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IEC61439-1/2 Design Verification Calculating, Deriving or Testing

Tech Experience 2017 May 16, 2017

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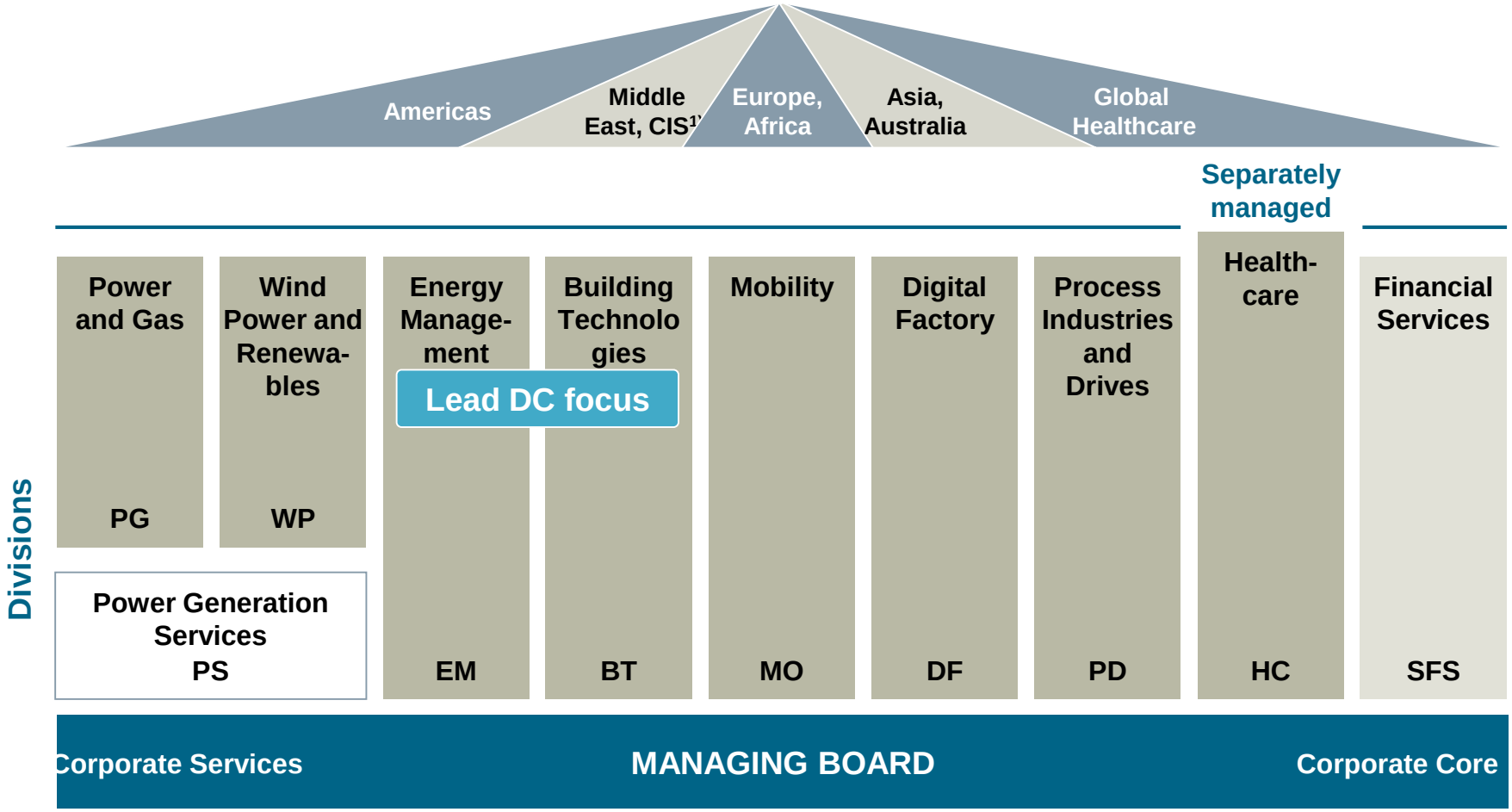

