## Innovation Talk IEC 61439 Standard Series – Low Voltage Switchgear and Controlgear Assembly

July 2021

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Schneider



### Speaker's biography



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## Training, conferences to present and explain, the IEC 61439 standard – The Low Voltage Switchgear & Controlgear Assembly standards

**Pascal LEPRETRE** 

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1 From 60439 to 61439 standard 2 Actors and responsibility 3 Goals of IEC 61439, changes in Ed. 3 4 Influence on the market Tools to communicate, specify and 5 influence 6 **Design and Routine Verification** 7 **Q & A** 



- IEC 60439 cancelled in the previous century (1999-12)
- 80% of the ASSEMBLIES worldwide do not comply with the standard
  - Requirements not always clear
  - Role and responsibility of Original manufacturer and assembly manufacturer (Panel Builder) not clear enough \_\_\_\_
  - Partially Type Tested Assembly (PTTA) concept abused and misused \_\_\_\_



### Elimination of TTA and PTTA concepts



#### Verified **ASSEMBLIES**

- Or possibility for only some of the verifications under clear and strict conditions to do
  - Comparison with a **tested** reference design (Design Rules)
  - Calculations including safety margins
- Same as TTA in 9 items instead of 3

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Old IEC 60439-X	LV Switchgear and Tested Assemblies						
controlgear Assemblies	60439-1	Distrib. Boards 60439-3	Constr. Sites 60439-4	Public networks 60439-5	Busbar Trunk 60439-2		
IEC 61439-X LV switchgear & controlgear	LV Switchgear and ( <i>61439-1</i> (Ed 1 2009-01 <b>/ Ed</b>	Controlgear Assemblie <b>3 2020-05</b> )	s - General Rules				Guidano to speci ASS.
ASSEMDILES	Power SC Ass. 61439-2 (Ed 1 2009-01 <b>Ed 3 2020 - 07</b> )	Distrib. Boards 61439-3 (2011-02)	Constr. Sites 61439-4 (2012-11)	Public networks 61439-5 (Ed 1 2010-11 <b>Ed 2 2014-08</b> )	Busbar Trunking 6 <i>1439-6</i> (Ed 1 2012-05)	Sp. applications 61439-7 (Ed 1 2018-12)	61439-0 (2013-04

- IEC 61439-2 is to be read in conjunction with IEC 61439-1, instead of IEC 60439-1 alone
- Structure aligned with Standard for protection devices IEC 60947
- Tests identical to those in IEC 60439-1 do not need to be repeated

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- IEC TR/61439-0 (2010-10) Specification guide. Next edition shall be published in 2021.
- IEC 61439-1 General rules Edition 3 (2020-05)
- IEC 61439-2 Power switchgear and controlgear Assemblies Edition 3 (2020-07)
- IEC 61439-3 Distribution boards intended to be operated by ordinary persons (DBO) (2012-02). Revision on-going.
- IEC 61439-4 Assemblies for construction sites (ACS) (2012-11)
- IEC 61439-5 Assemblies for power distribution in public networks Edition 2 (2014-08)
- IEC 61439-6 Busbar trunking systems (busways) (2012-05)
- IEC 61439-7 Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations (2018-12)



- Clear definition of actors and their responsibility
- Recognition of Original Manufacturer (Ex: Schneider Electric) and Assembly Manufacturer (Panel Builder)
- To be compliant with the new standard, PTTA/TTA have been replaced by a design verification: test, comparison, assessment
- Clarified and reinforced requirements



#### A means for specifier:

- It is important for the user to **specify** at most early precisely the **main technical** characteristics of the assembly in its environment
- In addition to the **functional and technical** description of the equipment, the specifier shall specify the framework for using the assembly on the **external** constraints linked to its environment, storage and transport conditions, considering of a possible environmental approach. Clarified & reinforced requirements.



#### A means for specifier:

- A dedicated part of IEC 61439: Low-voltage switchgear and controlgear assemblies – Part 0: Guidance to specifying assemblies
- Use shall be improved if local committee pushes to a specific country document





61439-0/Ed.3/DTR © IEC(E)

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121B/126/DTR

#### LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR ASSEMBLIES -

#### Part 0: Guidance to specifying assemblies

#### 1. Scope

Within the IEC 61439 series of standards for low-voltage switchgear and controlgear assemblies, there are system and application details that are specified by the specifier to enable the manufacturer to produce an assembly that meets the needs and expectations of the specifier.



