

TECHNICAL REPORT



Power systems management and associated information exchange – Part 2: Use cases and role models



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TECHNICAL REPORT



Power systems management and associated information exchange – Part 2: Use cases and role models

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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AND ASSOCIATED INFORMATION EXCHANGE –****Part 2: Use cases and role models****FOREWORD**

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IEC 62357-2, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this Technical Report is based on the following documents:

DTR	Report on voting
57/2042/DTR	57/2066/RVDTR

Full information on the voting for the approval of this Technical Report 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.

A list of all parts in the IEC 62357 series, published under the general title *Power systems management and associated information exchange*, 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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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

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INTRODUCTION

The IEC is in an operational implementation phase of the System approach of standardization. Technical Committee 57 (TC 57) has a crucial role in helping other Application Domain TCs extending their core standards (i.e. CIM standards/IEC 61850/IEC 62746/IEC 62351) to their specific domains. This should ensure efficient and secured power network management.

In the system approach working process, it is important for TC 57 to be able to consolidate, share and explain the numerous Use Cases serving as basis for its standardization work. These Use Cases are an excellent tool for design and implementation of new processes, also for external organisations (SDOs, User Groups, Alliances etc.)

The mission of this Technical Report is to list the Use Cases featured in the TC 57 standardization work, thus making them available for re-use in on-going and future work. Hopefully this will also promote Use Cases as a good tool for further work.

The intended audience for the document is the experts of TC 57 for their standardization work or experts of other Application Domain TCs for on-going standardization work, independently from TC 57 or through Joint Working Groups (JWG) or Task Forces (TF), as well as roadmaps and strategic vision through Ad-hoc Groups, Strategic Groups, System Evaluation Groups or System Committees.

This document structures and consolidates the TC 57 Use Cases (Status, WG and documents linked, roles used, roadmap) to facilitate their use and re-use. It will list the following elements:

- Existing Use Cases used to develop standards and their links with source documents, the IEC Status of this source document, a short Use Case description, its compliance to IEC 62559-2
- A roadmap: planned or drafted Use Cases (in on-going standardization work and PWI)
- Roles used in those Use Cases
- Terminology used in standardization work and not present in existing standards

This Technical report is split by active Working Group (WG) of TC 57

- WG 10 Power system IED communication and associated data models
- WG 13 Energy Management Systems Application Program Interfaces (EMS API)"
- WG 14 System interfaces for distribution management
- WG 15 Data and Communication Security
- WG 16 Deregulated Market Communications
- WG 17 Power system intelligent electronic device communication and associated data models for distributed energy resources and distribution automation
- WG 18 Hydroelectric power plants – Communication for monitoring and control
- WG 19 Interoperability within TC 57 in the long term
- WG21 Interfaces and protocol profiles relevant to systems connected to the electrical grid

POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE –

Part 2: Use cases and role models

1 Scope

This part of IEC 62357, which is a technical report, establishes the list of Use Cases developed by TC 57, Power systems management and associated information exchanges, in order to prepare International Standards, Technical Reports and Technical Specifications.

Use Cases are fundamental to TC 57 publications, as shown in Figure 1.

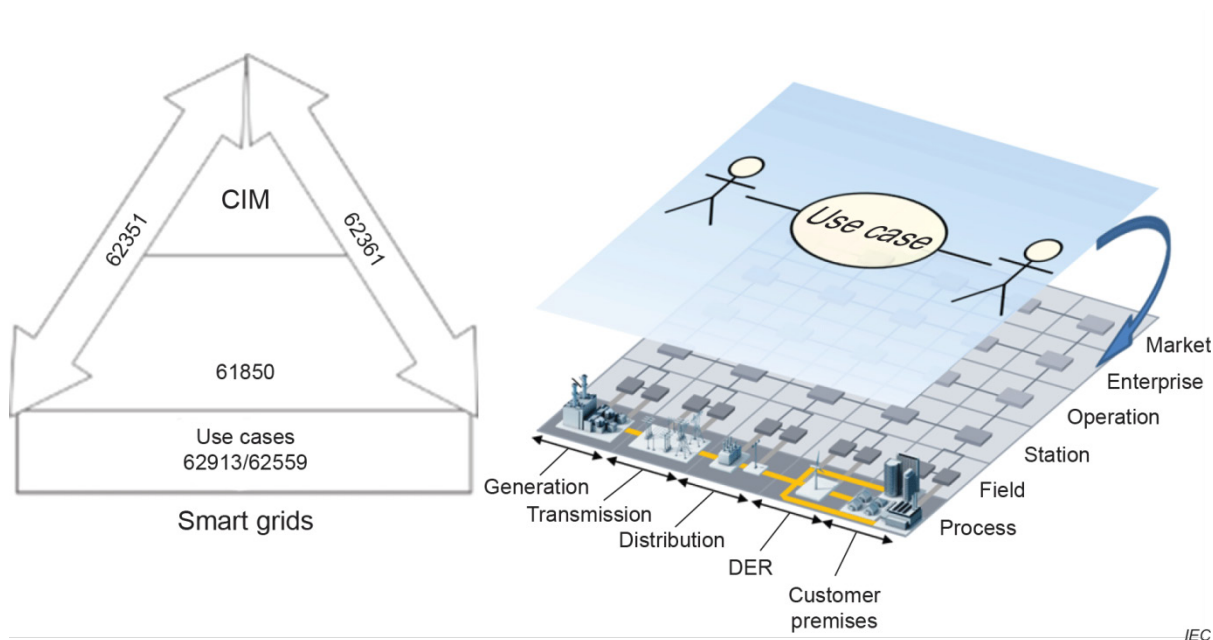


Figure 1 – TC 57 core standards

The Use Case creation process is shown in Figures 2, 3 and 4.

