Codes and Regulations for Panel Builders: Hitting a Moving Target
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- Introduction to the webinar
- Basic differences between North America and Europe

- Why this webinar?
- Webinar objectives
- Basic differences between North America and Europe
Why this webinar?

- In an increasingly globalized market, it is important to understand the differences in standards related to building “Industrial Control Panels” (ICP) for UL markets and “Low-voltage switchgear and control gear assemblies” for IEC markets.

- What is an Industrial Control Panel or Low-voltage switchgear and control gear assembly?

- *Which standards* are important for control panel design

- Address uncertainty with regard to the question: "*Who holds the responsibility?*"
Webinar objectives

- Introduction to European Directives and standards
- Refresher and update for the relevant North American standards (UL/NFPA)
- To provide an understanding important European Directives and standards
- To clarify the similarities and differences between relevant standards and their significance for control panel design
 Organizations
The global use of standards
What is an Industrial Control Panel (ICP)?

UL Definition:

**Industrial Control Panel.** An assembly of two or more components consisting of one of the following:

1. Power circuit components only, such as motor controllers, overload relays, fused disconnect switches, and circuit breakers
2. Control circuit components only, such as pushbuttons, pilot lights, selector switches, timers, switches, control relays
3. A combination of power and control circuit components

These components, with associated wiring and terminals, are mounted on or contained within an enclosure or mounted on a subpanel. The industrial control panel does not include the controlled equipment.
What is an Industrial Control Panel (ICP)?

IEC Definition:

Low-voltage switchgear and controlgear assembly [e.g. industrial control panel]

Assembly of one or several low-voltage switchgears and controlgears with related equipment for control, measurement, reporting, protection, and regulation, with all the internal electrical and mechanical connections and structural components
## Basic differences between U.S. and CE Markets

**Standards – Comparison between USA and IEC**

<table>
<thead>
<tr>
<th>UL / NEMA Standard</th>
<th>IEC Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA 70</td>
<td>IEC 60364-1</td>
<td>Use of electrical equipment</td>
</tr>
<tr>
<td>NFPA 79</td>
<td>IEC 60204-1</td>
<td>Installation of electrical equipment</td>
</tr>
<tr>
<td>UL508A</td>
<td>IEC 61439-1</td>
<td>Design standards for Industrial Control Panels</td>
</tr>
<tr>
<td>UL 489 (CBs)</td>
<td></td>
<td>Design standards for individual components</td>
</tr>
<tr>
<td>UL 508 (Control components)</td>
<td></td>
<td>(UL uses separate standards for different types of components. IEC standard 60947 has different sections for different types of components)</td>
</tr>
<tr>
<td>UL 98 (Safety switches)</td>
<td>IEC 60947</td>
<td></td>
</tr>
<tr>
<td>UL 248 (Fuses)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UL … (etc.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Basic differences between U.S. and CE Markets

Standards – Comparison between USA and IEC

- IEC 60947
- IEC 61008
- IEC 60204-1
- IEC 61439-1
- NEC = NFPA 70
- NFPA 79
- UL 508 A
- UL 489
- UL 508
- UL 98
- UL 248
- UL xxx
- IEC 60947
- IEC 61008
### Differences between Europe & North America

<table>
<thead>
<tr>
<th>Europe</th>
<th>USA / North America</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Responsibility of the equipment manufacturer</td>
<td>- Responsibility of the operator/user</td>
</tr>
<tr>
<td>- Responsibility of the operator/user</td>
<td>- Protection targets and requirements are defined by laws</td>
</tr>
<tr>
<td>- Protection targets are defined by directives</td>
<td>- Certification/listing of products</td>
</tr>
<tr>
<td>- Presumption of conformity with the application of harmonized standards (ISO9000 et seqq., self-certification, self-responsibility)</td>
<td>- Verification by independent NRTL/AHJ (Electrical Inspector) (third-party certification)</td>
</tr>
</tbody>
</table>

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The importance of standards

In general, standards are:

- **Standards are not laws** – yet they are followed willingly and strictly. When they are followed they are similar to laws

- **Reflect rules / the state of technology** and are considered a proven method in the respective field of application

- **A support function** used to achieve a minimum level of procedure (in different countries, etc.)

- Fulfilling standards is not an achievement – it is the minimum expected

- The highest protection objectives of standards are: the safety of people, livestock, and property
Similarities Between UL and IEC ICP Standards

- Fulfilling standards is not an achievement – it is the *minimum expected*
- Short Circuit Current Rating (SCCR) is required if power circuits are present. An SCCR is not required if only control components (relays, pilot devices, etc.) are included in the ICP.
- A Main Disconnect means is required.
- ICPs for use in hazardous locations must meet additional standards (UL698A and IEC 60079)
- Arc flash risks are mitigated upstream of the ICP.
### Differences between Europe & North America

#### USA / North America
- Primary standard UL 508A
- 600V maximum (NEC 409 allows 1000V, but UL and available components do not support)
- Main disconnecting means must be interlocked with the door requiring an intentional act with a tool to open. All components that are not deenergized by the main disconnect must be either touch safe or barriered.

