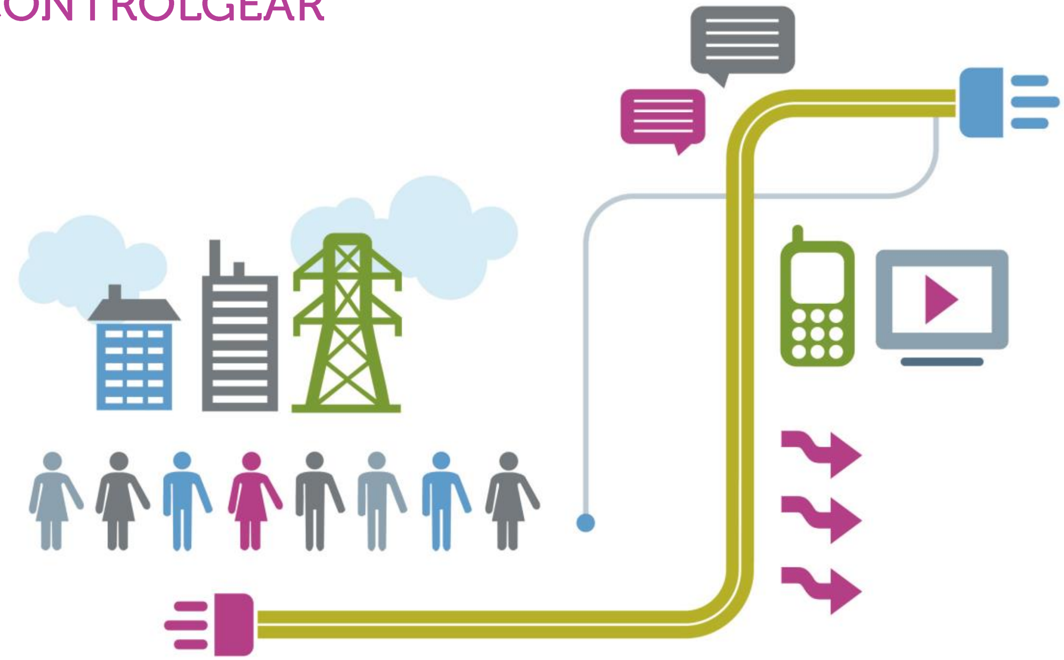
BEAMA ENGINEERED SYSTEMS PRODUCT GROUP
CHANGES IN IEC 61439-1 & 2 ED. 3

POWER SWITCHGEAR AND CONTROLGEAR ASSEMBLIES

November 2020



INTRODUCTION – WHO WE ARE

BEAMA is a member association that represents manufacturers of electrical infrastructure products and systems, from transmission through distribution to the environmental systems and services in the built environment, with over 200 members ranging from SMEs to large multinationals. BEAMA member's products provide a sustainable, safe, efficient and secure UK electrical system. We support our members in ensuring that the UK has a strong electrotechnical industry that is recognised as an essential part of modern society and brings invaluable economic, social and environmental benefits.

About the Engineered Systems Product Group

The BEAMA Engineered Systems Product Group comprises companies who manufacture Low Voltage Factory Built Switchboard Assemblies and Busbar Trunking Systems.

Our Representation

BEAMA engages across the wide spectrum of product legislation, standardization and market surveillance initiatives representing the interests of members and assisting the markets' understanding of constantly changing requirements. BEAMA's success comes about through its membership of:

- Strategic Standardisation committees at National and International level
- BSI, the UK National Standards Body
- Orgalim, the European federation of national industrial associations representing the European mechanical, electrical, electronic, and metal articles industries and
- European sectoral associations.

BEAMA is one of the leading nominating organisations to BSI with BEAMA members serving on upwards of 200 standards committees at a national (BSI), European (CENELEC) and International (IEC) level. Members of ESPG hold Chair and Convenorships on BSI, CLC and IEC committees responsible for maintaining standards for Low Voltage Switchgear and Controlgear Assemblies .

WHO BEAMA BUILDING ELECTRICAL SYSTEMS ENGAGE WITH…

We have established collaborative and longstanding links with key Building Electrical Systems policy makers and wider market participants including…

AMDEA – The Association of Manufacturers of Domestic Appliances

bsi.