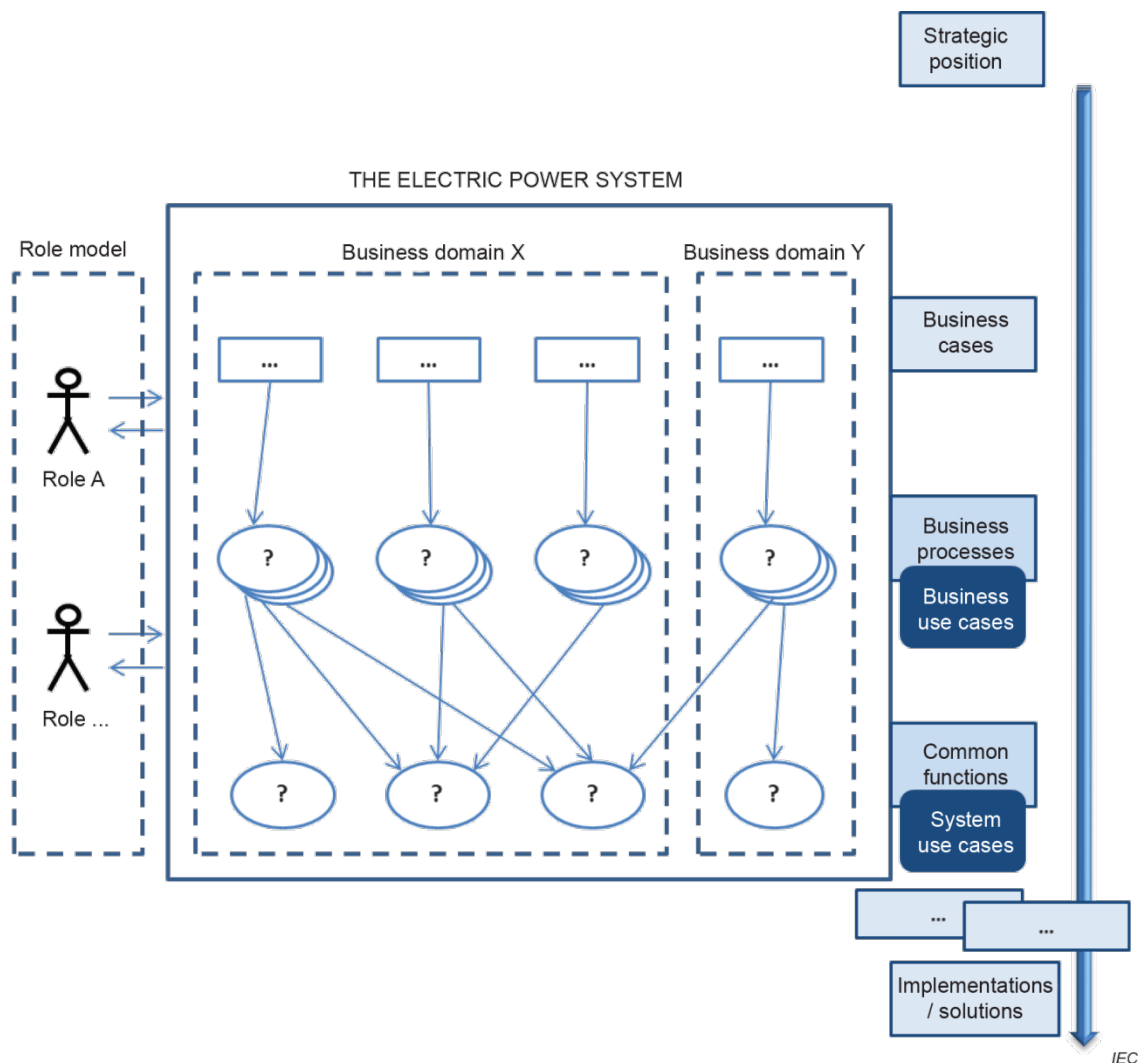


Figure 2 – UML-driven top/down approach supporting IEC 62559 and IEC 62913

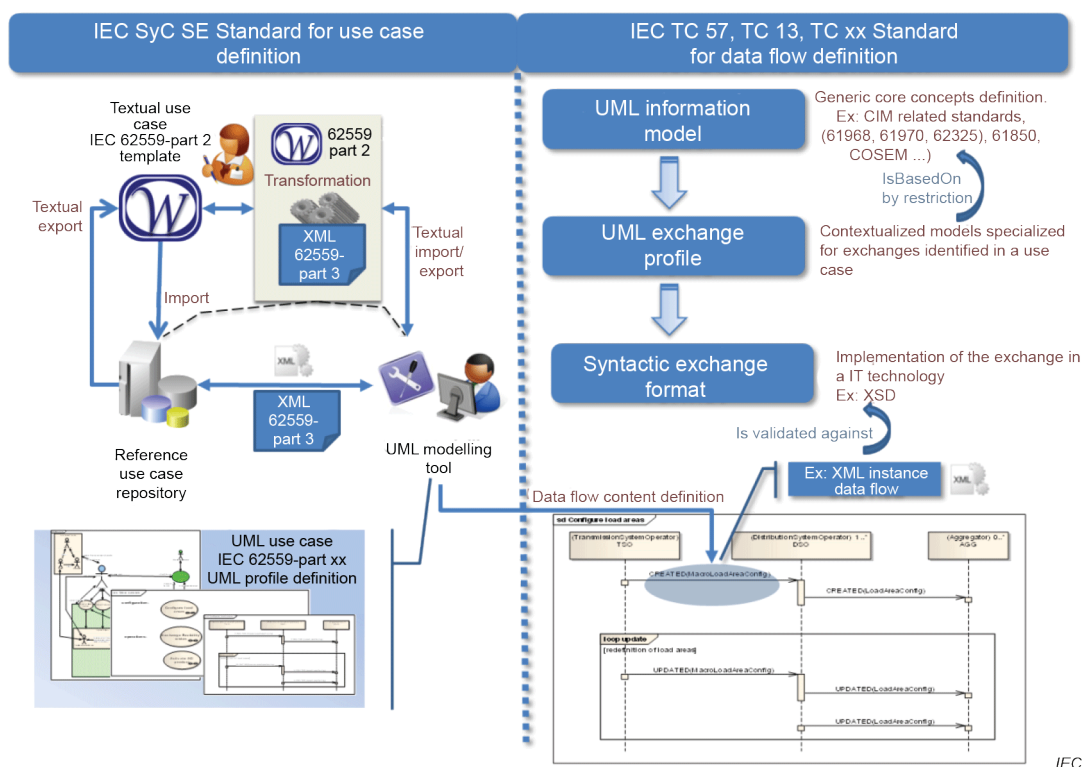


Figure 3 – Use Case design process

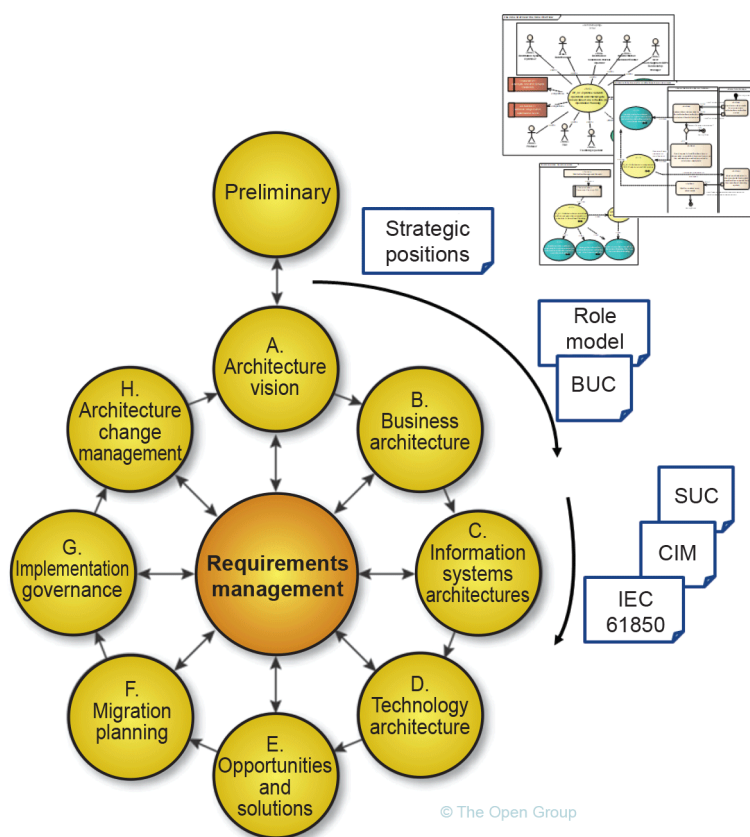


Figure 4 – Enterprise architecture and IEC core standards relationships

This Technical Report:

- Identifies in existing standards, technical specification, reports and in ongoing TC 57 work (CD, DTS, DTR etc.) the Use Cases used as well as their links to standards, their status as Use Cases (level of description, standardization of the description referring to IEC 62559) and as IEC deliverables (are they in a TR/TS/IS, what is the status of the document CD, CDV etc.)
- Helps System Committees consolidate Use Cases through terminology and term definition work (link with existing relevant standards on the TC Terminology) and building links between roles and modelling frameworks (Role models). For example in TC 57 building links between the Use Case methodology and the roles used in IEC 62913-2 with CIM Interface Reference Model (IRM – IEC 61968).
- Shares and promotes those Use Cases within TC 57 and outside it. TC 57 mainly describes System Use Cases in the standards it publishes. Business roles and business Use Cases are mainly described within SyC SE (System Committee Smart Energy) deliverables (IEC 62559 series and IEC 62913 series).
- This document provides good input in reusing System Use Cases and System Roles inside and outside TC 57.
- Explains the content of its Use Cases to potential users and providing support on using those Use Cases for standardization (Normative context, maturity of the Use Case, location in standardization work, roles implied)

Those Use Cases aimed to be used as tools to identify requirements as input to further development of technical standards (whether TC 57 or not) and improve the consistency in this work and in that way contribute to interoperability. Use Cases facilitate cooperation at a system level with TCs, other standards-developing organizations, non-traditional players of electrotechnology, and regional organizations. Inside the IEC they provide a convergence platform with overall system level value for support of the Technical Committees and other standard development groups.

This document allows TC 57 to self-assess its work on Use Cases through KPIs (Key Performance Indicator) such as:

- % of Use Cases compliant with IEC 62559-2
- % of Business Use Cases (BUC) and System Use Cases (SUC)
- % of Business Roles and System Roles
- % of non-defined roles

Another objective of this document is to fill up the TC 57 Use Case Repository, as shown in Figure 5.

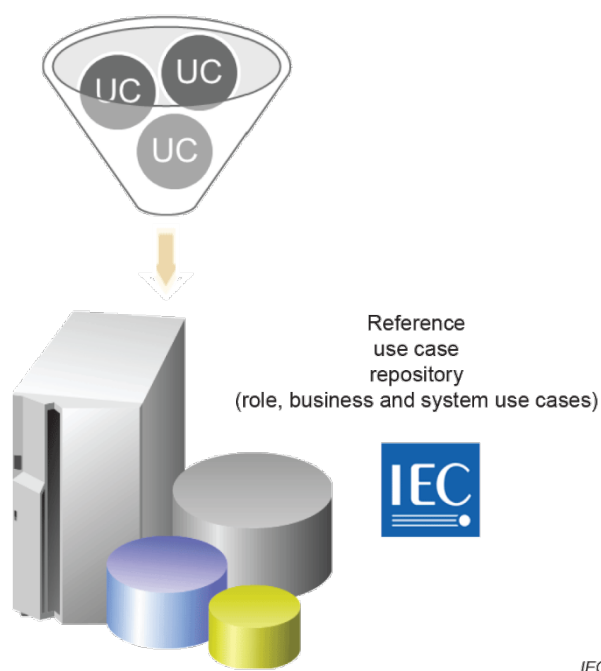


Figure 5 – Use Case Repository

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 60870-5, *Telecontrol equipment and systems – Part 5: Transmission protocols*

IEC 60870-6, *Telecontrol equipment and systems – Part 6: Telecontrol protocols compatible with ISO standards and ITU-T recommendations*

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

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

IEC 61970 (all parts), *Energy management system application program interface (EMS-API)*

IEC 62351 (all parts), *Power systems management and associated information exchange – Data and communications security*

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

IEC 62361 (all parts), *Power systems management and associated information exchange – Interoperability in the long term*

IEC 62559-2:2015, *Use case methodology - Part 2: Definition of the templates for use cases, actor list and requirements list*

IEC 62746 (all parts), *Systems interface between customer energy management system and the power management system*

IEC TS 62913-1, *Generic Smart Grid Requirements – Specific application of the Use Case methodology for defining Generic Smart Grid Requirements according to the IEC System approach*¹

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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>

3.1

actor

entity that communicates and interacts

Note 1 to entry: These actors can include people, software applications, systems, databases, and even the power system itself.

Note 2 to entry: In IEC TS 62913-1 this term includes the concepts of Business Role and System Role involved in Use Cases.

[SOURCE: IEC 62559-2:2015]

3.2

business role

role describing a finite set of responsibilities that is assumed by a party (organizations, organizational entities or physical persons)

3.3

levels of maturity

set of structured levels that describe how well a process, or Use Case, is implemented through an organization and relates to its degree of formality, optimization and reliability

Note 1 to entry: Proposed levels of maturity:

- Level "Already implemented": the process is implemented in and between several organizations, it is well defined, reliable, sustainable and few uncertainties remain in its framework (regulatory, business or technological).
- Level "Adjustments in progress": the process is implemented in few organizations, it is well defined but subject to remaining major uncertainties in its framework (regulatory, business or technological).
- Level "Explorative": the process is tested in very few organizations, it is not completely defined and subject to numerous major uncertainties in its framework (regulatory, business or technological).

3.4

role

type of actor which has responsibilities and represents the external intended behavior of a party

EXAMPLE 1 A legally defined market participant (e.g. grid operator, customer), a generic role which represents a bundle of possible roles (e.g. flexibility operator) or an artificially defined body needed for generic process and Use Case descriptions.

Note 1 to entry: IEC TS 62913 uses two kinds of roles: Business Roles and System Roles.

¹ Under preparation. Stage at the time of publication: IEC/RPUB 62913-1:2019.

Note 2 to entry: Legally or generically defined external actors may be named and identified by their roles.

Note 3 to entry: Between Systems, Devices and Operators can be described or modelled as System Use Cases.

[SOURCE: SG-CG/M490/C:2012-12]

3.5

system role

role describing a finite set of functionalities that is assumed by an entity (devices, information system, equipment)

3.6

Use Case

specification of a set of actions performed by a system, which yields an observable result that is, typically, of value for one or more actors or other stakeholders of the system

Note 1 to entry: There are two types of Use Cases:

- Business Use Cases describe how Business Roles interact to execute a business process. These processes are derived from services, i.e. business transactions, which have previously been identified.
- System Use Cases describe how System and/or Business Roles of a given system interact to perform a Smart Grid Function required to enable / facilitate the business processes described in Business Use Cases. Their purpose is to detail the execution of those processes from an Information System perspective.

Note 2 to entry: Since a Smart Grid Function can be used to enable / facilitate more than one business process, a System Use Case can be linked to more than one Business Use Case.

Table 1 highlights the differences between these 2 types of Use Case.