#### A means for the **original manufacturer**:

- The IEC 61439-1 standard lists the design requirements of an assembly to the original manufacturer
- The original manufacturer needs to develop reference system configurations and verify them by tests, calculations or design rules
- The original manufacturer shall provide the (full) assembly technical documentation to assembly manufacturer
- **12 tests of construction and performance** need to be verified to the design of an assembly
- All the **design verification** must be **assessed** by an independent **certification body** (ASEFA, ASTA, KEMA,...).



#### A means for the **assembly manufacturer**:

- The assembly manufacturer builds the assembly respecting the technical documentation.
- The panel-builder "translates" and concretizes the need of the customer in term of a solution suitable technique
- He is responsible:
  - The choice and mounting of components in accordance with the technical instructions provided
  - The execution of **9 routine tests** on each manufactured assembly
  - The **final approval** of the assembly



#### Synthesis:

- Specifier (design office, End user,...)
  - Specifies the needs and constraints for design, installation, operation and upgrading of the complete system
- Original Manufacturer (System manufacturer)
  - Carries out the original design
  - Carries out the design verifications (12) that can be certified through a certification body (Veritas, LCIE, Kema...)
- Assembly Manufacturer (Panel Builder)
  - Takes the responsibility for the final Assembly
  - Carries out **routine verifications** (9)
- Assembly System
  - Composed of mechanical & electrical components (Enclosure, Electrical equipment, Linergy busbars and thermal control...)



### Main goals of the IEC 61439

Your customers need...

**Electrical safety** 

![](_page_14_Picture_3.jpeg)

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#### **Power availability**

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![](_page_14_Picture_10.jpeg)

### Main goals of the IEC 61439

### Guarantee to our customers: Electrical safety

#### List of design and routine verification point related to risk of fire in IEC 61439-1

Clause 10 design verification	Clause 11 routine verification	Point of verification	Mitigation of fire risk ignition
10.2 10.2.3 10.2.3.1		Strength of material and parts <ul> <li>Properties of insulation materials</li> <li>Thermal stability</li> <li>Resistance to abnormal heat</li> </ul>	Addresses the risk of short circuit including insulation fault inside the switchboard that causes internal arc fault
10.3	11.2	Degree of protection of enclosures	Thanks to the protective insulation covers up to form 4 in equipment that cannot be damaged by bad usage of tools, loose parts or be penetrated by animals like rodents
10.4	11.3	Measurement of clearances distances     Measurement of creepage distances	Addresses risk of short circuit including insulation fault inside the switchboard that causes internal arc faults
10.6	11.5	Incorporation of switching devices and components	Addresses connection issues and temperature rises
10.7	11.6	Internal electrical circuits and connections	
10.8	117	Terminals for external conductors	
10.9	11.9	<ul> <li>Dielectric properties</li> <li>Power frequency withstand voltage</li> <li>Impulse withstand voltage</li> </ul>	Addresses risk of short circuit including insulation fault inside the switchboard that causes internal arc faults
10.10		Temperature-rise limits (including test)	Manages heating dissipation and temperature rise limits to avoid abnormal heat, hot points and potential fire

![](_page_15_Picture_7.jpeg)

### Main goals of the IEC 61439

Guarantee to our customers: Power availability

Some examples across the world:

- France
  - Electrical origin fire in a tools manufacturer losses = \$ 1.2 M —
  - 1 fire on 5 electrical origin
  - 55,000 lost working days
- USA
  - \$10 B of losses in industry commerce per year
- Germany
  - Dusseldorf airport fire 3 days of complete closing full recovery of exploitation after 2 months
- China •
  - 45,000 fires of electrical origin in 2008
- India
  - 56% of industrial disaster are due to electrical fire

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![](_page_16_Picture_19.jpeg)

