



Developing an equipment SCCR standard for manufacturers of industrial equipment

Contents

| Description | Page |
|---|------|
| Background | 2 |
| The method behind equipment SCCR | 2 |
| Challenges associated with equipment SCCR and code compliance | 3 |
| Misconceptions regarding equipment SCCR | 4 |
| Concepts for developing an effective SCCR strategy | 5 |
| Exceeding your clients' expectations | 8 |
| Help and support resources | 8 |
| Appendix A: "Worst case" available fault current calculation | 9 |
| Appendix B: Equipment SCCR design comparison worksheet | 10 |



Powering Business Worldwide



Equipment SCCR that is lower than the available fault current can pose a serious danger.

Background

Short-Circuit Current Rating (SCCR) is the amount of current an electrical component or assembly is able to safely withstand in the event of a fault when properly applied. SCCR's apply to almost all industrial control panels used for operating machinery and equipment. The Occupational Safety and Health Administration (OSHA) and the National Electrical Code® (NEC®) require sufficient short-circuit current protection of industrial control panels to protect equipment and personnel from certain risks in the event of a short-circuit (fault) event. Protection from fault current events is often properly specified and applied in electrical switchgear and distribution equipment (such as panel boards and switchboards), but it is often misunderstood or misapplied when it comes to machinery and industrial control panels.

This application note is written to raise the level of awareness of equipment SCCR and cover the major issues and potential risks associated with misapplied or insufficient SCCR's. It also presents a strategy to define a standard for equipment SCCR when requirements are often unknown or varying from jobsite to jobsite.

However, it is important to note that the facilities that purchase industrial equipment may have unique needs and circumstances that require careful consideration when determining the level of protection required for a particular installation site. Always consult qualified resources and adhere to the requirements of prevailing agency, code and regulatory requirements when evaluating and executing an SCCR plan.

The NEC® requires industrial control panels be marked with the equipment SCCR as well (409.110, 670.3(A), 440.4(B)). The NEC® and OSHA require that electrical equipment provide sufficient protection against short circuit-current events. 1910.303(b)(5) of the OSHA regulation requires all electrical equipment, including equipment that is already installed and new equipment being installed, meet this requirement and does not provide for any exemptions. Section 409.22 of the NEC® prohibits installing industrial control panels in locations where available fault currents exceed the equipment's assembly short-circuit current rating. The available fault current is the amount of current that would be available in the event of a short-circuit event, and can vary depending on the location in the electrical distribution system, among other factors.

What is the risk?

Panels with an insufficient assembly SCCR that are subjected to a short-circuit event can expose personnel and equipment to serious danger. Without an adequate assembly SCCR, it is likely that the devices inside the panel will sustain, and even create damage within the panel. It's also possible that damage may extend outside the control panel.

An insufficient assembly SCCR poses the following major hazards:

- Electric shock and burns
- Burns associated with arc flash and contact with heated surfaces
- Injury associated with flying debris
- Damage to equipment or the facility
- Arc blast (shock waves, shrapnel, etc.)
- Vaporized metal

Additionally, panels with an insufficient assembly SCCR may result in commissioning delays, strained customer relationships, fines, or negative publicity.

The method behind equipment SCCR

How is equipment SCCR determined?

UL 508A defines a procedure to determine the SCCR of an industrial control panel. This rating is established through testing of the assembly (less common), or using a procedure based on the components and their configuration in the assembly. Proper application not only applies to correct use and interpretation of the UL standard, but also proper application of the components according to their component short-circuit current ratings.

How do components used in industrial control panels relate to a short-circuit event?

When a short-circuit event occurs, overcurrent protective devices, such as circuit breakers and fuses, will operate and open the circuit. It is not enough that the overcurrent protective devices have an adequate interrupting rating. The component being protected, such as contactors and starters, disconnects, power distribution blocks and others, will also see a portion of the available fault current. The current level these devices experience is the amount of current the overcurrent protective device "lets-through" before completely opening the circuit (sometimes referred to as the "let-through current" of the overcurrent protective device). The amount of "let-through" current varies depending on the magnitude of the fault current, type of overcurrent protective device, and the amp rating or setting of the overcurrent protective device. It is important that the components not intended to interrupt fault-level currents be properly paired with overcurrent protective devices.

These non-overcurrent protective devices must be properly rated with sufficient “withstand” ratings in conjunction with overcurrent protective devices so that they do not sustain extensive damage. This rating, called the Short-Circuit Current Rating (SCCR) of the device, is typically applied to components that do not provide overcurrent protection used in power circuits of industrial control panels. These component SCCRs are established and certified through actual short-circuit testing to validate the SCCR and the conditions by which the rating is achieved.