Table 1 – Differences between Business and System Use Cases

Type of Use Case	Description	Actors involved
Business Use Cases (BUC)	Depicts a business process– Expected to be system agnostic	Business Roles (organizations, organizational entities or physical persons)
System Use Cases (SUC)	Depicts a function or sub-function supporting one or several business processes	Business Roles and System Roles (Devices, Information System)

4 Use case analytics

Table 2 gathers information that characterizes each WG's set of Use Cases.

Table 2 – Use Case analytics per Working Group

WG 10	232	98	9,27 %	5,6 % ^a	80,1 % ^a	228	9,65 % ^a	89,91 % ^a	16,23 %
WG 13	20	24	0 %	75 %	25 %	21	9,52 %	90,48 %	80,95 %
WG 14	72	98	12,5 %	1,39 %	98,61 %	63	25,40 %	74,60 %	20,7 %
WG 15	12	0	0 %	25 %	75 %	21	42,86 %	57,14 %	60,4 %
WG 16	59	10	1,7 %	100 %	0 %	23 / 37 ^b	100 %	0 %	0 % / 64,9 % ^b
WG 17	38	3	0 %	0 %	100 %	21	14,29 %	85,71 %	14,3 %
WG 18	6	6	0 %	0 %	100 %	0	N/A	N/A	N/A
WG 19	7	3	28,6 %	0 %	100 %	17	23,53 %	76,47 %	5,9 %
WG21	55	47	100 %	1,8 %	98,2 %	23	21,74 %	78,26 %	0 %
JWG 11	8	0	100 %	75 %	25 %	9	44,44 %	55,56 %	0 %
Global	509	289	19 %	19,25 %	74,2 %	464	26,94 %	73,06 %	23,49 %

^a The sum does not match 100 % because some Use Cases and roles of WG 10 can be classified as neither business nor system.

^b The roles of WG 16 are divided between those from the eBIX, EFET and ENTSO-E role model and the others, hence the two numbers that respectively characterize these two parts.

5 Use Cases and roles of TC 57 WG 10, Power system IED communication and associated data models

5.1 General

The scope of WG 10, *Power system IED communication and associated data models*, is to develop standards and technical reports related to the communication and data models of Power System IEDs, to take responsibility for the generic aspects of IEC 61850 and to coordinate with other WGs that are developing domain specific data models.

5.2 Documents used

IEC reference	Name	Publication status	Edition
61850-4	System and project management	Published	2
61850-6	Configuration description language for communication in electrical substations related to IEDs	Published	2
61850-7-4	Configuration description language for communication in power utility automation systems related to IEDs	Published	2
61850-7-500	Use of logical nodes for modeling application functions and related concepts and guidelines for substations	Published	1
61850-7-5	Use of logical nodes for modeling application functions and related concepts and guidelines for substations	PWI	1
61850-90-1	Use of IEC 61850 for the communication between substations	Published	1
61850-90-2	Using IEC 61850 for communication between substations and control centres	Published	1
61850-90-3	Using IEC 61850 for condition monitoring diagnosis and analysis	Published	1
61850-90-4	Network engineering guidelines	Published	1
61850-90-5	Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118	Published	1
61850-90-6	Use of IEC 61850 for Distribution Automation Systems	BPUB	1
61850-90-11	Methodologies for modeling of logics for IEC 61850 based applications	PWI	1
61850-90-14	Using IEC 61850 for FACTS (Flexible AC Transmission Systems) data modelling	PWI	1

IEC reference	Name	Publication status	Edition
61850-90-16	System management for IEC 61850	ACD	1
61850-90-17	Using IEC 61850 to transmit power quality data	Published	1
61850-90-18	Alarm Handling	PWI	1
61850-90-20	Guideline to redundancy systems	PWI	1
61850-90-21	Travelling Wave Fault Location	PWI	1

5.3 TC 57 WG 10 Use Case reporting

WG number of identified Use Cases	% of Use Cases described with 62559-2	% of Business Use Cases	% of System Use Cases	Number of roles identified			% of non-defined roles
232	9,27 %	5,6 %^a	80,1 %^a	228	9,65 % ^a	89,91 % ^a	16,23 %
^a The sum does not match 100 % because some Use Cases and roles of WG 10 can neither be classified business or system.							