### IEC 61439-1:2020

Main changes compared to the previous edition

- Integration of electronic systems such as VFD, SMPS, UPS etc., although these electronic components are tested to their respective products and assembly standard, but when they are incorporated in assemblies the incorporation should be in accordance with the IEC 61439 series
- New terminology Group rated Current of circuit & more emphasis on temperature rise verification on these characteristics
- Recognition of Aluminum as conductor with very well-defined temperature rise criteria limits 55K for Untreated Aluminum
- Increase in the test duration from 5 seconds to 60 seconds in case of Dielectric verification for the power frequency test
- Addition of requirements in respect of DC
- Introduction of the concept of class I and class II assemblies regarding protection against electric shock

![](_page_17_Picture_15.jpeg)

### Influence on the market

![](_page_18_Figure_1.jpeg)

+ many IEC national ADOPTIONS (e.g., AS/NZS 61439...) with potential **DEVIATIONS** 

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![](_page_18_Picture_6.jpeg)

![](_page_18_Picture_9.jpeg)

### Influence on the market

### IEC Standards international references

![](_page_19_Picture_2.jpeg)

LV electrical Installations: **IEC 60364** & local standards Switchboard: Old: IEC 60439-1 New: IEC 61439-1/2 **Busbar trunking:** Old: IEC 60439-2 New: IEC 61439-6 Switchgear & controlgear: **IEC 60947-x** 

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## Tools to communicate, specify and influence

### Documentation

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### Tools to communicate, specify and influence

### Blogs related to Assemblies

![](_page_21_Picture_2.jpeg)

How Electrical Conductivity and With IEC 61439, Assure Temperature-rise Limitations Impact LV Switchboards

Pascal Lepretre | August 27, 2018 8.5K views 📊 0 🧗 0 🖂 626

![](_page_21_Picture_5.jpeg)

Thermal Stability and Reliability in Low Voltage Electric

Pascal Lepretre | July 10, 2018 19.9K views in 0 f 0 🔀 720

![](_page_21_Picture_8.jpeg)

Ensure Short Circuit Withstand Strength in Low Voltage Electric Switchboards

Pascal Lepretre | June 28, 2018 20.6K views in 0 10 20.6K views 10 978

![](_page_21_Picture_11.jpeg)

Avoid the Wrong Type of Electrical Fireworks with IEC 61439

Pascal Lepretre | May 10, 2018 18.5K views in 4 🖬 0 🖂 1.0K

![](_page_21_Picture_14.jpeg)

Circuit breaker: derating is not Aluminium: Inherently good for downgrading

Pascal Lepretre | April 23, 2014

![](_page_21_Picture_18.jpeg)

IEC 61439: Ensure Insulating Material Properties To Protect Electrical Panels

Pascal Lepretre | June 20, 2018 17.6K views 📊 9 🚹 0 🖂 716

![](_page_21_Picture_21.jpeg)

Clearances and Creepage Distances in LV Electrical Switchboards

Pascal Lepretre | June 6, 2018 38.5K views 📊 8 🚹 0 🖂 1.6K

![](_page_21_Picture_24.jpeg)

IEC 61439: Rated current of Electrical Panel and Switchboard Protection

Pascal Lepretre | May 23, 2018 28.2K views in 7 👫 0 🖂 1.4K

![](_page_21_Picture_27.jpeg)

IEC 61439, More than just an upgrade, a whole new approach

Pascal Lepretre | March 29, 2013 10.8K views in 39 10 🖂 1.7K

![](_page_21_Picture_32.jpeg)

![](_page_21_Picture_33.jpeg)

bus bars

Pascal Lepretre	April 2,	2014	
47.9K views	in 598	fo	27.3K

![](_page_21_Picture_36.jpeg)

## Tools to communicate, specify and influence

### Schneider Electric Exchange

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#### https://community.exchange.se.com/t5/Power-Standards-Regulations/bd-p/power-standards-regulations-forums

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## Design verifications of IEC 61439-1 (Annex D)