1) Commonwealth of Independent States

IEC61439-1/2 Design Verification Case

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•Design Verification per IEC61439 is much clearer defined compared to (Partially) Type Testing per the superseded IEC60439

•However, IEC61439 Design Verification still allows for interpretation

•Interpretation has consequences

•This case study investigates interpretation and its impact

•Current Carrying Capability of high current Switchgear-to-External interfaces is particularly critical

•A Siemens Air Circuit Breaker in Siemens Switchgear interfacing to similar Siemens Bus Way types is assessed on this aspect

The outcome might be counter intuitive …

IEC61439-1/2 Design Verification Aspects & Methods

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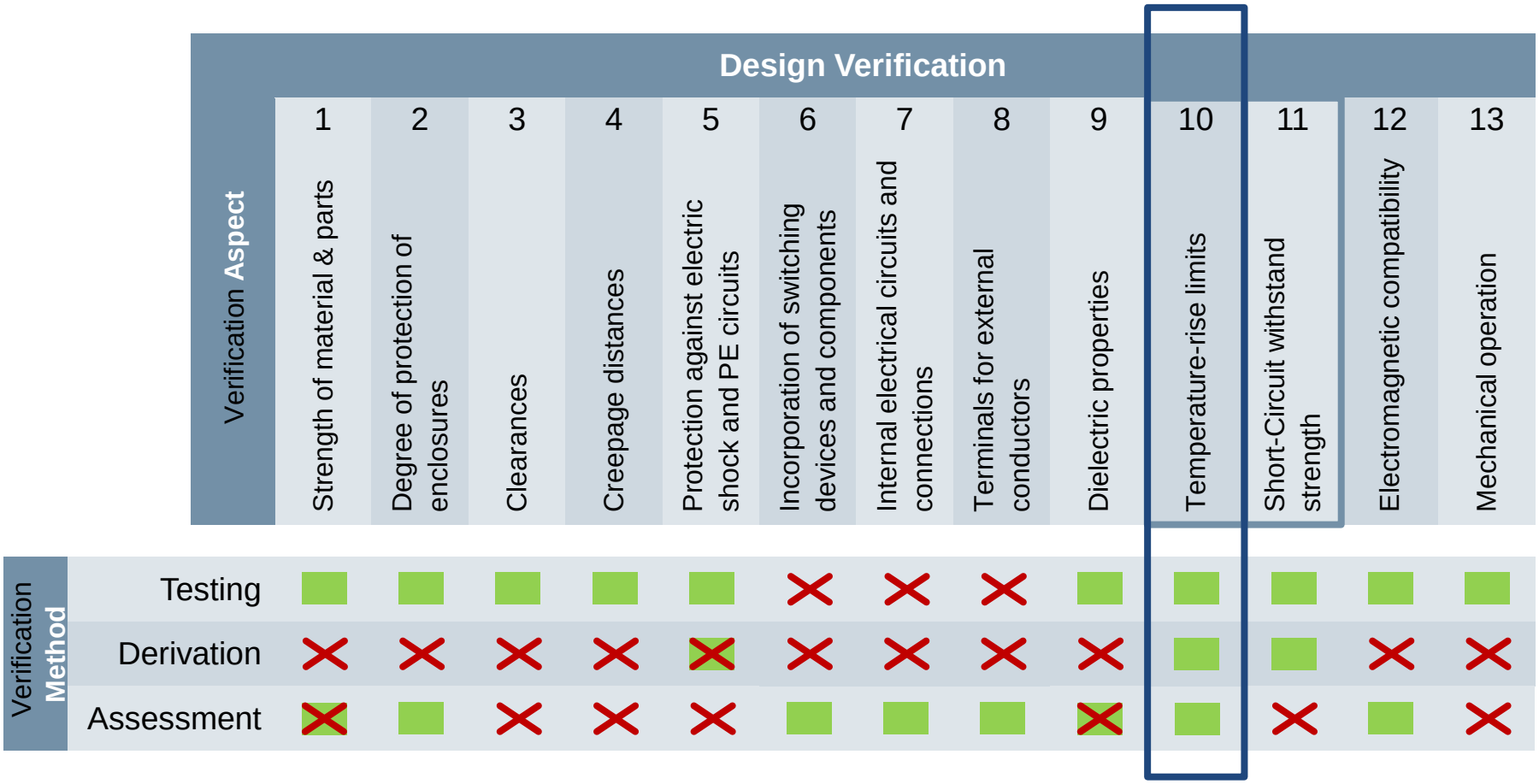
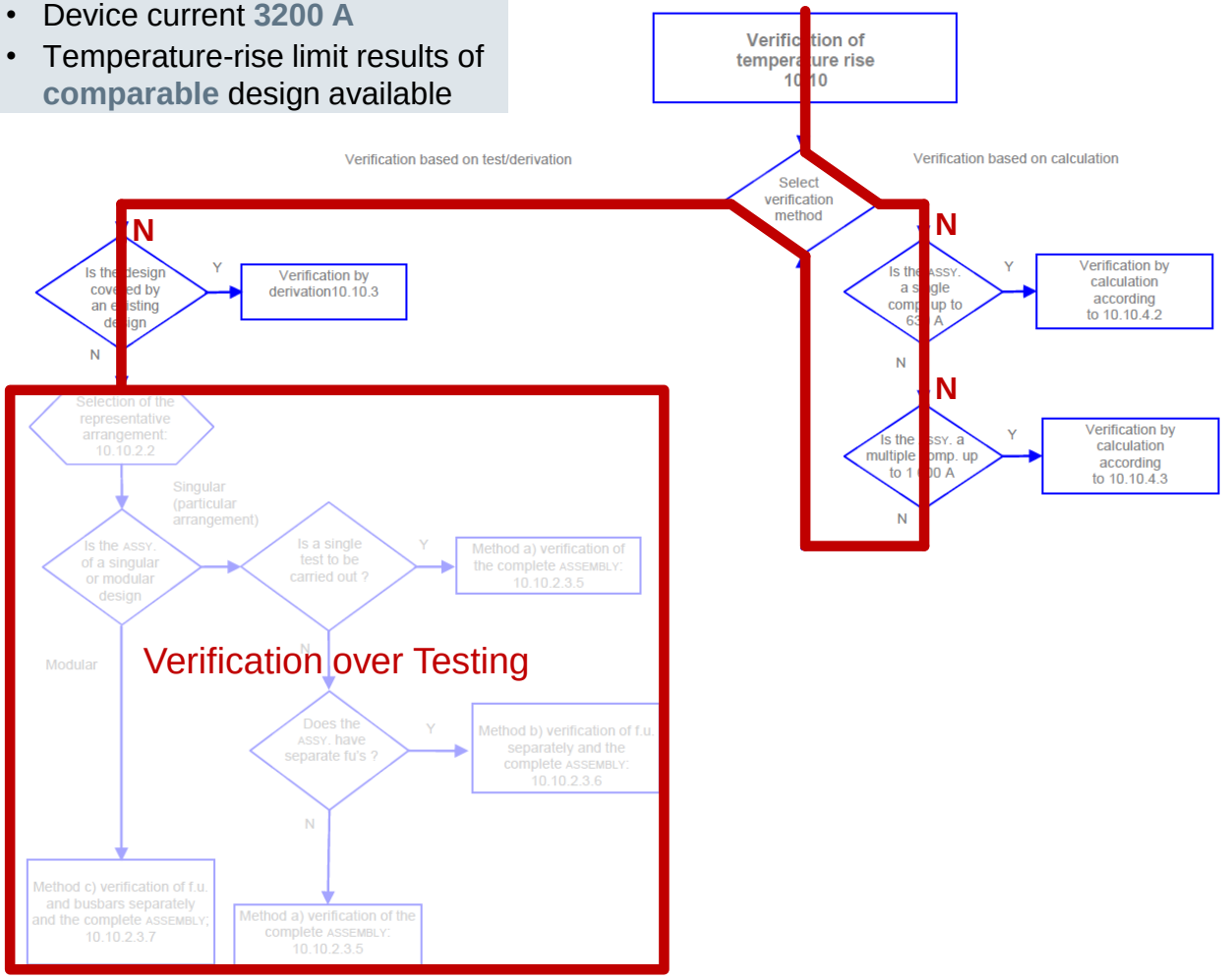