CAPIEL – european coordinating committee of manufacturers of electrical switchgear and controlgear

CATAPULT Energy Systems

cecapi

cen

CENELEC

Certsure

Department for Business, Energy & Industrial Strategy

Department for International Trade

Department for Transport

ECA – Excellence in Electrotechnical & Engineering Services

EDA – ELECTRICAL DISTRIBUTORS' ASSOCIATION

Electrical Safety First

ena – energy networks association

IEC

IET

MSSI ELECTRICAL – MARKET SURVEILLANCE SUPPORT INITIATIVE

NAPIT

NICEIC

orgalim – EUROPE'S TECHNOLOGY INDUSTRIES

SELECT

Introduction & Overview

The purpose of this webinar is to highlight:

- After 9 years development: IEC 61439-1 & 2:Edition 3:2020 have been published
- IEC are international standards developed through consensus by experts from countries around the world
- There are several changes, varying from minor to very significant
- The significant changes affect how assemblies are specified, manufactured and used

Th… wi… to pa…


IEC
IEC 61439-1
Edition 3.0 2020-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Low-voltage switchgear and controlgear assemblies –
Part 1: General rules

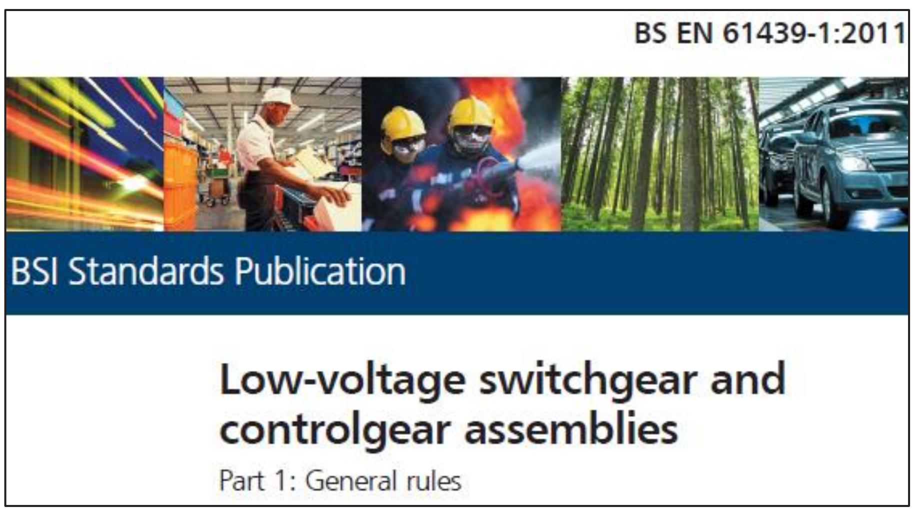

IEC
IEC 61439-2
Edition 3.0 2020-07

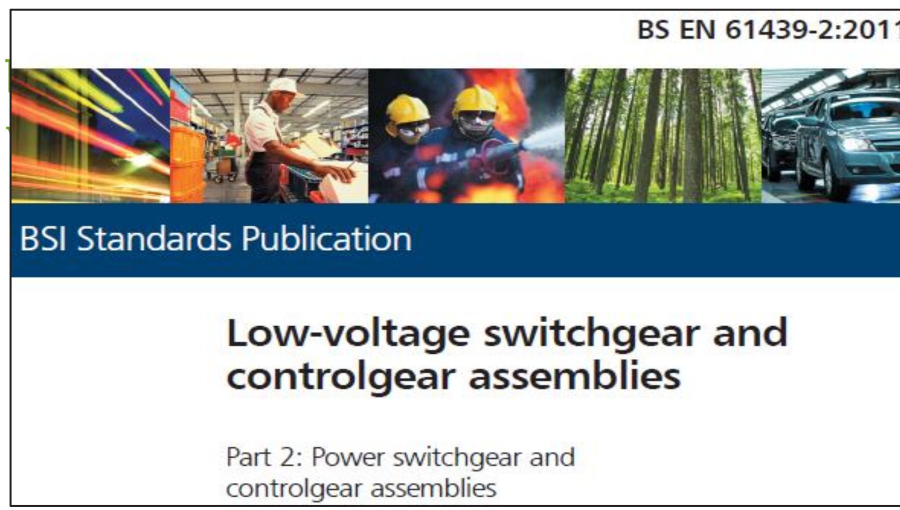
INTERNATIONAL STANDARD

Low-voltage switchgear and controlgear assemblies –
Part 2: Power switchgear and controlgear assemblies

Current UK harmonization situation

- IEC standards are implemented in the EU through ENs and then for UK as BS ENs
- IEC 61439-1 & 2 Ed. 3 are currently under review to transpose into ENs for listing in the European Journal (OJ) as a means of providing a presumption of conformity with the essential safety requirements of the Low Voltage Directive (LVD) & EMC directive
- Once published, the new BS ENs are likely to have a 3 year transition period TBC





Classification of Changes in IEC 61439-1 & 2 Ed. 3.