	Table D. 1 - List of design to be performed		Verificatio	on option available	
	Characteristic to be verified	Clauses or subclauses	Testing	Comparison with a reference design	Assessment
1	Strength of material	10.2			
	Resistance to corrosion	10.2.2	yes	No	No
	Properties of insulating materials	10.2.3			
	Thermal stability	10.2.3.1	yes	No	No
	Resistance to abnormal temperature and fire due to internal electric effects	10.2.3.2	yes	No	yes
	Resistance to ultra-violet	10.2.4	yes	No	yes
	Lifting	10.2.5	yes	No	No
	Mechanical Impact	10.2.6	yes	No	No
	Marking	10.2.7	yes	No	No
2	Degre of protection of enclosures	10.3	yes	No	yes
3	Clearances and crepage distances	10.4	yes	No	No
4	Protection against electric shock and integrity of protective circuits	10.5			
	- Effective continuity between the exposed conductive parts of the assembly and the protective circuit	10.5.2	yes	No	No
	- Short-circuit withstand strength of the protective circuit	10.5.3	yes	yes	Νο
5	Incorporation of switching devices and components	10.6	No	No	Yes
6	Internal electrical circuits and connections	10.7	No	No	Yes
7	Terminal for external conductors	10.8	No	No	Yes
8	Dielectric properties	10.9			
	- Power-frequency withstand voltage	10.9.2	Yes	No	No
	- Impulse withstand voltage	10.9.3	yes	No	Yes
9	Temperature-rise limits	10.10	yes	yes	Yes
10	Short-circuit withstand strength	10.11	yes	yes	No
11	Electromagnetic compatibility (EMC)	10.12	yes	Νο	Yes
12	Mechanical operation	10.13	yes	No	No

### 1 to 7 are "Construction verification" 8 to 12 are "Performance verification"

![](_page_23_Picture_3.jpeg)

Strength of material

![](_page_23_Picture_5.jpeg)

Incorporation of switching devices

![](_page_23_Picture_7.jpeg)

![](_page_23_Picture_8.jpeg)

![](_page_23_Picture_10.jpeg)

![](_page_23_Picture_12.jpeg)

Degree of protection

![](_page_23_Picture_14.jpeg)

Creepage distances

![](_page_23_Picture_16.jpeg)

Protection against electric shock...

![](_page_23_Picture_18.jpeg)

Internal circuit & connections

![](_page_23_Picture_20.jpeg)

Terminals for external conductors

![](_page_23_Picture_22.jpeg)

**Dielectric properties** 

![](_page_23_Picture_24.jpeg)

Short-circuit withstand

![](_page_23_Picture_26.jpeg)

![](_page_23_Picture_27.jpeg)

![](_page_23_Picture_28.jpeg)

### Design verifications of IEC 61439-1 (Annex D)

To detect faults in materials and workmanship and to ascertain proper functioning, and to confirm that the proofs of **design verification** are available

	Characteristics to be verify	Clauses
1	Degree of protection of enclosures	11.2
2	Clearances and creepage distances	11.3
3	Protection against electric shock and integrity of protective circuit	11.4
4	Incorporation of built-in components	11.5
5	Internal electrical circuits and connections	11.6
6	Terminals for external conductors	11.7
7	Mechanical operation	11.8
8	Dielectric properties	11.9
9	Wiring, operation performance and function	11.10

![](_page_24_Picture_4.jpeg)

![](_page_24_Picture_5.jpeg)

![](_page_24_Picture_6.jpeg)

![](_page_24_Picture_7.jpeg)

![](_page_24_Picture_8.jpeg)

![](_page_24_Picture_9.jpeg)

Wiring, operational performance

![](_page_24_Picture_11.jpeg)

### 1 to 7 are "Construction verification" 8 to 9 are "Performance verification"

![](_page_24_Picture_15.jpeg)

Clearances & Creepage distances

![](_page_24_Picture_17.jpeg)

Protection against electric shock...

![](_page_24_Picture_19.jpeg)

Internal circuit & connections

![](_page_24_Picture_21.jpeg)

Terminals for external conductors

![](_page_24_Picture_23.jpeg)

![](_page_24_Picture_24.jpeg)