5.4 TC 57 WG 10 List of Use Case per normative document

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-4	System and project management	Published			
61850-4	System engineering process for designing and configuring an automation system	Published	Describes actors and tools	Project Requirement Engineer, Project Design Engineer, System Manufacturer, System Integrator, IED parameterizing Engineer, Testing and Commissioning Engineer	
61850-4	Replacement of one IED with one coming from the same vendor	Published	Replacement of an IED due to device failure	IED, Vendor A	
61850-4	Replacement of one IED with one coming a different vendor	Published	Replacement of an IED due to device failure	IED, Vendor A, Vendor B	
61850-4	Extension with addition of one IED into an existing system	Published	Addition of a device	IED, Vendor A or B	
61850-4	Extension of the system with new functionalities	Published	UAS extension	IED, Vendor A or B	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-6	<i>Configuration description language for communication in power utility automation systems related to IEDs</i>	<i>Published</i>			
61850-6	Engineering process with System Configuration description Language	Published	Defines tool roles	IED Configurator, System Configurator	
61850-6	Engineering process with System Configuration description Language – system specification	Published	A system specification in terms of the single line diagram, and allocation of logical nodes (LN) to parts and equipment of the single line to indicate the needed functionality	IED Configurator, System Configurator	
61850-6	Engineering process with System Configuration description Language – process configuration	Published	Complete process configuration with all IEDs bound to individual process functions and primary equipment, enhanced by the access point connections and possible access paths in subnetworks for all possible clients	IED Configurator, System Configurator	
61850-6	Engineering process with System Configuration description Language – IED configuration	Published	The IED Configurator loads IED configuration into the IED	IED Configurator, System Configurator	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-6	Engineering process with System Configuration description Language – data exchange between projects	Published	As far as the engineering responsibility is concerned, a complete secondary system can be split into different parts. Examples include separate engineering of high-voltage level and medium-voltage level, of a transformer-related part, or even of different substations exchanging data e.g. for line protection or interlocking. For the purposes of this standard, such a system part with responsibility for all its contained IEDs is called a project. To allow the engineering of online communication data flow between such projects, some interfacing data has to be exchanged between the projects, and the engineered interfaces have to be reimported to the concerned projects.	IED Configurator, System Configurator	
61850-6	Engineering process with System Configuration description Language – IED modifications	Published	During the engineering process it may happen that the IED-related data has to be changed. This can in principle be done by removing the IED from the system, and reinstantiating a modified IED description file in the system. However, in this case also all existing references from or to the IED are lost and have to be re-established.	IED Configurator, System Configurator	
61850-7-4	Basic communication structure – Compatible logical node classes and data object classes	Published	Functions are described in more detail in IEC 61850-7-500		
61850-7-4	Substation control and supervision	Published	Implied		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-7-4	Substation bay process control	Published	Implied		
61850-7-4	Substation switch gear process control	Published	Implied		
61850-7-4	Protection relay and protection functions	Published	Implied		
61850-7-4	Metering and measurement	Published	Implied		
61850-7-4	Power Quality Monitoring	Published	Implied		
61850-7-500	Use of logical nodes for modelling application functions and related concepts and guidelines for substations	Published	Functions are described in detail, but not modelled as Use Cases		
61850-7-500	Control of switchgear	Published	The switchgear is basically represented by logical nodes XCBR or XSWI. The application of the time critical GOOSE service according to IEC 61850-8-1 is needed between the control (CSWI) and protection (Pxxx-PTRC) at bay level and the switchgear to operate or trip the switchgear. It refers for time-critical functions, also to the position indication from the switchgear.		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-7-500	Synchrocheck	Published	The synchrocheck allows closing of an open circuit breaker only if both the amplitudes, phase angles and frequencies of the voltage on both sides are within predefined intervals.		
61850-7-500	Interlocking	Published	The interlocking should forbid dangerous switching operations which may harm people or destroy equipment. The requirements are easily derived from the task and properties of the switches. Simple and common requirement examples are to avoid switching power to ground, creating a short circuit or breaking or connecting power by disconnectors which would destroy this kind of equipment.		
61850-7-500	Blocking	Published	By definition, blocking switching operations refers not to the condition of the rest of the switchgear but only to the behavior of the switch which is intended to be operated. There could be a mechanical problem with the operating mechanism, too low gas density or not enough drive energy. The blocking of switchgear could be also issued by an operator command to the X-nodes by the DO BlkOpn and BlkCls.		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-7-500	Operation 1 out of n	Published	If more than one switch is operated at once, then overlapping of contact movement with dangerous power transfer may happen. Unpredictable transient events may occur. Therefore, as a general rule in most substations, only one of the switches should be operated at same time, at least in interconnected parts of the substation.		
61850-7-500	Control authority management	Published	Control actions in a substation may be accomplished at different control levels. For safety reasons, an operator or service person if applicable shall be able to isolate a level from the others by claiming the control authority for that level.		
61850-7-500	Protection	Published	The bay protection (Protection IED) is connected to the station level and other bays (if applicable) by the station bus providing communication over Ethernet. The bay protection is hardwired (parallel copper wires) to the switchgear (process). External process states and measured values are converted to data according to the IEC61850 data model in the Protection IED. Therefore, the boundary LNs are all in this IED. The switchgear is shown as single phase switches.		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-7-500	Point on wave switching	Published	Point-on-wave switching (also known as controlled switching or synchronous switching) means to open or close the circuit breaker at a predefined instant of time i.e. at a certain value of the sinusoidal current or voltage.		
61850-7-500	Breaker failure protection	Published	Since also in three-phase breakers differences in the pole positions per phase may happen, the modeling of supervision requests three instances of XCBR. The common XCBR reports the phase discrepancy if any. The trip may be performed for all three phases (three-phase trip) or per phase (single phase tripping), which is very common at higher voltage levels e.g. to keep the power system synchronization.		
61850-7-500	Line differential protection (see as well 61850-90-1)	Published	The current differential protection (LN PDIF, one instance per phase) checks that the currents on both or more sides of the protected object are the same disregarding the sign, i.e. under no fault conditions the sum of the currents is zero according to the Kirchhoff law.		
61850-7-500	Line distance protection with teleprotection schemes (see as well IEC 61850-90-1)	Published	The distance protection PDIS (one instance per zone) measures current and voltage (TCTR, TVTR) at one side of the line and permanently calculates the impedance. The impedance is calculated in different zones.		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-7-500	Autorecloser	Published	In case of transient faults, after the trip by protection (LN Pxxx) the auto recloser (LN RREC) shall try to close the tripped circuit breaker as fast as possible with some boundary conditions to minimize the interruption on power delivery. RREC will make a predefined number of reclosing cycles (e.g. 3) but declare the fault permanent if this number of trials is exhausted. For a more detailed description of this LN, see IEC 61850-5.		
61850-7-500	Switch on to fault	Published	If the circuit breaker is open for some time, it is often not clear what is with the network conditions on both side of the breaker. It could be that one side is connected to earth and the other one to power. Then, closing will create a short circuit. The protection should switch off this short circuit without any delay e.g. between start and trip. Another problem is to distinguish between a short circuit and the high current which is loading up the capacities of an overhead grid or cable grid part after a black-out.		
61850-7-500	Operation of parallel transformers	Published			
61850-7-500	Reverse blocking	Published	The reverse blocking function is applied in case of a unidirectional (radial) power flow from typical one infeed to many loads and implements some kind of a simple busbar protection based on overcurrent protection.		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-7-500	Load shedding	Published			
61850-7-5	<i>Use of logical nodes for modeling application functions and related concepts and guidelines for substations</i>	<i>PWI</i>			
61850-7-5	Busbar change-over	PWI	An outgoing line is supplied from busbar 1 of a double busbar substation. This line shall be changed over to busbar 2 without interrupting the supply.	Network Operator	
61850-7-5	The IED is restarted	PWI			
61850-7-5	Another setting group is activated	PWI			
61850-7-5	LD Beh or LN Mod are changed	PWI			
61850-7-5	Sequence using UC "Another setting group is activated" and "LD Beh or LN Mod are changed"	PWI			

