>
      </m:Assets>
      <m:Location>
        <m:direction>At intersection of Gatehouse Drive and Dead Mouse Creek</m:direction>
        <m:mainAddress>
          <m:townDetail>
            <m:name>Thorton Heath</m:name>
            <m:stateOrProvince>Arizona</m:stateOrProvince>
          </m:townDetail>
        </m:mainAddress>
      </m:Location>
      <m:Names>
        <m:name>Furman 34kV F06 R-066</m:name>
      </m:Names>
    </m:FaultyEquipment>
  </m:EquipmentFault>
</m:EquipmentFaults>
```

5.17 **LineFaults** payload

5.17.1 General

A **LineFault** is a fault that occurs on an AC line segment at some point along the length.

LineFaults messages communicate the detailed fault information as part of **UnplannedOutages** messages. **LineFaults** define all types of faults that occur on AC line segments. This information is added as soon the fault is located and confirmed by a crew. The fault is identified by the concerned AC line segment and may have a reference to the corresponding asset.

A sequence diagram that shows a possible way of associating a **LineFault** to an **UnplannedOutage** is shown in Figure 87.

LineFaults message payloads may also be used to communicate fault information, e.g. for reporting use cases.

Another example of creating a **LineFault** is shown in Figure 90. This could be used in the case where the FLISR function resides in a different system to the outage management system, and the **LineFault** information needs to be communicated between the two systems.

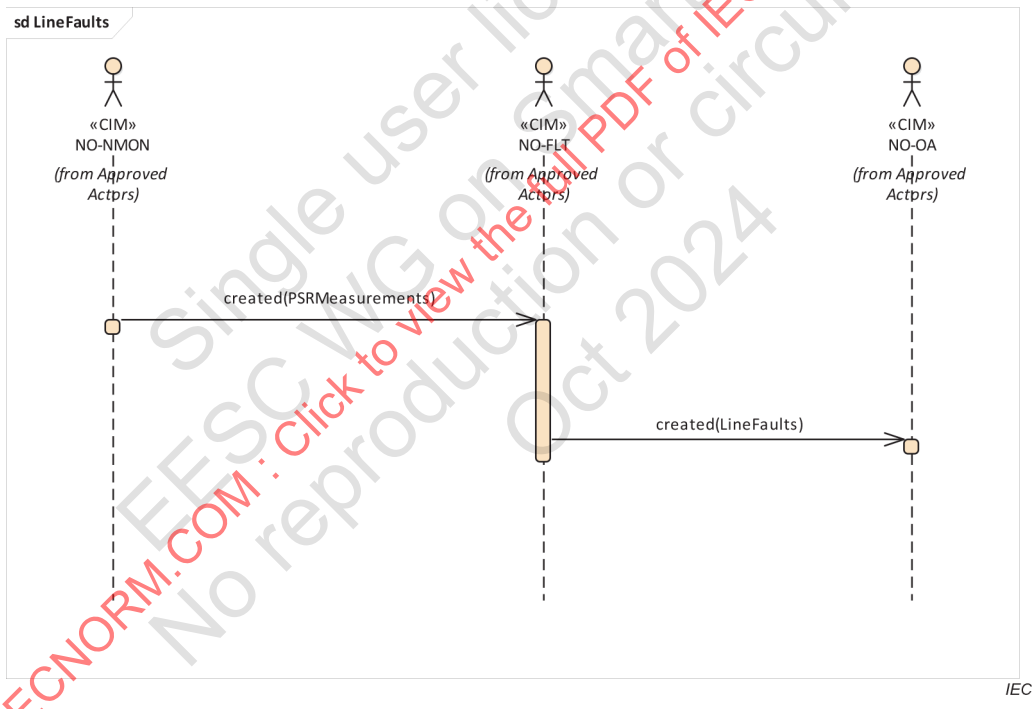

Figure 90 – LineFaults sequence diagram

5.17.2 Message payload

Figure 91 shows the **LineFaults** message payload in graphical form. The details are shown in Table B.68.

Table 55 – LineFaults payload

Faults: LineFaults				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
LineFaults	LineFault	[1..*]		
Profile Attributes				
description	String	[0..1]		Free-form text field that describes the **LineFault.**
mRID	String	[0..1]	GUID	mRID of the LineFault.
Names	Name	[0..*]	See B.56	Human-readable names for the LineFault.
kind	PhaseConnectedFaultKind	[0..1]	See C.13	The kind of phase fault.
lengthFromTerminal1	Length	[0..1]		The length to the place where the fault is located starting from terminal with sequence number 1 of the faulted line segment.
occuredDateTime	DateTime	[0..1]		The date and time at which the fault occurred.
phases	PhaseCode	[0..1]	See C.12	The phases participating in the fault. The fault connections into these phases are further specified by the type of fault.
ACLineSegment	ACLineSegment	[0..1]	See B.4	ACLineSegment where the fault has occurred.
FaultCauseTypes	FaultCauseType	[0..*]	See B.40	Type of cause of the fault. There can be zero, one or many causes of the fault, e.g. weather and a wire down.
impedance	FaultImpedance	[0..1]	See B.39	Fault impedance. Its usage is described by 'kind'.
Location	Location	[0..1]	See B.52	Geographic location of the fault.

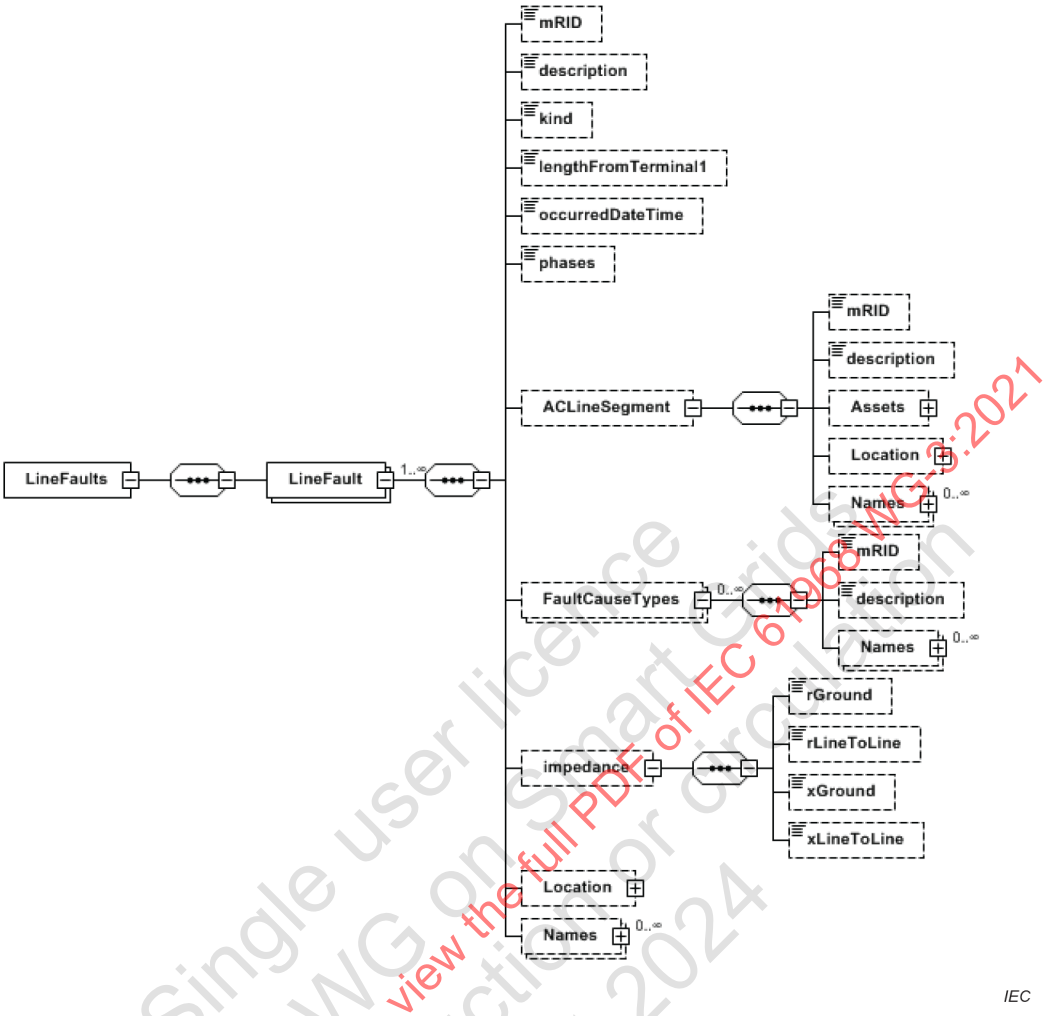

Figure 91 – LineFaults message payload

5.17.3 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:LineFaults xmlns:m="http://iec.ch/TC57/2019/LineFaults#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/LineFaults# LineFaults.xsd ">
  <m:LineFault>
    <m:mRID>cce3f88e-7ecb-442e-8aa6-8dab3bb04795</m:mRID>
    <m:kind>lineOpen</m:kind>
    <m:lengthFromTerminal1>125.0</m:lengthFromTerminal1>
    <m:occurredDateTime>2019-06-03T12:02:00</m:occurredDateTime>
    <m:phases>A</m:phases>
    <m:ACLineSegment>
      <m:mRID>b7e3453e-63ec-4203-898e-d23b8876f1f7</m:mRID>
    </m:ACLineSegment>
    <m:Location>
      <m:PositionPoints>
        <m:xPosition>35.7718409</m:xPosition>
        <m:yPosition>-78.6801357</m:yPosition>
      </m:PositionPoints>
    </m:Location>
  </m:LineFault>
</m:LineFaults>
```

5.18 **UnplannedOutages** payload

5.18.1 General

An unplanned outage refers to an unexpected state where energy is not delivered.

UnplannedOutage message payloads communicate unplanned outages. An **UnplannedOutage** can be created as shown in the sequence diagram, Figure 92. **UnplannedOutage**s may occur as a result of faults such as short circuit faults and downed lines.

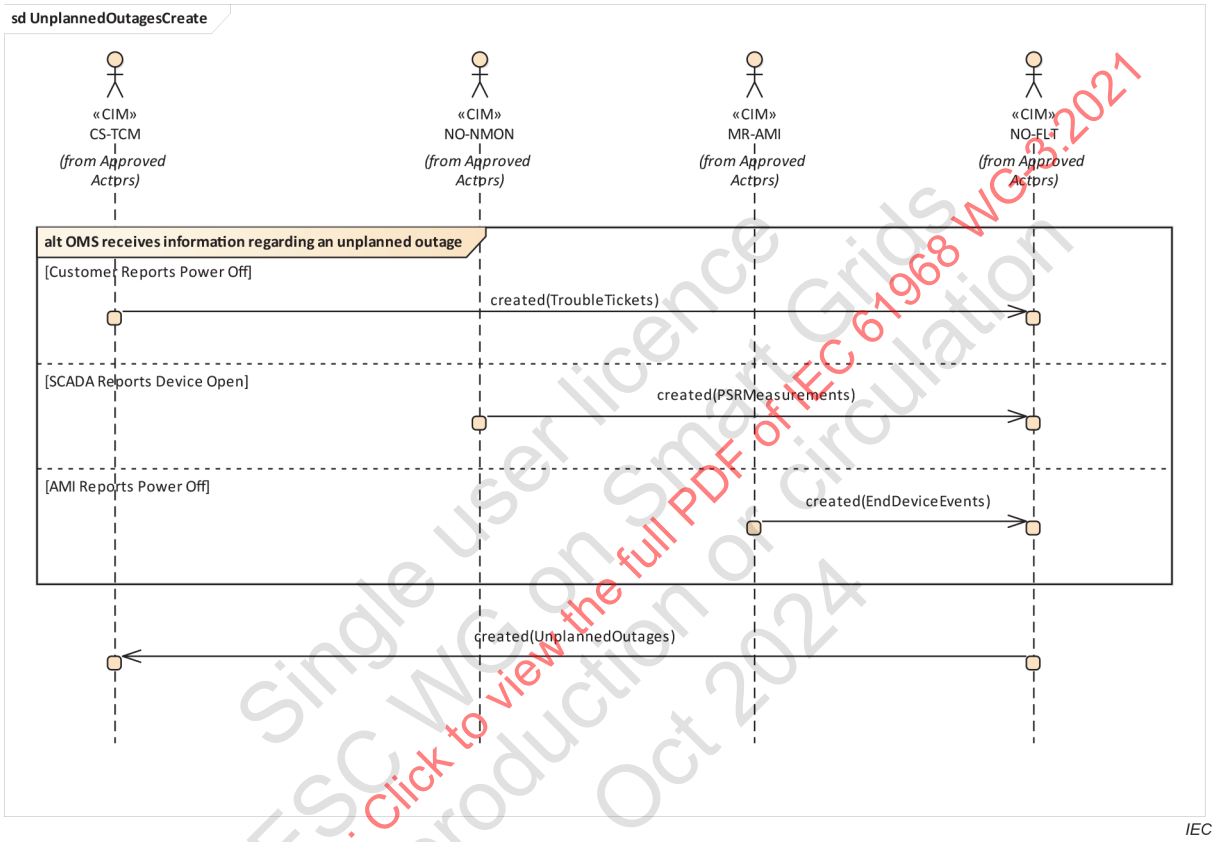

Figure 92 – UnplannedOutages sequence diagram

An **UnplannedOutage** can be created as a result of any of the following triggers:

- After an outage is detected via remote devices, for instance a device trip detected by SCADA, SCADA (NO-CTL) creates a **PSRMeasuresments** and sends it to NO-FLT, which creates the **UnplannedOutage**
- AMI detects a last-gasp power off notification from a meter. MR-AMI creates an **EndDeviceEvent** and sends it to NO-FLT, which creates the **UnplannedOutage**
- A customer reports that their power is out. Customer service (CS-TCM) creates a **TroubleTicket** and sends it to NO-FLT, which creates the **UnplannedOutage**

UnplannedOutage information may be used by different applications depending on the type and cause of the outage:

- After an **UnplannedOutage** is confirmed, Fault Management may request a switching plan for isolation and service restoration. Based on this request an application (i.e. Switch Action Scheduling) will determine the necessary steps to isolate the fault and to restore power to the healthy islands of the network. The variants may show additional information that supports the user in choosing the best alternative.

- During the lifecycle of outages, the outage information is updated, e.g. to notify about changed outage state (expected restoration time, customers are partially or completely restored to power, etc.).

Detailed information concerning the faulted equipment or line are communicated as part of an **UnplannedOutage** as **EquipmentFault** and **LineFault**, see Subclause 5.16 for **EquipmentFault** and 5.16.3 for **LineFault** profiles. An **UnplannedOutage** may include zero (i.e. the fault is not detected yet) to many equipment and/or line faults.

5.18.2 Message payload

Figure 93 shows the payload for **UnplannedOutages** at a high level.

The attributes of the **UnplannedOutages** profile are described in Table 56.

Table 56 – UnplannedOutages Profile

UnplannedOutages					
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**	**Profiles Used In, in addition to this profile.**
UnplannedOutages	UnplannedOutage	[1..*]			
Profile Attributes					
description	String	[0..1]		Free-form text field that describes the **UnplannedOutage**	TroubleOrders
mRID	String	[0..1]	GUID	**mRID** of the **UnplannedOutage**	TroubleOrders
Names	Name	[0..*]	See B.56	Can be used to provide additional information such as internal outage number.	TroubleOrders
cause	String	[0..1]		The cause of this outage. This is the cause that is used to present to external entities. That is, the cause is weather, equipment failure, etc. Note: At present, this is a free text; could be replaced with a separate associated class in case we have multiple causes (e.g. OutageCauseType, inheriting from IdentifiedObject). It should be noted that EquipmentFault and LineFault support multiple FaultCauseTypes, so the information can be captured there and summarized in the cause field of the message. May not be known early in the lifecycle of the **UnplannedOutage** but can be populated once the information is known.	TroubleOrders
causeKind	OutageCauseKind	[0..1]	See C.9	This enumeration describes the primary cause of the outage – planned, unplanned, etc.	TroubleOrders
comment	String	[0..1]		Operator comments associated with the outage.	TroubleOrders
communityDescriptor	String	[0..1]		A name to denote the community – this could be a name or a code of some kind.	
createdDateTime	DateTime	[0..1]		DateTime that the UnplannedOutage was initially created.	
customersRestored	Integer	[0..1]		Number of customers that have been restored in the area.	TroubleOrders
lastModifiedDateTime	DateTime	[0..1]		DateTime that the UnplannedOutage was last changed.	
metersAffected	Integer	[0..1]		The updated number of meters affected by the outage as reported by the OMS within the utility. It is assumed this number will be updated repeatedly until the full outage is resolved.	TroubleOrders

UnplannedOutages					
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**	**Profiles Used In, in addition to this profile.**
originalCustomersServed	Integer	[0..1]		The total number of customers that are served in the area (both outaged and not outaged).	
originalMetersAffected	Integer	[0..1]		The original number of meters that were affected as reported by the OMS within the utility. That is, this is the total number of meters that were out at the beginning of the outage.	
outageKind	OutageStatusKind	[0..1]	See C.11	Defines if the outage has been verified or is only estimated	TroubleOrders
reportedStartTime	DateTime	[0..1]		DateTime of the earliest call or AMI event that created the outage	TroubleOrders
statusKind	CrewStatusKind	[0..1]	Enumeration. See C.1	Defines the status of the crew as in dispatched or arrived, etc. If there are multiple crews assigned to the UnplannedOutage at the same time, then the statusKind shall be the highest priority status as defined in Table 57. The dispatch status of individual crews is available in the FieldDispatchHistory part of the Crew payload fragment in this profile. See Annex B.22	TroubleOrders
subject	String	[0..1]		String that describes the outage	TroubleOrders
type	String	[0..1]		String that describes the extent of the outage, e.g. customer, distribution transformer, fuse, recloser, circuit breaker, etc.	TroubleOrders
utilityDisclaimer	String	[0..1]		This contains an disclaimers the utility would like to place on the data provided to any stakeholder. This may be different for different stakeholders. This should possibly be an attribute under the Organization class but it is placed here for now.	
actualPeriod	DateTimeInterval	[0..1]		Actual outage period; end of the period corresponds to the actual restoration time.	TroubleOrders
Crew	Crew	[0..*]	See B.22	Crews assigned to this UnplannedOutage.	
DeEnergizedUsagePoint	UsagePoint	[0..*]	See B.27	List of usage points that are currently de-energized by this outage.	TroubleOrders
EnergizedUsagePoint	UsagePoint	[0..*]	See B.35	List of usage points that were previously de-energized by this outage but are now energized.	TroubleOrders
EstimatedRestorationTime	EstimatedRestorationTime	[0..1]	See B.38	The Estimated Restoration Time for a single outage	TroubleOrders

UnplannedOutages					
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**	**Profiles Used In, in addition to this profile.**
Fault	EquipmentFault or LineFault	[0..*]	EquipmentFault – see 5.16 LineFault – see 5.17	There can be multiple EquipmentFaults associated with an UnplannedOutage. Therefore each EquipmentFault has its own Location, independent of the location of the UnplannedOutage. The EquipmentFault also has a phase and a FaultyEquipment attribute that identify where the fault has been predicted. The FaultyEquipment attribute identifies names (FaultEquipment.Names) and type of the equipment (FaultyEquipment.PSRType). There can be multiple LineFaults associated with an UnplannedOutage. A LineFault can also be predicted based on the results of a short circuit analysis and as a result there could be multiple candidate locations for the predicted fault that all have the same short circuit current. Therefore each LineFault has its own Location and phase, independent of the location of the UnplannedOutage. The LineFault also has an ACLineSegment and a lengthFromTerminal1 attribute. These can be used by network-aware applications to display the LineFault in a network diagram, for example.	TroubleOrders
Incident	Incident	[0..*]	See 5.15	List of Incidents associated with this UnplannedOutage	
OutageIsolationEquipment	ConductingEquipment	[0..*]	See B.63	The OutageIsolationEquipment attribute of the payload is shown in Figure B.29 and B.63. This attribute can be used to define the boundary of the outage in the case where an UnplannedOutage has been identified and isolated by opening the switches or other conducting equipment, either automatically by a function such as FLISR, or by a crew opening switches downstream of the fault and back feeding those customers from another feeder. There can be multiple OutageIsolationEquipment and each has its own geographic Location, electrical identifier and phase, using the Terminal attribute.	TroubleOrders
Summary	ServicePointOutageSummary	[0..1]	See B.77	Summary of how many customers are out.	
TroubleTickets	TroubleTicket	[0..*]	See 5.14	List of TroubleTickets associated with this UnplannedOutage. mRID, description and Names only	

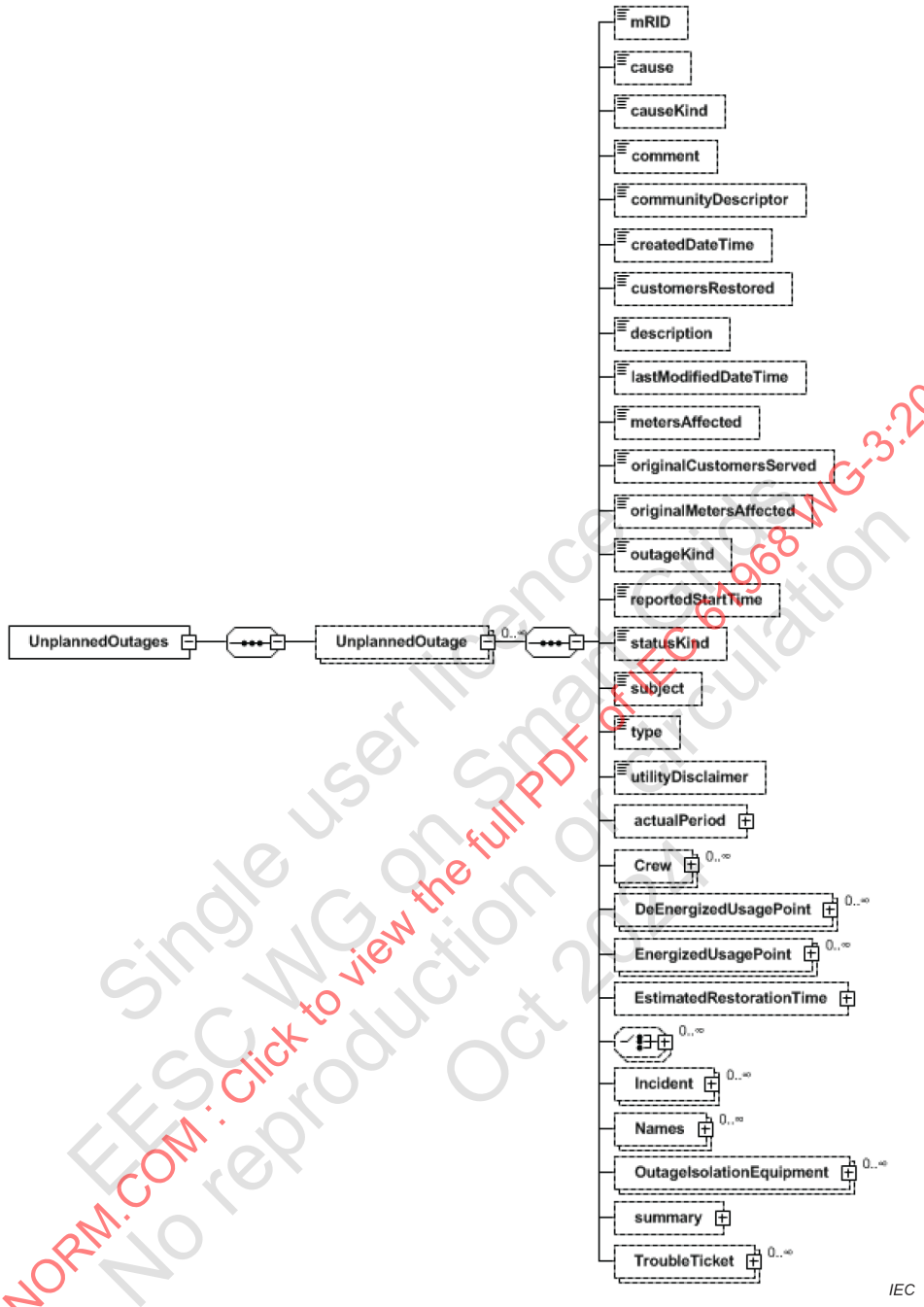

Figure 93 – UnplannedOutages message payload top level

Figure 94 shows the **UnplannedOutages** message payload, **LineFault** detail. See subclause 5.16.3 for a description of the **LineFault** detail.

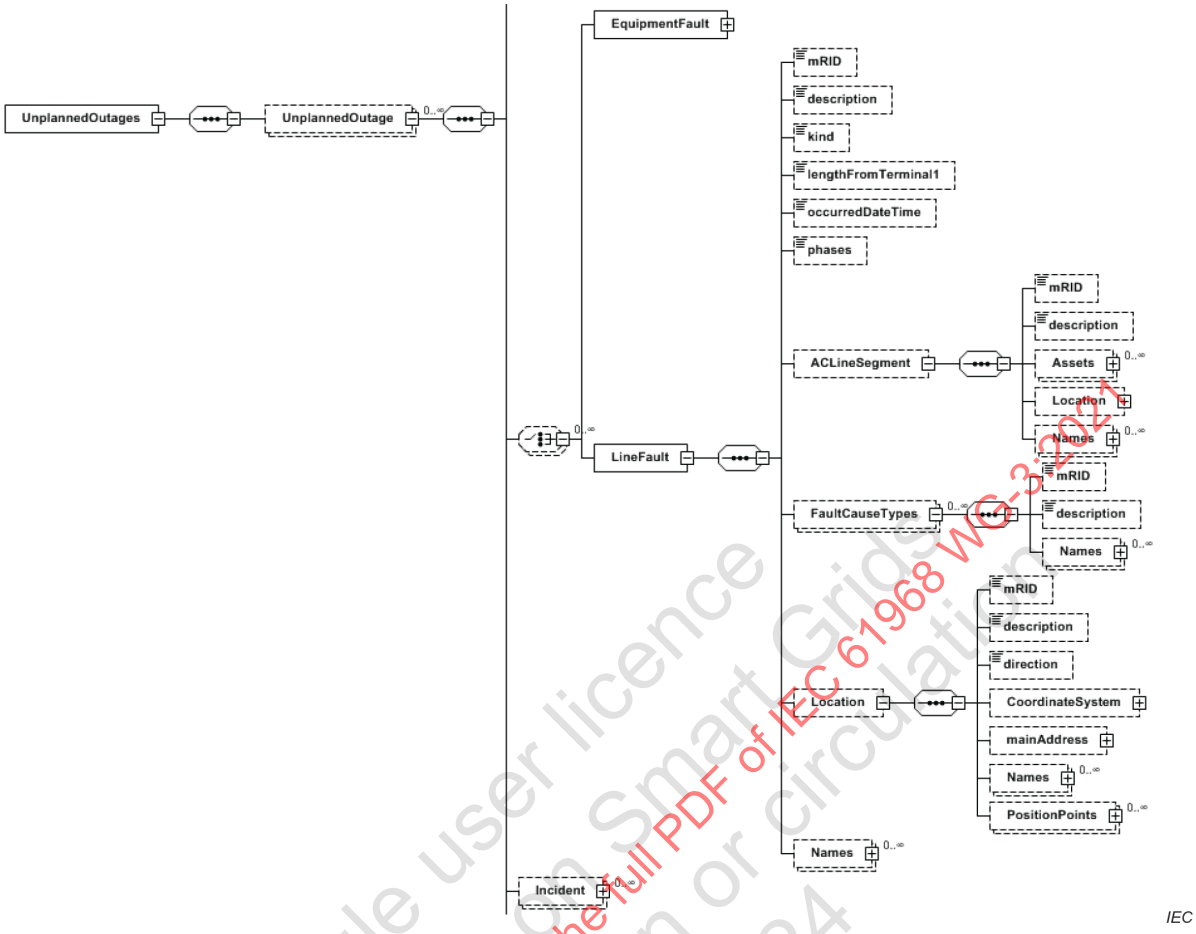

Figure 94 – UnplannedOutages message payload, LineFault detail

Figure 95 shows the payload for UnplannedOutages, **EquipmentFault** detail. Please see Subclause 5.16 for a description of the payload.

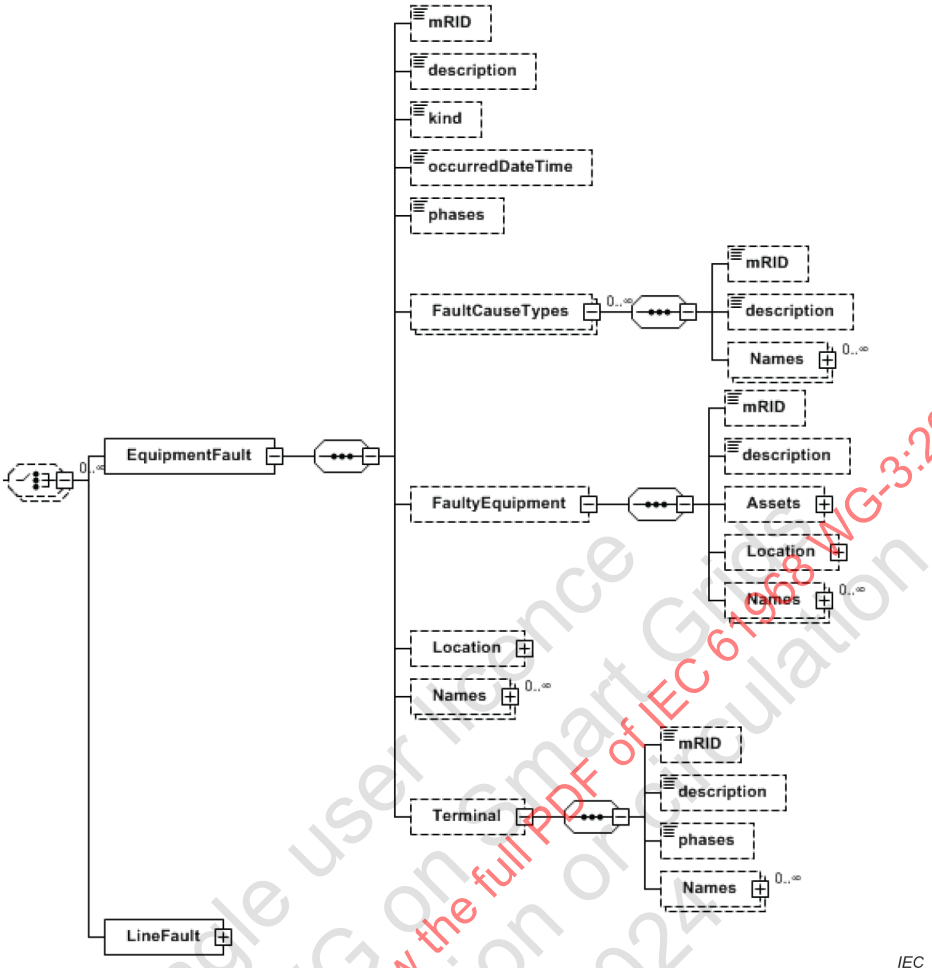

Figure 95 – UnplannedOutages message payload, EquipmentFault detail

Table 57 – Priority of statusKind when multiple crews assigned

Crew Status	Priority, 1 = highest
arrived	1
enroute	2
assigned	3
awaitingCrewAssignment	4
fieldComplete	5

5.18.3 Example XML

```
<?xml version="1.0" encoding="UTF-8"?>
<m:UnplannedOutages xmlns:m="http://iec.ch/TC57/2019/UnplannedOutages/#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/UnplannedOutages/# UnplannedOutages.xsd ">
  <m:UnplannedOutage>
    <m:mRID>357e3411-e68e-40d4-9b2e-fd48491fdbae</m:mRID>
    <m:cause>Weather</m:cause>
    <m:causeKind>lightningStrike</m:causeKind>
    <m:communityDescriptor>Buncome County</m:communityDescriptor>
    <m:createdDateTime>2019-06-03T12:43:00</m:createdDateTime>
    <m:customersRestored>0</m:customersRestored>
    <m:lastModifiedDateTime>2019-06-03T12:43:00</m:lastModifiedDateTime>
    <m:metersAffected>1206</m:metersAffected>
    <m:outageKind>predicted</m:outageKind>
    <m:reportedStartTime>2019-06-03T12:39:00</m:reportedStartTime>
    <m:statusKind>assigned</m:statusKind>
```

```
    <m:type>Recloser</m:type>
    </m:actualPeriod>
    <m:Crew>
      <m:FieldDispatchHistory>
        <m:FieldDispatchStep>
          <m:dispatchStatus>assigned</m:dispatchStatus>
          <m:occurredDateTime>2019-06-03T12:45:00</m:occurredDateTime>
          <m:sequenceNumber>1</m:sequenceNumber>
        </m:FieldDispatchStep>
        <m:Names>
          <m:name>James Smedley IV</m:name>
        </m:Names>
      </m:FieldDispatchHistory>
      <m:Names>
        <m:name>James Smedley IV</m:name>
      </m:Names>
    </m:Crew>
    <m:DeEnergizedUsagePoint>
      <m:mRID>cf6ca9ee-44c0-4e5e-8539-806042820bf6</m:mRID>
      <m:CustomerAgreement>
        <m:Customer>
          <m:kind>commercialIndustrial</m:kind>
          <m:locale>en</m:locale>
          <m:specialNeed>iceCreamMaker</m:specialNeed>
          <m:Names>
            <m:name>Nice Ice Creams Inc.</</m:name>
          </m:Names>
          <m:Organisation>
            <m:electronicAddress>
              <m:email1>jenny@nice-ice-creams.com</m:email1>
            </m:electronicAddress>
            <m:phone1>
              <m:areaCode>919</m:areaCode>
              <m:cityCode>555</m:cityCode>
              <m:localNumber>1234</m:localNumber>
            </m:phone1>
          </m:Organisation>
        </m:Customer>
      </m:CustomerAgreement>
      <m:Meters>
        <m:Names>
          <m:name>Meter CDS-1020910234</m:name>
        </m:Names>
      </m:Meters>
      <m:UsagePointLocation>
        <m:accessMethod>Gate code 44312</m:accessMethod>
        <m:siteAccessProblem>Bad dogs</m:siteAccessProblem>>
        <m:mainAddress>
          <m:postalCode>27606</m:postalCode>
          <m:streetDetail>
            <m:name>Main Campus Drive </m:name>
            <m:number>901</m:number>
          </m:streetDetail>
          <m:townDetail>
            <m:name>Raleigh</m:name>
            <m:stateOrProvince>NC</m:stateOrProvince>
          </m:townDetail>
        </m:mainAddress>
      </m:UsagePointLocation>
    </m:DeEnergizedUsagePoint>
    <m:EstimatedRestorationTime>
      <m:confidenceKind>low</m:confidenceKind>
      <m:ert>2019-06-03T14:30:00</m:ert>
      <m:ertSource>Automatic calculation</m:ertSource>
    </m:EstimatedRestorationTime>
    <m:LineFault>
      <m:mRID>cce3f88e-7ecb-442e-8aa6-8dab3bb04795</m:mRID>
      <m:kind>lineOpen</m:kind>
      <m:lengthFromTerminal1>125.0</m:lengthFromTerminal1>
      <m:occurredDateTime>2019-06-03T12:02:00</m:occurredDateTime>
      <m:phases>A</m:phases>
      <m:ACLineSegment>
        <m:mRID>b7e3453e-63ec-4203-898e-d23b8876f1f7</m:mRID>
      </m:ACLineSegment>
      <m:Location>
        <m:PositionPoints>
          <m:xPosition>35.7718409</m:xPosition>
          <m:yPosition>-78.6801357</m:yPosition>
```

```
        </m:PositionPoints>
      </m:Location>
    </m:LineFault>
    <m:Names>
      <m:name>Outage #1039212</m:name>
    </m:Names>
    <m:OutageIsolationEquipment>
      <m:mRID>80304bce-c43b-4584-80cf-04b5c1daebc0</m:mRID>
      <m:description>m:description</m:description>
      <m:Assets>
        <m:Names>
          <m:name>R-0483</m:name>
        </m:Names>
      </m:Assets>
      <m:Location>
        <m:direction>2 spans west of Old Hickory Road at gas station</m:direction>
        <m:PositionPoints>
          <m:xPosition>35.019823</m:xPosition>
          <m:yPosition>-76.23092</m:yPosition>
        </m:PositionPoints>
      </m:Location>
      <m:Names>
        <m:name>R-0483</m:name>
      </m:Names>
    </m:OutageIsolationEquipment>
    <m:TroubleTickets>
      <m:mRID>c95251c5-bf5f-4657-a9fb-0178fdff3f70</m:mRID>
      <m:description>Lights out</m:description>
      <m:Names>
        <m:name>Ticket # 4398402</m:name>
      </m:Names>
    </m:TroubleTickets>
  </m:UnplannedOutage>
</m:UnplannedOutages>
```

5.19 Metering message payloads

5.19.1 EndDeviceEvents

EndDeviceEvents message payloads are designed to communicate state changes of a metering device. This information may be used by applications e.g. for outage management. A sequence diagram for **EndDeviceEvents** is shown in Figure 96.