Excerpt from IEC61439-1:2011, Annex D

Temperature-rise limits
Selection of Verification Method

Assessed Example Cubicle

- Device current **3200 A**
- Temperature-rise limit results of **comparable** design available



Determination of permitted **Verification Method**

Verification by **Calculation ?**

Single compartment and **≤630 A ? No**

Multiple compartment and **≤1600 A ? No**

Verification by **Test** or **Derivation**

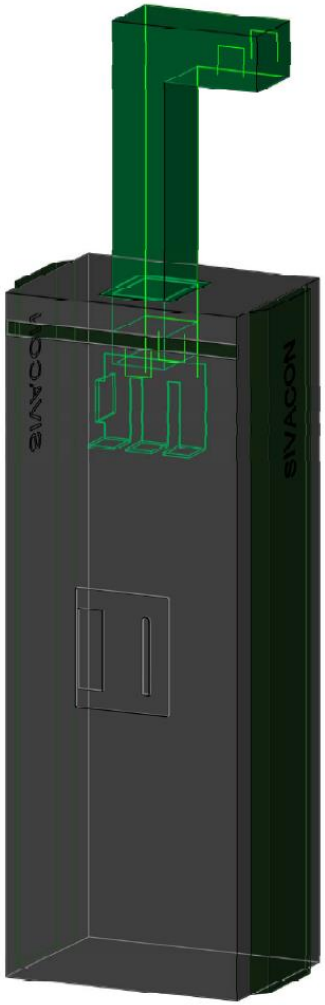
Verification by **Derivation** from existing design accepted when:

- ✓ Breaker of same series
- ? Same construction
- ✓ ≥ Overall dimensions
- ? Same cooling conditions
- ✓ Same internal separation
- ✓ Same power loss

2 × '**?**' → **Decision:** Verification by **Test**

Excerpt from IEC61439-1:2011, Annex O

Switchgear - Bus Way interface
Assessment definition



Example Cubicle

- Siemens SIVACON S8 Switchgear platform
- Single cubicle
- Withdrawable **A**ir **C**ircuit **B**reaker
- Rated device current **3200 A**
- **Bus Way** top entry

Starting point

- Temperature-rise limit test results of example cubicle with SIVACON-8PS **Type: LDA-3200A** Bus Way are available

Assessment

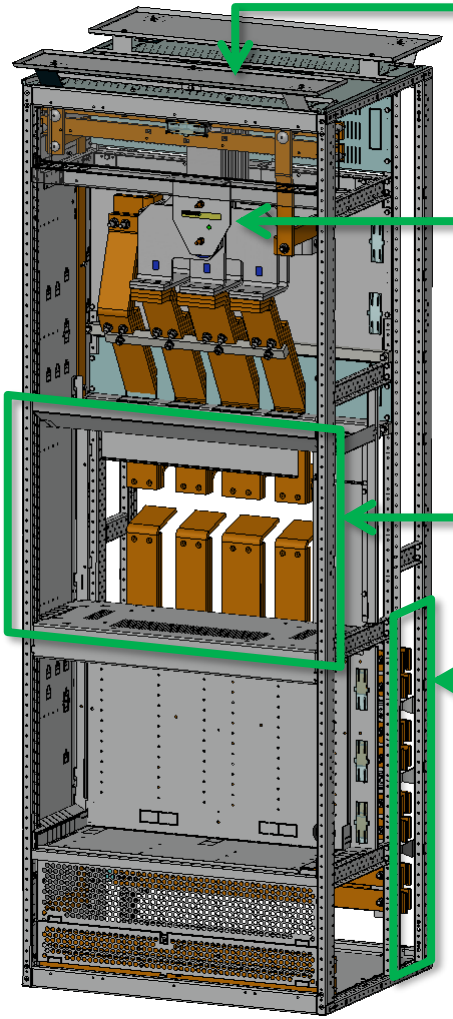
- Find Current Carrying capability of example cubicle with SIVACON-8PS **Type: LXA-3200A** Bus Way