#### Europe
- Primary standard IEC 61439-1
- 1000VAC or 1500VDC maximum
- Interlocking of the main disconnect with the enclosure is not required. Opening the enclosure door does tool operated access (bolt down cover), but not interlocking. All components that are not deenergized by the main disconnect must be either touch safe or barriered.

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Industry Sector / I A CE S V
Differences between Europe & North America

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**USA / North America**

- UL listed fuses, Class CC, R, J, L, etc. are acceptable

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**Europe**

- IEC rated fuses must be used. UL listed fused cannot be used in an IEC panel.

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UL 508A Procedure for Establishing the SCCR

Determination of the short-circuit current rating (SCCR) acc. to NEC409.110 (4):

- **Step 1: necessary!**
  SCCR of the installed and UL-listed components

- **Step 2: necessary!**
  Establishment of the SCCR on the basis of standard values (UL508A suppl. SB or UL-guide; chapter 5.8.4).

- **Step 3: Optional, very helpfull!**
  SCCR of tested industrial control equipment assemblies
  (series rating = 2 circuit breakers in series or combination tests = motor branch circuits)

- **Step 4: Optional, not very helpfull!**
  Use of current limiting devices (transformers, fuses, circuit breakers)
UL 508A Procedure for Establishing the SCCR

Determination of the short-circuit current rating (SCCR) acc. to NEC409.110 (4):

- **Step 1: necessary!**
  SCCR of the installed and UL-listed components

- SCCR of listed components can be found on the device label, manufacturer supplied Certificate of Compliance (CoC), or in UL508A Table SB4.1

<table>
<thead>
<tr>
<th>Component</th>
<th>Short circuit current rating, kA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus bars</td>
<td>10</td>
</tr>
<tr>
<td>Circuit breaker (including GFCI type)</td>
<td>5</td>
</tr>
<tr>
<td>Current meters</td>
<td>3</td>
</tr>
<tr>
<td>Current shunt</td>
<td>10</td>
</tr>
<tr>
<td>Fuseholder</td>
<td>10</td>
</tr>
<tr>
<td>Industrial control equipment:</td>
<td></td>
</tr>
</tbody>
</table>
  a. Auxiliary devices (overload relay) | 5                          |
  b. Switches (other than mercury tube type) | 5                          |
  c. Mercury tube switches  |
    Rated over 60 amperes or over 250 volts | 5                          |
    Rated 250 volts or less, 60 amperes or less, and over 2 kVA | 3.5                        |
    Rated 250 volts or less and 2 kVA or less | 1                          |
| Motor controller, (including combination motor controllers, float and pressure operated motor controllers, power conversion equipment and solid state motor controllers), rated in horsepower (kW) | |
  a. 0 – 50 (0 – 37.3) | 5°                          |
  b. 51 – 200 (38 – 149) | 10°                         |
  c. 201 – 400 (150 – 293) | 18°                         |
  d. 401 – 600 (299 – 447) | 30°                         |
  e. 801 – 900 (448 – 671) | 42°                         |
  f. 901 – 1600 (672 – 1193) | 65°                         |
Verification of rated currents for short circuits via

- Comparison with a tested reference construction (checklist or calculation)
- Testing

Verification of the short-circuit withstand strength of circuits *is not required* for:

a) Switchgear and controlgear assemblies with a rated short-term withstand current $I_{cw}$ or a conditional rated short-circuit current $I_{cc}$ with a root mean square value of 10 kA at the most;

b) Switchgear and controlgear assemblies *or* circuits of switchgear and controlgear assemblies, protected by current-limiting devices, whose peak-let through current at the highest permissible uninfluenced short-circuit current at the in-feed terminals of the switchgear and controlgear assembly *does not exceed* 17 kA;

c) For *auxiliary circuits*: $U_N \geq 110 \text{ V}$, $P_N \leq 10 \text{ kVA}$ and $u_k \geq 4$

$U_N < 110 \text{ V}$, $P_N \leq 1.6 \text{ kVA}$ and $u_k \geq 4$
Enclosure Environmental ratings, NEMA and IEC

Note that the NEMA Enclosure Ratings and IEC Equivalent (IP) ratings are approximations, not direct 1:1 equivalents.

![Enclosure Rating Table]

- Protection Against:
  - 1 indoor
  - 2 indoor
  - 3 outdoor
  - 3S outdoor
  - 4 indoor/outdoor
  - 4X indoor/outdoor
  - 6 indoor/outdoor
  - 6P indoor/outdoor
  - 12 indoor
  - 13 indoor
  - PW12 indoor/outdoor

- NEMA 1, NEMA 2, NEMA 3, NEMA 3S, NEMA 4, NEMA 4X, NEMA 6, NEMA 6P, NEMA 12, NEMA 13, PW12

- IP10, IP11, IP54, IP54, IP56, IP67, IP67, IP52, IP54, IP69K
Additional Information Resources

Additional information and resources regarding industrial control panel design can be obtained by following these links:

www.usa.siemens.com/controlpaneldesign

or

Thank you!

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Questions?