One or multiple meters report a power down status. This information may indicate an outage in the respective area of the network.

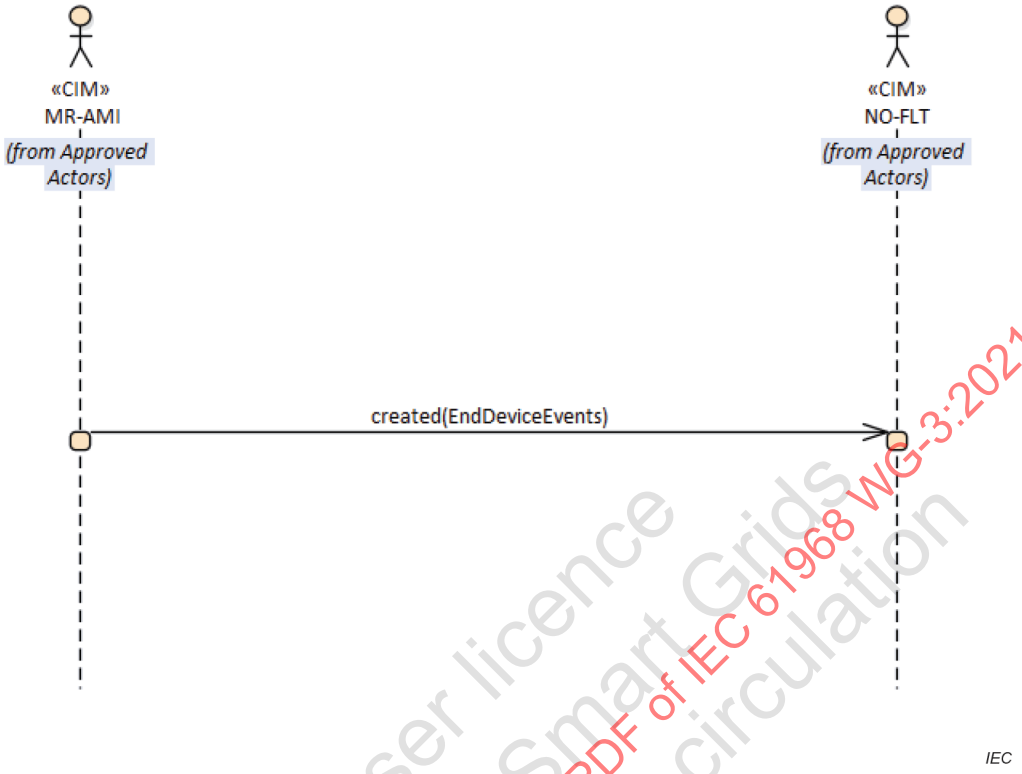

Figure 96 – EndDeviceEvents

For further details regarding **EndDeviceEvents** payload, see IEC 61968-9.

5.19.2 MeterReadings

MeterReadings message payloads are designed to read the state of one or multiple metering devices. This information may be used by applications e.g. for outage management. Figure 97 shows a typical meter reading sequence.

The state of one or multiple metering devices is requested to check if the power is restored in the respective area of the network.

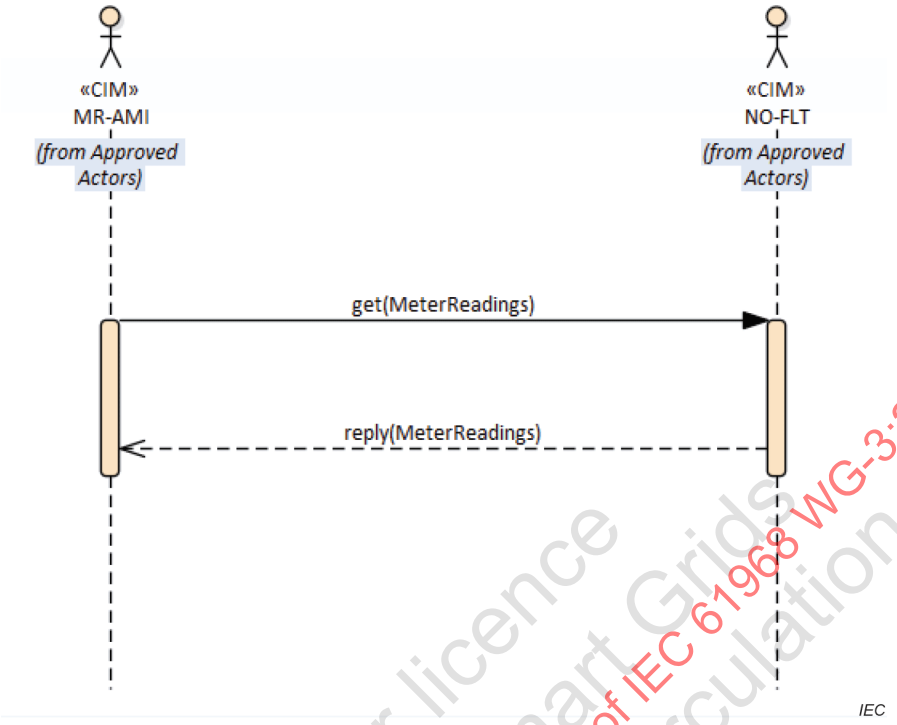

Figure 97 – MeterReadings sequence diagram

For further details regarding **MeterReadings** payload, see IEC 61968-9.

5.20 Work message payloads

5.20.1 WorkRequests payload

WorkRequests message payloads are designed to communicate requests for maintenance work including the work progress. Examples of requested work in the context of this document are:

- Request for a work request number during unplanned outage repairs. This could be used for time recording purposed, for example.
- Request to clear trees prior to performing outage restoration or to prevent future outages
- Request to perform permanent repairs after an emergency fix has been made to restore power after an unplanned outage

A **WorkRequest** may be communicated between different parties during its life cycle as shown in Figure 98:

- create (WorkRequests) – OMS->WMS
- reply (WorkRequests) – WMS->OMS
- changed (WorkRequests) – WMS->OMS (status changed or request is completed)

More detailed examples are provided in Clauses A.8 and A.9.

Figure 98 – WorkRequests sequence diagram

For further details regarding **WorkRequests**, see IEC 61968-6.

5.21 TroubleOrders

5.21.1 General

TroubleOrders message payloads communicate requests for responding to **Incidents** and/or **UnplannedOutages** including the work progress received from the field crew. The payload also includes **TroubleTickets** associated with the **TroubleOrder**.

- The payload is used to communicate an **Incident** and/or an **UnplannedOutage** and/or one or more **TroubleTickets**
- The payload includes the location where the work is to be performed.
- In order to support the assignment of multiple crews to the same Incident or UnplannedOutage, the **TroubleOrder** payload contains one or more **WorkTasks.** There is one **WorkTask** per crew that is assigned to the **TroubleOrder. WorkTasks** track the progress of each crew in working the **TroubleOrder.**

As shown in the example in Figure 99, a trouble order may be communicated between different parties during its life cycle:

- A **TroubleOrder** is created to initiate the work
- A **TroubleOrder** is changed as the crews perform work and the status changes
- A **TroubleOrder** is changed if additional crews are assigned to the **TroubleOrder**
- A **TroubleOrder** is changed if additional information is received that causes the location of the **UnplannedOutage** or **Incident** to change.

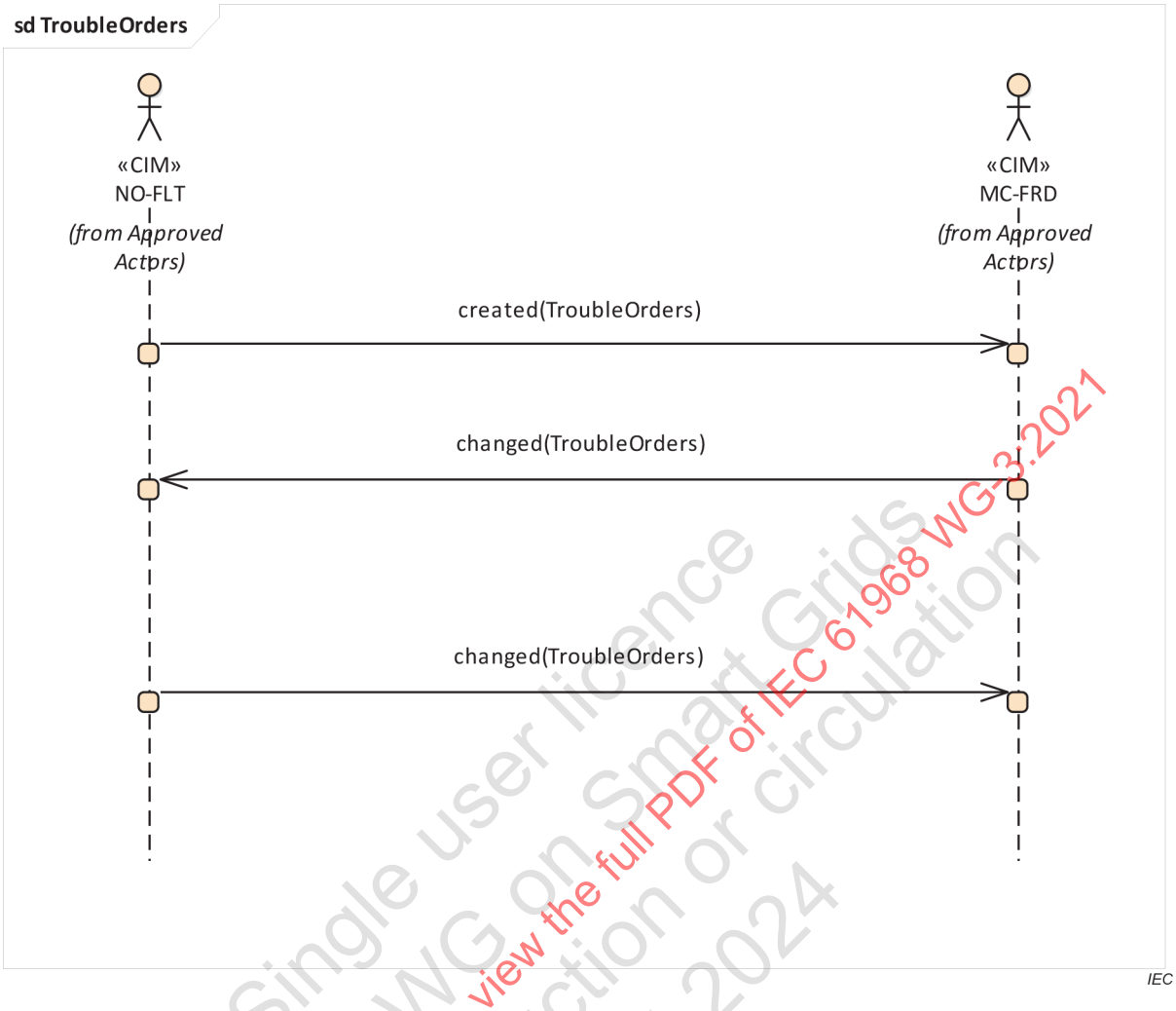

Figure 99 – TroubleOrders

5.21.2 Message payload

5.21.2.1 General

The top level of the **TroubleOrders** payload is shown in Figure 100. At the top level, key elements of a **TroubleOrder** include an **Incident** or an **UnplannedOutage** (or both) and the list of **TroubleTickets** which have been associated with them. In addition, the predicted or confirmed **Location** of the **Incident** or **UnplannedOutage** is defined in the **WorkTask**. This is where a crew would typically be sent to start an initial investigation. Instructions to the crew can be placed in the **comments** field for the **TroubleOrder**.

There may be one or more **WorkTask**s associated with the **TroubleOrder**. When initially creating a **TroubleOrder**, there must be at least one **WorkTask**. There must be a separate **WorkTask** for each **crew** that is assigned to the **TroubleOrder**, so that estimated time to arrive (ETA) and other status associated with each crew can be tracked.

The attributes of the **TroubleOrders** profile are described in Table 58.

Table 58 – TroubleOrders Profile

Incidents				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
TroubleOrders	TroubleOrder	[1..*]		
Profile Attributes				
description	String	[0..1]		Free-form text field that describes the **TroubleOrder**
mRID	String	[0..1]	GUID	mRID of the TroubleOrder.
Names	Name	[0..*]	See B.56	Can be used to provide additional identifiers such as internal TroubleOrder number.
comment	String	[0..1]		Free-form comment associated with the TroubleOrder
createdDateTime	DateTime	[0..1]		DateTime that the TroubleOrder was initially created.
lastModifiedDateTime	DateTime	[0..1]		DateTime that the TroubleOrder was last changed.
revisionNumber	String	[0..1]		Revision number for this document.
subject	String	[0..1]		Document subject. Free-form text.
title	String	[0..1]		Document title. Free-form text.
type	String	[0..1]		Type of TroubleOrder.
Incident	Incident	[0..1]	See 5.21.2.2	Associated Incident, if any.
Issuer	Issuer	[0..1]	See B.47	Person who issued the TroubleOrder to the field crew or workforce management system.
status	Status	[0..1]	See B.79	Used to indicate whether the **TroubleOrder** is open or closed. Possible values of status.value are ‘Open’, ‘Closed’.
TroubleTicket	TroubleTicket	[0..*]	See 5.21.2.4	List of TroubleTickets that are associated with this TroubleOrder
UnplannedOutage	UnplannedOutage	[0..1]	See 5.21.2.3	The UnplannedOutage, if any, associated with this TroubleOrder
WorkTask	WorkTask	[0..*]	See 5.21.2.5	The set of WorkTasks associated with this TroubleOrder

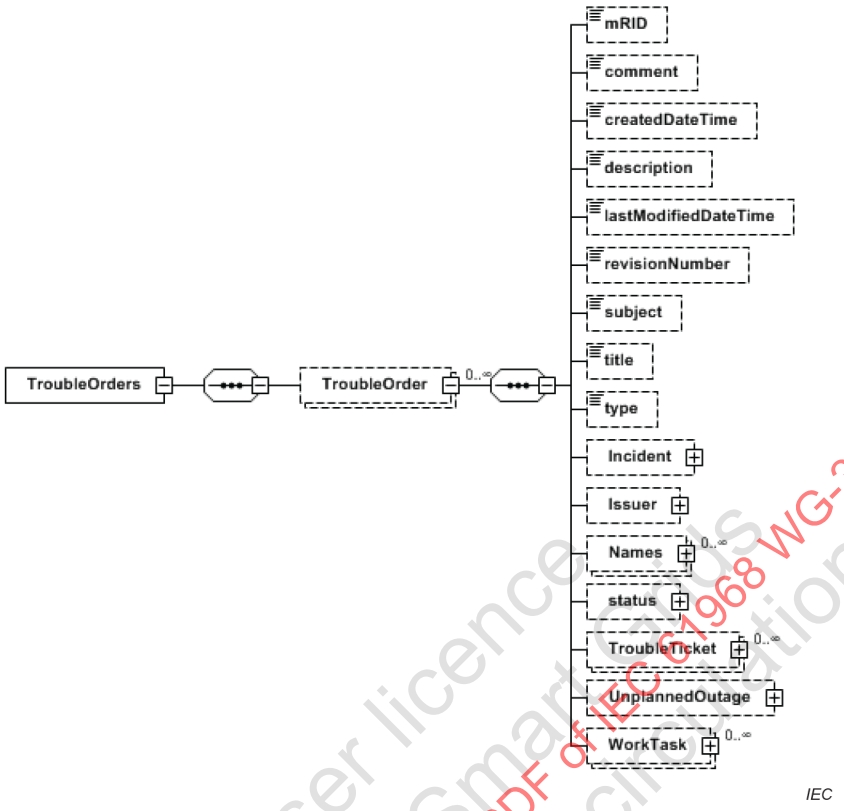

Figure 100 – TroubleOrders top level message payload

5.21.2.2 TroubleOrders payload – Incident

The **Incident** component of **TroubleOrders** is shown in Figure 101. The purpose of this part of the payload is to describe the details of the **Hazard**.

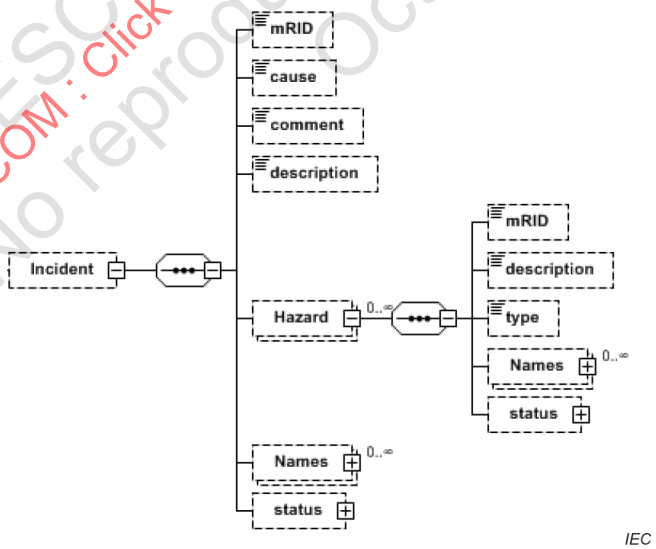

Figure 101 – TroubleOrders – Incident payload fragment

5.21.2.3 TroubleOrders payload – UnplannedOutage

The **UnplannedOutage** element of **TroubleOrders** is shown in Figure 102. The attributes of the **UnplannedOutage** appearing in the **TroubleOrders** profile are described in detail in 5.18.2.

The payload includes sufficient information to get the crew to the location of the **UnplannedOutage**. The **comment** and **description** are free-form text fields that describe the **UnplannedOutage**, while the **Location** provides more precise geographic location information. **Names** can be used to provide additional identifiers such as internal outage number.

When using this payload to dispatch a crew to an **UnplannedOutage**, the following information can be populated as described below:

- **metersAffected** – a count of how many meters are currently predicted or confirmed de-energized by this outage. Can be used to help determine restoration priority
- **reportedStartTime** – date/time when the first customer lost power
- **Names** – can be used to convey internal outage number
- **type** – string that describes the extent of the outage, e.g. customer, distribution transformer, fuse, recloser, circuit breaker, etc.
- **description** – comments regarding the outage
- **outageIsolationEquipment** – in the case of a radial network configuration, this is a single piece of equipment where the outage has been predicted or confirmed. In the case of a meshed network configuration, there may be multiple pieces of outage isolation equipment. See Clause B.63.

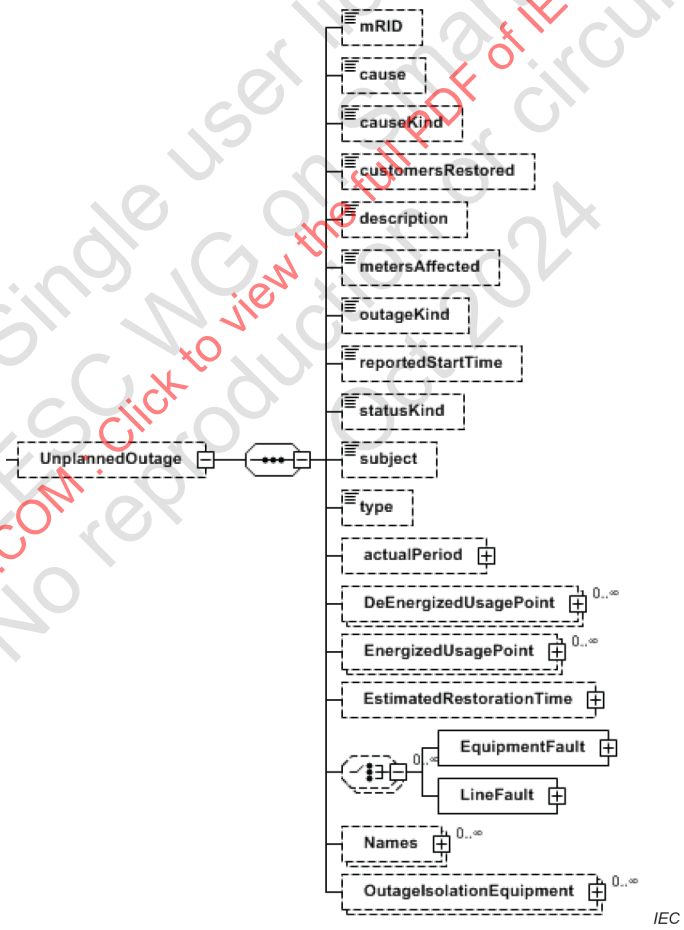

Figure 102 – TroubleOrders – UnplannedOutage payload fragment

When a field crew is dispatched to an **UnplannedOutage**, they need to know its predicted or confirmed location. The geographic location is provided in the **TroubleOrder.Location** element of the **TroubleOrder** message.

Additional location information can be provided in the payload in order to assist the crew in responding to the unplanned outage. This consists of unplanned outage location information and fault location information. Fault location is the location of the fault itself, such as a wire down. Unplanned outage location is the location of the device that operated as a result of the fault, such as a recloser or circuit breaker. This distinction is shown in Figure 103.

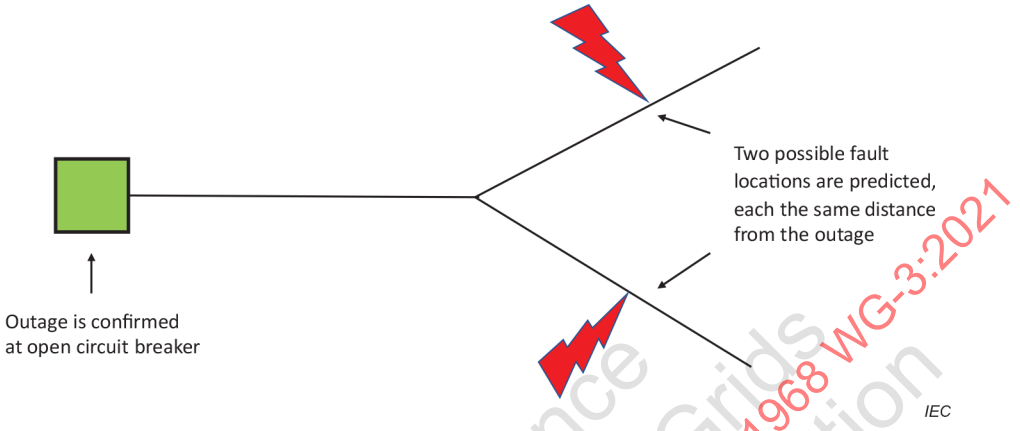

Figure 103 – Distinction between outage location and fault location

If fault location is available, **LineFault** and/or **EquipmentFault** may appear in the initial **TroubleOrders** payload when it is sent to the field crew. In addition, the field crew may identify the actual location of the fault and it is communicated back to the control room in the **LineFault** and/or **EquipmentFault** elements of the payload.

The various use cases of outage location and fault location information are shown in Table 59. The table also shows how **UnplannedOutage.type** determines where the information appears in the payload.

Table 59 – Additional outage location information

Use Case	UnplannedOutage.type	Additional outage location information	Additional fault location information
Predicted or confirmed customer outage	Customer	Location of the outage is available in **DeEnergizedUsagePoints.UsagePointLocation**. It may be necessary to know the meter number when the outage is predicted to an apartment building, for example, or there are multiple meters at the same address. Meter number is available in **DeEnergizedUsagePoints.Meters.Names**	
Predicted or confirmed service transformer outage	Service transformer	Location of the outage is available in **OutageIsolationEquipment.Location**, which specifies the location of the transformer.	
Predicted or confirmed equipment outage on radial network	Equipment	Location of the outage is available in **OutageIsolationEquipment.Location**, which specifies the location of the protective device.	
Predicted or confirmed equipment outage on meshed network	Equipment	Location of the outage is available in **OutageIsolationEquipment.Location**, which specifies the location of one or more protective devices.	

Use Case	UnplannedOutage.type	Additional outage location information	Additional fault location information
Predicted equipment outage and fault location information is available	Equipment	Location of the outage is available in **OutageIsolationEquipment.Location**, which specifies the location of one or more protective devices.	**LineFault** and/or **EquipmentFault** identify one or more locations where the actual fault is predicted to have occurred.

The **DeEnergizedUsagePoint** part of the payload is shown in Figure B.8 and is described in Subclause B.27.

The **EquipmentFault** attribute of the payload is shown in Figure 104.

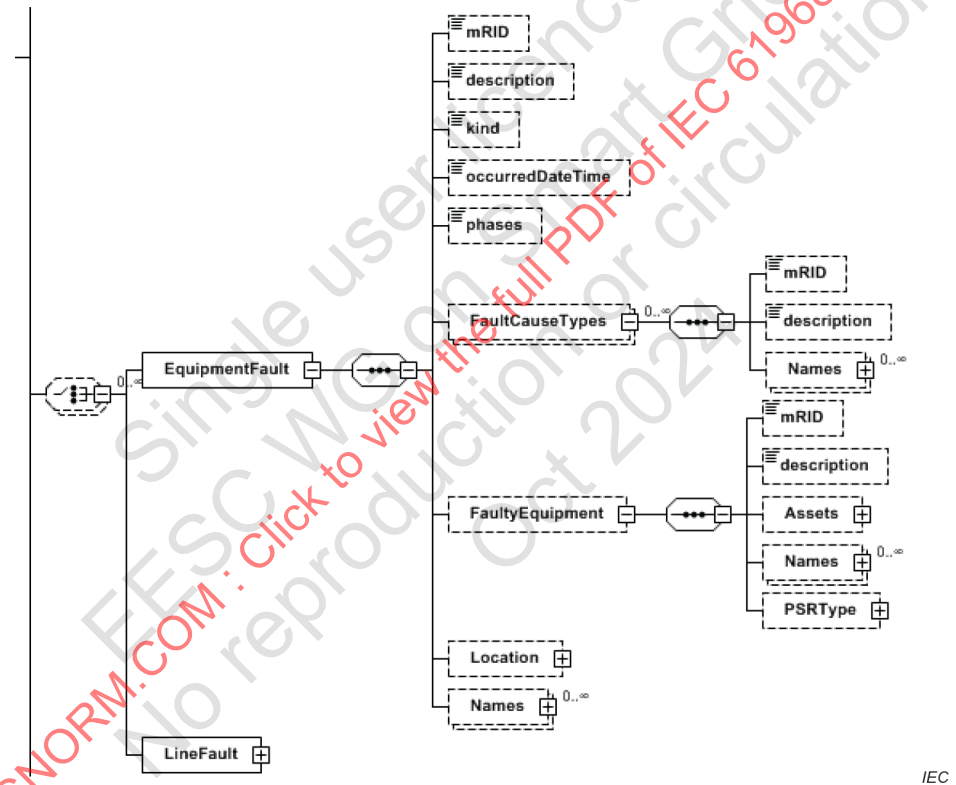

Figure 104 – TroubleOrders, UnplannedOutage, EquipmentFault payload fragment

The **LineFault** attribute of the payload is shown in Figure 105.

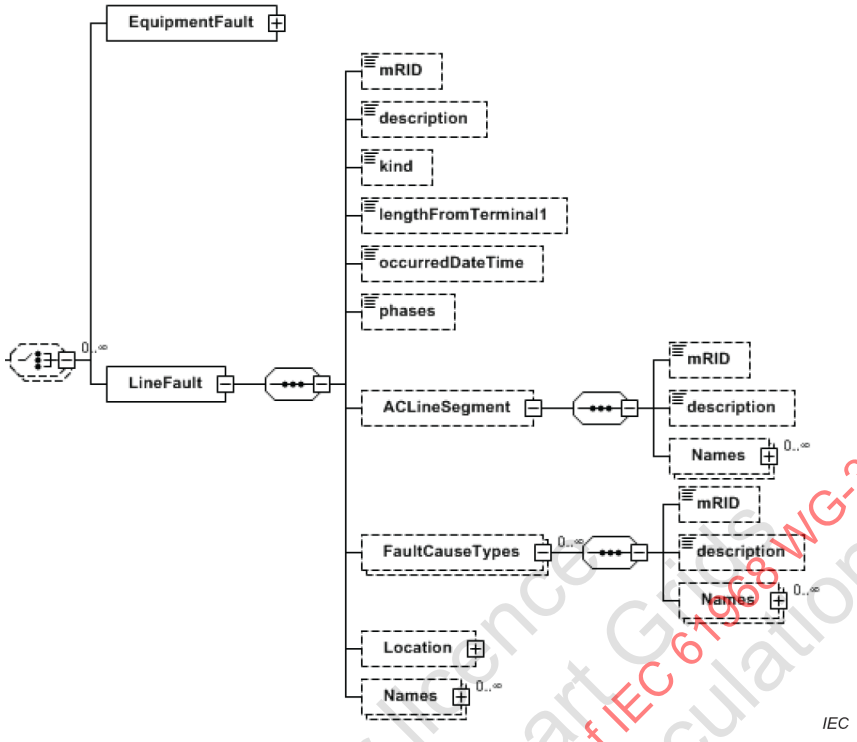

Figure 105 – TroubleOrders, UnplannedOutage, LineFault payload fragment

Other attributes for **UnplannedOutage** are:

- **outageKind** – enumeration that defines whether the outage is **closed**, **confirmed**, **partiallyRestored**, **predicted** or **restored**.
- **statusKind** – enumeration that defines the overall crew status for the **UnplannedOutage**. Values are **arrived**, **assigned**, **awaitingCrewAssignment**, **enroute** or **fieldComplete**
- **actualPeriod** – used to record the actual power off and restoration times of the **UnplannedOutage**, using the **start** and **end** attributes. See Figure 106

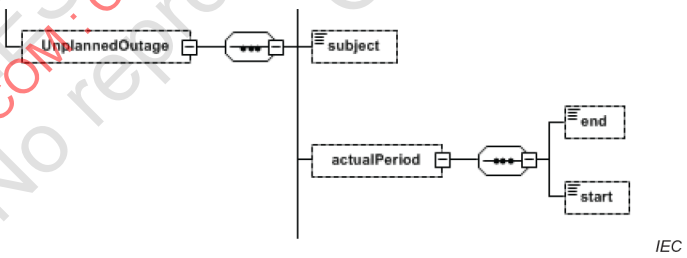

Figure 106 – TroubleOrders, UnplannedOutage – actualPeriod payload fragment

5.21.2.4 TroubleOrders payload – TroubleTicket

The **TroubleTicket** part of the payload is shown in Figure 107.