## Routine verifications of IEC 61439-1

### List of routine tests verification

Characteristics to be verify	Visual inspection	Test	Criterias
1 Degree of protection of enclosures	x		To confirm that the prescribed measures to achieve the designated degree of protection are maintained.
2 Clearances and creepage distances	x		Less than the values given in Table 1, Uimp test If not evident, physical measurement
Creepage distances	X		Or if not evident physical measurment
Protection against electric shock and 3 integrity of protective circuit	X		Random verification of tightness of the connections of protective circuit
4 Incorporation of built-in components	x		Shall be in accordance with the assembly manufacturing instructions.
5 Internal electrical circuits and connections	X		The connections, especially screwed and bolted connections, shall be checked for the correct tightness on a random basis.
6 Terminals for external conductors	X		The number, type and identification of terminals shall be checked in accordance with the assembly manufacturing instructions.
7 Mechanical operation	X		The effectiveness of mechanical actuating elements, interlocks and locks including those associated with removable parts shall be checked.
8 Dielectric properties		Х	Power-frequency dielectric test (rating above 250A (630A next ED3)), or verification of insulating resistance
9 Wiring, operation performance and function		Х	Verification of completeness of information & markings, inspection of wiring and Function test where relevant

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![](_page_26_Picture_3.jpeg)

### Q1. What is the significance of increasing the dielectric test from 5 sec to 60 seconds?

#### Answer

When you perform a dielectric test, in case of conductive particles along the creepage distances, it will use a certain time to broke this dielectric. Perhaps with 5s it will work, but perhaps not with 60s. Sure this constrain is much higher compared with the previous edition but in line with the requirement of the IEC60947-1 used for LV products.

![](_page_27_Picture_5.jpeg)

![](_page_27_Picture_6.jpeg)

### Q2. What limit would be applied to Aluminium when it is treated? 55K or something else?

#### Answer

The limit is linked to the coated itself.

Usually, aluminum tin coated the limit is 105°C absolute temperature that mean 70K. Aluminum silvered coated could be 140°C absolute temperature that mean 105K.

In any case the original manufacturer shall provide conformity declaration based on tests (ageing) proving that performance.

![](_page_28_Picture_7.jpeg)

![](_page_28_Picture_8.jpeg)

# Q3. Does IEC call for complete functional unit with Protection + Switching + Electronic component testing?

#### Answer

IEC calls for all type of electrical or electronic products.

The original manufacturer shall provide documents (technical guide) to install them in the assembly and shall be incorporated in minimum one of a configuration tested.

![](_page_29_Picture_7.jpeg)

# Q4. For short S/C withstand capability...can you please elaborate on table 13 importance and role?

#### Answer

Table 13, remind all the different parameter to check to extrapolate a result from a test. Because the customer configuration is "always" different compared to the tested configuration. This one should be the worst case, but there is a need to verify some points. In case of doubt, the IEC propose to use the IEC TR60865 to calculate and validate the customer configuration.

![](_page_30_Picture_5.jpeg)

![](_page_30_Picture_6.jpeg)

Q5. On the test report documents, can we mention rated current up to 4000A when we have only tested the assembly/switchboard for 4000A not for lower ratings?

#### Answer

When you want to cover a range of assemblies, if you can prove that your assembly 4000A cover everything you can write 'rated' current up to 4000A".

BUT unfortunately, the configuration of the assembly 4000A can be different compared to 1000A.

I suppose the volume of the 4000A configuration should be much higher compared to 1000A.

That the reason why there is, a lot of time, a need to perform several configuration to cover a range of assembly.

Example

800-1000-1250-1600 because the depth is 400mm

2000-2500 because the depth is 600mm

3200-4000 because the depth is 1000mm

For business, some countries appreciate to have one configuration per rating which is the case to BlokSet.

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### Q6. Is the Edition 3 backward compatible with Edition 2?

#### Answer

The official answer of the IEC61439-1:2020 is

Where tests on the assembly have been conducted in accordance with the previous editions of the IEC 61439 series, and the test results fulfil the IEC 61439-1:2020-05, IEC requirements of the current edition of the relevant part of IEC 61439 series, the verification of these requirements need not be repeated.

Schneider-Electric will perform all the tests of the IEC61439-1/2 to a range of assembly to get new complete certificates.

![](_page_32_Picture_7.jpeg)

![](_page_32_Picture_8.jpeg)

![](_page_32_Picture_9.jpeg)

## For further information

 Recording of the webinar
 The recording of the webinar is as below: https://youtu.be/Slb1asAJGXg

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![](_page_33_Picture_5.jpeg)

# Thank You!

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