IEC 61439-1 & 2 Ed. 3 includes numerous changes, some of which have made the new standards closer to the requirements of:

- the IEC installation rules IEC 60364 which are implemented in CENELEC via Harmonized Document 60364 and adopted in the UK via BS 7671 and
- BS EN 60204-1, assemblies for machines
- These will be covered in more detail later in this presentation

The key changes can be generally classified into four categories:

1) Market needs; reflecting evolving markets
2) Significant technical changes
3) Opportunities for verification by means other than test
4) Important clarifications including: test, verification and specification.

1) Key changes: Market needs

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Market needs: Assemblies for photovoltaic (PV) applications

New informative annex giving best practice for assemblies for PV applications

- Recognizes PV is an onerous application; the maximum load coinciding with the maximum ambient temperature, possible solar effects & heavy condensation
- The main focus relates to combiner boxes

Additional design verifications to prove suitability for the PV environment including:

- Thermal cycling tests
- Climatic tests
- Solar effects temperature rise test (outdoor assemblies subject to direct sun)
- Multiple incoming circuits all fully loaded at the same time – one outgoing circuit.

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Market needs: Internal arc fault performance of assemblies

IEC 61439-2 now recognizes the need for assemblies incorporating measures to limit the implications of an internal arcing fault for some applications

Possible measures include:

- Limiting the probability of an arcing fault being initiated
- Containing the arc fault within the assembly,
- Quenching an arc quickly, within a few milliseconds

The standard doesn't contain specific requirements, but three key references:

1) IEC 61439-0: Guidance to specifying assemblies, which includes guidance on the performance of assemblies under arc fault conditions
2) IEC TR 61641: testing of assemblies under arc fault conditions
3) IEC TS 63107: incorporation of arc fault mitigation systems into assemblies

Important note: the foregoing are risk reduction measures; they are not guaranteed

There is a link to BS 7671 wiring regulations: Regulation 532.5 Internal arc fault

Market needs: wider use of Direct Current (DC)

With wider use of DC generation, e.g. PV applications, and migration in some applications to DC distribution, the standard has greater emphasis on DC, for example:

- Acceptance that AC RMS short-time withstand current tests can cover DC short-time withstand current tests (this does not apply to breaking tests)
- More clarity on when AC and DC dielectric tests should be used
- Frequent reference to AC RMS or mean value of DC, and
- Typical DC peak factor of 1.42 for short-circuit tests.

2) Significant technical changes

Technical change: New characteristic; group rated current of a circuit (I_{ng})

A reminder: current requirements within IEC 61439-1 & 2 Ed. 2

Assumption that a device will have a rated current I_n in accordance with its own product standard, e.g. IEC 60947-2

- Determined with the device in free air
- This is not an enclosed assembly rating

The manufacturer is obliged to determine and declare the rated current of the circuit I_{nc}

- Determined by temperature rise test; or,
- Must not exceed 80 % of I_n when verified by calculation

The manufacturer is obliged to determine and declare the rated diversity factor (RDF)

- Determined for the assembly as a whole; and/or,
- Determined for individual sections within an assembly.

Technical change: The new characteristic; group rated current of a circuit (I_{ng})

The **new** characteristic I_{ng} within IEC 61439-1 & 2 Ed. 3:

The group rated current of a main circuit (I_{ng}) is the current that can be carried by this circuit when it is loaded **continuously** and **simultaneously** together **with at least one other circuit** in the same section of the assembly, in a **specific arrangement** as defined by the original manufacturer.