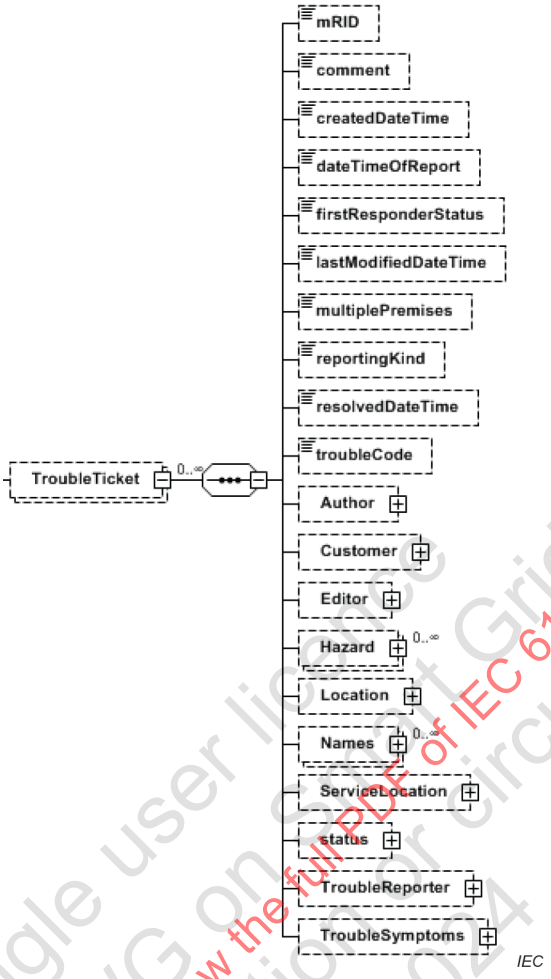

Figure 107 – TroubleOrders – TroubleTicket payload fragment

Since there may be many **TroubleTickets** associated with an **UnplannedOutage**, it may not be practical to send all of the **TroubleTickets** with the **TroubleOrder**. It is an implementation issue to determine how many and which **TroubleTickets** to send. For example, only those **TroubleTickets** that have a **Hazard**, or have a customer with **specialNeeds** could be sent. The attributes of the **TroubleTicket** fragment are shown in Table 60.

Table 60 – TroubleTicket attributes

Customer: TroubleTicket				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	**mRID** of the TroubleTicket
description	String	[0..1]		Free form description of the TroubleTicket
Names	Name	[0..*]	See B.56	Can be used to provide additional identifiers such as internal TroubleTicket number.
comment	String			Any comments that the customer provided that might help diagnose the source of the outage
createdDateTime	DateTime	[0..1]		Date and time this activity record has been created (different from the 'status.dateTime', which is the time of a status change of the associated object, if applicable). time the TroubleTicket was created. This may be different (later) than the time that the TroubleTicket was reported. For example, an IVR might receive the information some seconds or minutes before the ticket is actually created.
dateTimeOfReport	DateTime	[0..1]		Date and time the trouble has been reported.
firstResponderStatus	String	[0..1]		Indicates whether the first responder such as police, fire department etc.has been notified and whether they are on site or en route.
lastModifiedDateTime	DateTime	[0..1]		Last time and date that the TroubleTicket was modified.
multiplePremises	Boolean	[0..1]		Set to true if the outage report indicated that other neighbors are also out of power.
reportingKind	TroubleReportingKind	[0..1]	See C.24	Indicates how the customer reported trouble. Enumeration that defines how the customer reported the ticket. Values: call, email, ivr, letter, other
resolvedDateTime	DateTime	[0..1]		Date and time this trouble ticket has been resolved.
troubleCode	String	[0..1]		Trouble code (e.g., power down, flickering lights, partial power, etc).
Author	Author	[0..1]	See B.13	Person who created the TroubleTicket, usually the customer service represenatative who entered the TroubleTicket.
Customer	Customer	[0..1]	See B.25	Defines the name of the customer; locale is the language spoken, while kind is an enumeration with values: commercialIndustrial, residential, etc. specialNeed is used to indicate life support, etc.
Editor	Editor	[0..1]	See B.31	Person who last made changes to the TroubleTicket.
Hazard	Hazard	[0..*]	See B.46	Defines whether there is a hazardous condition associated with the TroubleTicket. There can be zero, one or many.
Location	Location	[0..1]	See B.52	Defines the location of the trouble identified by the **TroubleTicket** when it refers to trouble that is not associated with a **ServiceLocation**, such as a car hit pole.

Customer: TroubleTicket				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
ServiceLocation	ServiceLocation	[0..1]	See B.76	A **ServiceLocation** is a real estate location, commonly referred to as premises.
status	Status	[0..1]	See B.79	Can be used to log changes to the status of the TroubleTicket
TroubleReporter	TroubleReporter	[0..1]	See B.94	Person reporting the trouble.
TroubleSymptoms	TroubleSymptoms	[0..1]	See B.94	Set of symptoms that define the type of trouble being reported.

5.21.2.5 **TroubleOrders** payload – WorkTask

The top level of the **WorkTask** part of the payload is shown in Figure 108 and Figure 109. On the initial assignment, there could be only one **WorkTask** for the **TroubleOrder** and a small sub-set of the attributes would be set, such as:

- **comment**, **subject**, **title**: free form text indicating any information regarding the work to be performed
- **kind** (enumeration, values include: inspection, maintenance, repair, other)
- **statusKind** (enumeration indicating status of task; values include: **approved**, **canceled**, **closed**)
- **crews** information. See the description of crew information below.
- **priority** defines the relative priority of the **WorkTask** and is a compound. The **rank** part of the compound is an integer that defines the priority order.
- **workLocation**, which could be different to the location of the overall **TroubleOrder**, as defined by the various locations in the **UnplannedOutage**, **TroubleTicket** and **Incident** elements of the payload.

Detailed attributes for **WorkTask** are described in Table 61.

Table 61 – WorkTask attributes

Work: WorkTask				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the WorkTask
description	String	[0..1]		Free form description of the WorkTask.
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the WorkTask
comment	String	[0..1]		Free-form text string associated with the WorkTask
completedDateTime	DateTime	[0..1]		Date and time work task was completed.
contractorCost	Money	[0..1]		Total contractor costs associated with the work task.
createdDateTime	DateTime	[0..1]		Date and time WorkTask was created.
crewETA	DateTime	[0..1]		Estimated time of arrival, so that customer or police/fire department can be informed when the crew will arrive.
estimatedCompletionTime	DateTime	[0..1]		Estimated date/time that the WorkTask will be completed.

Work: WorkTask				
Attribute	**Data Type**	**Cardinality**	**Comments**	**Description**
kind	WorkKind	[0..1]	See C.34	Kind of work.
laborCost	Money	[0..1]		Total labor costs associated with the work task.
laborHours	Hours	[0..1]		Hours of labor expended under work task.
lastModifiedDateTime	DateTime	[0..1]		Date and time WorkTask was last modified.
materialCost	Money	[0..1]		Total material costs associated with the work task.
startedDateTime	DateTime	[0..1]		Date and time work task was started.
statusKind	WorkStatusKind	[0..1]	See C.35	Kind of status, specific to work.
subject	String	[0..1]		Free-form text.
taskKind	WorkTaskKind	[0..1]	See C.36	Kind of work.
title	String	[0..1]		Free-form text.
Assets	Assets	[0..*]	See B.9	Defines the assets that are involved in the WorkTask, if any.
Crews	Crew	[0..1]	See B.22	Crew type requested for this WorkTask or crew assigned to this WorkTask.
priority	Priority	[0..1]	See B.69	Priority definition.
SwitchingPlan	SwitchingPlan	[0..1]	See 5.8.2	mRID, description and Names only.
WorkActivityRecords	WorkActivityRecord	[0..*]	See B.102	Records information about the status of work or work task at a point in time.
WorkLocation	WorkLocation	[0..1]	See B.52	This inherits from Location and has the same attributes.

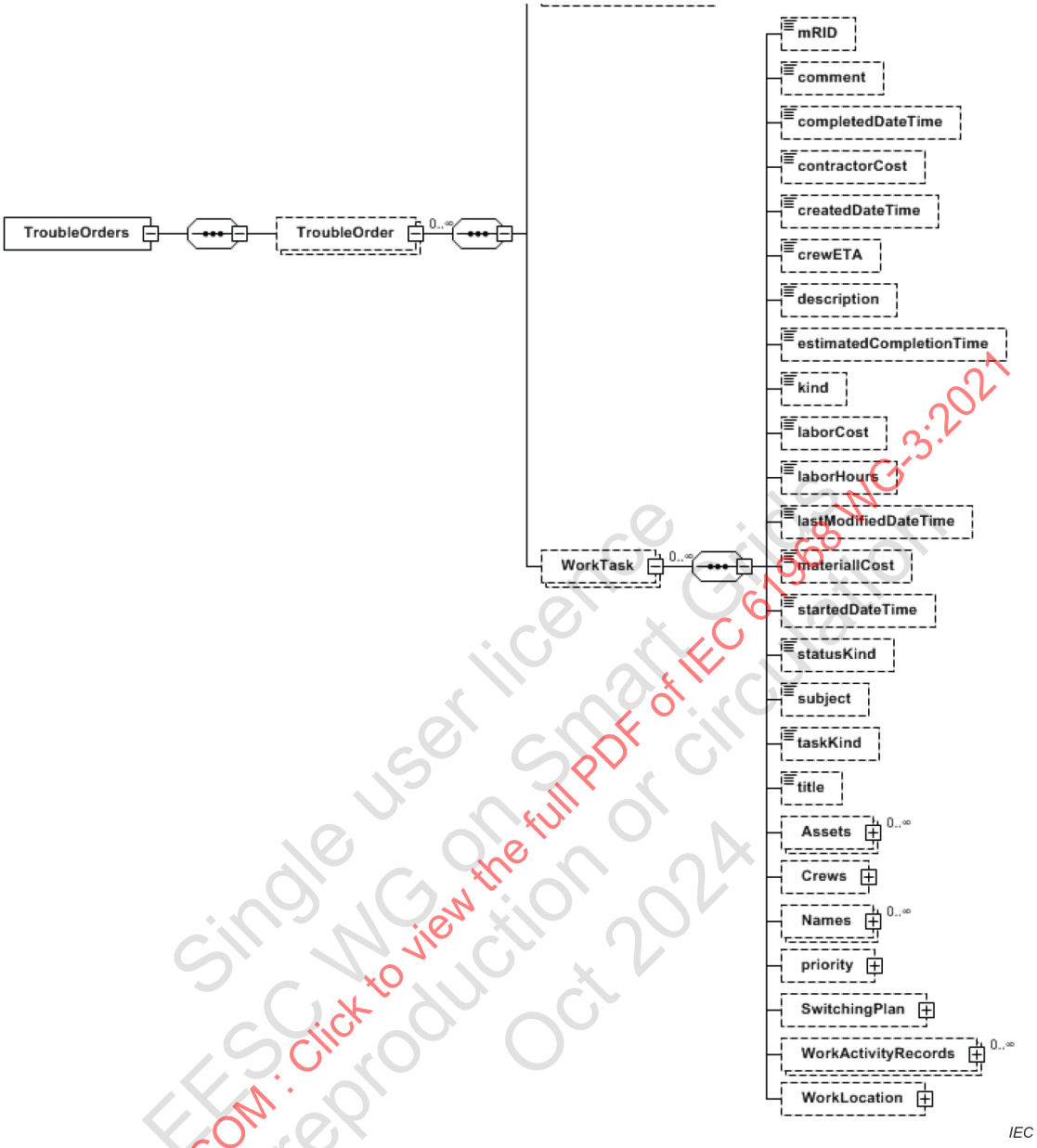

Figure 108 – TroubleOrders – WorkTask payload fragment (1)

Crews information for the **WorkTask** is shown in Figure B.5. The payload can be used in two different ways, depending on where the crew assignment function is being performed. Crew assignment means determining the best crew to perform the work at the location defined by **WorkLocation** and with the skillset defined by **CrewType**. For example, crew assignment could be performed either in an OMS or in a mobile workforce management system.

WorkLocation is a class that inherits from **Location** and in this message payload it has the same attributes as the **Location** class.

If the crew assignment function is being performed by the business function that initiates the **TroubleOrder**, then the **TroubleOrder** payload identifies the specific **Crew**, **CrewType** and/or **CrewMembers**. Otherwise if the assignment is being performed by the business function that receives the **TroubleOrder**, then the **CrewType** can be populated, leaving the **Crew** and/or **CrewMembers** blank.

The **FieldDispatchHistory** element is used to track crew dispatch status changes related to this **WorkTask** and would typically be filled out as the field worker works through the steps in the lifecycle of the **WorkTask**. Each time the crew dispatch status changes, a new **FieldDispatchStep** is added to the payload.

Figure 109 shows the **priority**, **SwitchingPlan** and **WorkLocation** elements of the **WorkTask** payload. **Priority** and **WorkLocation** have already been described. **SwitchingPlan** is a reference to a **SwitchingPlan** that is being used to coordinate switching for the work identified by the **TroubleOrder**.

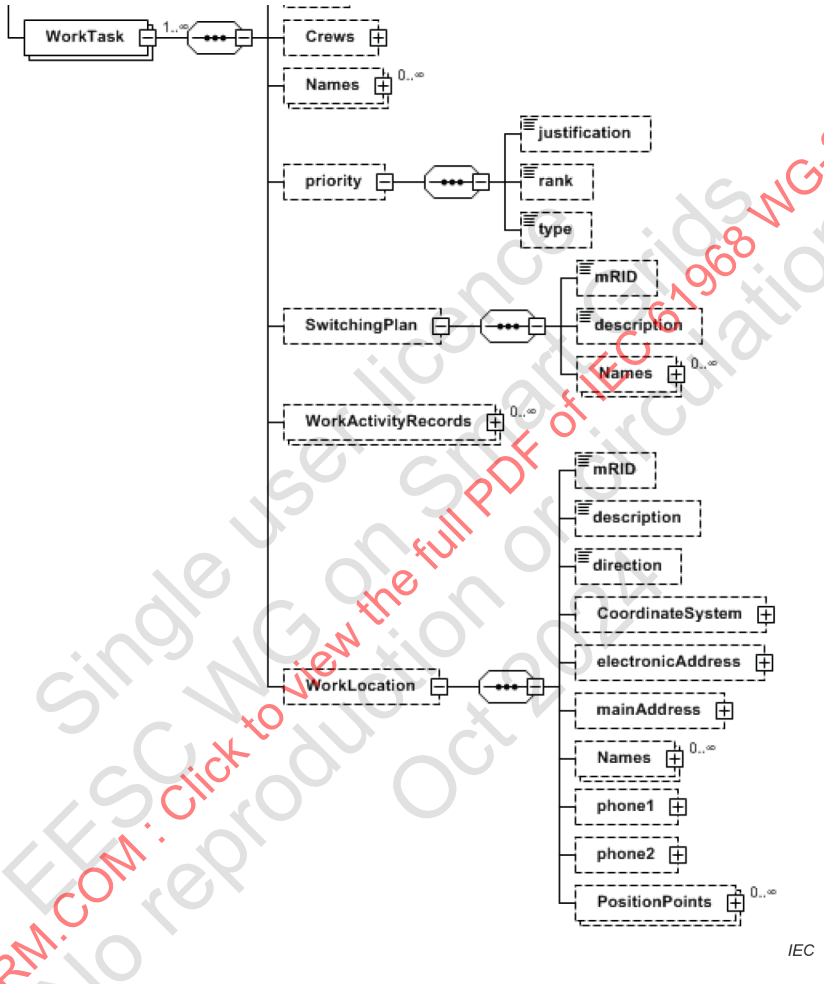

Figure 109 – TroubleOrders – WorkTask payload fragment (2)

The **WorkActivityRecords** part of the payload is shown in Figure 110. This is used to record any activities performed by the field crew. See Clause B.102 for a description of the elements.

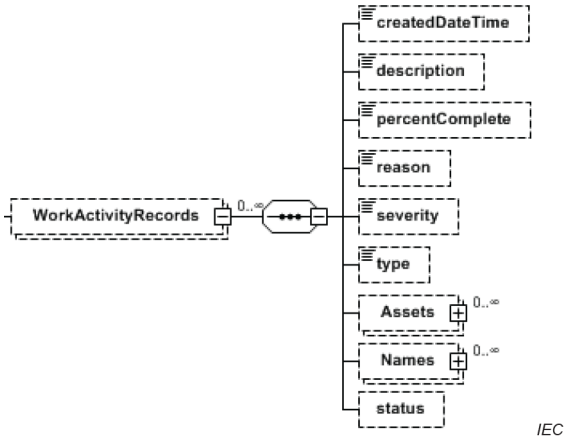

Figure 110 – TroubleOrders – WorkTask WorkActivityRecords payload fragment

The **Assets** part of the **WorkActivityRecords** is shown in Figure 111. See Clause B.102 for a description of **WorkActivityRecord**. Attributes include:

- **AssetContainer** – container of the **Asset**, such as a **Cabinet**, **Ductbank**, **Pole**, **Tower** or **UndergroundStructure**
- **AssetInfo** – type data such as conductor type or device type
- **Ownerships** – who owns the asset, such as a pole that is shared
- **PowerSystemResources** – asset as it pertains to the electrical network

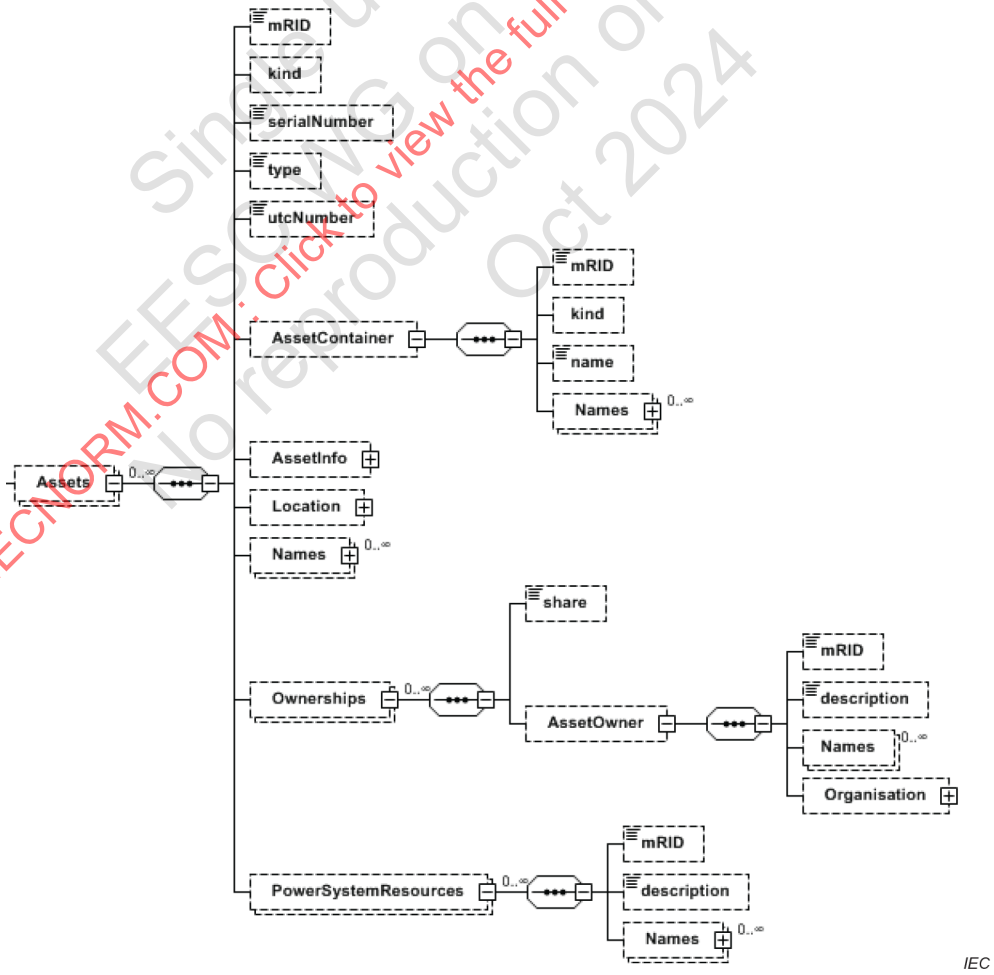

Figure 111 – TroubleOrders – WorkTask, WorkActivityRecords, Assets payload

5.21.3 Example XML for an **Incident TroubleOrder**

The example XML below shows a **TroubleOrder** message that has an **Incident** associated with it. This is used to communicate a request for a trouble shooter to be dispatched to an **Incident**. This is indicated in the crew part of the payload that has a blank crew but a crew type of “Trouble Shooter”.

The **Incident** was reported from a single **TroubleTicket** that is also part of this message, but the **Incident** details are in the **Incident** itself. The **Incident** is referenced by the **TroubleTicket**.

```
<?xml version="1.0" encoding="UTF-8"?>
<m:TroubleOrders xmlns:m="http://iec.ch/TC57/2019/TroubleOrders#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://iec.ch/TC57/2019/TroubleOrders# TroubleOrders.xsd ">
  <m:TroubleOrder>
    <m:mRID>812b9002-c245-401b-bd32-467c1dce81aa</m:mRID>
    <m:comment>Car hit pole incident</m:comment>
    <m:createdDateTime>2019-05-31T08:03:00</m:createdDateTime>
    <m:description>Car hit pole at Jackson and Spear in Ontario</m:description>
    <m:lastModifiedDateTime>2019-05-31T08:03:00</m:lastModifiedDateTime>
    <m:subject>Trouble Order</m:subject>
    <m:title>TroubleOrder 19201 for Incident 23153</m:title>
    <m:type>TroubleOrder for Incident</m:type>
    <m:Incident>
      <m:mRID>33870e3d-4777-45c3-b12c-fc8bfb80ac26</m:mRID>
      <m:cause>Car hit pole</m:cause>
      <m:comment>Car hit a pole at Jackson and Spear. No power reported out.</m:comment>
      <m:description>Wire is down</m:description>
      <m:Hazard>
        <m:type>Electric</m:type>
        <m:Names>
          <m:name>Hazard 32125</m:name>
        </m:Names>
        <m:status>
          <m:dateTime>2019-05-31T07:54:00</m:dateTime>
          <m:value>Unsafe condition</m:value>
        </m:status>
      </m:Hazard>
      <m:Location>
        <m:direction>Intersection of Jackson St and Spear Ave</m:direction>
      </m:Location>
      <m:Names>
        <m:name>Incident 23153</m:name>
      </m:Names>
      <m:status>
        <m:dateTime>2019-05-31T08:11:00</m:dateTime>
        <m:value>Associated with Trouble Order 19201</m:value>
      </m:status>
    </m:Incident>
    <m:Issuer>
      <m:Names>
        <m:name>Officer Forest Gump</m:name>
      </m:Names>
    </m:Issuer>
    <m:Names>
      <m:name>Trouble Order 19201 </m:name>
    </m:Names>
    <m:status>
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      <m:value>Pending trouble shooter assignment</m:value>
    </m:status>
    <m:WorkTask>
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      <m:comment>Request for a trouble shooter to investigate Incident 23153</m:comment>
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      <m:kind>inspect</m:kind>
      <m:lastModifiedDateTime>2019-05-31T08:31:00</m:lastModifiedDateTime>
      <m:statusKind>waitingToBeScheduled</m:statusKind>
      <m:Crew>
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          </m:Names>
        </m:CrewType>
      </m:Crew>
```

```
      <m:priority>
        <m:rank>99</m:rank>
        <m:type>Hazardous Incident</m:type>
      </m:priority>
    </m:WorkTask>
    <m:TroubleTicket>
      <m:mRID> f369fda9-cccd-4bec-9951-dbc041a72c05</m:mRID>
      <m:comment>Caller (police) reports that a car has hit a pole at Jackson and
Spear</m:comment>
      <m:createdDateTime>2019-05-31T07:22:00</m:createdDateTime>
      <m:dateTimeOfReport>2019-05-31T07:22:00</m:dateTimeOfReport>
      <m:firstResponderStatus>Police are on the scene</m:firstResponderStatus>
      <m:lastModifiedDateTime>2019-05-31T08:09:00</m:lastModifiedDateTime>
      <m:reportingKind>call</m:reportingKind>
      <m:troubleCode>Wire down</m:troubleCode>
      <m:Author>
        <m:Names>
          <m:name>Johnny Peters</m:name>
        </m:Names>
      </m:Author>
      <m:Customer>
        <m:Names>
          <m:name>Officer Forest Gump</m:name>
        </m:Names>
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        </m:Names>
      </m:Editor>
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        </m:Names>
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          <m:dateTime>2019-05-31T08:01:00</m:dateTime>
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        </m:status>
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      </m:Names>
      <m:status>
        <m:dateTime>2019-05-31T07:36:00</m:dateTime>
        <m:value>Open</m:value>
      </m:status>
    </m:TroubleTicket>
  </m:TroubleOrder>
</m:TroubleOrders>
```


6 Document Conventions

6.1 Message payload definitions

6.1.1 General

Message payload diagrams and tables 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 payloads.

6.1.2 Mandatory versus Optional

The message payloads described within this standard were derived from use cases in Annex A 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 payload 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 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.

6.3 Message exchanges

6.3.1 General

Refer to IEC 61968-100 for further information on message exchanges.

Annex A
(informative)

Use cases

A.1 General

This annex provides examples of network operations use cases associated with network outage detection and response. It is important to note that the use cases and sequence diagrams provided in this part of IEC 61968 are informative in nature, and are intended to provide examples of usage for the normative messages payloads. There is no intent in this part of IEC 61968 to standardize specific business processes.

The FLISR use cases describe the workflow necessary for informing operational systems of an outage and fault location, and for responding with fault isolation and restoration of healthy islands of network. FLISR stands for Fault Location, Isolation, and Service Restoration. When an outage is detected by SCADA or predicted by outage analysis, typically the best information is association of outage with a protective device that has tripped. Fault location refers to the additional observations, signals, and analysis necessary to identify the true cause of the outage, typically a line fault downstream of the protective device. Isolation is the process of switching and cutting that allows the fault location to be safely isolated for repaires. The process of restoring power to healthy islands of network around the isolated area is referred to as service restoration. There are two FLISR use cases, one for automatic closed loop control and one where crews perform the switching manually.

A.2 FLISR for SCADA-detected outage, SCADA switching

A.2.1 Description of the use case

A.2.1.1 Name of use case

use case identification		
ID	**Domain(s)**	**Name of use case**
	Outage Management, Work Management, Distribution Management	FLISR for SCADA-detected outage, SCADA switching

A.2.1.2 Version Management

Version management changes / Version	Date (dd/mm/yyyy)	Name author(s) or committee	Area of expertise / domain / role	Title	Approval status draft, for comments, for voting, final
1	30/04/2019	WG14 Part 3 Team	Outage Management, Distribution Management and Work Management		Draft

A.2.1.3 Scope and objectives of use case

Scope and objectives of use case	
Related business case	FLISR based on centralised control, IEC 61850-90-6
Scope	This use case covers the receipt of a breaker open event and the automatic generation and execution of a switching plan to isolate the fault and restore the healthy part of the feeder by feeding the downstream part of the feeder from another feeder.

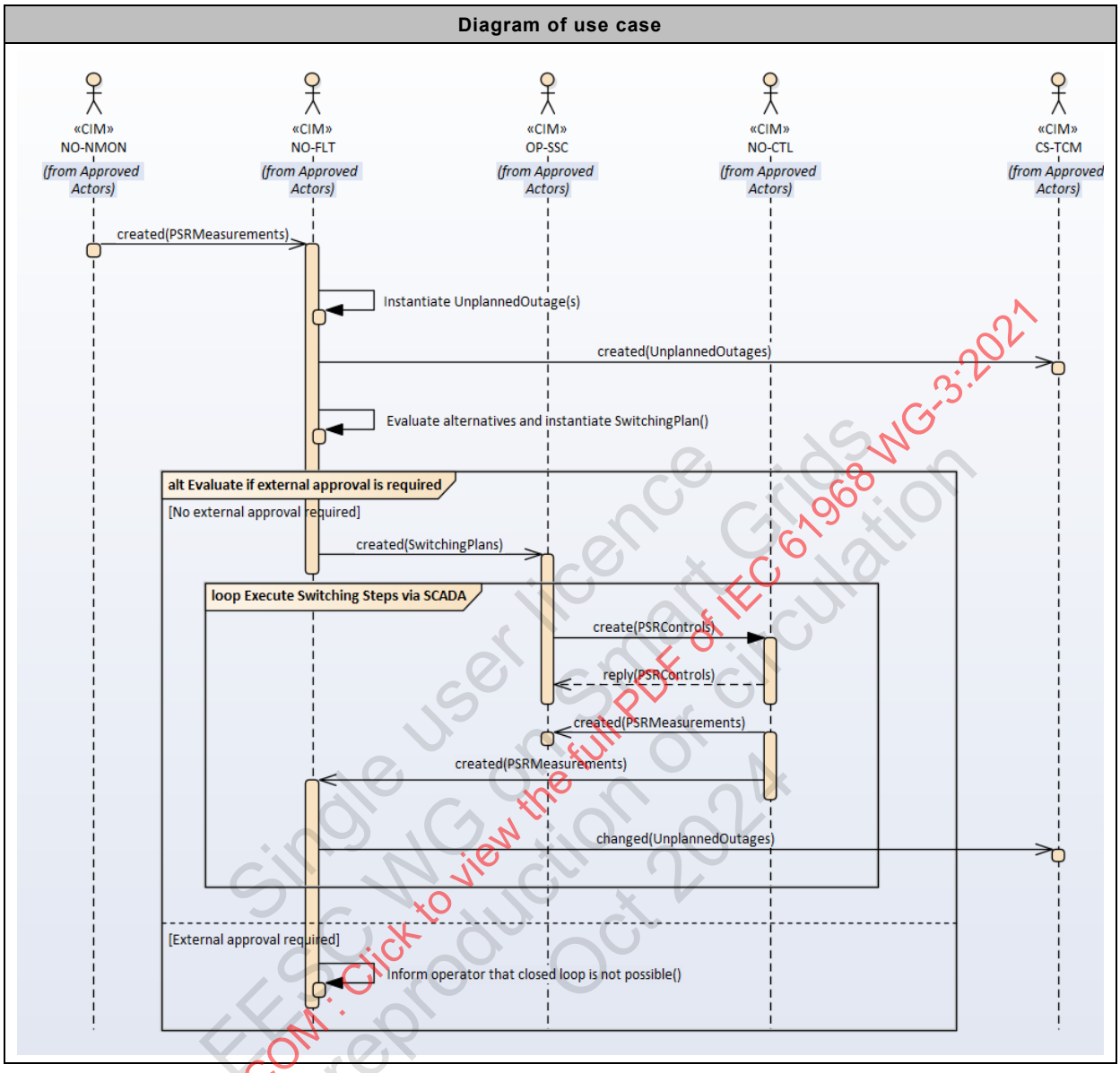
A.2.1.4 Narrative of use case

Narrative of use case
Short description – max 3 sentences
This FLISR workflow assumes a self-healing network, with all monitoring and control of the system provided by SCADA and automatic outage response directed by the Fault Management function of a DMS. The message flow is shown in the sequence diagram in Figure A.1, along with a description of the message flow in the table in A.2.4.2. The use case considers the situation where a DSO may require approval from a TSO prior to transferring load, such as when transferring more than a certain number of MVA between different substations
Complete description
This FLISR workflow assumes a self-healing network, with all monitoring and control of the system provided by SCADA and automatic outage response directed by the Fault Management function of a DMS. The message flow is shown in the sequence diagram in Figure A.1, along with a description of the message flow in the table in A.2.4.2. The use case considers the situation where a DSO may require approval from a TSO prior to transferring load, such as when transferring more than a certain number of MVA between different substations. When Network Monitoring (NO-MON, aka SCADA) detects an unexpected change in status of a protective device, it will report the change in status to Fault Management (NO-FLT, aka OMS). NO-FLT creates an **UnplannedOutage** and sends the information to Customer Operations (CS-TCM). At this point, Customer Operations might be notifying Fault Management of trouble tickets. Fault Management can correlate tickets to the outage and inform Customer Operations of the incident used for management of the problem. Fault Management will evalulate different alternatives and create a switching plan to isolate the problem and restore power to healthy islands of network. Fault Mangement will evaluate one or more switching plan variations for this purpose, and it will chose the one that provides the most optimal balance of reserve current in neighboring circuits. Fault Management will then evaluate whether external approval of the switching plan is required. If external approval is required, the operator will be notified and no switching plan will be executed. It is possible that after the operator has gained approval to execute the plan, then the switching plan can be executed under operator control a later time. This is not included in the scope of this use case. If external approval is not required, then Fault Management will send the **SwitchingPlan** to Switch Action Scheduling (OP-SSC). Switch Action Scheduling will direct Network Control to execute each step of the selected switching plan. With the execution of each step, Fault Management will receive notification of changes to the network due to switching, as well as operational safety tags for specific devices. Fault Management will inform Customer Operations when customers who are out of power become restored to power during the process.

A.2.1.5 General remarks

General remarks

A.2.2 Use case diagrams



A.2.3 Technical details

A.2.3.1 Actors: People, systems, applications, databases, the power system, and other stakeholders

This use case is written using the following actors:

Actors			
Grouping (Community)		**Group description**	
Network Operations (NO) Customer Service (CS)		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**
NO-NMON	System	Network Operations – Network Monitoring. Receives changes in measurement values from the field.	
NO-FLT	System	Network Operations – Fault Management. Analyses incoming data from a variety of sources and creates and manages unplanned outages to track customers out of power.	
OP-SSC	System	Network Operations – Switch Order Scheduling.	
NO-CTL	System	The business function within SCADA that sends remote commands to field devices.	
CS-TCM	System	Customer Service – Trouble Call Management. Receives calls from customers and reports status of unplanned outages to customers.	

A.2.3.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	A breaker trips due to a fault		Although the FLISR function may process multiple measurements from different fault sensing devices, only a single PSRMeasurements is shown in this use case.

A.2.3.3 References / issues

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
	Standards	IEC 61968-3, IEC-61968-8		Use case is being used to validate these standards.		

A.2.3.4 Further information to the use case for classification / mapping

Classification information
Relation to other use cases
IEC 16850-90-6 details the interaction between field devices and the FLISR function. This use case is concerned with the interactions between FLISR, switching plans and customer service.
Level of depth
System level use case that illustrates and guides system implementation.
Prioritisation
Generic, regional or national relation
View
Further keywords for classification

A.2.4 Step by step analysis of use case

A.2.4.1 Preconditions

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
A.2.4.2	FLISR for SCADA-detected outage, SCADA switching	NO-NMON	A breaker opens due to a downstream fault		The fault location is identified and automatic switching is performed to isolate the fault and minimize the number of customers out.