The ability of these devices to handle short-circuit current levels depends greatly on the overcurrent protective device attributes and sometimes external factors (such as wire size, length, enclosure volume, etc.). The requirements are specified in the component SCCR and must be applied properly in order to obtain the proper level as part of SCCR protection.

How high should an equipment SCCR be?

Sufficient assembly SCCR begins with the available fault current level. Fault current level is the amount of current that would be available should a short-circuit event occur, and can vary depending on the location in the circuit, among other factors. Industrial control panels must have an assembly SCCR greater than or equal to the available fault current at the point in the circuit in which it is installed. Understanding available fault current is one of the main challenges to achieving a sufficient assembly SCCR. This challenge, as well as other challenges to achieving a sufficient assembly SCCR is covered in the following sections.

Challenges associated with equipment SCCR and code compliance

Even though sufficient assembly SCCR is required on new or existing equipment, survey data indicate it is not uncommon for equipment to be installed with insufficient assembly SCCR. But why does this happen if the code requires adequate assembly SCCR? It may be due to several factors:

- Not knowing code requirements
- Unknown available fault current at each circuit location where equipment is located
- Lack of assembly SCCR requirements on new equipment specifications
- Difficulty locating SCCR of components used in industrial control panels
- Misinterpretation/misapplication of the UL 508A standard for control panels
- Changes in the electrical system that can raise available fault current, thus potentially affecting the adequacy of the existing equipment’s assembly SCCR

Code requirements

The Code requirement that industrial control panels be rated with an assembly SCCR was established in the 2005 cycle of the NEC®. Many equipment manufacturers now calculate and mark their industrial control panels with an assembly SCCR, and customer surveys indicate that a significant percentage mark their industrial control panels using the minimum 5kA default value. However, the Code also requires that equipment cannot be installed in or relocated to a location where the available fault current exceeds the panel’s assembly SCCR. In other words, the equipment’s assembly SCCR must be equal to or greater than the available fault current at the location in the electrical system where the equipment is installed. When comparing the mix of industrial control panel SCCR to the mix of transformer fault current levels, data indicate there is an issue when it comes to applying this requirement of the code.

Unknown available fault current

Fault current studies are commonly performed during installations of electrical distribution equipment (such as switchboards and panelboards), but often ignored at downstream equipment. Available fault current calculation can range from simple to complex, which may require the support of calculation tools or a qualified third party to perform this task.

Lack of equipment SCCR requirements on new equipment specifications

For the reasons mentioned above, many specifications provided to equipment manufacturers fail to define a minimum, acceptable equipment SCCR. Thus, manufacturers often provide a standard design with the minimum default rating of 5kA. Many equipment manufacturers fail to recognize the need for, or see the benefit of standardizing on a defined level of equipment SCCR, as available fault current can vary from jobsite to jobsite and locations in an electrical distribution system. Without clear guidance, equipment SCCR may be misapplied during design and installation. Once installed, it is often very difficult and costly to raise the equipment’s SCCR.

Difficulty locating component SCCR

Surveys show that seven out of ten equipment designers have some degree of difficulty locating component SCCR for the devices in their industrial control panels. This can result in extended design costs and project delays. Because component SCCR may be difficult to locate, equipment designers may choose less cost-effective components, resulting in higher material costs and possibly a larger enclosure. Component SCCR are found on the product label, or an instruction sheet. Certain component SCCR are posted on UL’s SCCR web page by manufacturer, but not all applicable component SCCR types are included. This often creates confusion and frustration for the design engineer. These difficulties can negatively impact sourcing panel components for the manufacturer. The ability to source components with the correct ratings to achieve assembly SCCR compliance in an efficient manner is an important consideration in the design process.

Misinterpretation/misapplication of industrial control panel SCCR standards

Surveys show that four out of ten equipment designers claim to have some degree of difficulty understanding or applying the UL 508A standard for determining the SCCR for their industrial control panels. This could result in insufficient protection against short-circuit current levels, or it could result in an inefficient or costly design. It is important that equipment manufacturers provide proper documentation that verifies the equipment's assembly SCCR was determined properly in accordance with UL 508A, or that the design was tested and certified by a qualified third party. Errors could have a significant impact should a short-circuit occur.