Focus

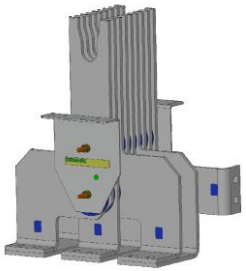
- Design Verification 10 - Temperature-rise limits

Temperature-rise limits
Rated current Assembly @ 35 ºC Ambient

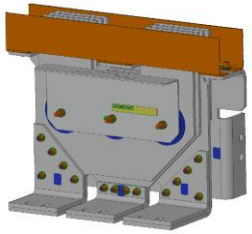
Comparable Cubicle Configuration



Top Bus Way Connection



Bus Way Interface
LDA-3200A



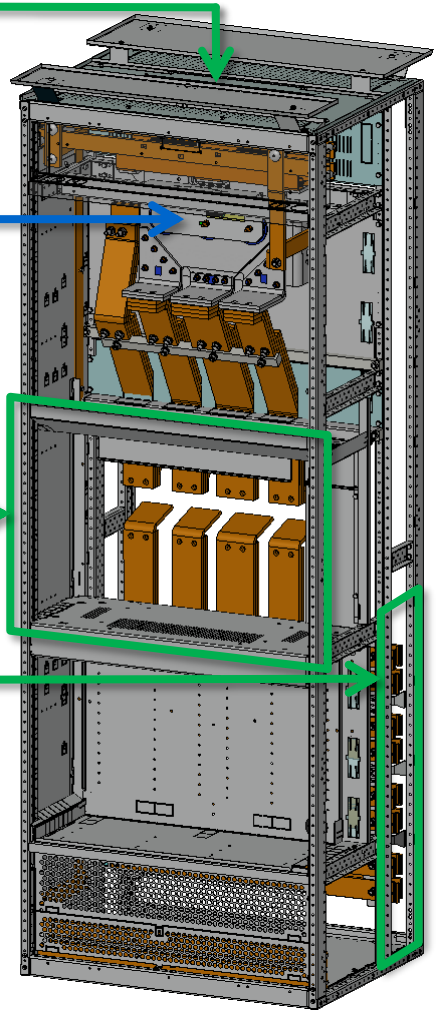
Bus Way Interface
LXA-3200A

Position of 3200 A Air Circuit Breaker (ACB not shown)

Main Bus Bar position

2660 A

2530 A

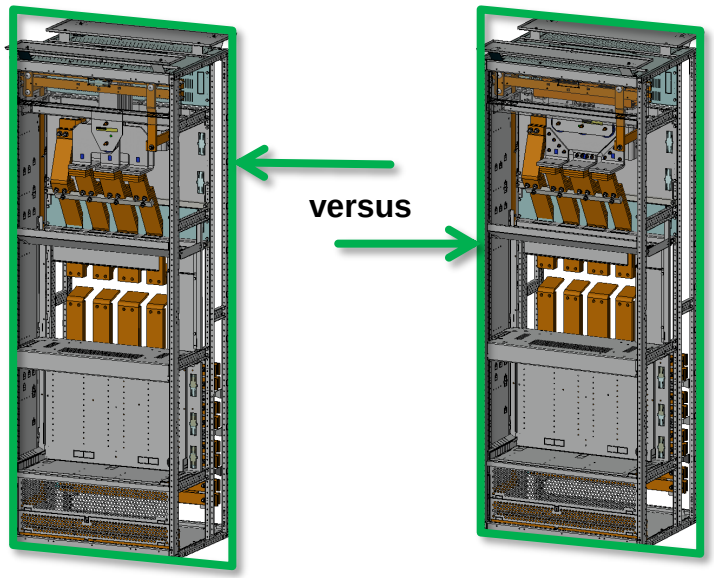


Assessed Cubicle Configuration

Temperature-rise limits
Consequences of Results

Decision on **Test** over **derivation**
based on 2 × '**?**' in verification assessment

Would choice for **Derivation** over **test** been defendable?