Technical change: "The new approach" Group rated current of a circuit (I_{ng})

The new approach within IEC 61439-1 & 2 Ed. 3:

A device has a rated current I_n to its own product standard, e.g. IEC 60947-2

- This is determined with the device in free air
- This is not an enclosed assembly rating

The assembly manufacturer must **now** declare either:

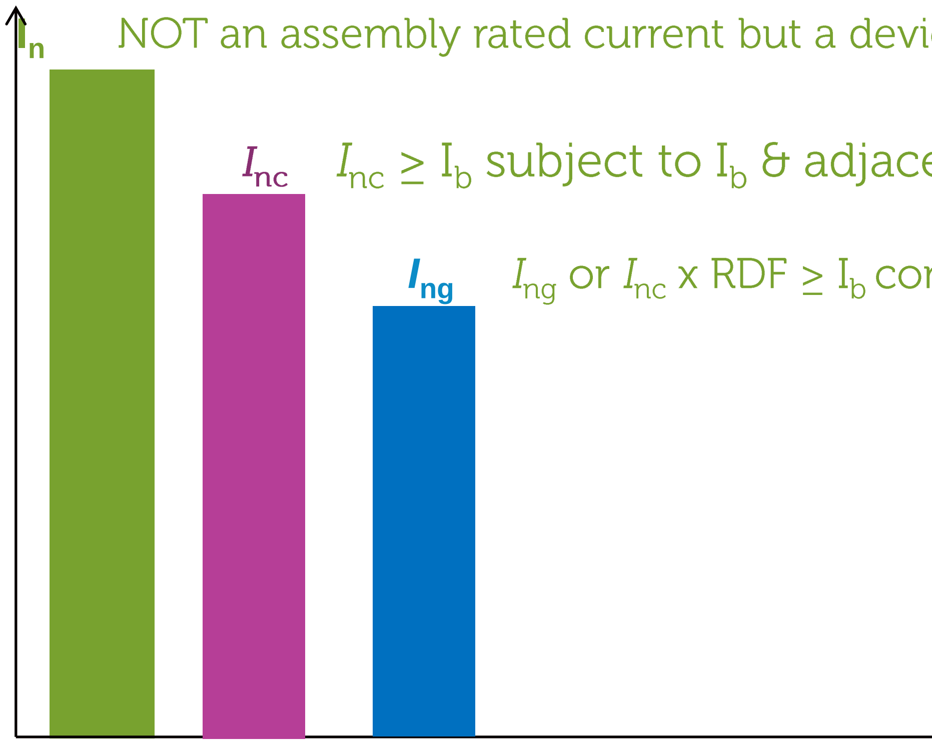
- the group rated current I_{ng} for each circuit
  - Determined and applicable to an individual circuit in a particular arrangement of assembly

  OR
- the rated current of a circuit (I_{nc}) as previous, together with Rated Diversity Factor

The Rated Diversity Factor is established by calculation: I_{ng} / I_{nc} where I_{ng} and I_{nc} are derived by test.

Technical change: Group rated current of a circuit (I_{ng})

Summary of probable relative rating of devices, circuits and typically descending values



NOT an assembly rated current but a device rating in free air

$I_{nc} \geq I_b$ subject to I_b & adjacent circuit load characteristics*

I_{ng} or I_{nc} x RDF $\geq I_b$ continuous loading of adjacent circuits**

* Consideration should be taken of the load (I_b), it's duration & simultaneous, light or no loading of adjacent circuits.

**The electrical installation designer, can calculate the thermally equivalent current for predictably varying/intermittent loads which should not exceed the group rated current of the circuit I_{ng} of the assembly unless precise information is available for loading of adjacent circuits

Technical change: Group rated current of a circuit (I_{ng})

Two key points to note:

1) The group rated current I_{ng} cannot just be specified in Amps alone. The assembly manufacturer must define the loading of adjacent circuits for which the I_{ng} applies

2) When the rated current I_{nc} of the circuit is declared, subject to the loading characteristics of adjacent circuits, the design current I_b for a given circuit can be increased to the rated current I_{nc} of the circuit. **This potentially, allows for higher utilization of the assembly, avoids over-engineering and the most economical solution.**

Technical Change: Specifying rated currents

- If the **specifier** does **not** state the required I_{nc} , I_{ng} or the design current of the circuit I_b , the assembly manufacturer **will assume** the rated currents given are the currents of the protective devices I_n
- In the **absence of any other information**, the manufacturer can assume the load current I_b to be the rated current of the **protective device** I_n , multiplied by the **assumed loading factor** from Table 101.

Table 101

Type of load	Assumed loading factor
Distribution – 2 and 3 circuits	0,9
Distribution – 4 and 5 circuits	0,8
Distribution – 6 to 9 circuits	0,7
Distribution – 10 or more circuits	0,6
Electric actuator	0,2
Motors ≤ 100 kW	0,8
Motors > 100 kW	1,0

For example: If a specification states: "MCCB 400 A" without further qualification, this is assumed to be the MCCB I_n. If the MCCB is in a group of 6-9 circuits, the assumed loading factor is 0.7. therefore: the assumed maximum I_b is: 400 x 0.7 = 280 A

- Warning: The manufacturer can assume lower values than Table 101.