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-1	<i>Use of IEC 61850 for the communication between substations</i>	<i>Published</i>			
61850-90-1	Distance line protection with permissive overreach tele-protection scheme	Published	When a distance relay detects a forward fault in the overreach zone, it sends a permissive signal to the remote end. If that relay also receives a permissive signal (from the remote end), the relay sends a trip signal to the local CB.	Measuring equipment, Comm. I/F –S, Comm. I/F –R, CB	
61850-90-1	Distance line protection with blocking overreach tele-protection scheme	Published	When a distance relay detects reverse faults, it sends a blocking signal to the remote end. If the relay detects a forward fault and does not receive the blocking signal, the relay sends a trip signal to the local CB. A variant involves the directional comparison blocking (DCB) using a non-directional element to send a blocking signal for any fault (other wording: "starts the carrier"). The operation of the forward element removes the blocking signal ("stops the carrier") and sends a trip signal to the local CB.	Measuring equipment, Comm. I/F –S, Comm. I/F –R, CB	
61850-90-1	Directional comparison protection	Published	When a directional relay (typically a directional overcurrent relay) detects a forward fault, the relay sends a permissive signal to the remote end. If the relay also receives a permissive signal from the remote end, the relay sends a trip signal to the local CB.	Measuring equipment, Comm. I/F –S, Comm. I/F –R, CB	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-1	Transfer/Direct tripping	Published	Local equipment sends a trip command to the remote equipment. This function is sometimes called inter-tripping as well.	Commander, Comm. I/F –S, Comm. I/F –R, CB	
61850-90-1	Interlocking	Published	The interlocking of the line earth switch depends on whether there is voltage on the line or not. To be able to detect this, the states of the earthing switch, and the line disconnector switch of the other line side, should be transferred and used. The method of under-voltage measurement may still be considered as back-up functionality in case of losing the communication link.	Switch state acquisition, Comm. I/F –S, Comm. I/F –R, Interlocking Controller	
61850-90-1	Multi-phase auto-reclosing application for parallel line systems	Published	Multi-phase auto-reclosing (1-phase, 2-phase, 3-phase) is a scheme that is applied to the double line circuit. In multi-phase auto-reclosing applications, the scheme decides its actions based on CB status of the remote end (not usually used for other auto-reclosing methods). This Use Case focuses on how to use or how to transmit CB status information for multi-phase auto-reclosing. Normal auto-reclosing processes (e.g. checking dead time etc.) are omitted in the explanation.	Protection relay, Comm. I/F –S, Comm. I/F –R, CB	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-1	Current differential line protection	Published	Current differential relays measure the current of the protected line at both ends. A local relay sends the current data (Ia) to the remote end and receives the current data from the remote end (Ib). Current differential relays detect faults in the protected line (internal faults) by comparing the current from the remote relay with the current of the local terminal. When current differential relays detect an internal fault, they send a trip signal to the local circuit breaker.	Measuring equipment, Comm. I/F –S, Comm. I/F –R, CB	
61850-90-1	Phase comparison protection	Published	When a phase comparison relay detects a positive current, above a set threshold, the relay sends an "on" signal to the remote end. The relay compares the local data signal with that from the remote end. If the time that both signals are "on" is very short, the phases of the currents detected by both ends are opposite and the relay restrained. If the time is sufficiently long, the relay recognizes there is an internal fault and sends a trip signal to the local CB.	Measuring equipment, Comm. I/F –S, Comm. I/F –R, CB	
61850-90-1	Fault locator system (2, 3 terminals)	Published	By using all terminal information, precise estimation of the fault location is possible. The voltages and currents of all ends are necessary.	Measuring equipment, Comm. I/F –S, Comm. I/F –R	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-1	System integrity protection schemes (SIPS)	Published	The described system integrity protection scheme comprises remote terminal units (RTU) and central equipment (CE). Remote terminal units are located at power stations and measure voltage. These remote terminal units periodically send measured data to the central equipment. The central equipment calculates the differences of the voltage angles between the western generators and the other generator groups (northern group, eastern group and southern group), and also estimates the future angle differences. If the central equipment predicts that the generators will lose synchronisation, the central equipment sends a trip signal to the circuit breaker of the tie line.	Measuring equipment, Comm. I/F –S-RT, Comm. I/F –R-RT, Comm. I/F –S-CE, Comm. I/F –R-CE, CB	
61850-90-1	Real time predictive generator shedding	Published	This wide area protection system comprises remote terminals and central equipment. Remote terminal A and B measure the voltage and current at power station A and B. These remote terminals periodically send the active power, which is calculated from the voltage and current, to the central equipment. Remote terminal C sends voltage data to the central equipment. When a fault occurs, if the central equipment predicts that the generators will lose synchronisation, the central equipment sends a trip signal to the generators.	Measuring equipment, Comm. I/F –S-RT, Comm. I/F –R-RT, Comm. I/F –S-CE, Comm. I/F –R-CE, CB	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-1	Out-of-step detection	Published	By comparing the angle of voltage between the two ends, it can be detected whether the centre of the out-of-step is between the two ends or not. When the two voltages are in the opposite direction, an out-of-step occurs and the centre of out-of-step is in between the two ends.	Measuring equipment, Comm. I/F –S, Comm. I/F –R, CB	
61850-90-1	Remedial action schemes (RAS)	Published	Remedial action schemes (RAS) are designed to monitor and protect electrical systems. They perform automatic switching operations in response to adverse network conditions to ensure the integrity of the electrical system and to avoid a collapse of the network.	Central Controller	
61850-90-2	Using IEC 61850 for communication between substations and control centres	Published			
61850-90-2	Telecontrol – Supervisory Control and Data Acquisition	Published	Contains sub-Use Cases, presented below	Control Centre, IED	
	Acquisition of status		<i>IED acquires the current status of a power system device (e.g. open, close...) and, if it has changed, sends the new status, cause of transmission, time stamp, etc., to the control centre.</i>		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
	Acquisition of measurement		• Sending Measurement on change IED acquires measurement (P, Q, I, V...) and, if it changed significantly (using dead band), sends it to the control centre. • Sending measurement cyclically IED acquires measurement (P, Q, I, V...) and sends it, cyclically (user configured), to the control centre.		
	Acquisition of alarms		IED receives alarms from substation equipment and sends them to the control centre.		
	Remote control		• Sending a direct command Control centre sends a command to a power system device to change its current position. • Sending a SBO command Control centre sends a command to a power system device to change its current position using SBO functionality.		
	Sending setpoint		Control centre sends a setpoint to a generator or to a tap changer transformer or FACTS		
	General interrogation		Control centre issues a request to refresh the control centre database image of substation information.		
	Control authority management		Isolation of remote control for maintenance purposes.		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
	<i>Telemonitoring blocking</i>		<i>Temporarily disable the update of information from the substation, or a part of it, to the control centre.</i>		
61850-90-2	Telecontrol – Supervisory Control and Data Acquisition	Published	Synchrophasor communication can be used within a substation for synchrocheck or substation level state estimation, as well as between several substations and a centre which performs regional or network level alarms and stability calculations. Subclause 5.3.3 describes only those Use Cases which require a communication to a centre. The transmission of synchrophasor information is defined in detail in IEC TR 61850-90-5:2012.	Maintenance centre, Storage device	
61850-90-2	Disturbance Records	Published	Contains sub-Use Cases, presented below	Maintenance centre, Storage device	
	<i>Getting list of disturbance or fault records</i>		<i>After received request from maintenance centre storage device sends the list of available disturbance or fault records. At least, the list should indicate for each file:</i> <i>the concerned high voltage device,</i> <i>the first sample time stamp,</i> <i>the duration (disturbance records).</i>		
	<i>Getting disturbance or fault records corresponding to a given period of time</i>		<i>The maintenance centre sends a request including a given period of time to the storage device in order to get disturbance or fault records. Once received, the storage device sends related information.</i>		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
	Getting disturbance or fault records for one given device		<i>The maintenance centre sends a request including one given high voltage device in order to get disturbance or fault records. Once received, the storage device sends related information.</i>		
	Sending disturbance or fault records		<i>The storage device sends disturbance or fault records to the maintenance centre.</i>		
	Getting configuration recording parameters		<i>After request from the maintenance centre, the storage device sends configuration recording parameters.</i>		
	Setting configuration recording parameters		<i>The maintenance centre sends configuration recording parameters to storage device.</i>		
61850-90-2	Metering	Published	Contains sub-Use Cases, presented below	User, Meter	
	Acquisition of integrated totals		<i>Memorization of integrated totals and transmission to the maintenance centre.</i>		
	Acquisition of incremental information		<i>Memorization of integrated totals; reset of the integrated totals and transmission to the maintenance centre.</i>		
	Request counting information		<i>Memorization of integrated totals or incremental information. Locally stored in the device. Transferred to the maintenance centre on request.</i>		
61850-90-2	Power Quality Monitoring	Published	Contains sub-Use Cases, presented below	IED, User	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
	<i>Request for power quality information</i>		<i>After received request from control centre and/or maintenance centre, IED sends the right information to the user</i>		
	<i>Retrieve LOG of power quality information</i>		<i>Historic power quality information that has been stored in the IED can be retrieved on request of the control centre.</i>		
	<i>Sending of power quality information</i>		<i>Power quality information measured/calculated in the IED will be transferred to the user spontaneously</i>		
61850-90-2	Remote parameter and configuration changes	Published	Contains sub-Use Cases, presented below	IED, Maintenance centre	
	<i>Request for configuration files</i>		<i>After receiving request from maintenance centre, IED sends configuration files.</i>		
	<i>Sending configuration files</i>		<i>Maintenance centre sends configuration files to IED</i>		
	<i>Request for operational parameters</i>		<i>After received request from maintenance centre, IED sends current operational parameters.</i>		
	<i>Setting operational parameters</i>		<i>Maintenance centre sends operational parameters to IED then IED validates new parameters. IED sends an acknowledgement after having successfully activated new parameters.</i>		