Electrical system changes that result in higher available fault current

Fault current is influenced by a myriad of factors. Changes such as utilities installing lower impedance transformers, or updating a building's electrical distribution system could raise or lower available fault current levels downstream. Fault current is subject to the available fault current at the source supply and the amount of impedance in the circuit. Some changes that yield positive benefits in the area of electrical efficiency or electrical capacity may inadvertently increase available fault current levels. For example, replacing an upstream transformer with a larger or higher efficiency one that will have a lower impedance. Another example would be replacing conductors with larger conductors or a more efficient busway (with lower impedance). A more common example is relocating existing equipment to another location where higher fault current exists. Any of the above may result in higher available fault current at the location where equipment is installed, which in turn may be larger than the equipment's assembly SCCR. Industrial facilities should consider an equipment SCCR plan that provides a protection level that takes into account future changes that can increase fault current levels.

Misconceptions regarding equipment SCCR

In addition to the aforementioned difficulties, misconceptions have developed regarding the application of equipment SCCR. The following lists these misconceptions and their validity:

- Standardizing on a high assembly SCCR will result in significantly higher equipment costs or a compromise in functionality.
 - This is not necessarily true provided the right component solutions exist. The most significant challenge regarding equipment SCCR is the inability to locate component SCCR solutions, which has led to oversized devices in some instances. While some component SCCR solutions may result in a slight material cost increase, it's important to remember that the electrical component material costs are often a relatively small portion of the equipment's total cost. In many cases, high equipment SCCR can be achieved with limited to no increase in total equipment costs.

- Responsibility for assembly SCCR compliance belongs solely to equipment's purchaser and/or specifier.
 - While an obligation exists in the OSHA regulations that requires employers to ensure the equipment installed has adequate assembly short-circuit current rating, the NEC® also has requirements regarding the installation. It is important that equipment designers, specifiers, purchasers and installers communicate clear expectations concerning available fault current levels and minimum, acceptable equipment short-circuit current ratings.
- Responsibility of code compliance for assembly SCCR belongs solely with the local electrical inspector.
 - In many cases, an equipment installation does not require a permit or approval from a local governing agency. Thus it is not uncommon for machinery or other equipment to be installed without a local inspector to review and approve the installation. Regardless of whether an equipment installation is inspected by an agency does not negate the requirement for code compliance. The Authority Having Jurisdiction (AHJ) is responsible for verifying compliance with the prevailing and applicable code requirements for assembly SCCR. In cases where no federal, state, regional or local authority governs an installation, the property owner or their designated agent is considered the AHJ according to the NEC®.
- Current-limiting fuses or circuit breakers resolve all insufficient equipment SCCRs.
 - This may be true in some cases, but not all. Context of current-limiting overcurrent protective device application must be considered before declaring the panel's assembly SCCR. UL 508A Supplement SB permits using current-limiting devices to raise the SCCR of downstream devices, but only for branch circuit components. They do not apply to any of the devices in the feeder circuit, nor can they be used to raise the interrupting rating of a downstream overcurrent protective device.
- The interrupting rating of the circuit breaker or fuse upstream from the equipment control panel can be used to determine the required SCCR of the downstream equipment.
 - This is incorrect. Often, series ratings are applied in electrical distribution equipment where they are used to raise the interrupting ability of a downstream device when tested in combination with an upstream device. Series ratings permit more cost-effective panelboard solutions to be used in a distribution system, but must not be used to determine the assembly SCCR requirement of the equipment's control panel.

The regulations, standards and code requirements for equipment SCCR exist to improve the safety of the electrical systems for the worker and the workplace. A solid understanding of the NEC® is necessary for a manufacturer to effectively implement an equipment SCCR plan and is a key step towards preparing for the needs of customer short-circuit current protection. An effective plan is also beneficial for minimizing engineering changes associated with meeting equipment SCCR needs, and potentially gaining a competitive edge over the competition.

Concepts for developing an effective equipment SCCR strategy

An effective strategy strives to achieve the necessary equipment SCCR for each installation with minimal costs, resources and effort. This can be difficult considering the aforementioned challenges. No single plan will work for every industry or application. Each manufacturer must carefully consider the various factors when developing their equipment SCCR strategy. However, there are some common concepts that may be helpful toward developing an effective strategy.

- Understanding available fault current
- Understanding the range of fault current levels encountered in the industries served.
- Defining an equipment SCCR level that best meets the majority of the applications.
- Developing and comparing designs at this equipment SCCR level and the worst case installation (highest fault current) to determine the difference in cost, installation and other factors deemed important.
- Evaluating “last minute” options that resolve high fault current applications
- Choosing the equipment SCCR design that best meets your needs.
- Validating and documenting your industrial control panel’s SCCR.