A.2.4.2 Steps

Scenario							
Scenario name:		FLISR for SCADA-detected outage, SCADA switching					
Step No.	**Event**	**Name of process/activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**
1	A fault occurs on the network and a breaker trips.	Protection equipment operation	Notification of change in status of a protective device due to an outage.	created	NO-NMON	NO-FLT	**PSRMeasurements**
2	Fault analysis	FLISR	Based on fault current information, NO-FLT notifies of an outage with location of wire down fault downstream of tripped protective device. At this point, outage device and fault location are confirmed.	created	NO-FLT	CS-TCM	**UnplannedOutages**
3	Creation of switching plan	FLISR	Notification of new switching plan to isolate the outage and restore power to healthy islands of network.	created	NO-FLT	OP-SSC	**SwitchingPlans**
4	Execution of switching plan	FLISR	Request for SCADA-commanded operation of a switch for execution of switching plan.	create	OP-SSC	NO-CTL	**PSRControls**
5	Execution of switching step	SCADA	Confirmation that **PSRControls** has been received and is being processed.	reply	NO-CTL	OP-SSC	**PSRControls**
6	Confirmation of switching step execution	SCADA	Notification of change in status of a switch due to switching operation. Switch Order scheduling uses this to execute the next step in the sequence.	created	NO-CTL	OP-SSC	**PSRMeasurements**
7	Confirmation of switching step execution	SCADA	Notification of change in status of a switch due to switching operation. Outage analysis uses this to determine the change in customer count for the UnplannedOutage, if any.	created	NO-CTL	NO-FLT	**PSRMeasurements**
8	Communication of change in customer count	Outage Analysis	Notification of restoration of customers that are associated with the **UnplannedOutage**	changed	NO-FLT	CS-TCM	**UnplannedOutages**

A.2.5 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data R-ID**
PSRMeasurements	Discrete and analog value changes from the field.	
PSRControls	Commands to open and close switches.	
SwitchingPlans	Sequence of open and close commands to isolate a fault and restore the maximum number of customers.	
UnplannedOutages	Affected customer counts and list of de-energized usage points.	

A.2.6 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.3 FLISR for trouble call and AMI outage, crew switching

A.3.1 Description of the use case

A.3.1.1 Name of use case

Use case identification		
ID	**Domain(s)**	**Name of use case**
	Outage Management, Work Management, Distribution Management	FLISR for trouble call and AMI outage, crew switching

A.3.1.2 Version management

Version management changes / Version	Date (dd/mm/yyyy)	Name author(s) or committee	Area of expertise / Domain / Role	Title	Approval status draft, for comments, for voting, final
1	24/05/2019	WG14 Part 3 Team	Outage Management, Distribution Management and Work Management		Draft

A.3.1.3 Scope and objectives of use case

Scope and objectives of use case	
Related business case	FLISR based on centralised control, IEC 61850-90-6
Scope	This use case covers the receipt of a breaker open event and the dispatch of a crew to determine the location of the fault. It covers the manual or automatic generation of a switching plan to isolate the fault and restore the healthy part of the feeder by feeding the downstream part of the feeder from another feeder. The switching is performed manually by a field crew or a control room operator sending control commands from the switch order.

A.3.1.4 Narrative of use case

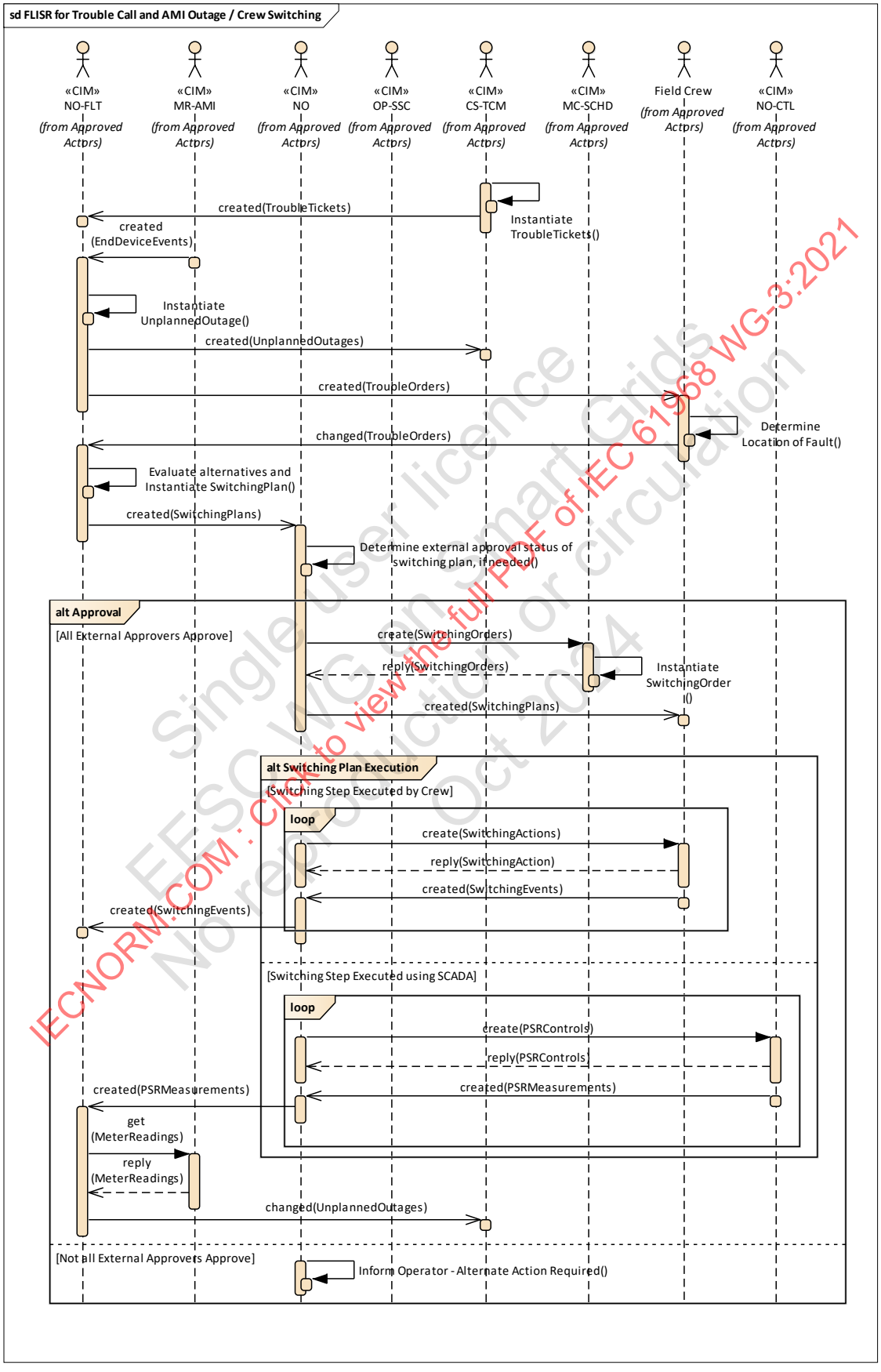
Narrative of use case
Short description – max 3 sentences
This FLISR workflow assumes a network with no ability to automatically detect a fault and no automatic outage response. All investigation and switching activities are performed by a field crew. The use case considers the situation where a DSO may require approval from a TSO prior to transferring load, such as when transferring more than a certain number of MVA between different substations
Complete description
An unplanned outage can be created as a result of receiving any combination of TroubleTickets from CIS or EndDeviceEvents from AMI. This results in a crew being dispatched to the predicted location of the unplanned outage to determine the location of the fault. Once the crew has located the fault, they communicate this back to the control room and a switching plan is written that will isolate the fault and energize customers both downstream and upstream of the fault, if possible. Fault Management will then evaluate whether external approval of the switching plan is required. If external approval is required, the operator will be notified and no switching plan will be executed. If external approval is not required, Network Operations provides the selected switching plan to Workforce Management. A field crew will execute each step of the selected switching plan. Workforce Management will keep Network Operations informed of the progress of the switching plan. With the execution of each step, Network Operations will notify Fault Management of changes to the network due to switching, jumpers, and cuts, as well as operational safety tags for specific devices. Some or all of the switching steps can be executed using SCADA commands, instead of the field crew performing them. To verify restoration of customers, Fault Management may ping Metering. Fault Management will inform Customer Operations of customers it believes have become restored to power. If callbacks to customers by Customer Operations reveal that a customer is still out of power, Customer Operations will submit a new trouble ticket to Fault Management.

A.3.1.5 General remarks

General remarks

A.3.2 Use case diagrams

Diagram of use case



A.3.3 Technical details

A.3.3.1 Actors: People, systems, applications, databases, the power system, and other stakeholders

This use case is written using the following actors

Actors			
Grouping (Community)		**Group description**	
Network Operations (NO) Customer Service (CS) Maintenance and Construction (MC) Meter Reading (MR)		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**
NO-NMON	System	Network Operations – Network Monitoring. Receives changes in measurement values from the field.	
NO-FLT	System	Network Operations – Fault Management. Analyses incoming data from a variety of sources and creates and manages unplanned outages to track customers out of power.	
OP-SSC	System	Network Operations – Switch Order Scheduling.	
NO-CTL	System	The business function within SCADA that sends remote commands to field devices.	
CS-TCM	System	Customer Service – Trouble Call Management. Receives calls from customers and reports status of unplanned outages to customers.	
MR-AMI	System	Advanced Metering Infrastructure	
MC-SCHD	System		

A.3.3.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	A breaker trips due to a fault		

A.3.3.3 References / issues

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
	Standards	IEC 61968-3, IEC 61968-6, IEC-61968-8, IEC-61968-9		Use case is being used to validate these standards.		

A.3.3.4 Further Information to the use case for classification / mapping

Classification information
Relation to other use cases
IEC 16850-90-6 details the interaction between field devices and the FLISR function. This use case is concerned with the interactions between manual fault location, field crews, switching plans and customer service.
Level of depth
System level use case that illustrates and guides system implementation.
Prioritisation
Generic, regional or national relation
View
Further keywords for classification

A.3.4 Step by step analysis of use case

A.3.4.1 Preconditions

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
A.3.4.2	FLISR for trouble call and AMI outage, crew switching	NO-FLT	A breaker opens due to a downstream fault		The fault location is identified and manual switching is performed to isolate the fault and minimize the number of customers out.

A.3.4.2 Steps

Scenario							
Scenario name:		FLISR for trouble call and AMI outage, crew switching					
Step No.	**Event**	**Name of process/activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**
1 alt a	Customer Loses power	Trouble Call Entry	Customer calls utility. Customer service representative creates a TroubleTicket and it is sent to NO-FLT	created	Customer Service Representative (CSR)	NO-FLT	**TroubleTickets**
1 alt b	A fault occurs that triggers system protection to open and one or more AMI meters are de-energized.	AMI	Metering receives the last gasp notification from a meter and creates and EndDeviceEvents.	created	MR-AMI	NO-FLT	**EndDeviceEvents**
2	OMS creates an unplanned outage	Outage Analysis	An unplanned outage is created.	created	NO-FLT	CS-TCM	**UnplannedOutages**
3	OMS dispatches the outage to a crew.	Crew dispatch	The known information regarding the unplanned outage is sent to a field crew	created	NO-FLT	MC-FRD	**TroubleOrders**
4	Field crew locates the fault	Manual fault location	The field crew receives the information regarding the unplanned outage and patrols the feeder in order to determine the location of the fault.				
5	Field crew reports fault location to OMS	Manual fault location reporting	The field crew communicates the location of the fault to the OMS	changed	MC-FLD	NO-FLT	**TroubleOrders**
6	OMS determines optimal switching plan	Fault isolation and restoration	NO-FLT receives the fault location and either an operator or an automated process determines the best combination of switches to operate in order to isolate the areas upstream and downstream of the fault and to restore power to customers who are not part of the fault zone.	created	NO-FLT	NO	**SwitchingPlans**

Scenario							
Scenario name:		FLISR for trouble call and AMI outage, crew switching					
Step No.	**Event**	**Name of process/activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**
7	A switching plan is created and its impact must be evaluated.	Evaluation of switching plan	The switching plan is evaluated to determine whether external approval is needed, e.g. if a TSO needs to approve switching that will be performed by a DSO that involves a load transfer between substations of more than a certain threshold.	Manual process			
8 alt a	External approval for switching plan is required and the switching request is rejected.	External rejection of switching plan	Notify operator that switching is not permitted and terminate the use case.	Manual process			
8 alt b	External approval for switching plan is either not required, or the switching request is approved.	Schedule a resource to execute the switching plan	NO sends a request to crew scheduling to get a crew assigned to the SwitchingPlan.	created	NO	MC-SCHD	**SwitchingOrders**
9	Scheduling request is fulfilled	Scheduling function	Scheduling function has assigned crew(s) to work on the SwitchingPlan	reply	MC-SCHD	NO	**SwitchingOrders**
10	SwitchingPlan is communicated to field crew	Network operations	The SwitchingPlan is sent to the crew(s) so that they can begin executing it.	created	NO	MC-FRD	**SwitchingPlans**
11	SwitchingPlan is executed						
11 alt 1a	Switching Step Executed by Crew	Manual step execution	Switch order scheduling requests the field crew to execute one or more steps. If there are multiple field crews assigned to the SwitchingPlan, only the crew assigned to the step is sent the switching action.	create	OP-SSC	MC-SCHD	**SwitchingActions**. SwitchingPlan reference, SwitchingStepGroup number, SwitchingStep number and appropriate action.
11 alt 1b		Manual step execution	The field crew responds that they have received the request	reply	MC-SCHD	OP-SSC	SwitchingActions
11 alt 1c		Manual step execution	The field crew confirms that they have executed the step (or they could not execute the step)	created	MC-SCHD	OP-SSC	SwitchingEvents

Scenario							
Scenario name:		FLISR for trouble call and AMI outage, crew switching					
Step No.	**Event**	**Name of process/activity**	**Description of process/ activity**	**Service**	**Information producer (Actor)**	**Information receiver (Actor)**	**Information exchanged**
11 alt 1 d		Step notification	The change in network state is communicated to NO-FLT	created	NO	NO-FLT	SwitchingEvents
11 alt 2a	Switching Step executed by SCADA	Automatic step execution	Switch order scheduling requests SCADA to execute one step	create	OP-SSC	NO-CTL	PSRControls
11 alt 2b		Automatic step execution	SCADA confirms that the control request has been received and is in progress	reply	NO-CTL	OP-SSC	PSRControls
11 alt 2c		Automatic step execution	SCADA confirms that the value has changed	created	NO-CTL	OP-SSC	PSRMeasurements
11 alt 2d		Step notification	The change in network state is communicated to NO-FLT	created	NO	NO-FLT	PSRMeasurements
12 alt 1a	Customer count changes and there is AMI	Outage analysis	Outage analysis receives SwitchingEvents and PSRMeasurements and determines that some usage points that are associated with the unplanned outage have changed their energization status. This initiates a meter ping sequence to confirm restoration.				
12 alt 1b	Meters are pinged	Outage analysis	Outage analysis pings meters that it believes are now energized.	get	NO-FLT	MR-AMI	MeterReadings
12 alt 1c	Meters reply	Outage analysis	Energized meters respond	reply	MR-AMI	NO-FLT	MeterReadings
12 alt 1d	Customers are confirmed energized	Outage analysis	Usage point energization status and customer counts for the UnplannedOutage are updated.	changed	NO-FLT	CS-TCM	UnplannedOutages
12 alt 2	Customer count changes and there is no AMI	Outage analysis	Outage analysis receives SwitchingEvents and PSRMeasurements and determines that some usage points that are associated with the unplanned outage have changed their energization status. Outage restoration is assumed for the customers in the energized zone.	changed	NO-FLT	CS-TCM	UnplannedOutages

A.3.5 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data R-ID**
MeterReadings	Request/reply to determine the energization status of a meter	
PSRMeasurements	Discrete and analog value changes from the field.	
PSRControls	Commands to open and close switches.	
SwitchingActions	Request to execute a switching plan step. Includes operation to be performed and the network component to perform it on.	
SwitchingEvents	Notification of a change in the state of the network. Includes operation performed and the network component that it was performed on.	
SwitchingOrders	Request to schedule crews to a SwitchingPlan	
SwitchingPlans	Sequence of open and close commands to isolate a fault and restore the maximum number of customers.	
TroubleOrders	Request to schedule a crew to an UnplannedOutage. Confirmed fault location of UnplannedOutage	
TroubleTickets	Customer report of an outage. Includes customer identification and usage point impacted.	
UnplannedOutages	Affected customer counts and list of de-energized usage points.	

A.3.6 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.4 Planned outage for maintenance – Manual process

The sequence shown in Figure A.3 is based on the business process of a large European utility. The current process includes very little interoperability between systems, but instead manual interactions. Also this sequence assumes that all switches are not telemetered and require manual operation.

When planned work requires isolation of an area for maintenance, a work manager first submits a work request to the work management system (in this case SAP). The work manager then separately makes a request to a control room operator via email for a switching plan to isolate the work area. The operator creates “switching schedules”, which are essentially a work order and switching plan combined (perhaps the closest concept in CIM would be a SwitchingPlan). One switching plan contains all steps for isolation, service restoration, and return to normal state. After the necessary approvals, the operator emails the switching schedules to the work manager.

The work manager now assigns the switching schedules to a field crew, and assigns individual switching steps to crew members based on qualifications. For example, only some of the crew members may be able to perform switching and grounding. The work manager either emails the switching schedules to the crew leader, or just prints it out and hands it to him.

The field crew travels to the work area. Upon arrival, the crew leader contacts the operator to say they are ready for work. The operator validates that the switching schedule is still valid in the current state of the network. Now the crew is free to execute all isolation and service restoration steps in the switching schedule, and informs the operator when this switching is complete. The operator updates the DMS to reflect the changes.

The work area is now de-energized. The maintenance crew contacts the operator to request a “permit for work”, also known as a clearance. The crew lead receives and owns the permit to work during the maintenance. Note that only one person can receive the permit to work, typically the crew lead. This person cannot reassign the permit to work to another crew member – only the operator can do this.

After completion of the maintenance work, the crew lead contacts the operator to return the permit to work. Then the crew continues execution of the switching schedule to return the network to normal state and informs the operator.

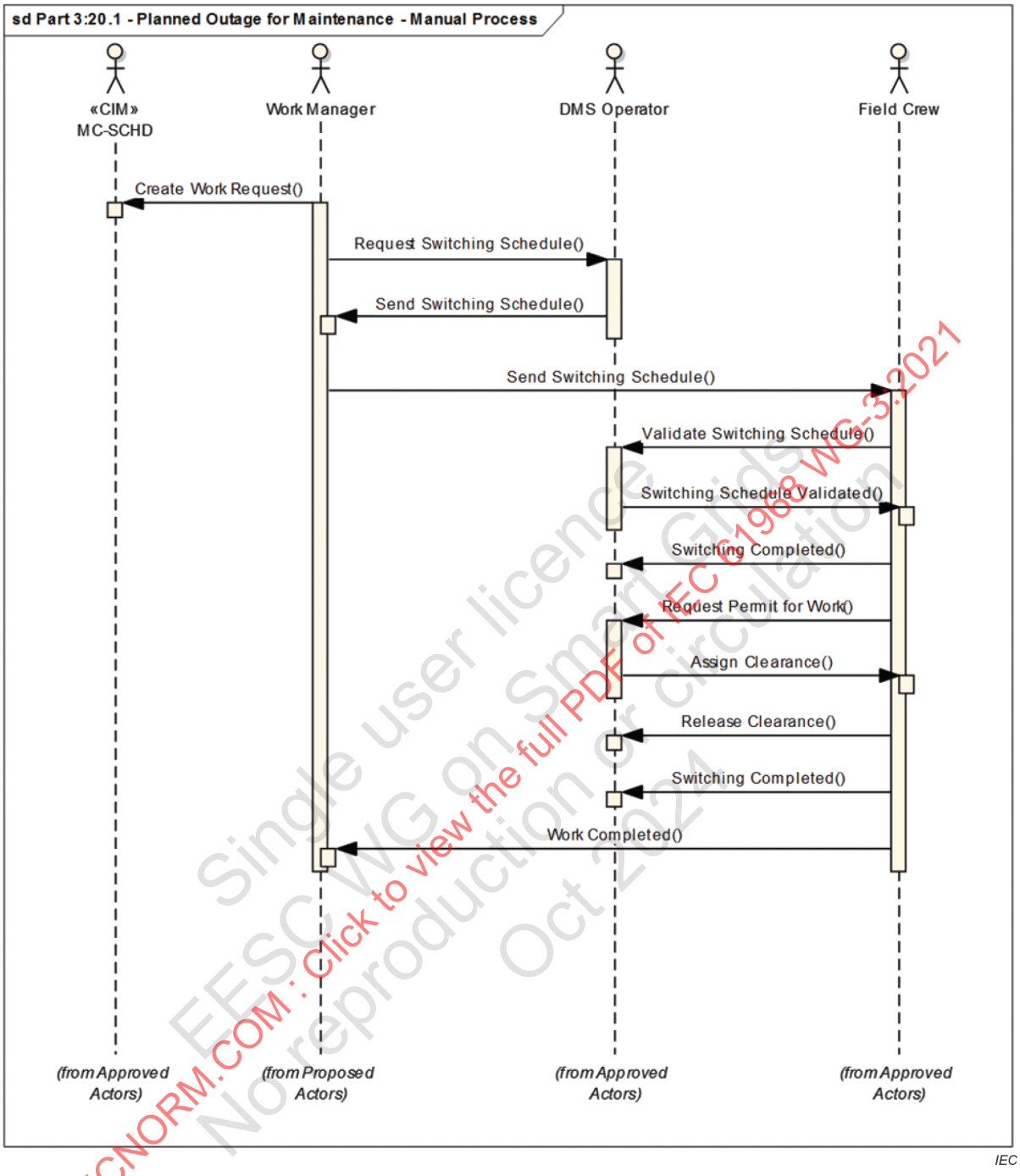


Figure A.1 – Planned outage for maintenance – Manual process

A.5 Planned outage for maintenance

A.5.1 General

This use case describes how a planned outage is requested, a switching plan is created and the switching plan is executed. It follows the manual process described in Clause A.4, but in this case the majority of the steps are automated. It was developed using the IEC use case template.

A.5.2 Description of the use case

A.5.2.1 Name of use case

Use case identification		
ID	**Domain(s)**	**Name of use case**
	Customer Support, Outage Management, Work Management	Request, creation and execution of a planned outage.

A.5.2.2 Version management

Version management changes / Version	Date (dd/mm/yyyy)	Name author(s) or committee	Area of expertise / Domain / Role	Title	Approval status draft, for comments, for voting, final
1	24/04/2019	WG14 Part Teams Focus Community	Customer Information Systems, Outage Management and Work Management		Draft

A.5.2.3 Scope and objectives of use case

Scope and objectives of use case	
Related business case	
Scope	This use case covers the request, creation and execution of a planned outage.

A.5.2.4 Narrative of use case

Narrative of use case
Short description – max 3 sentences
A switching plan is requested by work management, which is then written by operations personnel. The switching plan is then scheduled for execution and customers who will be impacted are notified. Once the execution has started, customer service is notified of when customers are de-energized and then re-energized.
Complete description
The sequence starts with a SwitchingPlanRequest, which is used to convey a request from work management (or other business function) to network operations that switching needs to be performed. This could be a request to isolate part of the network in order for maintenance or construction work to be performed. The payload includes the type of work to be performed and when it should start. The typical outcome of a SwitchingPlanRequest is the creation of a SwitchingPlan. A SwitchingPlan is a sequence of pre-defined steps that typically perform operations to change the state of the network, such as a sequence of switch open and close operations. Switch Action Scheduling (OP-SSC) acknowledges receipt of the request with a reply message. The SwitchingPlan is then developed by creating steps, either manually or automatically. The SwitchingPlan goes through various review and approval processes within the Switch Action Scheduling function. Upon completion of the development of an approved SwitchingPlan, Switch Action Scheduling makes a request to Work Scheduling and Dispatching (MC-SCHD) to create a SwitchingOrder using the SwitchingOrders message. The SwitchingPlan is not yet communicated outside of the Switch Action Scheduling function. The SwitchingOrder is scheduled within Work Scheduling and Dispatching. Once it has been scheduled, Work Scheduling and Dispatching replies with a SwitchingOrders message, to indicate that the SwitchingOrder has been scheduled. Finally, Customer Service is notified of the planned outage via a PlannedOutageNotification message, which is used to notify customers about the planned outage. It is possible to reschedule or cancel a switching order. This request typically originates from network operations due to a change in the network configuration or a weather event. The request to reschedule goes to maintenance and construction to provide resources for the revised date/time. The new date/time is then communicated to customer support via a PlannedOutageNotification message. The actual operational steps for a SwitchingPlan are defined using the SwitchingPlan profile. Operational steps can comprise different SwitchingActions that determine what operation is to be performed and on what network component. At the time that the SwitchingPlan is executed, different profiles are used to coordinate the execution between the control room, field crews and SCADA. It is possible for a SwitchingPlan to consist solely of operational steps that are performed by a field crew or solely operational steps that are performed automatically via SCADA, or a combination of the two. The trigger that starts the execution of the SwitchingPlan is when OP-SSC sends a SwitchingPlans message to MC-FRD, which has the latest approved version of the SwitchingPlan to be executed. This is shown in Figure A.4. The sequence diagram then shows how a switching step is sent from the control room to a field crew by using a SwitchingActions message. Even though the field crew may already have a complete copy of the SwitchingPlan, this message is used to request the field crew to execute the specific step referenced in the message. The reply indicates that the field crew has received the instruction to execute a switching step. The SwitchingEvents message is a confirmation that the switching step has been executed. The sequence diagram also shows how a ControlAction step is coordinated by a sequence of PSRControls, reply and PSRMeasurements when the step is executed using SCADA commands. The sequence diagram also shows how customers support is notified when a SwitchingStep is executed that causes customers to be de-energized and whenever the customer count changes. These notifications are done using the PlannedOutages message.

A.5.2.5 General remarks

General remarks
The tracking of switch orders is a key to safely operating the electric network. Coordinating switch order execution electronically between the control room and field crews can reduce ambiguity in switching and reduce switching errors.

A.5.3 Use case diagrams

There are several sequence diagrams associated with this use case. The sequence diagrams are shown along with each step in the use case.

Diagram of use case
Figure A.2 is a diagram that shows the creation of a switching plan.
Figure A.3 shows changes being made to a switching plan
Figure A.4 shows the execution of a switching plan

A.5.4 Technical details

A.5.4.1 Actors: People, systems, applications, databases, the power system, and other stakeholders

This use case is written using the following actors

Actors			
Grouping (community)		**Group description**	
Network Operations (NO) Customer Service (CS) 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**
CS-CSRV	System	The customer service actor provides information to customers regarding their electric service.	
MC-SCHD	System	Maintenance and construction scheduling.	
OP-SSC	System	Network Operations – Switch Order Scheduling.	
NO-CTL	System	The business function within SCADA that sends remote commands to field devices.	
MC-FRD	System	Maintenance and Construction – field resource dispatch.	

A.5.4.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	A request for switching is created		All planned outages require a switching plan to be written and used to track its execution.

A.5.4.3 References / issues

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
	Standards	IEC 61968-3 IEC 61968-6 IEC-61968-8		Use case is being used to validate these three standards.		

A.5.4.4 Further information on the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
System level use case that illustrates and guides system implementation.
Prioritisation
Generic, regional or national relation
View
Further keywords for classification

A.5.5 Step by step analysis of use case

A.5.5.1 Preconditions

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
A.5.5.2	Creation of switching plan	MC-SCHD	A request is made for a switching plan to be created		A switching plan is created and impacted customers are notified.
A.5.5.3	Switching order is updated	OP-SSC	The start time/date of a switching order needs to be changed, e.g. due to bad weather.	A switching plan exists	The switching order is updated and impacted customers are notified.
A.5.5.4	Execution of switching plan	OP-SSC	The due time/date for a switching plan arrives.	A switching plan exists and resources are available to execute it.	The switching plan is executed.

A.5.5.2 Steps – SwitchingPlan is created

Scenario							
Scenario name:		Creation of switching plan					
Step No.	**Event**	**Name of process/Activity**	**Description of process/ Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
1	Work management is planning a new construction or maintenance project that requires part of the network to be isolated.	Maintenance and construction planning	A SwitchingPlanRequest is sent to network operations.	create	MC-SCHD	OP-SSC	**SwitchingPlanRequests**, which includes when the work is required, where it is required and what is to be done.
2	OP-SSC replies, indicating that it has received the request.	Switch order scheduling		reply	OP-SSC	MC-SCHD	**SwitchingPlanRequests**
3	The switching plan is written and is approved	Switch order writing	A person reviews the information in the request and creates a sequence of switching steps, capturing them in the switching plan. The switching plan goes through a review and approval cycle. Once it is approved, a request is made to maintenance and construction to schedule resources to perform the switching.	create	OP-SSC	MC-SCHD	**SwitchingOrders**. Contains location of work, skill sets and quantity required and date/time.
4	The switching work is scheduled.	Switch order scheduling	Maintenance and construction determines which crews will be assigned to work on the switch order	created	MC-SCHD	OP-SSC	**SwitchingOrders**. Contains the crews who have been assigned
5	Customers are notified about the planned outage	Customer communication	Switch order scheduling determines which customers will be affected and sends a notification to customer service, who will contact customers.	created	OP-SSC	CS-CSRV	**PlannedOutageNotifications**. Contains list of customers, reason for the outage and the date/time the planned outage will start and end.

Figure A.2 shows the creation of a **SwitchingPlan**.

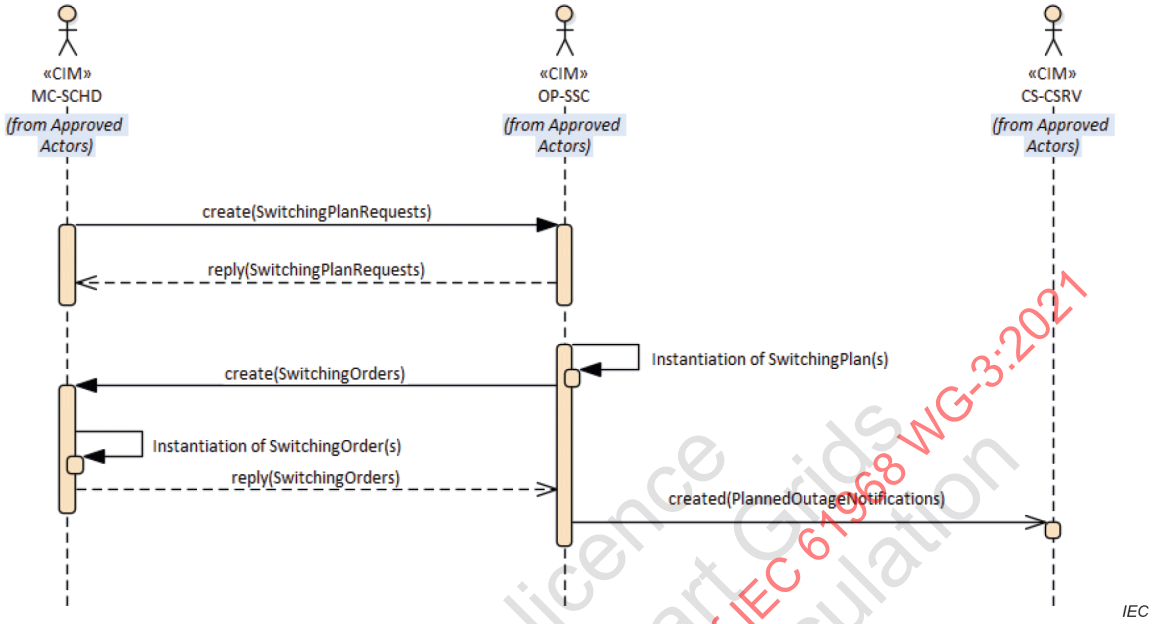


Figure A.2 – SwitchingPlan creation

A.5.5.3 Steps – SwitchingOrder changes

Scenario							
Scenario name:		Switching order is updated					
Step No.	**Event**	**Name of process/Activity**	**Description of process/ Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
1	Network or weather conditions change such that an approved switching order must be modified.	External event	OP-SSC notifies MC-SCHD that the date/time of a switching order must be changed.	change	OP-SSC	MC-SCHD	**SwitchingOrders**. New start/end date/time.
2	The switching order is rescheduled	Crew scheduling	Resources are assigned for the new date/time				
3	The new date/time is communicated to network operations	Crew scheduling		reply	MC-SCHD	OP-SSC	**SwitchingOrders** with new start/end date/time
4	Customer service is notified of the change	Customer communication		changed	OP-SSC	CS-CSRV	**PlannedOutageNotifications** with new start/end date/time

Figure A.3 shows the updates during the lifecycle of a SwitchingOrder. The same process can be repeated if several changes are required to be made over time. It is also possible to cancel the SwitchingOrder completely.