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-2	Asset management information	Published	After received request from maintenance centre, IED sends the requested information.	IED, Maintenance centre	
61850-90-3	Using IEC 61850 for condition monitoring diagnosis and analysis	Published			
61850-90-3	GIS SF6 monitoring	Published	The goal of the Monitoring is to detect leakages in an early stage. In case of a leakage it notifies maintenance planning. Furthermore it gives additional information to support repair works.	Gas Sensor, PD sensor, UHF Sensor, Other Sensors, Maintenance Worker, Maintenance Planner, Asset Manager	
61850-90-3	Circuit breaker abrasion monitoring	Published	Goal of abrasion monitoring is to calculate the effective wear on the main contacts, especially for circuit breakers.	Primary Current Sensor, Travel Sensor, Other Sensors (e.g. primary voltage), Maintenance Worker	
61850-90-3	Switch monitoring	Published	Switch monitoring allows the user to detect abnormal conditions on the switch before a regular maintenance is carried out. Furthermore it provides information to support maintenance planning.	Switch, Travel Sensor, Other Sensors (e.g. for motor current), Maintenance Worker	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	GIS maintenance	Published	Maintenance occurs typically at a periodic timebase or – at the best – the equipment itself calls for maintenance. Goal of the maintenance planning is to optimize the maintenance schedule based on the condition on several components inside the substation. Additionally the Monitoring System supports repair work by providing additional information.	Maintenance Worker, Maintenance Planner	
61850-90-3	ERP (Enterprise Resource Planning) update	Published	Goal of an ERP calculation is to estimate the remaining investment value of the substation. The calculation itself is carried out using specialized software. The monitoring system may provide information to update the ERP system based on the actual status.	ERP System	
61850-90-3	Operating mechanism monitoring	Published	Operating mechanism is mainly intended to help the operator to check the equipment's operating status.	Energy Sensor, Hydraulic Level Sensor, Hydraulic Temperature Sensor, Motor Current Sensor, Humidity Sensor, Hydraulic Pressur Sensor, Hydraulic Pump Sensor, Switch Position, Operator, Maintenance Worker	
61850-90-3	Maintenance planning (for operating mechanism)	Published	Maintenance planning is mainly intended to calculate time to maintenance.	Maintenance Worker	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	Operating mechanism monitoring for POW switching	Published	In the point-on-wave switching the phases are independently operated at the most favorable time instant. This results in better power quality and reduces the electrical stresses on the equipment which in turn allows for longer maintenance intervals. Specific monitoring information for process control is required to predict the operating time of the circuit breaker considering the parameters that have impact on CB closing/opening time. Specific monitoring information such as operation count comes from the CMD that are not the goal of this part of IEC 61850. Circuit breaker operating monitoring is intended to help the operator or the maintenance worker to predict operating time.	Coil Voltage, Hydraulic Pressure Sensor, Drive Temperature, Switch Position, Operator, Maintenance Worker, Configuration management, Travel Sensor	
61850-90-3	Transformer: Dissolved gas and moisture in oil supervision	Published	Dissolved Gas Analysis (DGA) is considered by most transformer experts as the single most important technique for CMD in transformers. It detects problems mainly in the core and coil components of the transformer. Online DGA is now very popular and adopted worldwide for transformers ranging from large transmission substations to smaller distribution. Several manufacturers offer products that measure from a single key gas to all combustible gases. A good percentage of online DGA analyzers available also measure relative humidity. Rate of change of gas concentrations is considered a very important indicator.	Dissolved gas and moisture sensor, Relative Humidity Sensor, Oil Temperature Sensor, Asset Management, Operation, Configuration Management	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	Transformer: Partial discharge (PD) supervision	Published	Various users prefer to use partial discharge analysis instead of online DGA. Others combine both techniques when monitoring critical transformers. There are different techniques for detection of PD: acoustic detection and electric detection. PD detects problems in the core and coil and bushing components of the transformer. Several manufacturers offer products that measure and analyze PD in the transformer.	Partial Discharge Sensor, Asset Management, Operation, Configuration Management	
61850-90-3	Transformer: Temperature supervision	Published	Most transformer components and sub-components are greatly affected by temperature. Higher temperatures will cause an accelerated aging of the transformer and a much higher risk of failure.	Direct Winding Temperature Sensor, Load Current Sensor, Top Oil Temperature Sensor, Bottom Oil Temperature Sensor, Asset Management, Operation, Configuration Management	
61850-90-3	Transformer: Solid insulation aging supervision	Published	Contrary to oil aging, solid insulation aging is an irreversible process due to the degradation of cellulose, which is the basic material of paper and barriers. This aging depends on several factors such as oil and winding temperature, moisture and presence of oxygen. It is very easy to measure moisture in oil but it is very impractical, if not impossible, to measure online the moisture content in the paper or in the barriers. Calculations are required to obtain those values.	Bottom Oil Temperature Sensor, Relative Humidity Sensor, Winding Hot Spot Temperature, Asset Management, Operation, Configuration Management	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	Transformer: Bubbling temperature supervision	Published	Bubbling is very dangerous for the integrity of the transformer and should be avoided. Bubbling is affected by moisture in the transformer and by the transformer temperature. The bubbling threshold temperature can be calculated for given moisture conditions.	Relative Humidity Sensor, Oil Temperature Sensor, Winding Hot Spot Temperature, Asset Management, Operation, Configuration Management	
61850-90-3	Transformer: Bushing supervision	Published	Bushing failures are responsible for a very large number of transformer failures. The use of bushing monitoring is increasing. There are different techniques; other than PD method already described, the most popular are the monitoring of $\tan \delta$, sum of currents, bushing capacitance.	Current Sensor, Voltage Sensor, Asset Management, Operation, Configuration Management	
61850-90-3	Transformer: Cooling supervision	Published	High temperatures will cause aging acceleration in the transformer. Loading capacity is also affected by high temperatures. Moreover the peak load period occurs during summer in various countries. Cooling is then a very important component of a transformer. Its efficiency can be calculated by using a thermal model and also banks, pumps and fans can be monitored for various conditions.	Load Current Sensor, Ambient Temperature Sensor, Top Oil Temperature Sensor, Cooling Bank Status Sensor, Pump/fan Current Sensor, Asset Management, Operation, Configuration Management	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	Transformer: Ancillary sensors supervision	Published	There are several other ancillary sensors in transformers. Their uses vary according to the design, size, age and other factors.	Buchholz Relay, Oil Level Sensor, Pressure Sensor, Conservator Membrane Rupture Detector, Asset Management, Operation, Configuration Management	
61850-90-3	Load Tap Changer: Monitoring operation property	Published		Motor-Driving Current Sensor, Torque Sensor, Tap Position Sensor, LTC Operation Signal Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	
61850-90-3	Load Tap Changer: Monitoring operation counts	Published		LTC Operation Signal Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	Load Tap Changer: Monitoring contact abrasion	Published		Load Current Sensor (CT Sensor in bushing), LTC Operation Signal Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	