Technical change: Assembly designation marking IEC 61439-1 & 2

In addition to other information, the following must **now** be provided on the designation label(s):

- rated current of the assembly I_{nA} (see 3.8.10.7 and 5.3.1);

This aligns with BS 7671: Regulation 536.4.202 Current ratings: *"The rated current of an assembly* I_{nA} *is the maximum load current that it is designed to manage and distribute"*

- Three key points:

1) The rated current of the assembly I_{nA} must **now** be on the assembly label together with rated voltage, rated frequency, mean's of unique reference, date of manufacture and manufacturers name or trade mark. This must be visible and legible when the assembly is installed and in operation
2) The rated current of the assembly, I_{nA} may be **lower** than the nominal rating of the incoming device(s)
3) Other applicable interface characteristics e.g. I_{nc}, RDF and / or I_{ng} shall be provided in the technical documentation supplied with the assembly.

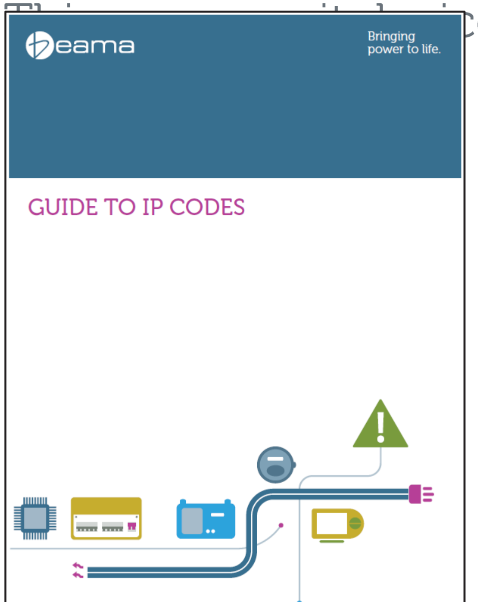
Technical change: Macro & Micro Environment

There is now a distinction between the environment within the assembly and environment outside the assembly (where it is installed)

- Macro environment is where the assembly is located (outside the assembly)
- Micro environment is inside the enclosure

This recognizes that the pollution degree inside the assembly, may be different from that of the macro-environment outside the assembly e.g. due to protection by an enclosure or internal heating to prevent absorption or condensation

ces and components with a lower pollution degree to be



"The possible effects of condensation may be solved by ventilation, use of anticondensation heaters, climate controls…".

Technical change: Aging of insulating materials

Insulating materials need to be suitable for the application, in particular their aging characteristics

- Insulating materials must be suitable for the normal maximum operating temperature
- Adequate performance of insulation materials e.g. barriers, busbar insulation, for the anticipated life of the assembly needs to be taken into account
- Insulating materials forming part of devices e.g. circuit- breakers, are dealt with by the appropriate device standard

Most assembly manufacturer's will use as a reference, a materials data base, e.g. UL746B considering all appropriate criteria.

3)Opportunities for verification by means other than test

Design verification: temperature-rise with active cooling

Active cooling is required to be operational as in normal service during verification of temperature rise by test

- Active cooling includes fans, internal air conditioning and heat exchangers

Verification of temperature rise **by calculation** with active cooling of assemblies not exceeding 1600 A is **now** recognised in IEC 61439-2;

- The reliability of verification by calculation is very dependant on the cooling equipment manufacturer's data.

Design verification other than by test: temperature-rise

There is now an increase in the current rating of an assembly where temperature rise assessment can be used:

Assemblies with a rated current I_{nA} **above 1600 A** can be verified by a combination of test, comparison to a reference design and by calculation as follows:

- Incoming and outgoing **circuits** rated **above 1600 A (I_{ng})** must be verified by test or comparison to a reference design
- Circuits rated **1600 A and lower** can be verified by using a reference design and calculation

Three key points:

1) A reference design must be available
2) The power loss of the circuit and the busbars in the reference design have been measured
3) The power loss of the components in the new design are known.