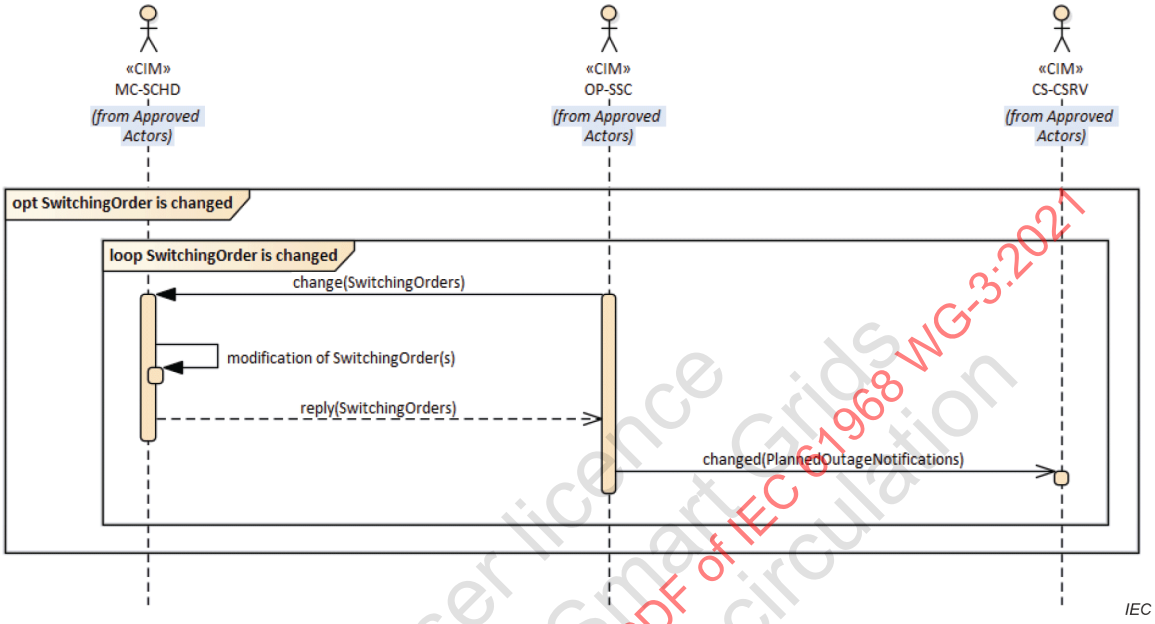


Figure A.3 – SwitchingOrder changes

A.5.5.4 Steps – SwitchingPlan is executed

Scenario							
Scenario name		Switching plan is executed					
Step No.	**Event**	**Name of process/Activity**	**Description of process/Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
1	The date/time to execute a switching plan arrives	Field Crew and Control Room manual interaction	On the day that a switching plan is scheduled to be executed, the crews will contact the control room to confirm that the switching plan is still to be executed (outside of the scope of this use case). The control room will confirm execution by sending the approved switching plan to all of the field crews involved in the switching	created	OP-SSC	MC-FRD	**SwitchingPlans**. The complete SwitchingPlan, including scheduled start/end time and detailed switching steps.
2	Steps are executed	Switching step coordination	In this use case, all switching steps are coordinated by the control room (OP-SSC) but it is also possible that steps could be coordinated by a field supervisor and the sequence of steps would be the same. Steps can either be executed by a field crew or remotely via SCADA, depending on the device in each step. The sequence diagram in Figure A.4 shows steps being executed in a loop.				
3 alt 1a	Switching Step Executed by Crew	Manual step execution	Switch order scheduling requests the field crew to execute one or more steps. If there are multiple field crews assigned to the SwitchingPlan, only the crew assigned to the step is sent the switching action.	create	OP-SSC	MC-SCHD	**SwitchingActions**. SwitchingPlan reference, SwitchingStepGroup number, SwitchingStep number and appropriate action.
3 alt 1b		Manual step execution	The field crew responds that they have received the request	reply	MC-SCHD	OP-SSC	**SwitchingActions**
3 alt 1c		Manual step execution	The field crew confirms that they have executed the step (or they could not execute the step)	created	MC-SCHD	OP-SSC	**SwitchingEvents**
3 alt 2a	Switching Step executed by SCADA	Automatic step execution	Switch order scheduling requests SCADA to execute one step	create	OP-SSC	NO-CTL	**PSRControls**

Scenario							
Scenario name		Switching plan is executed					
Step No.	**Event**	**Name of process/Activity**	**Description of process/Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
3 alt 2b		Automatic step execution	SCADA confirms that the control request has been received and is in progress	reply	NO-CTL	OP-SSC	**PSRControls**
3 alt 2c		Automatic step execution	SCADA confirms that the value has changed	created	NO-CTL	OP-SSC	**PSRMeasurements**
4	The first customer is de-energized	Customer Communication	When the first customer becomes de-energized as the result of executing a switching step, customer service is notified.	created	OP-SSC	CS-CSRV	**PlannedOutages**
5	The number of impacted customers changes	Customer Communication	Whenever the number of impacted customers changes after the first customer is de-energized, customer service is notified	changed	OP-SSC	CS-CSVR	**PlannedOutages**

Figure A.4 shows the execution of a switching plan.

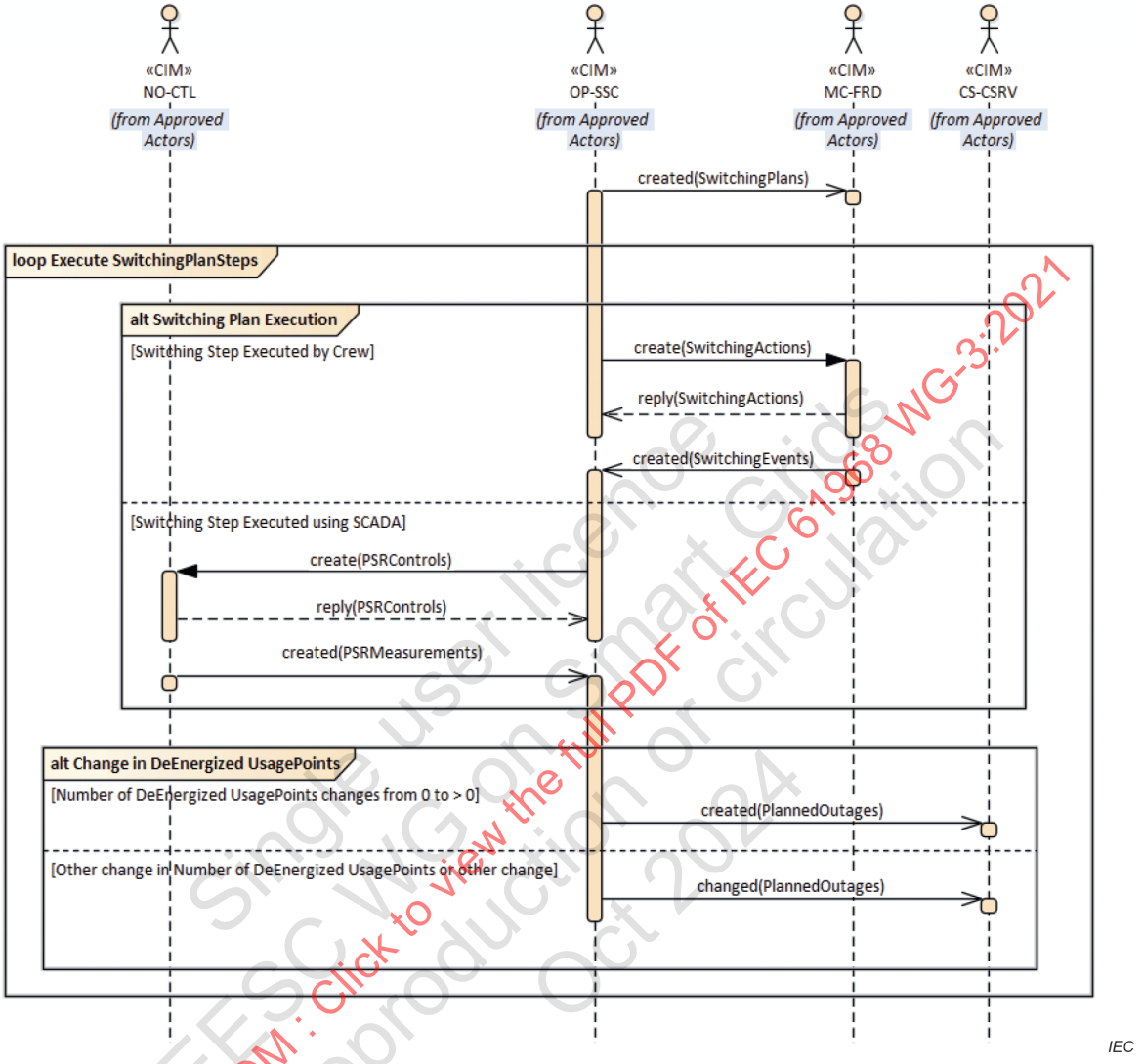


Figure A.4 – SwitchingPlan execution

A.5.6 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data R-ID**

A.5.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.6 TroubleTicket creation

A.6.1 Description of the use case

A.6.1.1 Name of use case

Use case identification		
ID	**Domain(s)**	**Name of use case**
		Outage trouble call entry into CIS and creation of trouble ticket

A.6.1.2 Version management

Version management						
Version management changes / version	**Date (dd/mm/yyyy)**	**Name author(s) or committee**	**Domain expert**	**Area of expertise / Domain / Role**	**Title**	**Approval status draft, for comments, for voting, final**
1	24/04/2019	WG14 Part Teams Focus Community		Customer Information Systems, Outage Management		Draft

A.6.1.3 Scope and objectives of use case

Scope and objectives of use case	
Related business case	Customer Information System interaction with Outage Management System
Scope	This use case includes customer interaction with a customer service representative as well as an automated call taking system such as a interactive voice response system.

A.6.1.4 Narrative of use case

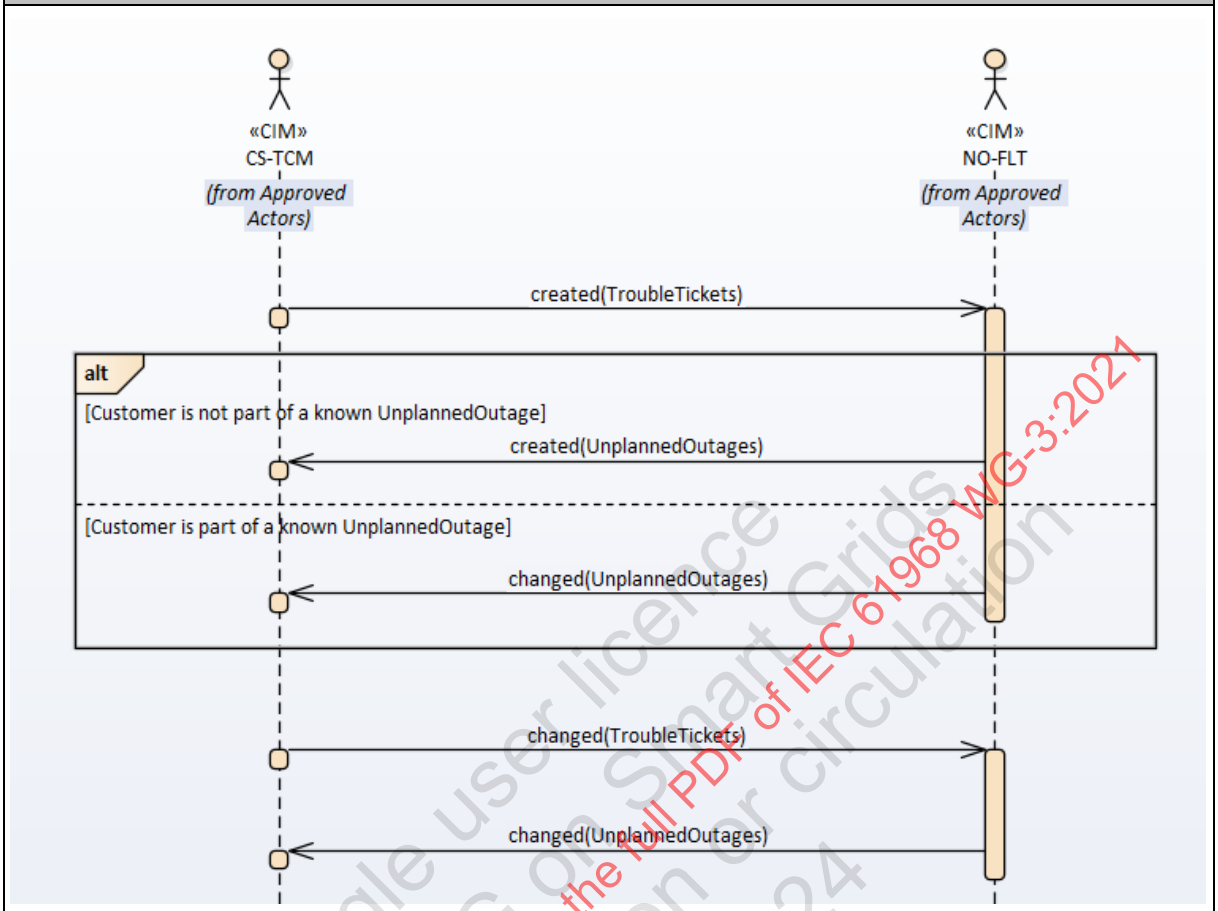
Narrative of use case
Short description – max 3 sentences
A customer experiences power out and calls the utility to report their power is out. The call taker collects information about the problem and records it in the CIS, which sends the trouble call information to the OMS. The OMS returns information about the outage if available.
Complete description
A customer experiences power out and calls the utility to report their power is out. The call taker collects information about the problem and records it in the CIS, which sends the trouble call information to the OMS. The OMS performs analysis to determine whether this is a new or existing outage and returns status and estimated restoration time for the outage if available.

A.6.1.5 General remarks

General remarks

A.6.2 Use case diagrams

The activity diagram shows the main activities from the main actors and the key deliverables.

Diagram of use case


A.6.3 Technical details

A.6.3.1 Actors: People, systems, applications, databases, the power system, and other stakeholders

This use case is written using the following actors

Actors			
Grouping (community)		**Group description**	
Network Operations (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**	**Further information specific to this use case**
Customer Information System (CIS)	System	A Customer Information System (CIS) is a computer system that stores customer information for a utility and manages interactions between the customer and the utility.	
Outage Management System (OMS)	System	An Outage Management System (OMS) is a computer system that keeps track of customers who are out of power and maintains electric system reliability indices.	
Customer Service Representative (CSR)	Person	A Customer Service Representative is a person at a utility who communicates with utility customers, usually via telephone.	
Customer	Person	A customer is a person who is supplied energy by the utility.	

A.6.3.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	A customer experiences a power outage	Customer had power.	

A.6.3.3 References / issues

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
	Standards	IEC 61968-3, IEC 61968-8		Use case is being used to validate these two standards.		

A.6.3.4 Further Information to the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
System level use case
Prioritisation
Generic, regional or national relation
View
Further keywords for classification

A.6.4 Step by step analysis of use case

A.6.4.1 Preconditions

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
4.1	Customer calls who is not part of a known outage	Customer Service Representative	Customer experiences a power outage who is not part of a known outage	Customer had power	A new UnplannedOutage is created in OMS
4.2	Customer calls who is part of a known outage and CIS cannot make this determination	Customer Service Representative	Customer experiences a power outage who is part of a known outage	Customer had power	A new UnplannedOutage is created in OMS
4.3	Customer calls who is part of a known outage and CIS can make this determination	Customer Service Representative	Customer experiences a power outage who is part of a known outage	Customer had power	A new UnplannedOutage is created in OMS

A.6.4.2 Steps – Normal

Scenario							
Scenario name:		Customer calls who is not part of a known outage					
Step No.	**Event**	**Name of process/Activity**	**Description of process/Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
1	Customer Loses power	Trouble Call Entry	Customer calls utility	N/A	Customer	Customer Service Representative (CSR)	Verbal – identification of service affected, outage symptoms
2	CSR enters outage information	Trouble Call Entry	CSR looks up customer in CIS and CIS retrieves customer information such as usage point and customer name. CSR enters callback information, outage symptoms. CIS creates a TroubleTicket [Each time a customer calls, a new TroubleTicket is created in CIS].	create	CSR	Customer Information System (CS-TCM)	TroubleTicket
3	CIS sends TroubleTicket to OMS	Trouble Call Entry		created	CIS (CS-TCM)	Outage Management System (NO-FLT)	TroubleTicket
4	OMS analyzes TroubleTicket	Outage Analysis	OMS checks to see if the customer is part of a known outage. If the customer is not part of a known outage, a new UnplannedOutage is created.	created	OMS (NO-FLT)	CIS (CS-TCM)	UnplannedOutage

A.6.4.3 Alternative 1 – Customer calls who is part of known outage but cis is not aware of this

NOTE This is identical to the normal case, so the messages are the same.

Scenario							
Scenario name:		Customer calls who is part of a known outage but CIS cannot make this determination					
Step No.	**Event**	**Name of process/Activity**	**Description of process/Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
2 alt	CSR enters outage information	Trouble Call Entry	CSR looks up customer in CIS and CIS retrieves customer information such as usage point and customer name. CSR enters callback information, outage symptoms. Each time a customer calls, a new TroubleTicket is created in CIS.	create	CSR	Customer Information System (CS-TCM)	TroubleTicket
3 alt	CIS sends TroubleTicket to OMS	Trouble Call Entry		created	CIS (CS-TCM)	Outage Management System (NO-FLT)	TroubleTicket
4 alt	OMS analyzes TroubleTicket	Outage Analysis	OMS checks to see if the customer is part of a known outage. If the customer is part of a known outage, the UnplannedOutage information is returned to CIS.	changed	OMS (NO-FLT)	CIS (CS-TCM)	UnplannedOutage

A.6.4.4 Alternative 2 – Customer calls who is part of known outage and cis is aware of this

Scenario							
Scenario name:		If the CIS is able to associate the trouble call with a known outage then it may decide not to send the trouble call to the OMS					
Step No.	**Event**	**Name of process/Activity**	**Description of process/Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
2 alt	CSR enters outage information	Trouble Call Entry	CSR looks up customer in CIS and CIS retrieves customer information such as usage point and customer name. CSR enters callback information, outage symptoms. CIS determines that the customer is part of a known outage and there is no need to send TroubleTicket to OMS.	create	CSR	Customer Information System (CS-TCM)	TroubleTicket

A.6.5 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data R-ID**
TroubleTicket	Location of the problem, nature of the problem, whether there is a hazard (e.g. wire down), name of customer, notification information	
UnplannedOutage	Location, related outage information including estimated time of restoration, status, hazard information.	

A.6.6 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.7 CIS and OMS interactions during an unplanned outage

A.7.1 General

This use case describes Customer Information system interactions with OMS when an unplanned outage is created or its status changes. It was developed using the IEC use case template.

A.7.2 Description of the use case

A.7.2.1 Name of use case

Use case identification		
ID	**Domain(s)**	**Name of use case**
	Customer Support, Outage Management	Customer Information system interactions with OMS when an unplanned outage is created or its status changes

A.7.2.2 Version management

Version management changes / Version	Date (dd/mm/yyyy)	Name author(s) or committee	Area of expertise / Domain / Role	Title	Approval status draft, for comments, for voting, final
1	24/04/2019	WG14 Part Teams Focus Community	Customer Information Systems and Outage Management		Draft

A.7.2.3 Scope and objectives of use case

Scope and objectives of use case	
Related business case	Customer Information System interaction with Outage Management System
Scope	This use case covers unplanned outage creation or status changes in OMS that need to be communicated to CIS. Planned outages are not included in this use case.

A.7.2.4 Narrative of use case

Narrative of use case
Short description – max. 3 sentences
An unplanned outage is created or the status of an unplanned outage changes such that customers who are part of the outage need to be notified or their status needs to be updated in CIS. This is needed so that customers can be provided with accurate information if they call the utility. In addition the CIS may maintain a history of outages for each customer.
Complete description
Various triggers can cause the status of an unplanned outage to change. These include crew status changes (assigned, enroute, arrived), estimated restoration time changes, the cause of the outage has been determined and the outage has been restored. Also, changes in the list of affected customers for the outage need to be communicated to the CIS. These changes are communicated to the CIS so that the CIS can update its TroubleTickets, outage history and/or notify the customers affected.

A.7.2.5 General remarks

General remarks
The reporting of the status of UnplannedOutages to customers is a key business process in a utility that can improve customer satisfaction.

A.7.3 Use case diagrams

The sequence diagram in Figure A.5 shows the main activities from the main actors. The remaining sequence diagrams are shown along with each step in the use case.

Diagram of use case
Figure A.5 is an overview diagram that shows the main steps of the use case.
Figure A.6 shows the creation of an Unplanned Outage.
Figure A.7 shows various updates during the lifecycle of an Unplanned Outage
Figure A.8 shows two outages being combined during outage prediction
Figure A.9 shows an outage being split into two outages during outage prediction.
Figure A.10 shows the restoration of an Unplanned Outage

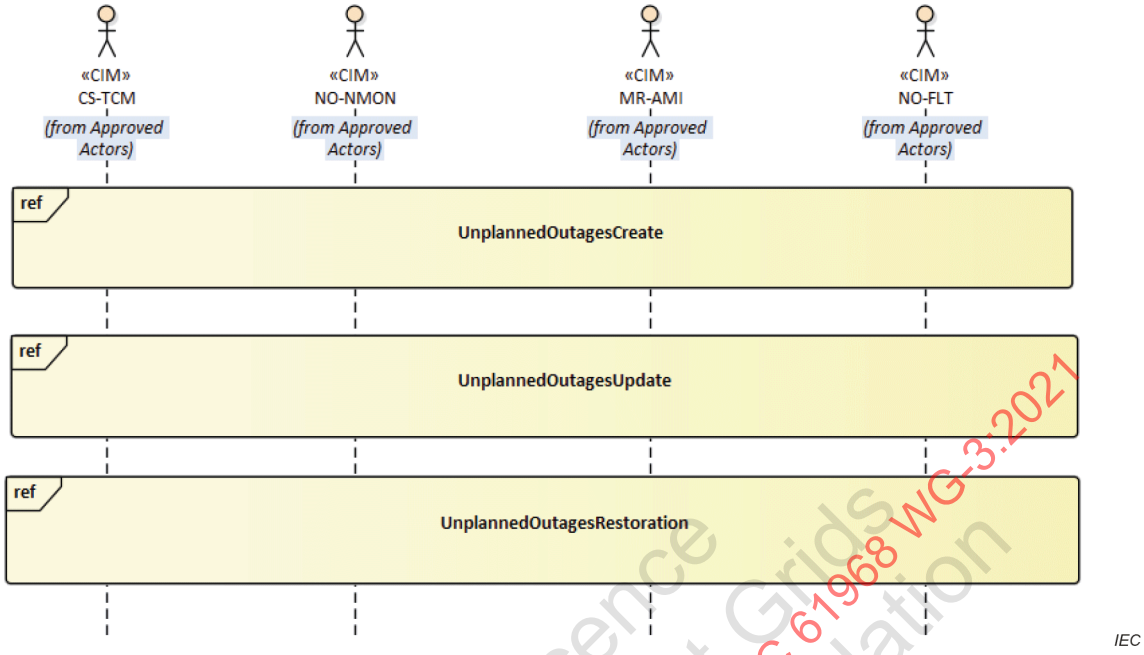


Figure A.5 – UnplannedOutages overview

A.7.4 Technical details

A.7.4.1 Actors: People, systems, applications, databases, the power system, and other stakeholders

This use case is written using the following actors:

Actors			
Grouping (community)		**Group description**	
Network Operations (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**	**Further information specific to this use case**
Customer Information System (CS-TCM)	System	A Customer Information System (CIS) is a computer system that stores customer information for a utility and manages interactions between the customer and the utility.	It is shown as CS-TCM in the diagrams.
Outage Management System (NO-FLT)	System	An Outage Management System (OMS) is a computer system that keeps track of customers who are out of power and maintains electric system reliability indices.	It is shown as NO-FLT in the diagrams.
Customer Service Representative (CSR)	Person	A Customer Service Representative is a person at a utility who communicates with utility customers, usually via telephone.	
Customer	Person	A customer is a person who is supplied energy by the utility.	
SCADA	System	Supervisory Control and Data Acquisition – a computer system that monitors the state of the electric network through remote sensor and can change the state of the network through commands to remote actuators.	It is shown as NO-NMON in the diagrams.
AMI	System	An AMI (Advanced Metering Infrastructure) is a system that sends and receives data from meters that can provide remote reading and other capabilities.	It is shown as MR-AMI in the diagrams.

A.7.4.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	An Unplanned Outage is created.		

A.7.4.3 References / issues

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
	Standards	IEC 61968-3, IEC 61968-8		Use case is being used to validate these two standards.		

A.7.4.4 Further Information to the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
System level use case that illustrates and guides system implementation.
Prioritisation
Generic, regional or national relation
View
Further keywords for classification

A.7.5 Step by step analysis of use case

A.7.5.1 Preconditions

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
A.7.5.2 alt 1	Unplanned outage created from SCADA event	SCADA	A fault occurs that triggers system protection to open.		
A.7.5.2 alt 2	Unplanned outage created from metering event	AMI	A fault occurs that triggers system protection to open and one or more AMI meters are de-energized. Metering reports an EndDeviceEvent to OMS.		
A.7.5.2 alt 3	Unplanned outage created from customer call	CIS	A fault occurs that triggers system protection to open and one or more customers are de-energized. A customer calls the utility to report an outage.		
A.7.5.3	Unplanned outage status changes	Outage Management System	Any change to an outage, such estimated restoration time change, outage cause added/changed, switching operation impacting the outage, outages being combined, outage being split.	Unplanned outages exist in the system.	
A.7.5.3	Unplanned outage crew status changes	Outage Management System	The crew status of an outage changes.	Unplanned outages exist in the system.	
A.7.5.4	Unplanned outage is restored	Outage Management System	Outage is restored.		

A.7.5.2 Steps – Unplanned outage is created

Scenario							
Scenario name:		OMS receives information regarding an unplanned outage					
Step No.	**Event**	**Name of process/Activity**	**Description of process/Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
1 alt a	OMS receives indication of system protection automatically operating.	SCADA	A digital measurement in SCADA changes from closed to open.	created	NO-NMON (SCADA)	NO-FLT (OMS)	PSRMeasurements indicating that a breaker or other interrupting device has opened.
1 alt b	A fault occurs that triggers system protection to open and one or more AMI meters are de-energized.	AMI	Metering receives the last gasp notification from a meter and creates and EndDeviceEvents.	created	MR-AMI	NO-FLT (OMS)	EndDeviceEvents
1 alt c	OMS receives TroubleTicket from a customer outage call	Trouble Call Entry					
2	OMS creates an unplanned outage	Outage Analysis	An unplanned outage is created.	created	NO-FLT (OMS)	CS-TCM (CIS)	UnplannedOutages
3	CIS receives UnplannedOutage message	Outage Analysis	CIS adds customers that are de-energized to its list of de-energized customers so that it can provide information regarding the Unplanned Outage when the customer calls. It can also use this information for filtering subsequent trouble calls.	N/A			

Figure A.6 shows the creation of an unplanned outage.

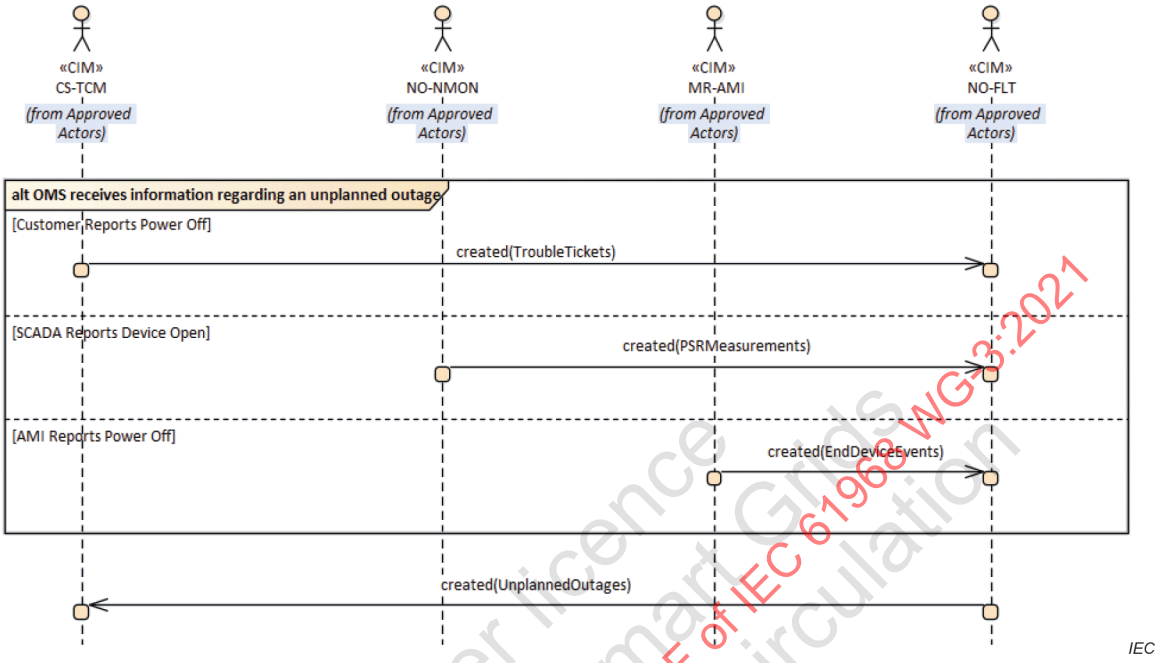


Figure A.6 – UnplannedOutage creation

A.7.5.3 Steps – Unplanned outage changes status

Scenario							
Scenario name:		OMS receives updated information regarding an unplanned outage					
Step No.	**Event**	**Name of process/Activity**	**Description of process/Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
1 alt 1	Crew status changes	Field Crew Work	Crew is assigned, goes enroute, arrives or completes.	changed	NO-FLT (OMS)	CS-TCM (CIS)	UnplannedOutages
1 alt 2	Estimated restoration time change	Field Crew Work		changed	NO-FLT (OMS)	CS-TCM (CIS)	UnplannedOutages
1 alt 3	Outage cause added/changed	Field Crew Work		changed	NO-FLT (OMS)	CS-TCM (CIS)	UnplannedOutages
1 alt 4	Switching operation that changes the customers (usage points) affected	Outage Analysis		changed	NO-FLT (OMS)	CS-TCM (CIS)	UnplannedOutages
1 alt 5a	Outages (outage A and outage B) being combined; original outages closed and new outage (outage C) created	Outage Analysis		changed (outage A) changed (outage B) created (outage C)	NO-FLT (OMS) NO-FLT (OMS) NO-FLT (OMS)	CS-TCM (CIS) CS-TCM (CIS) CS-TCM (CIS)	UnplannedOutages UnplannedOutages UnplannedOutages
1 alt 5b	Outages being combined (outage A and outage B); one of the original outages (outage A) closed and merged into remaining original outage (outage B).	Outage Analysis		changed (outage A) changed (outage B)	NO-FLT (OMS) NO-FLT (OMS)	CS-TCM (CIS) CS-TCM (CIS)	UnplannedOutages UnplannedOutages
1 alt 6a	Outage (outage A) being split into two outages – one existing and one new (outage A, outage B)	Outage Analysis		changed (outage A) created (outage B)	NO-FLT (OMS) NO-FLT (OMS)	CS-TCM (CIS) CS-TCM (CIS)	UnplannedOutages UnplannedOutages
1 alt 6b	Outage (outage A) being split into two outages – closing the existing outage (outage A) and creating two new outages (outage B, outage C)	Outage Analysis		changed (outage A) created (outage B) created (outage C)	NO-FLT (OMS) NO-FLT (OMS) NO-FLT (OMS)	CS-TCM (CIS) CS-TCM (CIS) CS-TCM (CIS)	UnplannedOutages UnplannedOutages UnplannedOutages

Figure A.7 shows various updates during the lifecycle of an unplanned outage.

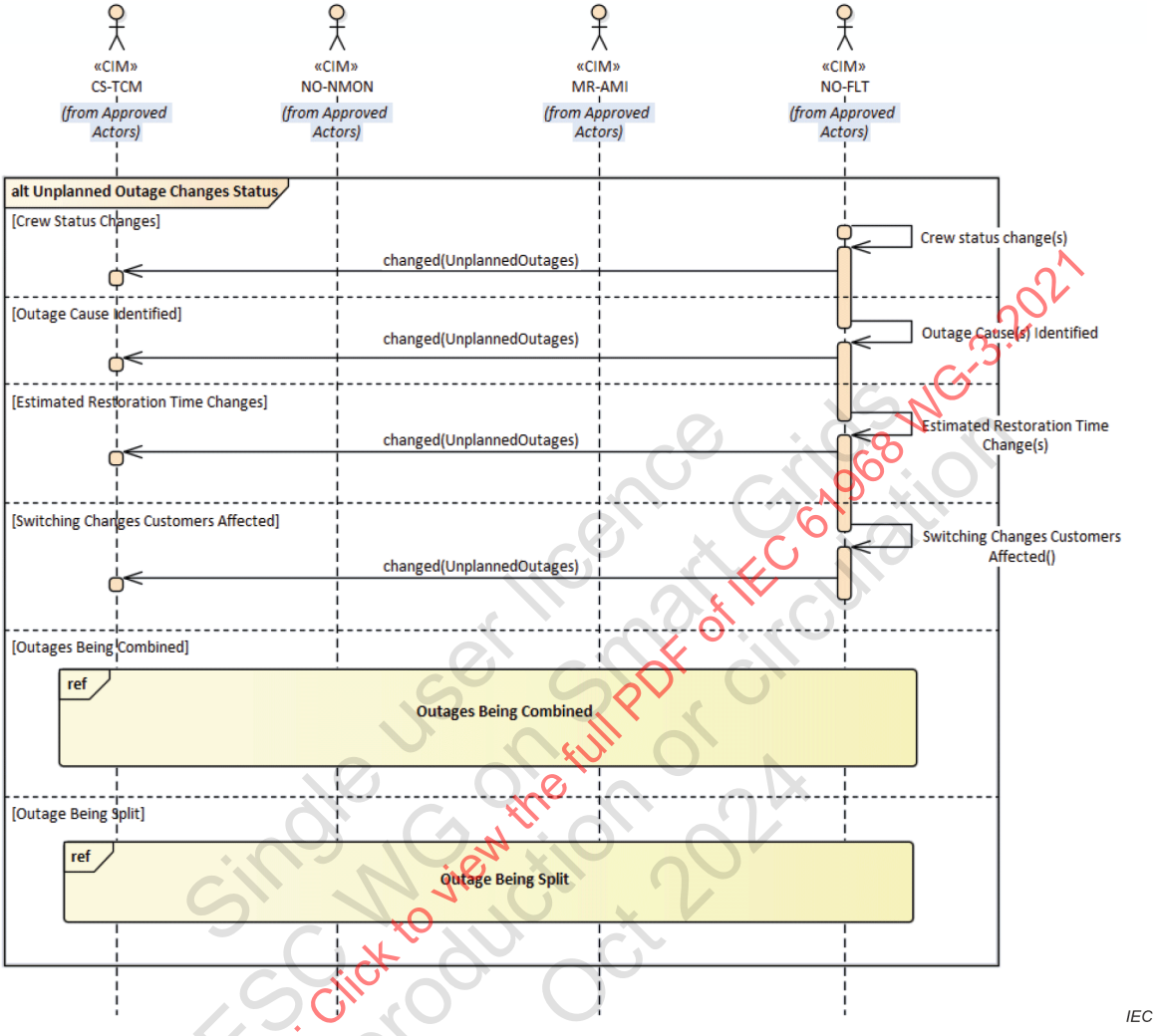


Figure A.7 – UnplannedOutages update

Figure A.8 shows two outages being combined during outage prediction. This typically happens when more information arrives that indicates that where there were two predicted outages, there is a common root cause upstream of the original outages. The two outages are therefore combined into a single outage upstream.