Designs deceivingly similar

↓

Derivation appears defendable

↓

Nonetheless testing revealed a **130A** □

↓

Responsibility for test or derivation with OEM

↓

Who ensures design verification reflects assembly capability ?

IEC61439-1/2

- ✓ Breaker of same series
- ? Same construction
- ✓ ≥ Overall dimensions
- ? Same cooling conditions
- ✓ Same internal separation
- ✓ Same power loss

?

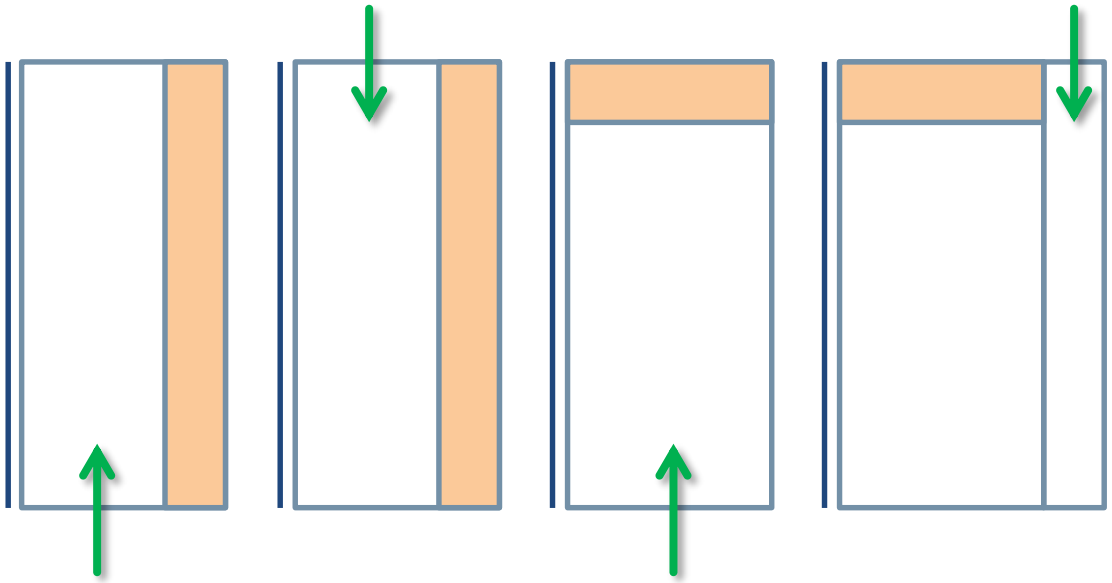
- ✓ Breaker of same series
- ✓ Same construction
- ✓ ≥ Overall dimensions
- ✓ Same cooling conditions
- ✓ Same internal separation
- ✓ Same power loss

Temperature-rise limits
Configurations & Capability overview (I)