4) Important clarifications including: test, verification and specification

Clarification: Classes of assembly

IEC 61439-1 & 2 have always covered conventional assemblies with metallic enclosures and those protected by 'total insulation', (an undefined term)

The standard has now been updated to recognize there are two Classes of assembly:

- Class I: Conventional assemblies with metallic enclosures or assemblies with an insulated enclosure having a protective circuit for external fault protection
- Class II: Typically assemblies having an enclosure made of double or reinforced insulation as the means of fault protection (typically used with IT supply systems e.g. hospital operating theatres, railway signalling).

Clarification: Incorporation of devices

IEC 61439-1 & 2 deals with the structure and correct functioning of the complete assembly

The standard now clarifies:

- It does not duplicate type tests undertaken on individual devices or equipment verified to their own product standard
- Verifications in accordance with IEC 61439-1 & 2 are undertaken to ensure the correct incorporation of devices and to ensure their mutual compatibility and that the assembly as a whole has a satisfactory and safe performance

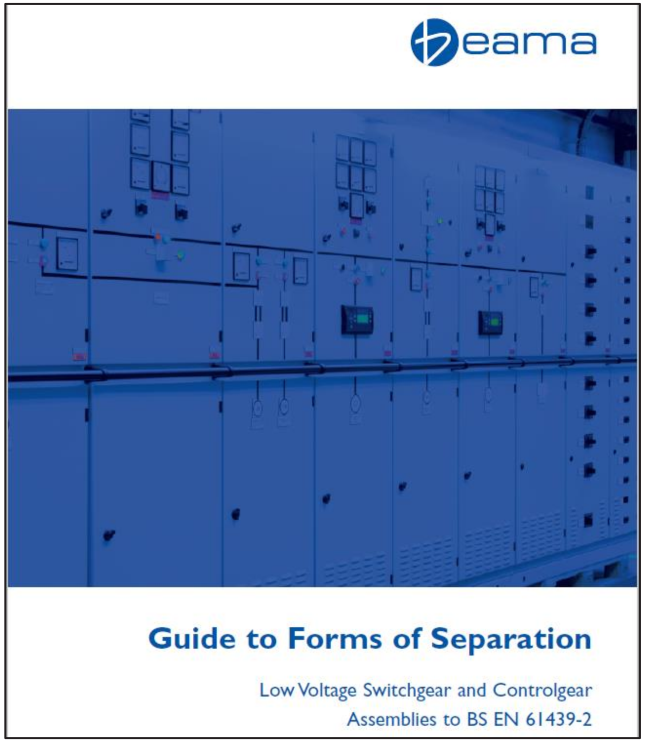
To emphasis and clarify the above, the standard includes a clear statement that switch-mode power supplies, uninterruptable power supplies, adjustable speed drives, etc. are tested in accordance with their own product standard. IEC 61439-1 & 2 deals with their incorporation into an assembly or into an empty enclosure forming an assembly.

Clarification: Forms of internal separation

Forms of internal separation are essentially as previous except:

- When the door or cover which provides the normal means of access to a compartment is opened, any hazardous live part must be protected against accidental contact with a standard jointed test finger (IP XXB minimum)

IEC 61439-2 is now aligned with good UK practice and principles of BEAMA members as covered in the BEAMA Guide to Forms of Separation.



Clarification: Induced heating of steel

A frequently debated issue and question is; *"when can a single AC load carrying conductor pass through a hole in a ferro-magnetic enclosure or plate"?*

The standard now clarifies the situation as follows:

- Permitted to pass through a single hole in a ferro-magnetic enclosure or plate when the current does not exceed 200 A
- For currents exceeding 200 A, only when the arrangement has been proven by temperature rise test
- It is permitted for an additional protective conductor to enter the ferro-magnetic enclosure through a separate hole.

Conclusion & summary

Conclusion

Summary:

- IEC 61439-1 & 2 have been revised and issued as Edition 3:2020
- Whilst the IEC Edition 3s are published, EN (and **BS EN**) 61439-1 & 2 Edition 3s are currently under review, regarding listing in the European Journal (OJ)
- The new editions will affect the way assemblies are specified, manufactured and used
- In the meantime, in the UK, conformity with BS EN 61439-1 & 2:2011 continue to be the means of presumption of conformity with the LVD and EMCD
- This presentation has only provided an overview of some of the changes and it is recommended that the standards are read in detail

BEAMA are developing more detailed guidance that will cover all the important changes affecting design, verification, specification and application of assemblies in accordance with the new BS EN standards.

Thank you

Questions