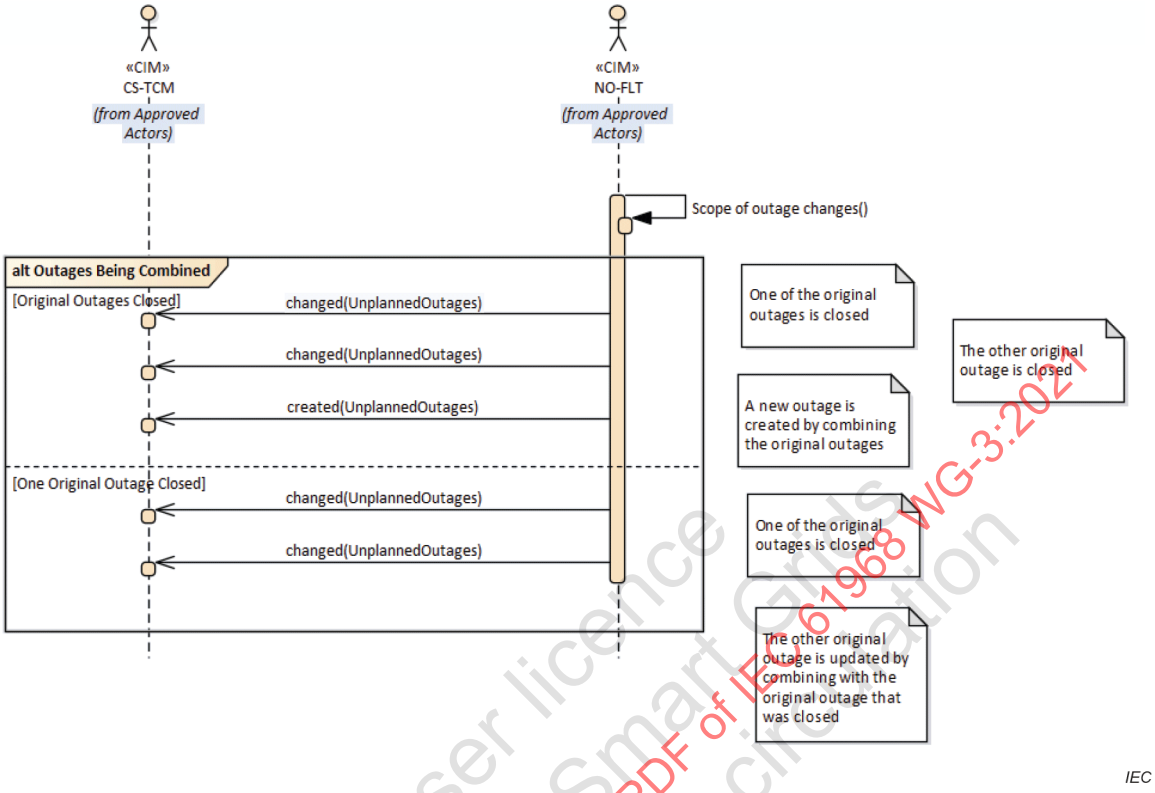


Figure A.8 – Outages being combined

Figure A.9 shows an outage being split into two outages during outage prediction. This can happen, for example, when a new confirmed outage is created downstream of a larger predicted outage and now the patten of TroubleTickets indicate that there should be two predicted outages instead of one.

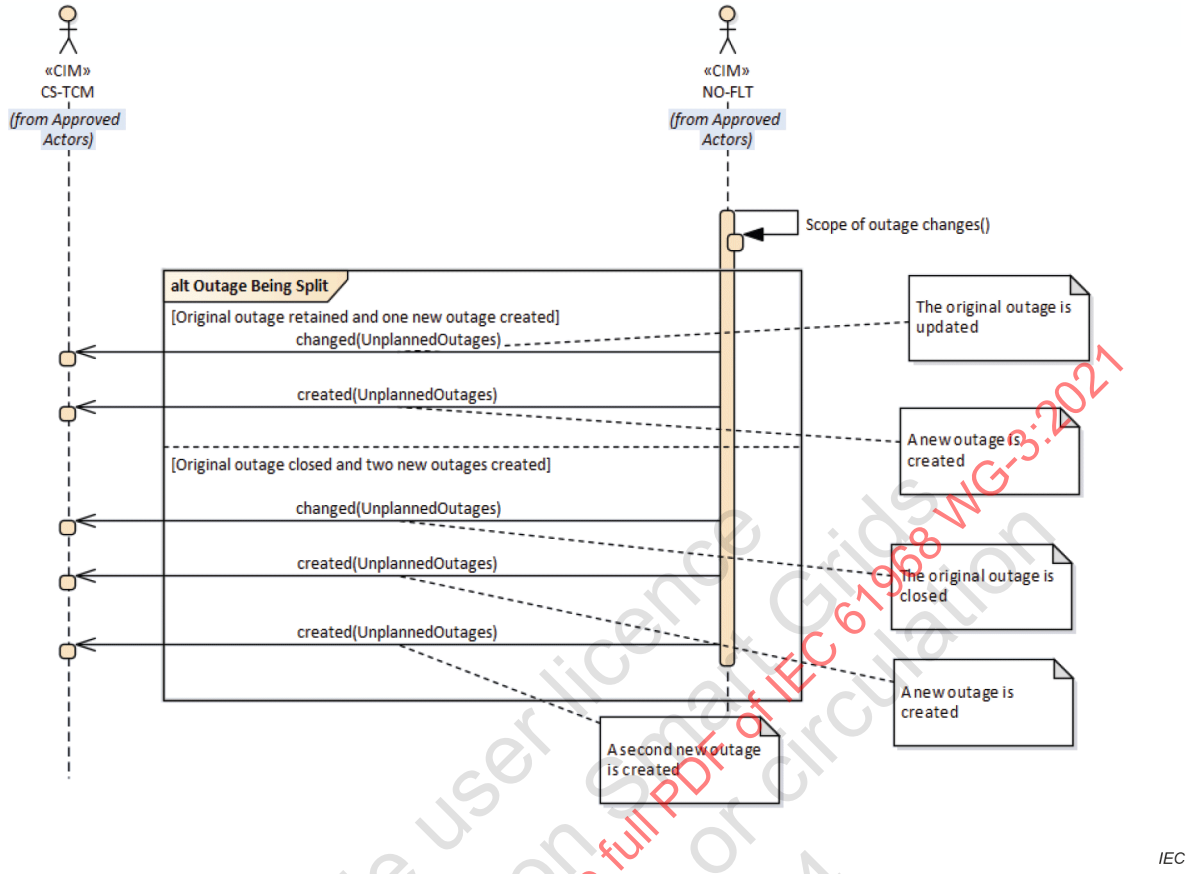


Figure A.9 – Outage being split

A.7.5.4 Steps – Unplanned outage is restored

Scenario							
Scenario name:	OMS restores an unplanned outage						
Step No.	**Event**	**Name of process/Activity**	**Description of process/ Activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
1	Outage is partially restored	Outage Analysis	Service to one or more customers who are part of an unplanned outage is restored	changed	NO-FLT (OMS)	CS-TCM (CIS)	UnplannedOutages
2	Outage is fully restored	Outage Analysis	Service to all customers who are part of an unplanned outage is restored	changed	NO-FLT (OMS)	CS-TCM (CIS)	UnplannedOutages

Figure A.10 shows the restoration of an unplanned outage.

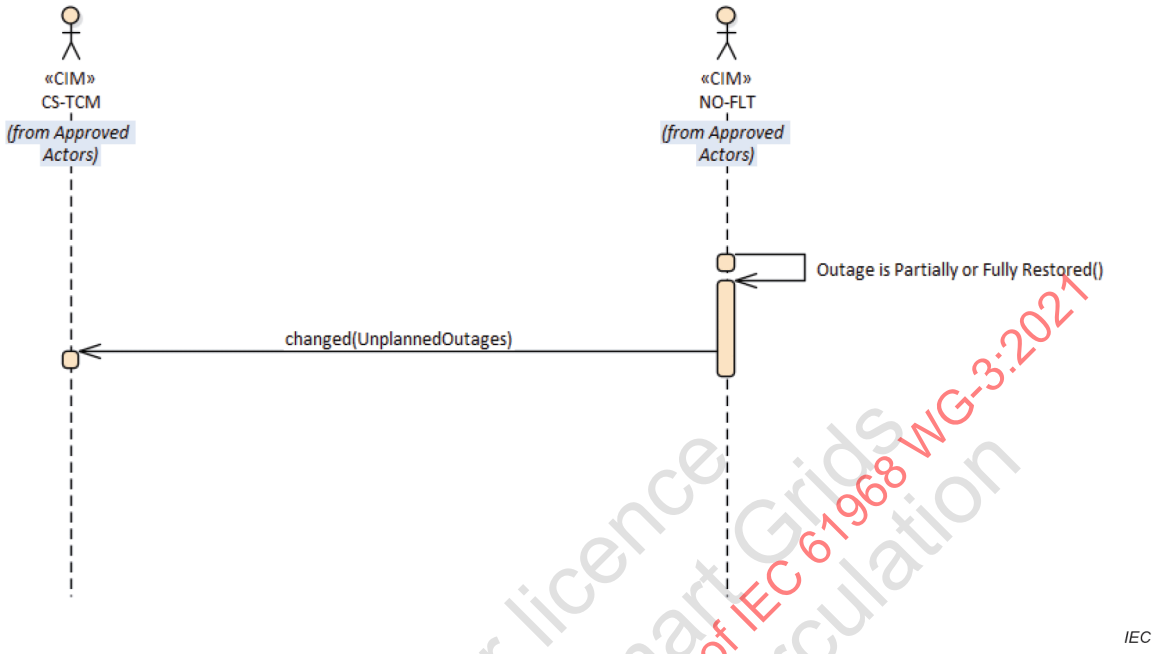


Figure A.10 – UnplannedOutage restore

A.7.6 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data R-ID**
EndDeviceEvents		
PSRMeasurements		
UnplannedOutages		

A.7.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.8 Car hits pole but there is no outage

A.8.1 Description of the use case

A.8.1.1 Name of use case

Use case identification		
ID	**Domain(s)**	
		Car hits pole but there is no outage; resulting interaction between customer service and network operations.

A.8.1.2 Version management

Version management						
Version management changes / Version	**Date (dd/mm/yyyy)**	**Name author(s) or committee**	**Domain expert**	**Area of expertise / Domain / Role**	**Title**	**Approval status draft, for comments, for voting, final**
1	24/04/2019	WG14 Part Teams Focus Community		Customer Information Systems, Outage Management		Draft

A.8.1.3 Scope and objectives of use case

Scope and objectives of use case	
Related business case	Car hits pole and there is an outage.
Scope	This use case includes passer-by interaction with a customer service representative after a car hits a utility pole but there is no outage, interaction between OMS and CIS, and interaction between OMS and field crew dispatch.

A.8.1.4 Narrative of use case

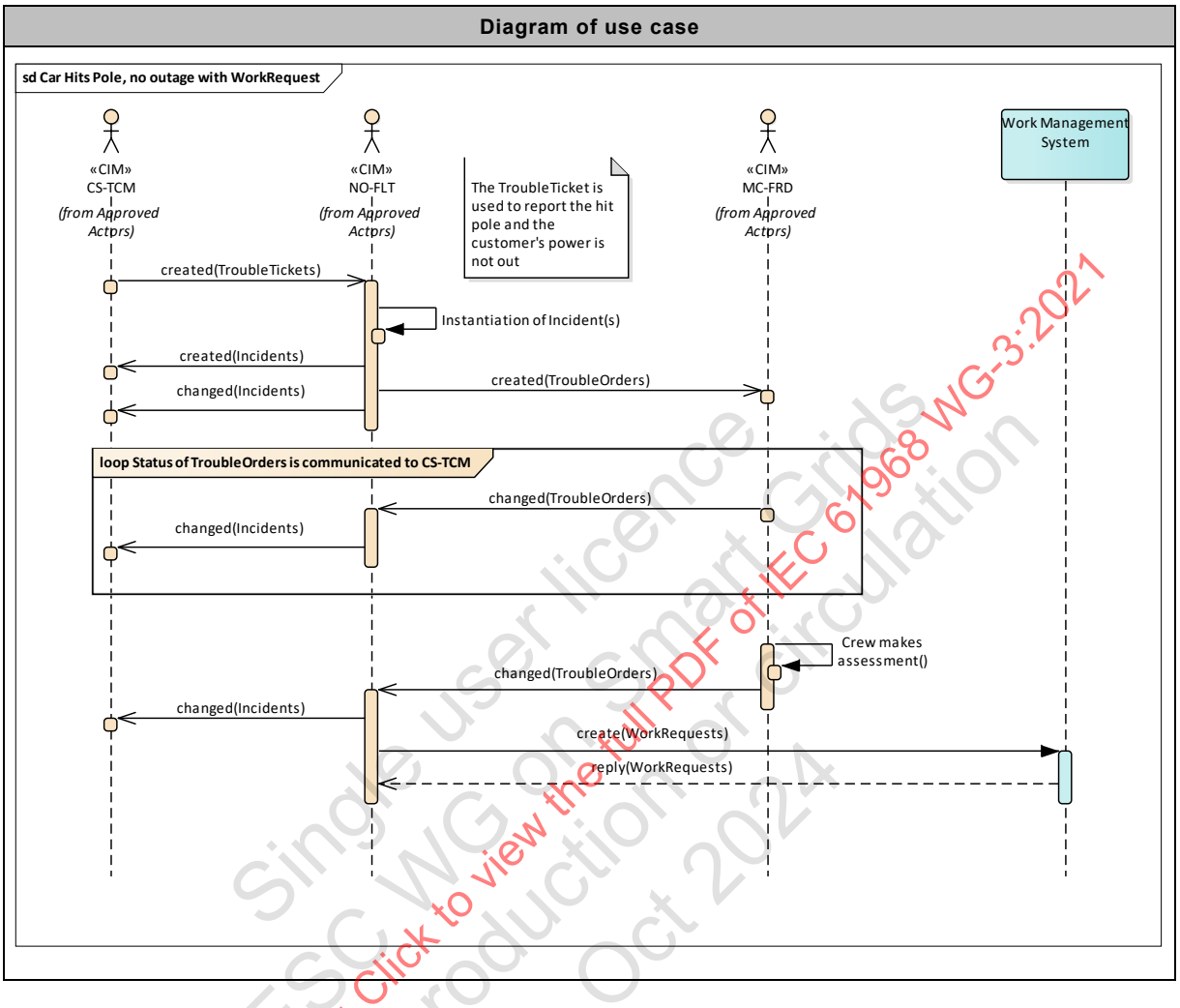
Narrative of use case
Short description – max 3 sentences
A vehicle hits a utility pole and a passer-by calls the utility to report that a pole has been hit. The information about the problem is sent to the OMS; no other information is received that there is an outage. The OMS tracks status changes and reports changes to the CIS, including repair of the pole.
Complete description
A vehicle hits a utility pole and a passer-by calls the utility to report that a pole has been hit. The call taker collects information about the problem and records it in the CIS, which sends the trouble call information to the OMS. The information in the TroubleTicket is used to create an Incident, which is dispatched to a field crew to investigate. Changes in the lifecycle of the incident are reported to the CIS and the incident status is changed to field complete after the field work has been completed.

A.8.1.5 General remarks

General remarks

A.8.2 Use case diagrams

The activity diagram shows the main activities from the main actors and the key deliverables.



A.8.3 Technical details

A.8.3.1 Actors: People, systems, applications, databases, the power system, and other stakeholders

This use case is written using the following actors:

Actors			
Grouping (community)		**Group Description**	
Network Operations (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**	**Further information specific to this use case**
Passer-by	Person	A person who is a member of the public and is not acting in the role of a utility customer.	
Customer Service Representative (CSR)	Person		
Trouble Call Management (TCM)	System		
Outage Management System (OMS)	System	An Outage Management System (OMS) is a computer system that keeps track of customers who are out of power and maintains electric system reliability indices.	
Maintenance and Construction Field Resource Dispatch	System		
Work Management System	System		

A.8.3.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	A vehicle hits a utility pole	The pole was intact and there were no ungoing unplanned outages on the circuit that is associated with the pole.	

A.8.3.3 References / issues

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
	Standards	IEC 61968-3, IEC 61968-6, IEC 61968-8		Use case is being used to validate these three standards.		

A.8.3.4 Further Information to the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
System level use case
Prioritisation
Generic, regional or national relation
View
Further keywords for classification

A.8.4 Step by step analysis of use case

A.8.4.1 Preconditions

Scenario Conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
4.1	Passer-by calls to report that a car has hit a pole	Customer Service Representative	Car hits a pole	Pole is intact	The pole is repaired.

A.8.4.2 Steps – Normal

Scenario							
Scenario name:		Passer-by calls to report that a vehicle has hit a pole and there is no outage					
Step No.	**Event**	**Name of process/activity**	**Description of Process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
1	A car hits a pole	N/A	Someone calls to say that a car hit pole (at this time it is not known whether anyone has lost power)	N/A	Customer	Customer Service Representative (CSR)	Verbal – identification of service affected, outage symptoms
2	CSR enters call information	N/A	CSR enters information regarding the time, nature of the problem and the location of the incident. CIS creates a TroubleTicket that is not associated with any electric service.	create	CSR	Customer Information System (CS-TCM)	TroubleTickets
3	CIS sends TroubleTicket to OMS	N/A		created	CIS (CS-TCM)	Outage Management System (NO-FLT)	TroubleTickets
4	OMS operator analyzes TroubleTicket	Outage Analysis	The OMS operator notices the TroubleTicket and creates an Incident and associates it with the TroubleTicket	create			Incidents
5			Time passes (e.g., several minutes) and no additional TroubleTickets, PSRMeasurements or EndDeviceEvents are received.				
6	OMS sends incident to CIS	Outage Analysis	The Incident with its association to TroubleTicket is sent to CIS (CS-TCM)	created	OMS (NO-FLT)	CIS (CS-TCM)	Incidents
7			A TroubleOrder is created within NO-FLT	create			TroubleOrders
8	The OMS operator dispatches the Incident to a field crew	Crew Dispatch	This results in OMS (NO-FLT) sending the TroubleOrder with the Incident information to a field crew (MC-FRD), either directly or through another system such as a dispatching system. The status of the TroubleOrder is set to dispatched	created	NO-FLT	MC-FRD	TroubleOrders
9	OMS sends update to CIS	Outage Analysis	A changed (Incidents) is sent to CIS (CS-TCM) with a status of dispatched, to ensure that CIS is aware of the new status of the Incident.	changed	NO-FLT	CS-TCM	Incidents

Scenario							
Scenario name:		Passer-by calls to report that a vehicle has hit a pole and there is no outage					
Step No.	**Event**	**Name of process/activity**	**Description of Process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
10	Field crew goes enroute		The field crew (MC-FRD) receives the TroubleOrder and reports that they are enroute to investigate. This causes the status of the TroubleOrder to be changed to enroute.	changed	MC-FRD	NO-FLT	TroubleOrders
11	OMS sends update to CIS	Outage Analysis	A changed (Incidents) is sent to CIS (CS-TCM) with a status of enroute	changed	NO-FLT	CS-TCM	Incidents
12	Field crew arrives		The field crew (MC-FRD) reports that they have arrived at the site of the downed pole. This causes the status of the TroubleOrder to be changed to arrived.	changed	MC-FRD	NO-FLT	TroubleOrders
13	OMS sends update to CIS	Outage Analysis	A changed (Incidents) is sent to CIS (CS-TCM) with a status of arrived.	changed	NO-FLT	CS-TCM	Incidents
14	Field crew makes an assessment.		The field crew (MC-FRD) reports that they have determined what work needs to be done This causes the status of the TroubleOrder to be changed to field complete.	changed	MC-FRD	NO-FLT	TroubleOrders
15	OMS sends update to CIS	Outage Analysis	A changed (Incidents) is sent to CIS (CS-TCM) with a status of field complete.	changed	NO-FLT	CS-TCM	Incidents
16	OMS creates WorkRequest	Outage Analysis	A request to create a WorkRequest is sent to Work Management to perform the repairs. Either the WorkRequest number (mRID or name) is included in the request or it is assumed it will be returned in the reply.	create	NO-FLT	Work Management	WorkRequests
17	Work Management creates a WorkRequest	Work Management	A WorkRequest is created and the reply includes the mRID or name of the WorkRequest, if it was not included in the original WorkRequest.	created	Work Management	NO-FLT	WorkRequests

A.8.5 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data R-ID**
TroubleTickets	Location of the problem, nature of the problem, whether there is a hazard (e.g. wire down).	
Incidents	Location, related field crew status information, incident status, hazard information.	

A.8.6 Common terms and definitions

Common terms and definitions	
Term	**Definition**

A.9 Car hits pole and there is an outage

A.9.1 Description of the use case

A.9.1.1 Name of use case

Use case identification		
ID	**Domain(s)**	
		Car hits pole and there is an outage; resulting interaction between customer service and network operations.

A.9.1.2 Version management

Version management						
Version management changes / Version	**Date (dd/mm/yyyy)**	**Name author(s) or committee**	**Domain expert**	**Area of expertise / Domain / Role**	**Title**	**Approval status draft, for comments, for voting, final**
1	24/04/2019	WG14 Part Teams Focus Community		Customer Information Systems, Outage Management		Draft

A.9.1.3 Scope and objectives of use case

Scope and objectives of use case	
Related business case	Car hits pole and there is no outage.
Scope	This use case includes passer-by interaction with a customer service representative after a car hits a utility pole and there is an outage, interaction between OMS and CIS, and interaction between OMS and field crew dispatch.

A.9.1.4 Narrative of use case

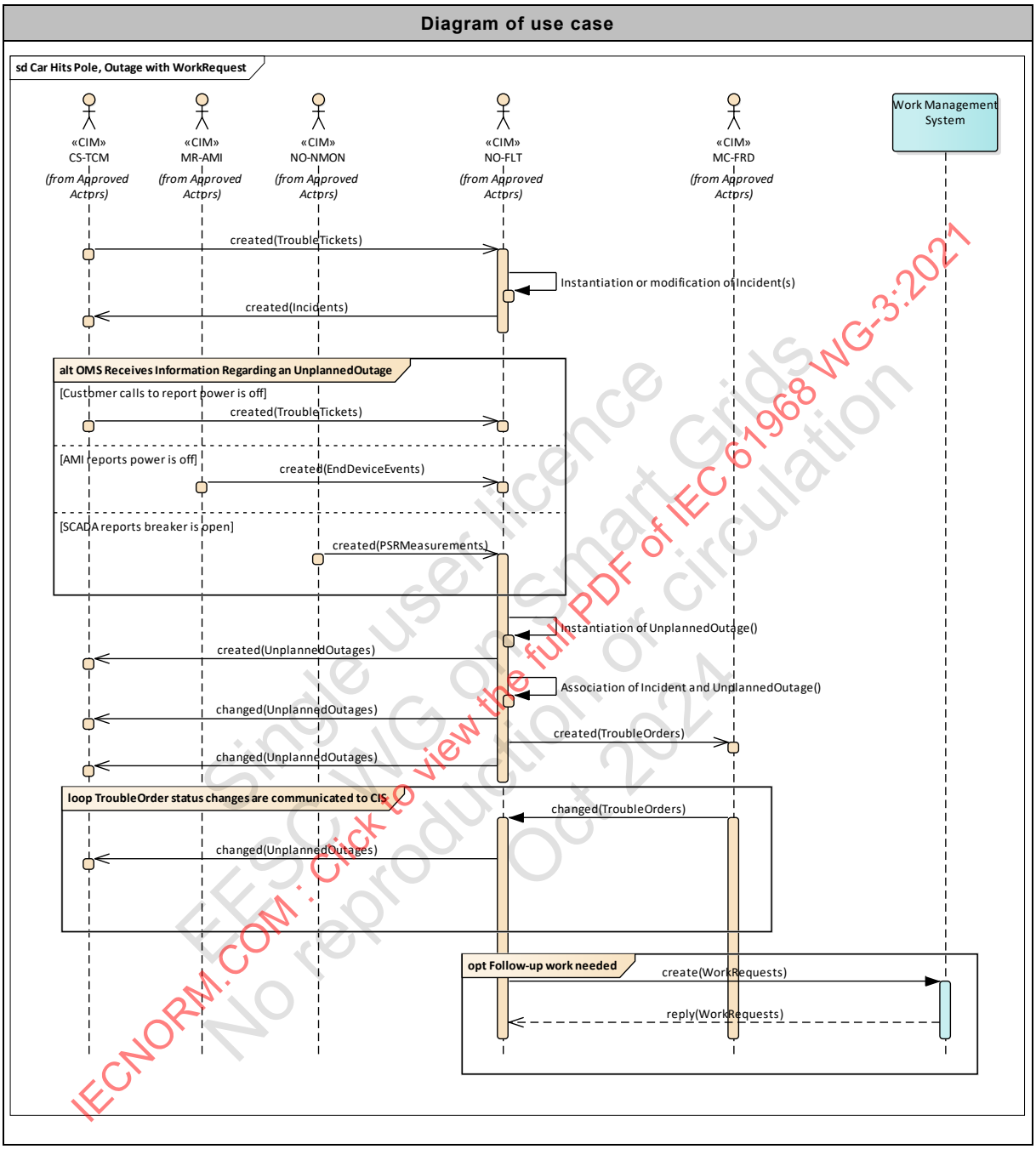
Narrative of use case
Short description – max 3 sentences
A vehicle hits a utility pole and a passer-by calls the utility to report that a pole has been hit. The information about the problem is sent to the OMS; subsequently other information is received that there is an outage. The OMS tracks status changes and reports changes to the CIS including repair of the pole and restoration of power.
Complete description
A vehicle hits a utility pole and a passer-by calls the utility to report that a pole has been hit. The call taker collects information about the problem and records it in the CIS, which sends the trouble call information to the OMS. The information in the TroubleTicket is used to create an Incident, which is dispatched to a field crew to investigate. Subsequently information is received from any combination of customer calls, AMI calls and SCADA status values, indicating that there is also an unplanned outage that resulted from the vehicle hit pole. The incident is associated with the unplanned outage and the association is reported to CIS. Changes in the lifecycle of the unplanned outage are reported to the CIS and the unplanned outage status is changed to field complete after the field work has been completed to repair the pole and restore power. This use case is sufficiently different from the car hits pole but there is no outage to warrant it being a use case in its own right. In the previous use case, the interactions between all parties (CIS, OMS and field crew) were done at the Incident level, while in this use case, the interactions are done at the UnplannedOutage level.

A.9.1.5 General remarks

General remarks

A.9.2 Use case diagrams

The activity diagram shows the main activities from the main actors and the key deliverables.



A.9.3 Technical details

A.9.3.1 Actors: People, systems, applications, databases, the power system, and other stakeholders

This use case is written using the following actors:

Actors			
Grouping (community)		**Group description**	
Network Operations (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**	**Further information specific to this use case**
Passer-by	Person	A person who is a member of the public and is not acting in the role of a utility customer.	
Customer Service Representative (CSR)	Person		
Trouble Call Management (TCM)	System		
Outage Management System (OMS)	System	An Outage Management System (OMS) is a computer system that keeps track of customers who are out of power and maintains electric system reliability indices.	
Maintenance and Construction Field Resource Dispatch	System		

A.9.3.2 Preconditions, assumptions, post condition, events

Use case conditions			
Actor/System/Information/Contract	**Triggering event**	**Pre-conditions**	**Assumption**
	A vehicle hits a utility pole	The pole was intact and there were no ungoing unplanned outages on the circuit that is associated with the pole.	

A.9.3.3 References / issues

References						
No.	**References type**	**Reference**	**Status**	**Impact on use case**	**Originator / Organisation**	**Link**
	Standards	IEC 61968-3, IEC 61968-6, IEC 61968-8		Use case is being used to validate these three standards.		

A.9.4 Further Information to the use case for classification / mapping

Classification information
Relation to other use cases
Level of depth
System level use case
Prioritisation
Generic, regional or national relation
View
Further keywords for classification

A.9.5 Step by step analysis of use case

A.9.5.1 Preconditions

Scenario conditions					
No.	**Scenario name**	**Primary actor**	**Triggering event**	**Pre-condition**	**Post-condition**
4.1	Passer-by calls to report that a car has hit a pole	Customer Service Representative	Car hits a pole	Pole is intact and there is no outage.	The pole is repaired and power is restored.

A.9.5.2 Steps – Normal

Scenario							
Scenario name:		Passer-by calls to report that a vehicle has hit a pole and there is and outage					
Step No.	**Event**	**Name of process/activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
1	A car hits a pole	N/A	Someone calls to say that a car hit pole (at this time it is not known whether anyone has lost power)	N/A	Customer	Customer Service Representative (CSR)	Verbal – identification of service affected, outage symptoms
2	CSR enters call information	Trouble Call Entry	CSR enters information regarding the time, nature of the problem and the location of the incident. CIS creates a TroubleTicket that is not associated with any electric service.	create	CSR	Customer Information System (CS-TCM)	TroubleTickets
3	CIS sends TroubleTicket to OMS			created	CIS (CS-TCM)	Outage Management System (NO-FLT)	TroubleTickets
4	OMS operator analyzes TroubleTicket	Outage Analysis	The OMS operator notices the TroubleTicket and creates an Incident and associates it with the TroubleTicket	create			Incidents
5	OMS sends incident to CIS	Outage Analysis	The Incident with its association to TroubleTicket is sent to CIS (CS-TCM)	created	OMS (NO-FLT)	CIS (CS-TCM)	Incidents
6 alt 1	Customer calls to report power is off	Trouble Call Entry		created			TroubleTickets
6 alt 2	AMI reports power is off	AMI		created			EndDeviceEvents
6 alt 3	SCADA reports breaker is open	SCADA		created			PSRMeasurements
7	The information is analysed by OMS	Outage Analysis	OMS predicts or confirms an UnplannedOutage at a location based on the information received. OMS associates any TroubleTickets with the UnplannedOutage	created	NO-FLT	CS-TCM	UnplannedOutages

Scenario							
Scenario name:		Passer-by calls to report that a vehicle has hit a pole and there is and outage					
Step No.	**Event**	**Name of process/activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
8	The UnplannedOutage and car hit pole TroubleTicket are analysed.	Outage Analysis	The OMS or the OMS operator determines that the UnplannedOutage and the car hit pole TroubleTicket are probably related to the same root cause. The UnplannedOutage is updated to reference the Incident. The Incident also includes the car hit pole TroubleTicket.	Changed	NO-FLT	CS-TCM	UnplannedOutages
9			A TroubleOrder is created within NO-FLT	create			TroubleOrders
10	The OMS operator dispatches the TroubleOrder to a field crew	Crew Dispatch	The OMS operator dispatches the TroubleOrder to a field crew (MC-FRD), with both the UnplannedOutage and the Incident information. The TroubleOrder is sent to a field crew, either directly or through another system such as a dispatching system. The status of the TroubleOrder is set to dispatched	created	NO-FLT	MC-FRD	TroubleOrders
11	OMS sends update to CIS	Outage Analysis	A changed (UnplannedOutages) is sent to CIS (CS-TCM) with a status of dispatched	changed	NO-FLT	CS-TCM	UnplannedOutages
12	Field crew goes enroute	Field Crew Work	The field crew (MC-FRD) receives the TroubleOrder and reports that they are enroute to investigate. This causes the status of the TroubleOrder to be changed to enroute.	changed	MC-FRD	NO-FLT	TroubleOrders
13	OMS sends update to CIS	Outage Analysis	A changed (UnplannedOutages) is sent to CIS (CS-TCM) with a status of enroute	changed	NO-FLT	CS-TCM	UnplannedOutages
14	Field crew arrives	Field Crew Work	The field crew (MC-FRD) reports that they have arrived at the site of the outage or downed pole. This causes the status of the TroubleOrder to be changed to arrived.	changed	MC-FRD	NO-FLT	TroubleOrders
15	OMS sends update to CIS	Outage Analysis	A changed (UnplannedOutages) is sent to CIS (CS-TCM) with a status of arrived.	changed	NO-FLT	CS-TCM	UnplannedOutages

Scenario							
Scenario name:		Passer-by calls to report that a vehicle has hit a pole and there is and outage					
Step No.	**Event**	**Name of process/activity**	**Description of process/activity**	**Service**	**Information producer (actor)**	**Information receiver (actor)**	**Information exchanged**
16	Field crew completes work	Field Crew Work	The field crew (MC-FRD) reports that they have completed repairs. This causes the status of the TroubleOrder to be changed to field complete.	changed	MC-FRD	NO-FLT	TroubleOrders
17	OMS sends update to CIS	Outage Analysis	A changed (UnplannedOutages) is sent to CIS (CS-TCM) with a status of field complete.	changed	NO-FLT	CS-TCM	UnplannedOutages
18 (optional)	OMS sends request for follow-up work to Work Management	Outage Analysis	If the field crew made temporary repairs to get the power back on, a create (WorkRequests) is sent to Work Management to have permanent repairs performed. Either the WorkRequest number (mRID or name) is included in the request or it is assumed it will be returned in the reply.	create	NO-FLT	Work Management	WorkRequests
19 (optional)	Work Management creates a WorkRequest	Work Management	Work Management creates a Work Request.	created	Work Management	NO-FLT	WorkRequests

A.9.6 Information exchanged

Information exchanged		
Name of information exchanged	**Description of information exchanged**	**Requirements to information data R-ID**
TroubleTicket	Location of the problem, nature of the problem, whether there is a hazard (e.g. wire down).	
Incident	Location, related field crew status information, incident status, hazard information.	