Siemens SIVACON S8 LV Switchgear key configurations

Front of Switchgear

Side view

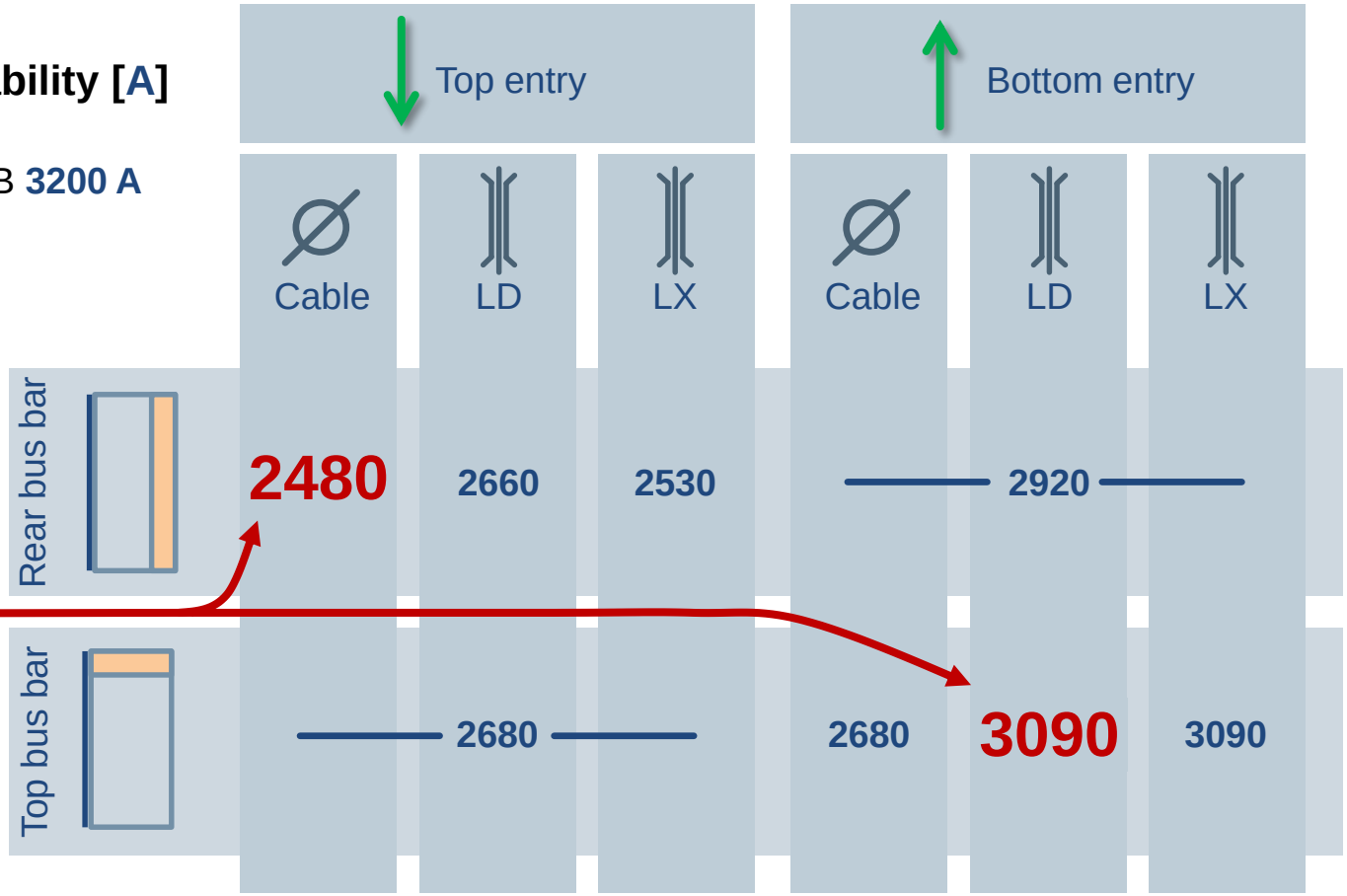


	Main Bus Bar position	Rear		Top	
→	Cable or Bus Way entry	Bottom	Top	Bottom	Top

Temperature-rise limits
Configurations & Capability overview (II)

SIVACON S8
Current carry capability [A]

- Nominal Current ACB **3200 A**
- 35 ºC Ambient
- IP4X / Form 4b
- Natural ventilation
- Status 2015