61850-90-3	Load Tap Changer: Monitoring LTC oil temperature	Published		LTC Oil Temperature Sensor, Transformer Oil Temperature Sensor, LTC Oil Flow Relay, Equipment Supervision, Maintenance Planning Support, Asset Management	
61850-90-3	Load Tap Changer: Monitoring operation of oil filter unit	Published		OFU (Oil Filter Unit) Operation Signal Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	
61850-90-3	Underground cable: Thermal aging supervision	Published		Temperature Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	Underground cable: Supervision of cable parts cracking	Published	The length of UGC varies according to its temperature, so that a force is applied to parts of a cable such as connection. If a force exceeds the proof strength of cable parts, they are cracked. Cable displacement is thought to have a relation to a force applied to a cable.	Position Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	
61850-90-3	Underground cable: Insulation aging supervision	Published		Partial Discharge Sensor, Voltage Sensor, Current Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	
61850-90-3	Underground cable: Water-tree supervision	Published		Current Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	
61850-90-3	Underground cable: Supervision of earth fault without circuit breaker trip	Published		Current Sensor, Voltage Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	Underground cable: Oil aging supervision	Published		Gas Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	
61850-90-3	Underground cable: Oil leak supervision	Published		Oil Pressure Sensor, Oil Level Sensor, Temperature Sensor, Equipment Supervision, Maintenance Planning Support, Asset Management	
61850-90-3	Transmission line: Line condition supervisor	Published	The line condition server collects line condition data from sensors. The line condition server (LCS) diagnoses the status of the transmission line by comparing collected and processed data with predefined setting values. If a violation of the predefined setting value is found, the line condition server sends an alarm event and statistical data to the NCC/RCC.	Line Sensor, Meteorological Sensor, Configuration Management, Asset Management	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	Transmission line: Tower condition supervisor	Published	The tower condition server collects tower condition data from sensors. The tower condition server (TCS) diagnoses the status of the transmission tower by comparing collected and processed data with the predefined setting value. In case of the tower condition server sends an alarm message and statistical data to the operation centre (NCC/RCC).	Meteorological Sensor, Tension Sensor, Inclination Sensor, Configuration Sensor, GPS Sensor, Configuration Management, Asset Management	
61850-90-3	Transmission line: Insulator condition supervisor	Published	The insulator condition server collects insulator related data from sensors. The insulator condition server (ICS) diagnoses the status of insulator by comparing collected and processed data with predefined setting values. In case of a violation of the predefined setting value, the insulator condition server sends an alarm event and statistical data to the operation centre (NCC/RCC).	Meteorological Sensor, Partial Discharge Sensor, Temperature Sensor, Current Leakage Sensor, Configuration Management, Asset Management	
61850-90-3	Transmission line: Surrounding area supervisor	Published	The surrounding area server sends a fire alarm message to the operation centre (NCC/RCC) on detecting the fire through the fire sensor.	Fire Sensor, Image Sensor, Configuration Management, Asset Management	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-3	Auxiliary power system supervision	Published	The typical auxiliary power system we have considered in this section: • Secured DC system from AC input power • Secured AC system from DC input with AC backup • Secured AC system from AC input with AC backup These three cases cover the most common cases of producing auxiliary power in Power Utility Automation	Main Power Input, Backup Power Input, Power Source Switches, Power Storage, Power Auxiliary Loads, Remote Operators	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-4	<i>Network engineering guidelines</i>	<i>Published</i>			
61850-90-4	Separated station bus and process bus rings	Published	This is a Use Case that combines a station bus network and a process bus network as rings. Separation of station bus and process bus rings avoids flooding the station bus with high traffic generated by SV publishers such as merging units. The IEDs have separate ports for station bus and for process bus. The internal implementation of both interfaces in each IED is vendor specific. The two interfaces of the IED shall not bridge frames, since this would create loops in the network. If they would bridge the bus – assuming they implement RSTP on both the station bus and/or process bus side, these integrated bridges would couple the process bus and the station bus rings and increase reconfiguration time possibly beyond tolerable values. This network setup effectively separates the station bus and process bus into two completely separate physical networks. To enable a reach-through (if needed) from the SCADA, engineering or other layer 3 application to devices on the process bus, e.g. the MUs, an IP router connects the two layer 2 networks through a layer 3 connection. The connections of the router into the two LANs and the router can be designed redundantly (utilizing e.g. the Virtual Router Redundancy Protocol VRRP) to provide fault tolerance, if desired. Alternatively, multicast filtering bridges can be used.	IED	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-5	<i>Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118</i>	<i>Published</i>			
61850-90-5	Synchro check (using phasor information)	Published	In this application, data are sent from one or more PMU devices to a sync check relay. The relay uses this information to assure the phase angles of the voltage on two sides of a breaker are close enough that the breaker can be closed without harm.	PMU, Relay, Breaker	
61850-90-5	Adaptive relaying	Published	In this application, data is sent from one or more PMU devices to a relay supervision function. The receiving device uses this information to adjust relaying parameters or settings so the relay is making optimal decisions based on the actual system configuration. This type of application as currently envisioned is a low-speed application that takes advantage of the precision and wider observability of the phasor measurement system.	PMU, Relay Supervisor	
61850-90-5	Out-of-step protection	Published	In this application, data is sent from two (or more) PMU devices to a controller that detects out-of-step conditions between substations or system areas. It uses the phase angle and frequency measurements to detect excessive and increasing phase angle, and takes action to reduce the angle or island the system.	PMU, Out-of-step Controller, Power System Control Equipment	

IEC document	Use Case Title	Pub. status	Description	Actors / Roles	IEC 62559-2 compliance
61850-90-5	Situational awareness	Published	In this application, data is sent from one or more PMU devices to alarm and display applications in a control centre. These applications may include processing and alarm functions such as oscillation detection and path loading limits. These applications provide alarms to operations personnel based on information derived from the data and compared with pre-programmed criteria.	PMU, ssPDC, PDC, User Applications	
61850-90-5	State estimation and on-line security assessment	Published	In this application, data is sent from one or more PMU devices to state estimator and security assessment applications in a control centre. The state estimator determines all the voltages and power flows in the grid. Security assessment determines the failure risks by applying various criteria to the state estimate. State estimation will initially use synchrophasor data to supplement traditional SCADA data for added functionality and improved performance since phasor measurements will initially be too sparse to fully support its requirements. Once sufficient measurements are available, state estimation can operate exclusively with phasor data.	PMU, ssPDC, PDC, User Applications	