A.9.7 Common terms and definitions

Common terms and definitions	
Term	**Definition**

Annex B
(normative)

Payload fragments

B.1 General

The tables in this clause are the normative data requirements for the Network Operations related profiles.

Complete data definitions can be found in IEC 61968-11, *Application integration at electric utilities – System interfaces for distribution management – Part 11: Common information model (CIM) extensions for distribution*.

The profiles in this clause may have many types of serialization such as XSD, RDF, XML, JSON, or protobuf. For SOAP or JMS based integration guidance the reader is referred to IEC 61968-100:2013.

Many classes inherit from identifiedObject shown in Table B.1. The mRID attribute is defined as a string, but leading practice is that mRID should be constrained to a globally unique ID (GUID).

Table B.1 – IdentifiedObject

Core: IdentifiedObject			
Attribute	**Type**	**Cardinality**	**Comment**
aliasName	string	[0..1]	Not used in Part 3 profiles
description	string	[0..1]	
mRID	string	[0..1]	GUID
name	string	[0..1]	Not used in Part 3 profiles

In the following tables, profiles are detailed with a combination of attributes and super classes. A super class is an attribute which is itself, a class, e.g. Status. These tables document parts of profiles and are hence referred to as payload fragments. The profiles that use these fragments are documented in Subclause 5.3 and subsequent subclauses.

B.2 Accumulator fragment

Accumulator represents an accumulated (counted) Measurement, e.g. an energy value.

The attributes of **Accumulator** that are used in IEC 61968-3 profiles are shown in Table B.2.

Table B.2 – Accumulator payload fragment

Meas: Accumulator				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
maxValue	Integer	[0..1]		Normal value range maximum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values.
measurementType	String	[0..1]		Specifies the type of measurement. For example, this specifies if the measurement represents an indoor temperature, outdoor temperature, bus voltage, line flow, etc. When the measurementType is set to "Specialization", the type of Measurement is defined in more detail by the specialized class which inherits from Measurement.
phases	PhaseCode	[0..1]	See C.12	Indicates to which phases the measurement applies and avoids the need to use 'measurementType' to also encode phase information (which would explode the types). The phase information in Measurement, along with 'measurementType' and 'phases' uniquely defines a Measurement for a device, based on normal network phase. Their meaning will not change when the computed energizing phasing is changed due to jumpers or other reasons. If the attribute is missing three phases (ABC) shall be assumed.
unitMultiplier	UnitMultiplier	[0..1]		The unit multiplier of the measured quantity.
unitSymbol	UnitSymbol	[0..1]		The unit of measure of the measured quantity.
AccumulatorValues	AccumulatorValue	[0..*]	See B.3	
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	

B.3 **AccumulatorValue** Fragment

AccumulatorValue represents an accumulated (counted) **MeasurementValue**.

The attributes of **AccumulatorValue** that are used in IEC 61968-3 profiles are shown in Table B.3.

Table B.3 – AccumulatorValue payload fragment

Meas: AccumulatorValue				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of AccumulatorValue.
description	String	[0..1]		Free-form description of AccumulatorValue.
Names	Name	[0..*]	See B.56	Human-readable names for AccumulatorValue.
sensorAccuracy	PerCent	[0..1]		The limit, expressed as a percentage of the sensor maximum, that errors will not exceed when the sensor is used under reference conditions.
timestamp	DateTime	[0..1]		The time when the value was last updated
value	Integer	[0..1]		The value to supervise. The value is positive.
MeasurementValueQuality	MeasurementValueQuality	[0..1]	See B.53	Measurement quality flags. Bits 0 to -10 are defined for substation automation in draft IEC 61850-7-3. Bits 11 to 15 are reserved for future expansion by that document. Bits 16 to 31 are reserved for EMS applications.
MeasurementValueSource	MeasurementValueSource	[0..1]	See B.55	MeasurementValueSource describes the alternative sources updating a MeasurementValue. User conventions for how to use the MeasurementValueSource attributes are described in the introduction to IEC 61970-301.

B.4 **ACLineSegment** fragment

An **ACLineSegment** is a wire or combination of wires, with consistent electrical characteristics, building a single electrical system, used to carry alternating current between points in the power system.

Figure B.1 shows the payload fragment for **ACLineSegment**.

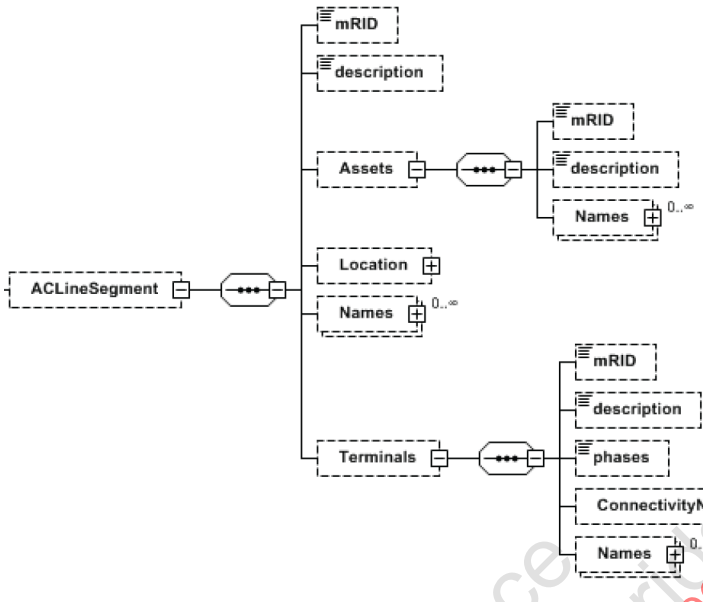


Figure B.1 – ACLineSegment payload fragment

The attributes of **ACLineSegment** that are used in IEC 61968-3 profiles are shown in Table B.4.

Table B.4 – ACLineSegment payload fragment

Wires: ACLineSegment					
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**	**Used by Profiles**
mRID	String	[0..1]	GUID	mRID of ACLineSegment.	UnplannedOutages SwitchingPlans SwitchingActions SwitchingEvents
description	String	[0..1]		Free-form description of ACLineSegment.	UnplannedOutages SwitchingPlans SwitchingActions SwitchingEvents
Names	Name	[0..*]	See B.56	Human-readable names for ACLineSegment.	UnplannedOutages SwitchingPlans SwitchingActions SwitchingEvents
Assets	Asset	[0..1]	See B.9	mRID, description and Names only. Asset associated with this ACLineSegment, such as a pole or a vault.	UnplannedOutages SwitchingPlans SwitchingActions SwitchingEvents
Location	Location	[0..1]	See B.52	Location of the ACLineSegment	UnplannedOutages SwitchingPlans SwitchingActions SwitchingEvents

Wires: ACLineSegment					
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**	**Used by Profiles**
Terminals	Terminal	[0..1]	See B.90	For IEC 61968-3 profiles, although there are two terminals associated with an ACLineSegment, only one is specified because the terminal is used to determine where to connect temporary equipment to the network. If temporary equipment needs to be connected to two ends of the same ACLineSegment then the same ACLineSeqment would be repeated, once with terminal1 and once with terminal2	SwitchingPlans SwitchingActions SwitchingEvents

B.5 **ActivityRecord** fragment

An **ActivityRecord** records activity for an entity at a point in time; activity may be for an event that has already occurred or for a planned activity. The attributes of **ActivityRecord** that are used in IEC 61968-3 profiles are shown in Table B.5.

Table B.5 – ActivityRecord payload fragment

Common: ActivityRecord				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of ActivityRecord.
description	String	[0..1]		Free-form description of ActivityRecord.
Names	Name	[0..*]	See B.56	Human-readable names for ActivityRecord.
createdDateTime	DateTime			Date and time this activity record has been created (different from the 'status.dateTime', which is the time of a status change of the associated object, if applicable).
reason	String	[0..1]		Reason for event resulting in this activity record, typically supplied when user initiated.
severity	String	[0..1]		Severity level of event resulting in this activity record.
type	String	[0..1]		Type of event resulting in this activity record.
status	Status	[0..1]	See B.79	Information on consequence of event resulting in this activity record.

B.6 **Analog** fragment

Analog represents an analog **Measurement**.

The attributes of **Analog** that are used in IEC 61968-3 profiles are shown in Table B.6.

Table B.6 – Analog payload fragment

Meas: Analog				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
maxValue	Float	[0..1]		Normal value range maximum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values.
measurementType	String	[0..1]		Specifies the type of measurement. For example, this specifies if the measurement represents an indoor temperature, outdoor temperature, bus voltage, line flow, etc. When the measurementType is set to "Specialization", the type of Measurement is defined in more detail by the specialized class which inherits from Measurement.
minValue	Float	[0..1]		Normal value range minimum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values.
normalValue	Float	[0..1]		Normal measurement value, e.g., used for percentage calculations.
phases	PhaseCode	[0..1]	See C.12	Indicates to which phases the measurement applies and avoids the need to use 'measurementType' to also encode phase information (which would explode the types). The phase information in Measurement, along with 'measurementType' and 'phases' uniquely defines a Measurement for a device, based on normal network phase. Their meaning will not change when the computed energizing phasing is changed due to jumpers or other reasons. If the attribute is missing three phases (ABC) shall be assumed.
positiveFlowIn	Boolean	[0..1]		If true then this measurement is an active power, reactive power or current with the convention that a positive value measured at the Terminal means power is flowing into the related PowerSystemResource.
unitMultiplier	UnitMultiplier	[0..1]		The unit multiplier of the measured quantity.
unitSymbol	UnitSymbol	[0..1]		The unit of measure of the measured quantity.
AnalogValues	AnalogValue	[0..*]	See B.7	
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	

B.7 **AnalogValue** fragment

AnalogValue represents an analog **MeasurementValue**.

The attributes of **AnalogValue** that are used in IEC 61968-3 profiles are shown in Table B.7.

Table B.7 – AnalogValue payload fragment

Meas: AnalogValue				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of AnalogValue.
description	String	[0..1]		Free-form description of AnalogValue.
Names	Name	[0..*]	See B.56	Human-readable names for AnalogValue.
sensorAccuracy	PerCent	[0..1]		The limit, expressed as a percentage of the sensor maximum, that errors will not exceed when the sensor is used under reference conditions.
timestamp	DateTime	[0..1]		The time when the value was last updated
value	Float	[0..1]		The value to supervise.
MeasurementValueQuality	MeasurementValueQuality	[0..1]	See B.53	Measurement quality flags. Bits 0-10 are defined for substation automation in draft IEC 61850 part 7-3. Bits 11-15 are reserved for future expansion by that document. Bits 16-31 are reserved for EMS applications.
MeasurementValueSource	MeasurementValueSource	[0..1]	See B.55	MeasurementValueSource describes the alternative sources updating a MeasurementValue. User conventions for how to use the MeasurementValueSource attributes are described in the introduction to IEC 61970-301.

B.8 **Approver** fragment

An **Approver** is a person who reviews and approves a document such as a **SwitchingPlan**. Either the **person** class can be used to specify individual parts of the person's name, or the **Name** class can be used to specify the names in a different format, e.g. employee ID.

Figure B.2 shows the payload fragment for an **Approver**.

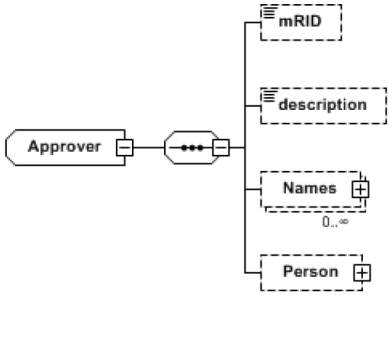


Figure B.2 – Approver payload fragment

The attributes of **Approver** that are used in IEC 61968-3 profiles are shown in Table B.8.

Table B.8 – Approver payload fragment

Common: Approver				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of Approver.
description	String	[0..1]		Free-form description of Approver.
Names	Name	[0..*]	See B.56	Human-readable names for Approver.
Person	Person	[0..1]	See B.65	General purpose information for name and other information to contact people.

B.9 Asset fragment

An **Asset** is a tangible resource of the utility, including power system equipment, various end devices, cabinets, buildings, etc. For electrical network equipment, the role of the asset is defined through PowerSystemResource and its subclasses, defined mainly in the Wires model (refer to IEC 61970-301 and model package IEC61970::Wires). Asset description places emphasis on the physical characteristics of the equipment fulfilling that role.

The attributes of **Asset** that are used in IEC 61968-3 profiles are shown in Table B.9.

Table B.9 – Asset payload fragment

Assets: Asset					
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**	**Profiles used in**
mRID	String	[0..1]	GUID	mRID of asset.	All
description	String	[0..1]		Free-form text description of asset.	All
Names	Name	[0..*]	See B.56	Human-readable names for asset.	All
kind	AssetKind	[0..1]	See C.1.	Kind of asset. Used in description of asset components in asset instance templates.	TroubleOrders
serialNumber	String	[0..1]		Serial number of this asset.	TroubleOrders
type	String	[0..1]		Utility-specific classification of Asset and its subtypes, according to their corporate standards, practices, and existing IT systems (e.g., for management of assets, maintenance, work, outage, customers, etc.).	TroubleOrders UnplannedOutages
utcNumber	String	[0..1]		Uniquely tracked commodity (UTC) number. This could a bar code on an asset, for example.	TroubleOrders
AssetContainer	AssetContainer	[0..1]	See B.10	Asset that is an aggregation of other assets such as conductors, transformers, switchgear, land, fences, buildings, equipment, vehicles, etc. Can be used to identify the location of equipment when it is part of an aggregation, e.g. a vault number can be used to identify the location of a switch within that vault. Can also be used to identify equipment that is attached to a structure, such as a pole.	TroubleOrders
AssetInfo	AssetInfo	[0..1]	See B.11	AssetInfo can be used to convey information such as conductor type for a LineFault, for example.	TroubleOrders
Location	Location	[0..1]	See B.52	Location of the asset.	TroubleOrders
Ownerships	Ownership	[0..*]	See B.64	Used to determine if the asset is shared with other parties (e.g. cable TV or phone company) so that they can be notified if there is damage to the asset.	TroubleOrders
PowerSystemResources	PowerSystemResource	[0..*]	See B.68		Incidents TroubleOrders

B.10 **AssetContainer** fragment

AssetContainer is an aggregation of other assets such as conductors, transformers, switchgear, land, fences, buildings, equipment, vehicles, etc. In the context of this document, can be used to identify the location of equipment when it is part of an aggregation, e.g. the **AssetContainer** could be a vault, whose number can be used to identify the location of a switch within that vault. **AssetContainer** could also be used to identify the pole that equipment is attached to.

The attributes of **AssetContainer** that are used in IEC 61968-3 profiles are shown in Table B.10.

Table B.10 – AssetContainer payload fragment

Assets: AssetContainer				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of AssetContainer
description	String	[0..1]		Free-form text description of AssetContainer
Names	Name	[0..*]	See B.56	Human-readable names for AssetContainer.

B.11 **AssetInfo** fragment

AssetInfo is a set of attributes of an **asset**, representing typical datasheet information of a physical device that can be instantiated and shared in different data exchange contexts:

- as attributes of an asset instance (installed or in stock)
- as attributes of an asset model (product by a manufacturer)
- as attributes of a type asset (generic type of an asset as used in designs/extension planning).

AssetInfo can be used to convey information such as conductor type for a **LineFault**, for example.

The attributes of **AssetInfo** that are used in IEC 61968-3 profiles are shown in Table B.11.

Table B.11 – AssetInfo payload fragment

Assets: AssetInfo				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of AssetInfo.
description	String	[0..1]		Free-form description of AssetInfo.
Names	Name	[0..*]	See B.56	Human-readable names for AssetInfo.

B.12 **AssetOwner** fragment

An **AssetOwner** is an organisation who owns a portion of an asset. An asset such as a pole can be shared by a cable TV or phone company, for example. Can be useful if a shared pole is damaged in order to determine who should be contacted to notify them of the damage.

The attributes of **AssetOwner** that are used in IEC 61968-3 profiles are shown in Table B.12.

Table B.12 – AssetOwner payload fragment

Assets: AssetOwner				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of AssetOwner.
description	String	[0..1]		Free-form description of AssetOwner.
Names	Name	[0..*]	See B.56	Human-readable names for AssetOwner.
Organisation	Organisation	[0..1]	See B.62	Contact information for the asset owner.

B.13 Author fragment

Figure B.3 shows the payload fragment for an **Author**. An **Author** is a person who created a document or activity record such as a **SwitchingPlan** or **TroubleTicket.** Either the **person** class can be used to specify individual parts of the person's name, or the **Name** class can be used to specify the names in a different format, e.g. employee ID.

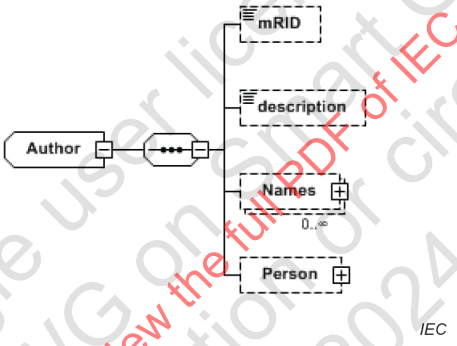


Figure B.3 – Author payload fragment

The attributes of **Author** that are used in IEC 61968-3 profiles are shown in Table B.13.

Table B.13 – Author payload fragment

Common: Author				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of Author.
description	String	[0..1]		Free-form description of Author.
Names	Name	[0..*]	See B.56	Human-readable names for Author.
Person	Person	[0..1]	See B.65	General purpose information for name and other information to contact people.

B.14 Cabinet fragment

A **Cabinet** is an enclosure that offers protection to the equipment it contains and/or safety to people/animals outside it. **Cabinet** inherits from **AssetContainer**, which in itself is an **Asset**.

The attributes of **Cabinet** that are used in IEC 61968-3 profiles are shown in Table B.14.

Table B.14 – Cabinet payload fragment

Assets: Cabinet				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the Cabinet
description	String	[0..1]		Free form description
Names	Name	[0..*]	See B.56	Human-readable names for the Cabinet.
kind	AssetKind	[0..1]	See C.1	Kind of asset. Used in description of asset components in asset instance templates.
serialNumber	String	[0..1]		Serial number of this asset.
type	String	[0..1]		Utility-specific classification of Asset and its subtypes, according to their corporate standards, practices, and existing IT systems (e.g., for management of assets, maintenance, work, outage, customers, etc.).
utcNumber	String	[0..1]		Uniquely tracked commodity (UTC) number. This could a bar code on an asset, for example.
Location	Location	[0..1]	See B.52	

B.15 Clamp fragment

A **Clamp** is a galvanic connection at a line segment where other equipment is connected. A **Clamp** does not cut the line segment. A **Clamp** is **ConductingEquipment** and has one **Terminal** which is associated with a **ConnectivityNode**. A terminal of any other **ConductingEquipment** can be associated with the same **ConnectivityNode**.

Clamps are used to connect **jumpers** to an **ACLineSegment** in the case where the **jumper** is to be connected part way along an **ACLineSegment**. If the **jumper** is to be connected at either end of an **ACLineSegment**, then a **clamp** is not required.

The attributes of **Clamp** that are used in IEC 61968-3 profiles are shown in Table B.14.

Table B.15 – Clamp payload fragment

Wires: Clamp				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the Clamp
description	String	[0..1]		free form description
Names	Name	[0..*]	See B.56	names associated with the Clamp that can be used to describe the Clamp to the field crew
lengthFromTerminal1	Length	[0..1]		The length to the place where the clamp is located starting from side one of the line segment, i.e. the line segment terminal with sequence number equal to 1.
ACLineSegment	ACLineSegment	[0..1]	See B.4	ACLineSegment that the Clamp is to be placed on or removed from
Terminals	Terminal	[0..1]	See B.90	Single terminal that is associated with the Clamp

B.16 **Clearance** fragment

A **Clearance** is of type **ClearanceDocument**, which inherits from **SafetyDocument**.

The attributes of **Clearance** that are used in IEC 61968-3 profiles are shown in Table B.16.

Table B.16 – Clearance payload fragment

Operations: Clearance				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the SafetyDocument.
Names	Name	[0..*]	See B.56	Names used for the Clearance, such as an internal Clearance number.
description	String	[0..1]		Free form description of the Clearance
comment	String	[0..1]		Free form comments associated with the Clearance
createdDateTime	DateTime	[0..1]		Date/time that the Clearance was created.
issuedDateTime	DateTime	[0..1]		Date and time this Clearance has been issued.
releasedDateTime	DateTime	[0..1]		Date and time this Clearance has been released.
type	String	[0..1]		String describing the type of the Clearance.
Approver	Approver	[0..1]	See B.8	Person who approved the Clearance.
Author	Author	[0..1]	See B.13	Person who wrote the Clearance document.
electronicAddress	electronicAddress	[0..1]	See B.32	Electronic address associated with the Clearance. This could be the author of the Clearance.
IssuedBySupervisor	OperationsSafetySupervisor	[0..1]	See B.61	Person who issued the Clearance.
IssuedToSupervisor	FieldSafetySupervisor	[0..1]	See B.42	Person that the Clearance was issued to.
ReleasedBySupervisor	FieldSafetySupervisor	[0..1]	See B.42	Person who released the Clearance.
ReleasedToSupervisor	OperationsSafetySupervisor	[0..1]	See B.61	Person that the Clearance was released to.
status	Status	[0..1]	See B.79	Current status of the Clearance. E.g. status.value of 'Not Issued', 'Issued', 'Released'.
mustBeDeenergized	Boolean	[0..1]		Boolean indicating whether the area defined by the Clearance must be de-energized before the Clearance can be issued.

Operations: Clearance				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mustBeGrounded	Boolean	[0..1]		Boolean indicating whether the area defined by the Clearance must be grounded before the Clearance can be issued.
TaggedPSRs	PowerSystemResource	[0..*]	See B.68	List of tagged PowerSystemResources. It is a list of the PowerSystemResources that must have tags placed on them as part of the Clearance. They define the area that is protected by the Clearance, which is bounded by these PowerSystemResources.

B.17 **ConductingEquipment** fragment

The attributes of **ConductingEquipment** that are used in IEC 61968-3 profiles are shown in Table B.17.

Table B.17 – ConductingEquipment payload fragment attributes

Wires: ConductingEquipment				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of ConductingEquipment
description	String	[0..1]		Free-form description of ConductingEquipment
Names	Name	[0..*]	See B.56	Human-readable names for ConductingEquipment
Assets	Asset	[0..*]	See B.9	Assets that are associated with the conducting equipment that can be used to help with its identification and to improve the efficiency of repair efforts.
Feeder	Feeder	[0..1]	See B.41	Feeder that is associated with this ConductingEquipment
Location	Location	[0..1]	See B.52	Location of the equipment
PSRType	PSRType	[0..1]	See B.71	PSRType of the equipment that can be used to classify instances of the same class, e.g. overhead and underground ACLineSegments. This classification mechanism is intended to provide flexibility outside the scope of this standard, i.e. provide customisation that is non standard.
Terminals	Terminal	[0..*]	See B.90	The phase of the equipment that is predicted open is specified by Terminal.phases and is the actual phase predicted open, not the as-built phase.

B.18 **Cut** fragment

A **Cut** separates a line segment into two parts. The cut appears as a switch inserted between these two parts and connects them together. As the cut is normally open there is no galvanic connection between the two line segment parts. But it is possible to close the cut to get galvanic connection.

The cut terminals are oriented towards the line segment terminals with the same sequence number. Hence the cut terminal with sequence number equal to 1 is oriented to the line segment's terminal with sequence number equal to 1.

The cut terminals also act as connection points for jumpers and other equipment, e.g. a mobile generator. To enable this, connectivity nodes are placed at the cut terminals. Once the connectivity nodes are in place any conducting equipment can be connected at them.

The attributes of **Cut** that are used in IEC 61968-3 profiles are shown in Table B.18.

Table B.18 – Cut payload fragment

Wires: Cut				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the cut
description	String	[0..1]		Description of the cut
Names	Name	[0..*]	See B.56	Human-readable names for the cut
lengthFromTerminal1	Length	[0..1]		length from terminal 1 of the ACLineSegment where the cut should be placed
ACLineSegment	ACLineSegment	[0..1]	See B.4	Conductor on which the cut should be placed.
SwitchPhase	SwitchPhase	[0..*]	See B.87	Defines which phases will be cut, the initial state and normal state of the cut. As an example, the normal state of the cut could be open and the initial state could be open if the cut is modelling the temporary removal of jumpers on a pole, or it could be placed in the closed state to model a temporary switch that has been installed for future use.
Terminals	Terminal	[0..*]	See B.90	The two terminals that are associated with the cut being placed or removed.

B.19 ConfigurationEvent fragment

Figure B.3 shows the payload fragment for **ConfigurationEvent**. A **ConfigurationEvent** is used to report details on creation, change or deletion of an entity or its configuration.

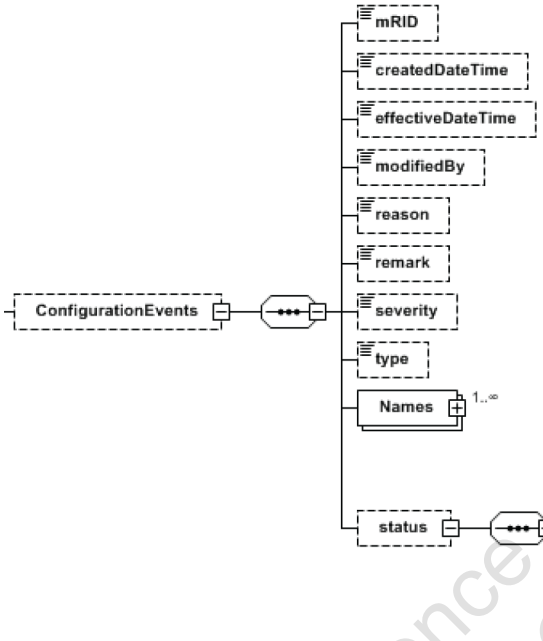


Figure B.4 – ConfigurationEvent payload fragment

The attributes of **ConfigurationEvent** that are used in IEC 61968-3 profiles are shown in Table B.19.

Table B.19 – ConfigurationEvent payload fragment

Common: ConfigurationEvent				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of ConfigurationEvent
createdDateTime	DateTime	[0..1]		Date and time this activity record has been created (different from the 'status.dateTime', which is the time of a status change of the associated object, if applicable).
effectiveDateTime	DateTime	[0..1]		Date and time this event has or will become effective.
modifiedBy	String	[0..1]		Source/initiator of modification.
reason	String	[0..1]		Reason for event resulting in this activity record, typically supplied when user initiated.
remark	String	[0..1]		Free text remarks.
severity	String	[0..1]		Severity level of event resulting in this activity record.
type	String	[0..1]		Type of event resulting in this activity record.
Names	Name	[0..*]	See B.56	Human-readable names for ConfigurationEvent.
status	Status	[0..1]	See B.79	Information on consequence of event resulting in this activity record.

B.20 ConnectivityNode fragment

Connectivity nodes are points where terminals of AC conducting equipment are connected together with zero impedance.

In this document, **ConnectivityNodes** are used to connect temporary equipment to the network during switching operations and unplanned outage restoration.

The attributes of **ConnectivityNode** that are used in IEC 61968-3 profiles are shown in Table B.20.

Table B.20 – ConnectivityNode payload fragment

Core: ConnectivityNode				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	
description	String	[0..1]		
Names	Name	[0..*]	See B.56	

B.21 CoordinateSystem fragment

This class defines the coordinate system that is used by the **PositionPoint** class. Its attributes that are used in IEC 61968-3 profiles are described in Table B.21.

Table B.21 – CoordinateSystem payload fragment

Common: CoordinateSystem				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
crsURN	String	[1..1]		A Uniform Resource Name (URN) for the coordinate reference system (crs) used to define 'Location.PositionPoints'. An example would be the European Petroleum Survey Group (EPSG) code for a coordinate reference system, defined in URN under the Open Geospatial Consortium (OGC) namespace as: urn:ogc:def:crs:EPSG::XXXX, where XXXX is an EPSG code (a full list of codes can be found at the EPSG Registry web site http://www.epsg-registry.org/). To define the coordinate system as being WGS84 (latitude, longitude) using an EPSG OGC, this attribute would be urn:ogc:def:crs:EPSG::4236. A profile should limit this code to a set of allowed URNs agreed to by all sending and receiving parties.

B.22 Crew fragment

Figure B.5 shows the payload fragment for **Crew**. A **Crew** is a group of people with specific skills.

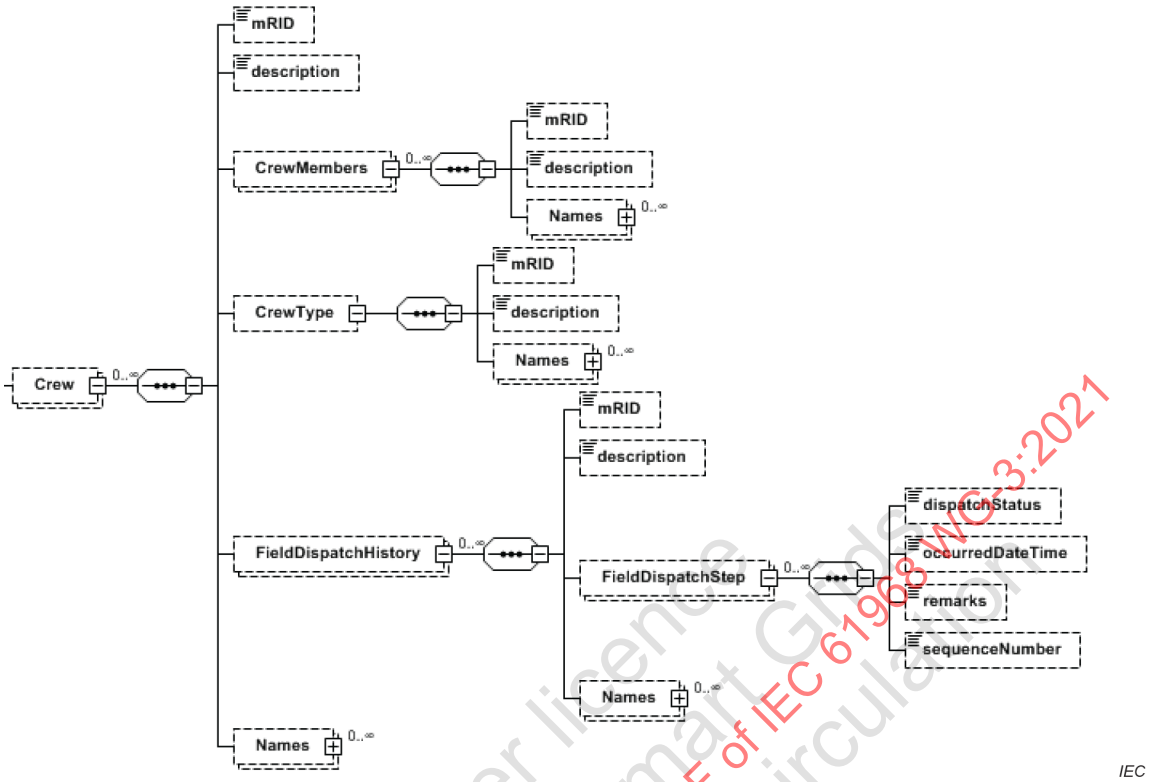


Figure B.5 – Crew payload fragment

The attributes of **Crew** that are used in IEC 61968-3 profiles are shown in Table B.22.

Table B.22 – Crew payload fragment

Common: Crew				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the crew.
description	String	[0..1]		Free-form text description of the crew.
CrewMembers	CrewMember	[0..*]	See B.23	List of people assigned to work on the crew
CrewType	CrewType	[0..1]	See B.24	Defines the skillset of the crew and can be used to determine the best available crew to work on a particular task
FieldDispatchHistory	FieldDispatchHistory	[0..*]	See B.43	Used to track crew events related to an **UnplannedOutage** or a **WorkTask**, for example, and would typically be filled out as the field worker works through the steps in the lifecycle of the task such as when a crew was dispatched, enroute, arrived, etc. Each time a new activity is performed, a new **FieldDispatchStep** is added to the history. The **FieldDispatchHistory** applies to the current **UnplannedOutage** or **WorkTask** that the **Crew** is assigned to, not the entire dispatch history for the **Crew**.
Names	Name	[0..*]	See B.56	List of human-readable names for the crew.

B.23 **CrewMember** fragment

A **CrewMember** is member of a Crew.

The attributes of **CrewMember** that are used in IEC 61968-3 profiles are shown in Table B.23.

Table B.23 – CrewMember payload fragment

Common: CrewMember				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of CrewMember.
description	String	[0..1]		Free-form description of CrewMember.
Names	Name	[0..*]	See B.56	Human-readable names for CrewMember.

B.24 **CrewType** fragment

Figure B.5 shows the payload fragment for **CrewType**. A **CrewType** is a custom description of the type of crew. This may be used to determine the type of work the crew can be assigned to. Examples include repair, tree trimming, switching, etc. In this document this is is used to specify the skill set need to perform various tasks, such as investigating an **UnplannedOutage** or executing a **SwitchingPlan**.

The attributes of **CrewType** that are used in IEC 61968-3 profiles are shown in Table B.24.