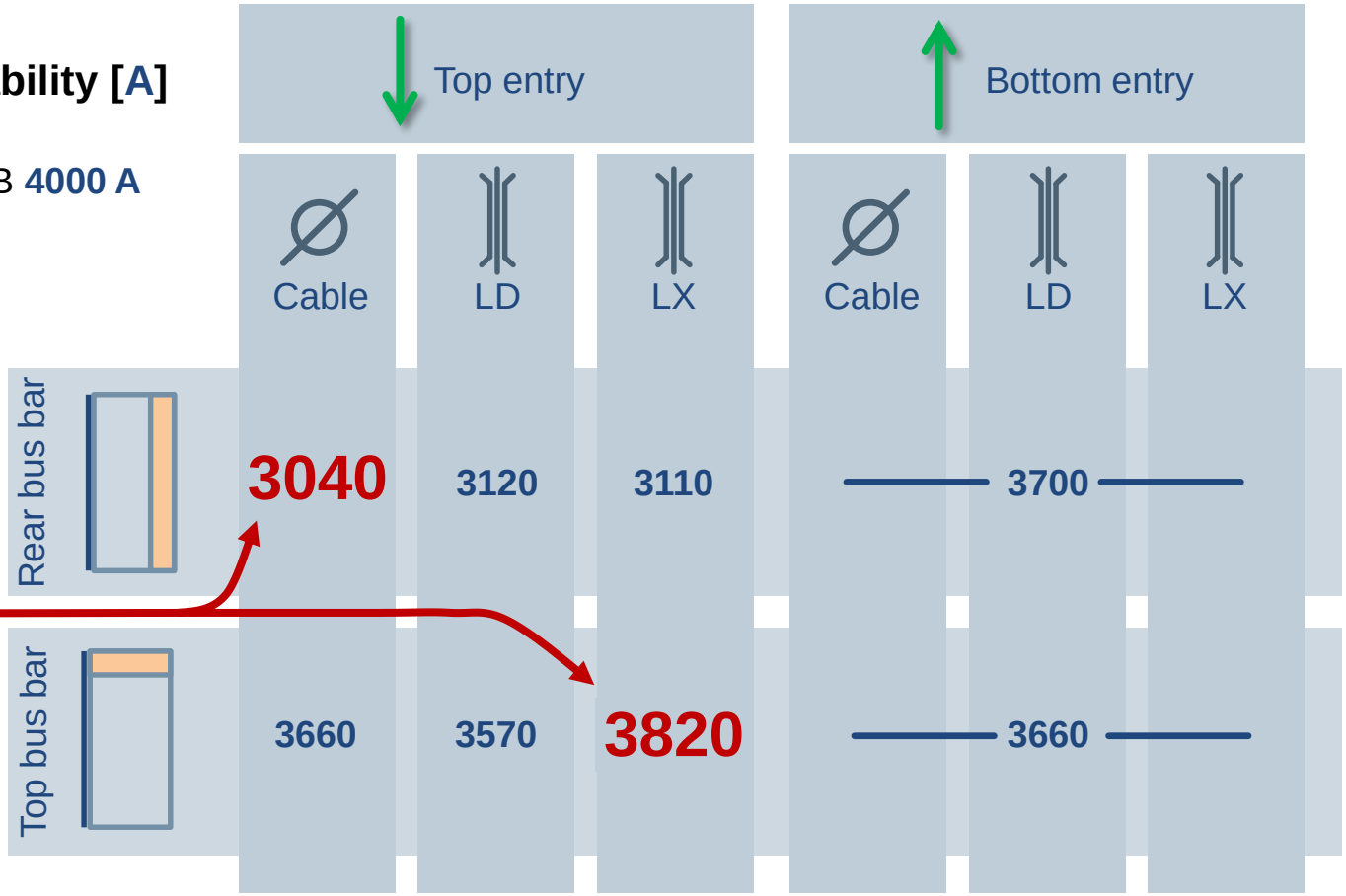
- **Same ACB**
- **□ 610 A**
- **Comparable ?**

Bus Way Interface Cable interface

Temperature-rise limits
Configurations & Capability overview (III)

SIVACON S8
Current carry capability [A]

- Nominal Current ACB **4000 A**
- 35 ºC Ambient
- IP4X / Form 4b
- Natural ventilation
- Status 2015



- **Same ACB**
- **□ 780 A**
- **Comparable ?**

Bus Way Interface Cable interface

IEC61439 Design Verification Conclusion

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Switchgear interfaces

- Significant variations in **current carrying capability** dependant on
  - Switchgear design
    - Ingress Protection degree - IP
    - Physical Dimensions
    - Form Factor
    - Position Main Bus Bar
    - Internal Panel Construction
  - Interface type
    - Bus Way & Bus Way type
    - Cable & Cable type
  - Interface position
    - Top entry
    - Bottom entry
- **Derivation** – even inline with IEC61439 – of current carrying capability is **no guarantee** for feasibility
- Counter intuitive test results

Siemens position	**Only Temperature rise testing** of each specific interface **guarantees** current carrying capability

Thank you for your attention