Table B.24 – CrewType payload fragment

Common: CrewType				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of CrewType.
description	String	[0..1]		Free-form description of CrewType.
Names	Name	[0..*]	See B.56	Human-readable names for CrewType.

B.25 **Customer** fragment

Important information for **Customer** includes **locale**, which determines the language spoken by the customer for notifications, for example, and **specialNeed**, such as life support, hospital, jail, etc. The customer contact information is part of the **Organisation** fragment (see B.62).

Note that the payload can be exchanged either with the requisite fields completed, or by using the **mRID** in conjuction with a previously exchanged **CustomerConfig** message with the same **mRID** (see Clause D.2).

The attributes of **Customer** that are used in IEC 61968-3 profiles are shown in Table B.25 and Figure B.6

Table B.25 – Customer payload fragment

Customers: Customer				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID for the customer
description	String	[0..1]		Free-form description of the customer.
Names	Name	[0..*]	See B.56	Human-readable names for the Customer.
kind	CustomerKind	[0..1]	See C.7	Defines the kind of customer, such as residential, commercial, etc.
locale	String	[0..1]		Locale designating language to use in communications with this customer.
specialNeed	String	[0..1]		True if customer organisation has special service needs such as life support, hospitals, etc.
Organisation	Organisation	[0..1]	See B.62	Used to define customer contact information.

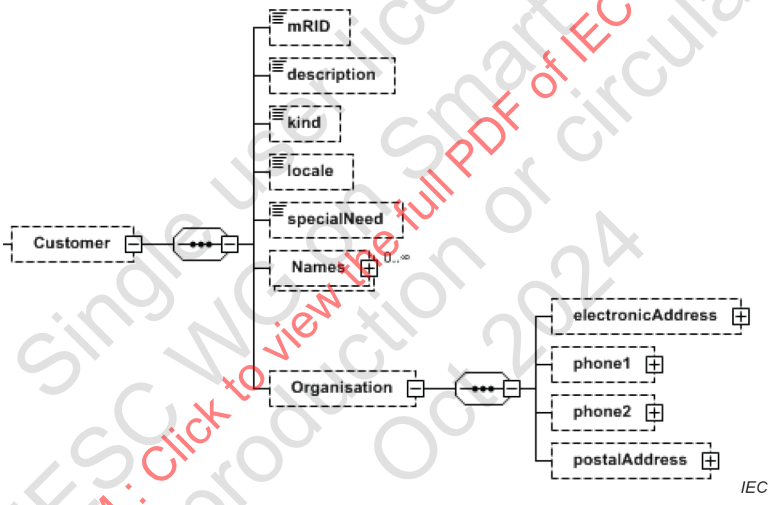


Figure B.6 – Customer payload fragment

B.26 CustomerAgreement fragment

Figure B.7 shows the payload fragment for **CustomerAgreement.** In the context of this document this is used to convey customer information in payloads such as the **TroubleTicket** part of the **TroubleOrder** message and in the **DeEnergizedUsagePoints** part of the **UnplannedOutages** message.

Note that the payload can be exchanged either with the requisite fields completed, or by using the **mRID** in conjuction with a previously exchanged **CustomerAgreementConfig** message with the same **mRID** (see Clause D.1).

The attributes of **CustomerAgreement** that are used in IEC 61968-3 profiles are shown in Table B.26.

Table B.26 – CustomerAgreement payload fragment

Customers: CustomerAgreement				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of CustomerAgreement.
description	String	[0..1]		Free-form description of CustomerAgreement.
Names	Name	[0..*]	See B.56	Human-readable names for CustomerAgreement.
Customer	Customer	[0..1]	See B.25	

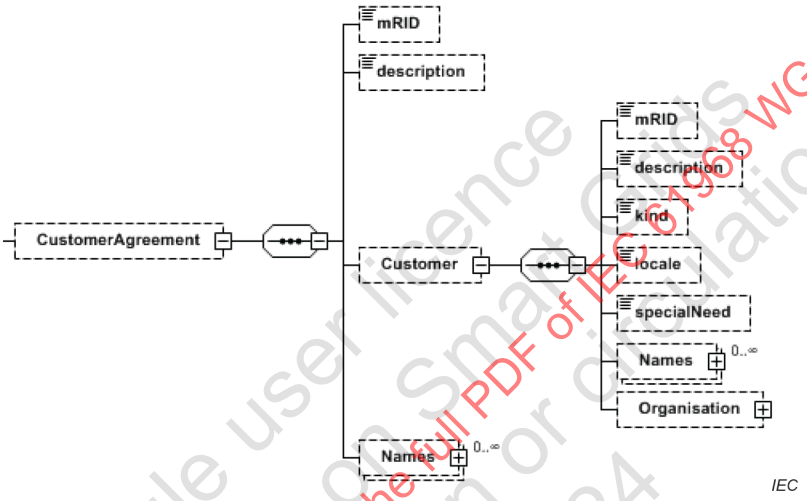


Figure B.7 – CustomerAgreement payload fragment

B.27 DeEnergizedUsagePoint fragment

Figure B.8 shows the payload fragment for **DeEnergizedUsagePoint**. A **DeEnergizedUsagePoint** is a **UsagePoint** at a **UsagePointLocation** that has been de-energized as a result of an **UnplannedOutage**. The **EnergizedUsagePoint** payload fragment has the same structure.

The **UsagePoint** payload is described in B.97.The payload also includes a list of **EndDevices**, which are used to convey the meter numbers impacted by the outage.

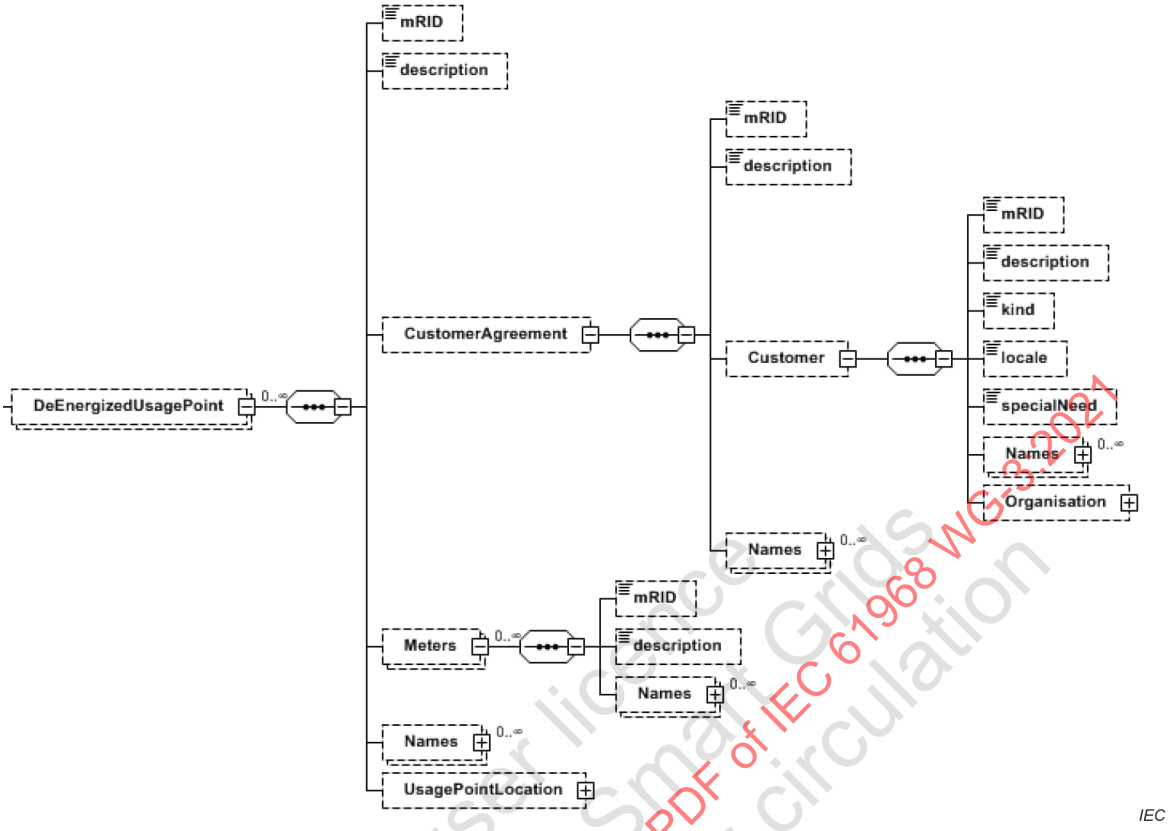


Figure B.8 – DeEnergizedUsagePoint payload fragment

B.28 Discrete fragment

The attributes of **Discrete** that are used in IEC 61968-3 profiles are shown in Table B.27.

Table B.27 – Discrete payload fragment

Meas: Discrete				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
maxValue	Integer	[0..1]		Normal value range maximum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values.
measurementType	String	[0..1]		Specifies the type of measurement. For example, this specifies if the measurement represents an indoor temperature, outdoor temperature, bus voltage, line flow, etc. When the measurementType is set to "Specialization", the type of Measurement is defined in more detail by the specialized class which inherits from Measurement.
minValue	Integer	[0..1]		Normal value range minimum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values.
normalValue	Integer	[0..1]		Normal value range minimum for any of the MeasurementValue.values. Used for scaling, e.g. in bar graphs or of telemetered raw values.
phases	PhaseCode	[0..1]	See C.12	Indicates to which phases the measurement applies and avoids the need to use 'measurementType' to also encode phase information (which would explode the types). The phase information in Measurement, along with 'measurementType' and 'phases' uniquely defines a Measurement for a device, based on normal network phase. Their meaning will not change when the computed energizing phasing is changed due to jumpers or other reasons. If the attribute is missing three phases (ABC) shall be assumed.
unitMultiplier	UnitMultiplier	[0..1]		The unit multiplier of the measured quantity.
unitSymbol	UnitSymbol	[0..1]		The unit of measure of the measured quantity.
DiscreteValues	DiscreteValue	[0..*]	See B.29	
PowerSystemResource	PowerSystemResource	[0..1]	See B.68	

B.29 **DiscreteValue** fragment

The attributes of **DiscreteValue** that are used in IEC 61968-3 profiles are shown in Table B.28.

Table B.28 – DiscreteValue payload fragment

Meas: DiscreteValue				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	
description	String	[0..1]		
Names	Name	[0..*]	See B.56	
sensorAccuracy	PerCent	[0..1]		The limit, expressed as a percentage of the sensor maximum, that errors will not exceed when the sensor is used under reference conditions.
timestamp	DateTime	[0..1]		The time when the value was last updated
value	Integer	[0..1]		The value to supervise.
MeasurementValueQuality	MeasurementValueQuality	[0..1]	See B.53	Measurement quality flags. Bits 0-10 are defined for substation automation in draft IEC 61850 part 7-3. Bits 11-15 are reserved for future expansion by that document. Bits 16-31 are reserved for EMS applications.
MeasurementValueSource	MeasurementValueSource	[0..1]	See B.55	MeasurementValueSource describes the alternative sources updating a MeasurementValue. User conventions for how to use the MeasurementValueSource attributes are described in the introduction to IEC 61970-301.

B.30 **DuctBank** fragment

A **DuctBank** contains individual wires in the layout as specified with associated wire spacing instances; number of them gives the number of conductors in this duct. **DuctBank** inherits from **AssetContainer**, which in itself is an **Asset**.

The attributes of **DuctBank** that are used in IEC 61968-3 profiles are shown in Table B.14.

Table B.29 – DuctBank payload fragment

Assets: DuctBank				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the Cabinet
description	String	[0..1]		Free form description
Names	Name	[0..*]	See B.56	Human-readable names for the Cabinet.
circuitCount	Integer	[0..1]		Number of circuits in duct bank. Refer to associations between a duct (ConductorAsset) and an ACLineSegment to understand which circuits are in which ducts.
kind	AssetKind	[0..1]	See C.1	Kind of asset. Used in description of asset components in asset instance templates.
serialNumber	String	[0..1]		Serial number of this asset.
type	String	[0..1]		Utility-specific classification of Asset and its subtypes, according to their corporate standards, practices, and existing IT systems (e.g., for management of assets, maintenance, work, outage, customers, etc.).
utcNumber	String	[0..1]		Uniquely tracked commodity (UTC) number. This could a bar code on an asset, for example.
Location	Location	[0..1]	See B.52	
WireSpacingInfos	WireSpacing	[0..*]	See B.99	

B.31 Editor fragment

Figure B.9 shows the payload fragment for an **Editor**. An **Editor** is a person who makes changes to an activity record or a document such as a **SwitchingPlan** or **TroubleTicket.** Either the **person** class can be used to specify individual parts of the person's name, or the **Name** class can be used to specify the names in a different format, e.g. employee ID.

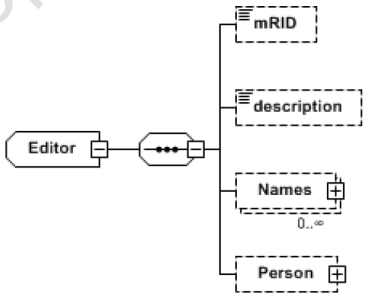


Figure B.9 – Editor payload fragment

The attributes of **Editor** that are used in IEC 61968-3 profiles are shown in Table B.30.

Table B.30 – Editor payload fragment

Common: Editor				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of Editor.
description	String	[0..1]		Free-form description of Editor.
Names	Name	[0..*]	See B.56	Human-readable names for Editor.
Person	Person	[0..1]	See B.65	General purpose information for name and other information to contact people.

B.32 ElectronicAddress fragment

Figure B.10 shows the payload fragment for **ElectronicAddress**. An **ElectronicAddress** defines email and other means of communication with a person or organization. It is also used to identify hardware addresses for assets such as intelligent electronic devices.

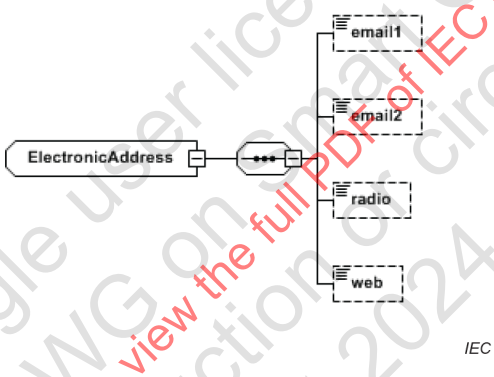


Figure B.10 – ElectronicAddress payload fragment

The attributes of **ElectronicAddress** that are used in IEC 61968-3 payload fragments are shown in Table B.31.

Table B.31 – ElectronicAddress payload fragment

Common: ElectronicAddress					
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**	**Used in Profile**
email1	String	[0..1]		Primary email address	All
email2	String	[0..1]		Alternative email address	All
radio	String	[0..1]		Radio ID for crew	All
web	String	[0..1]		Web address for an organization; could also be social media address for an organisation.	All
lan	String	[0..1]		Address on local area network.	AssetConfig
mac	String	[0..1]		MAC (Media Access Control) address.	AssetConfig
userID	String	[0..1]		User ID needed to log in, which can be for an individual person, an organisation, a location, etc.	AssetConfig
password	String	[0..1]		Password needed to log in.	AssetConfig

B.33 **EndDevice** fragment

An **EndDevice** is an asset container that performs one or more end device functions. One type of end device is a meter which can perform metering, load management, connect/disconnect, accounting functions, etc. Some end devices, such as ones monitoring and controlling air conditioners, refrigerators, pool pumps may be connected to a meter. All end devices may have communication capability defined by the associated communication function(s). An end device may be owned by a consumer, a service provider, utility or otherwise.

There may be a related end device function that identifies a sensor or control point within a metering application or communications systems (e.g., water, gas, electricity).

Some devices may use an optical port that conforms to the ANSI C12.18 standard for communications.

The attributes of **EndDevice** that are used in IEC 61968-3 payload fragments are shown in Table B.32.

Table B.32 – EndDevice payload fragment

Metering: EndDevice				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the EndDevice
Description	String	[0..1]		Free-form text description of the EndDevice
Names	Name	[0..*]	See B.56	Human-readable names for the EndDevice

B.34 **EnergyConsumer** fragment

An **EnergyConsumer** is a Generic user of energy – a point of consumption on the power system model.

The attributes of **EnergyConsumer** that are used in IEC 61968-3 profiles are shown in Table B.33 and graphically in Figure B.11.

Table B.33 – EnergyConsumer payload fragment

Wires: EnergyConsumer				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the EnergyConsumer
description	String	[0..1]		Free form description of EnergyConsumer
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the EnergyConsumer.
Assets	Asset	[0..1]	See B.9	Assets associated with the EnergyConsumer, identified by its mRID, description and Names
Location	Location	[0..1]	See B.52	Geographic location of EnergyConsumer

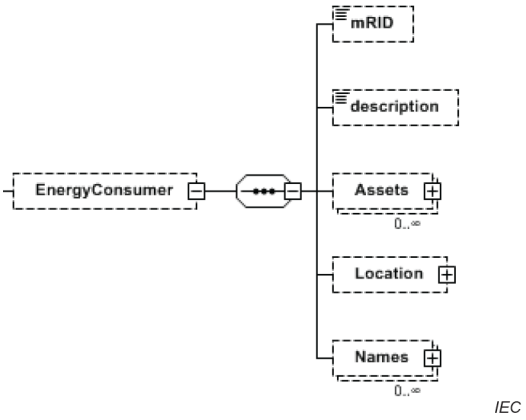


Figure B.11 – EnergyConsumer payload fragment

B.35 EnergySource fragment

An **EnergySource** is a generic equivalent for an energy supplier on a transmission or distribution voltage level. In the context of switching, it is a temporary means to energize the network, such as a temporary generator or a mobile transformer.

The attributes of **EnergySource** that are used in IEC 61968-3 profiles are shown in Table B.34 and graphically in Figure B.12.

Table B.34 – EnergySource payload fragment

Wires: EnergySource				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the EnergySource
description	String	[0..1]		Free form description of EnergySource
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the EnergySource.
activePower	ActivePower	[0..1]		High voltage source active injection. Load sign convention is used, i.e. positive sign means flow out from a node. Starting value for steady state solutions.
nominalVoltage	Voltage	[0..1]		Phase-to-phase nominal voltage.
pMax	ActivePower	[0..1]		This is the maximum active power that can be produced by the source. Load sign convention is used, i.e. positive sign means flow out from a TopologicalNode (bus) into the conducting equipment.
pMin	ActivePower	[0..1]		This is the minimum active power that can be produced by the source. Load sign convention is used, i.e. positive sign means flow out from a TopologicalNode (bus) into the conducting equipment.
r	Resistance	[0..1]		Positive sequence Thevenin resistance.
r0	Resistance	[0..1]		Zero sequence Thevenin resistance.
reactivePower	ReactivePower	[0..1]		High voltage source reactive injection. Load sign convention is used, i.e. positive sign means flow out from a node. Starting value for steady state solutions.
rn	Resistance	[0..1]		Negative sequence Thevenin resistance.

Wires: EnergySource				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
voltageAngle	AngleRadians	[0..1]		Phase angle of a-phase open circuit used when voltage characteristics need to be imposed at the node associated with the terminal of the energy source, such as when voltages and angles from the transmission level are used as input to the distribution network. The attribute shall be a positive value or zero.
voltageMagnitude	Voltage	[0..1]		Phase-to-phase open circuit voltage magnitude used when voltage characteristics need to be imposed at the node associated with the terminal of the energy source, such as when voltages and angles from the transmission level are used as input to the distribution network. The attribute shall be a positive value or zero.
x	Reactance	[0..1]		Positive sequence Thevenin reactance.
x0	Reactance	[0..1]		Zero sequence Thevenin reactance.
xn	Reactance	[0..1]		Negative sequence Thevenin reactance.
Assets	Asset	[0..1]	See B.9	Assets associated with the EnergySource, identified by its mRID, description and Names
Location	Location	[0..1]	See B.52	Geographic Location of where EnergySource is to be placed or removed.
Terminals	Terminal	[0..*]	See B.90	Terminal where the EnergySource is to be placed or removed on the network.

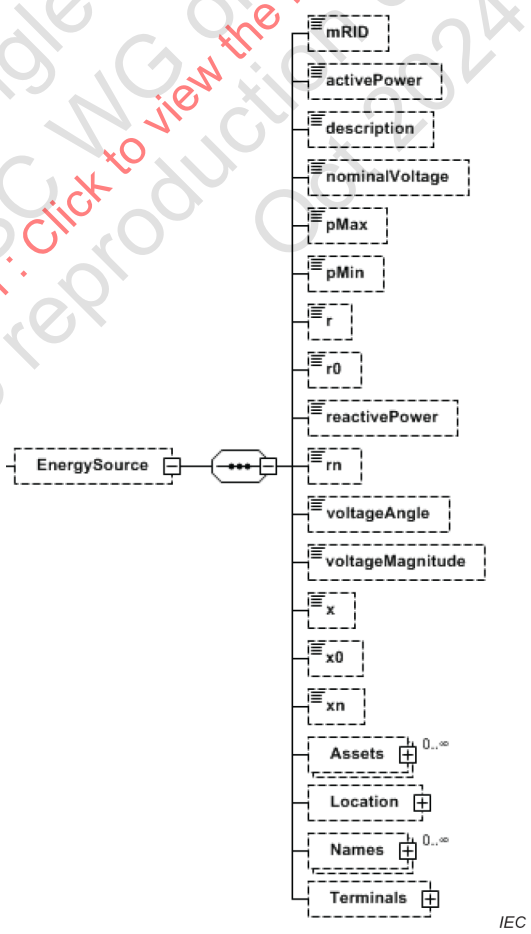


Figure B.12 – EnergySource payload fragment

B.36 **EnergizedUsagePoint** fragment

Figure B.13 shows the payload fragment for **EnergizedUsagePoint**. An **EnergizedUsagePoint** is a **UsagePoint** that has been energized as a result of an **UnplannedOutage** being restored.

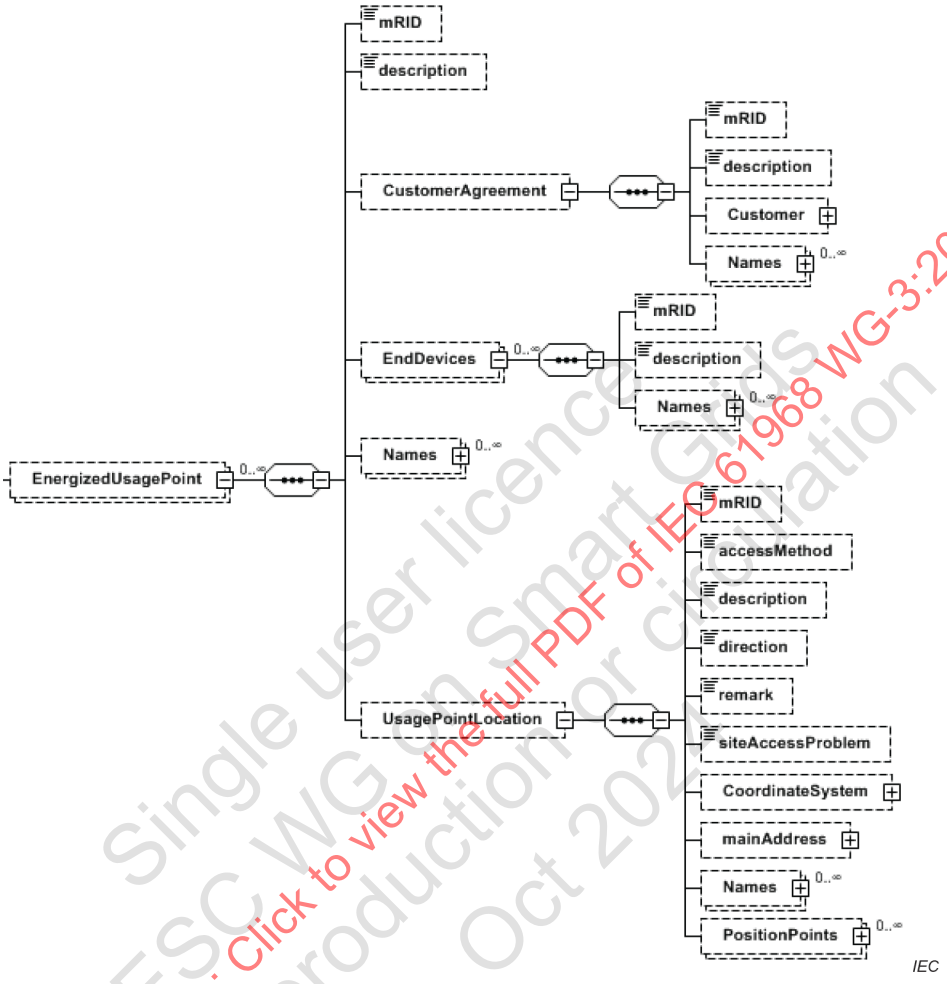


Figure B.13 – EnergizedUsagePoint payload fragment

The payload fragment has the same structure as the **DeEnergizedUsagePoint** payload fragment, but it is a list of **UsagePoints** that are now energized but were previously de-energized. It could be used to identify those **UsagePoints** that have been abnormally fed from an alternative feeder in order to partially restore the outage, for example.

The details of the UsagePoint fragment are described in B.97.

B.37 **Equipment** fragment

An **Equipment** is defined as the parts of a power system that are physical devices, electronic or mechanical.

The attributes of **Equipment** that are used in IEC 61968-3 profiles are shown in Table B.35

Table B.35 – Equipment payload fragment

Core: Equipment				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the Equipment
description	String	[0..1]		Free form description of Equipment
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the Equipment.
Assets	Asset	[0..1]	See B.9	Asset associated with the Equipment, identified by its mRID, description and Names
Location	Location	[0..1]	See B.52	Geographic location of the Equipment.

B.38 EstimatedRestorationTime fragment

The attributes for **EstimatedRestorationTime** that are used in IEC 61968-3 profiles are shown in Table B.36**.**

Table B.36 – EstimatedRestorationTime payload fragment

Operations: EstimatedRestorationTime				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
ertSource	String	[0..1]		Defines the source that provided the ERT value.
etr	DateTime	[0..1]		Estimated time the outage will be restored
confidenceKind	ertConfidenceKind	[0..1]	See C.8	The estimated time of restoration can have a confidence factor applied such as high or low confidence that the ERT will be accomplished. This confidence factor may be updated as needed during the outage period – just as the actual ERT can be updated.

B.39 FaultImpedance fragment

FaultImpedance is defined as the impedance description for the fault.

The attributes of **FaultImpedance** that are used in IEC 61968-3 profiles are shown in Table B.37.

Table B.37 – FaultImpedance payload fragment

Fault: FaultImpedance				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
rGround		[0..1]	Resistance	The resistance of the fault between phases and ground.
rLineToLine		[0..1]	Resistance	The resistance of the fault between phases.
xGround		[0..*]	Reactance	The reactance of the fault between phases and ground.
xLineToLine		[0..1]	Reactance	The reactance of the fault between phases.

B.40 **FaultCauseTypes** fragment

FaultCauseTypes is defined as the type of cause of the fault.

The attributes of **FaultCauseTypes** that are used in IEC 61968-3 profiles are shown in Table B.38.

Table B.38 – FaultCodeTypes payload fragment

Fault: FaultCauseTypes				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the FaultCauseType
description	String	[0..1]		Free-form description of FaultCauseType
Names	Name	[0..*]	See B.56	Human-readable names for FaultCauseType

B.41 **Feeder** fragment

A **Feeder** is a collection of equipment for organizational purposes, used for grouping distribution resources.

The organization of a feeder does not necessarily reflect connectivity or current operation state.

The attributes of **Feeder** that are used in IEC 61968-3 profiles are shown in Table B.39.

Table B.39 – Feeder payload fragment

Core: Feeder				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the Feeder
description	String	[0..1]		Free form description of Feeder
Names	Name	[0..*]	See B.56	Human-readable list of names associated with the Feeder.
Substation	Substation	[0..1]	See B.85	Substation associated with the Feeder, identified by its mRID, description and Names

B.42 **FieldSafetySupervisor** fragment

A **FieldSafetySupervisor** is a crew member on a work site responsible for all local safety measures for the work crew doing maintenance, construction and repair in a substation or on a power line/cable. Figure B.14 shows the payload fragment for a **FieldSafetySupervisor**.

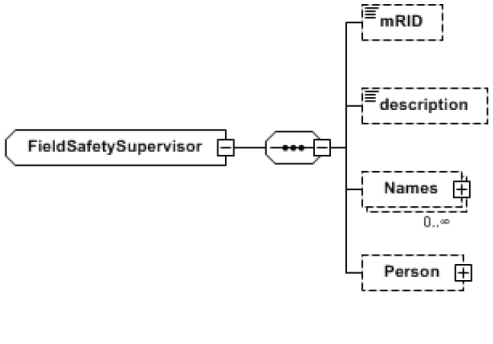


Figure B.14 – FieldSafetySupervisor payload fragment

The attributes of **FieldSafetySupervisor** that are used in IEC 61968-3 profiles are shown in Table B.40.

Table B.40 – FieldSafetySupervisor payload fragment

Common: FieldSafetySupervisor				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the FieldSafetySupervisor
description	String	[0..1]		Free-form description of FieldSafetySupervisor
Names	Name	[0..*]	See B.56	Human-readable names for FieldSafetySupervisor
Person	Person	[0..1]	See B.65	General purpose information for name and other information to contact people.

B.43 FieldDispatchHistory fragment

Figure B.15 shows the payload fragment for a **FieldDispatchHistory**. A **FieldDispatchHistory** is the history of field dispatch statuses for this work. It consists of zero or more **FieldDispatchSteps**.

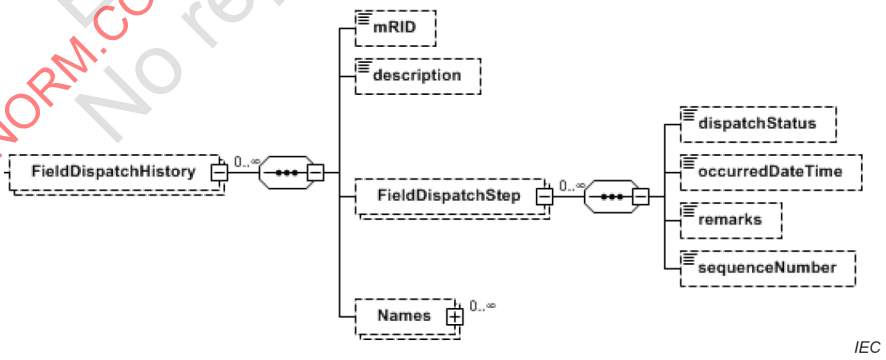


Figure B.15 – FieldDispatchHistory payload fragment

The attributes of **FieldDispatchHistory** that are used in IEC 61968-3 profiles are shown in Table B.41.

Table B.41 – FieldDispatchHistory payload fragment

Common: FieldDispatchHistory				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the FieldDispatchHistory
description	String	[0..1]		Free-form description of FieldDispatchHistory
Names	Name	[0..*]	See B.56	Human-readable names for FieldDispatchHistory
FieldDispatchStep	FieldDispatchStep	[0..*]	See B.44	

B.44 Ground fragment

A **Ground** is a point where the system is grounded used for connecting conducting equipment to ground. The power system model can have any number of **Ground**s.

The attributes of **Ground** that are used in IEC 61968-3 profiles are shown in Table B.42.

Table B.42 – Ground payload fragment

Wires: Ground				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of the Ground
description	String	[0..1]		Free-form description of the Ground
Names	Name	[0..*]	See B.56	List of Names of the Ground
Terminals	Terminal	[0..1]	See B.90	Single terminal that is used to attach the Ground to the component to be grounded

B.45 FieldDispatchStep fragment

The attributes of **FieldDispatchStep** that are used in IEC 61968-3 profiles are shown in Table B.43.

Table B.43 – FieldDispatchStep payload fragment

Common: FieldDispatchStep				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
dispatchStatus	CrewStatusKind	[0..1]	See C.1	Whether the crew is enroute, arrived, etc.
occurredTimeDate	DateTime	[0..1]		The date and time at which the dispatch status occurred.
remarks	String	[0..1]		Free form comments related to the dispatch to perform field work.
sequenceNumber	Integer	[0..1]		The sequence number of the field dispatch step within the field dispatch history. Begins with 1 and increments up.

B.46 **Hazard** fragment

Figure B.16 shows the payload fragment for **Hazard**. A **Hazard** represents a hazardous condition in the field, such as a wire down or a transformer fire. It can be made safe by changing its status. A **Hazard** can be associated with a **TroubleTicket** or an **Incident**. For futher details of **Hazard**, please see IEC 61968-8.

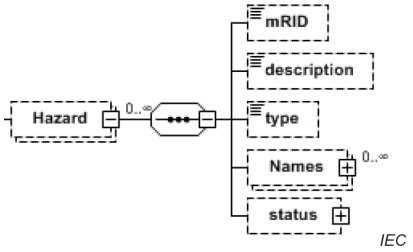


Figure B.16 – Hazard payload fragment

This class defines a hazardous situation associated with an incident. Examples are line down, gas leak, fire, etc. The class itself is part of the Customer package but the payload is defined here because it is used in Network Operations profiles.

The attributes for **Hazard** that are used in IEC 61968-3 profiles are shown in Table B.44.

Table B.44 – Hazard payload fragment

Common: Hazard				
Attribute	**Data type**	**Cardinality**	**Comments**	**Description**
mRID	String	[0..1]	GUID	mRID of Hazard
description	String	[0..1]		Free-form description of Hazard
Names	Name	[0..*]	See B.56	Human-readable names for Hazard
type	String	[0..1]		Type of tHazard
status	Status	[0..1]	See B.79	Status.value has values of ‘Open’, ‘Closed’ to indicate the status of the Incident.

B.47 **Issuer** fragment

Figure B.17 shows the payload fragment for an **Issuer**. An **Issuer** is a person who performs the role of issuing an order to a work management system, such as a **SwitchingOrder**, **OutageOrder** or **TroubleOrder**. Either the **person** class can be used to specify individual parts of the person’s name, or the **Name** class can be used to specify the names in a different format, e.g. employee ID.