Understanding fault capacity: The foundation for a solid equipment SCCR plan

Manufacturers of industrial control panels and machinery face a very difficult task when it comes to standardizing on equipment designs for an assembly SCCR. Unfortunately, an approach that works for one industry or application may not work for others. Installation sites can vary widely with differing equipment SCCR needs. The required equipment SCCR can even vary within the same facility, depending on its location in the electrical distribution system. *With so much variation, how can a machinery OEM define an acceptable equipment SCCR standard?* If an industrial control panel manufacturer chooses to standardize on 5kA assembly SCCR for all designs, and only designs to a higher assembly SCCR when requested or required, significant design changes may be needed to accommodate a specific equipment SCCR request. This could result in reengineering effort and increased material costs.

Another risk of standardizing on a 5kA equipment SCCR is revealed if a 5kA equipment is found to have inadequate SCCR after it is installed in the field. This scenario may not be easily corrected. Conversely, standardizing on an equipment SCCR design that far exceeds the needs of the intended industry may have an adverse effect on material costs or feature set, which could limit the design’s competitiveness. Even if an equipment SCCR design is standardized on the most common level of available fault current, there may still be requests for a higher equipment SCCR solution.

So how can equipment manufacturers implement an effective SCCR strategy?

It all starts with understanding available fault current levels.

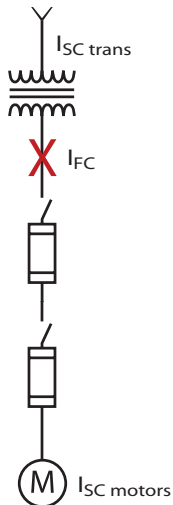
Available fault current is the amount of current that would be present in the event of a short-circuit event. The amount of available fault current will vary from jobsite to jobsite and installation point at a jobsite. Precisely determining the amount of available fault current depends on several variables, including available fault current from the utility (which is often unknown and subject to change), size of the upstream transformers, fault generation from motors, circuit impedances, voltage drop, power factor, and others. The complexity and interaction of these variables can make precise calculation difficult. To address this complexity, a conservative approach can be used to quickly and cost effectively estimate fault current levels and the level of equipment SCCR protection required for the location in question.

“Worst case” available fault current calculation is a conservative approach that assumes a worst case condition, thus minimizing the risk that the calculated available fault current level be too low.

A “worst case” approach makes several key assumptions intended to mitigate the effects of changes to these known and unknown variables, including (but not limited to) the following:

- Infinite fault current from the utility
- The worst case short-circuit current, which is a bolted fault
- Impedance accounted for only in those circuit items that can be reasonably estimated without subject to significant variation over the use of the panel’s operating life
- A conservative estimate of fault current contribution from motors
- A safety factor to accommodate variations in the transformer impedance

A worst case available fault current is calculated at the location in the circuit where the fault current is highest, which is at the secondary of the upstream transformer. It considers the fault current contribution from the transformer, motor loads, and other sources. Any other aspects that potentially increase fault current levels, including future changes to the electrical distribution system, should be considered when determining a worst case available fault current level.



$$I_{FC} = I_{sc\ trans} + I_{sc\ motors}$$

Where:

I_{FC} = "Worst case" fault current

$I_{sc\ trans}$ = Fault current contribution from transformer

$I_{sc\ motors}$ = Fault current contribution from motors

UL 1561 Listed transformers 25kVA and larger have a $\pm 10\%$ impedance tolerance, which can affect short-circuit current levels. Thus a 0.9 factor is applied to the transformer's impedance percentage (%). The fault current contribution of a 3 PH transformer ($I_{sc\ trans}$) is calculated using the following equation:

$$I_{sc\ trans} = \frac{kVA \times 1000}{V \times 1.732 \times Z \times 0.9}$$

Where:

kVA = Transformer size

V = Secondary voltage

Z = Transformer percent impedance

This equation assumes unlimited current from the utility. Often it is unknown how much current is available from the utility, and the above formula is commonly used to define a "worst case" condition from the utility. Generally this assumption will not vary significantly from the actual value.

A commonly accepted practice to estimate motor generated short circuit current ($I_{sc\ motors}$) is to multiply the total motor FLA by 4.

Fault current from other sources are less common and in most cases have limited fault current but should be considered in the worst case scenario if the source is supplying power the same time as the transformer source.

An example of how "worst case" is applied is found in the appendix of this document.

Another option in calculating available fault current is to use applications. Eaton has a web-based and mobile application that calculates available fault current called FC². It considers transformer contribution, motor contribution and conductor/bus impedance when determining a fault current level. This application quickly calculates available fault current levels. Visit www.cooperbusmann.com/FC2 for details.

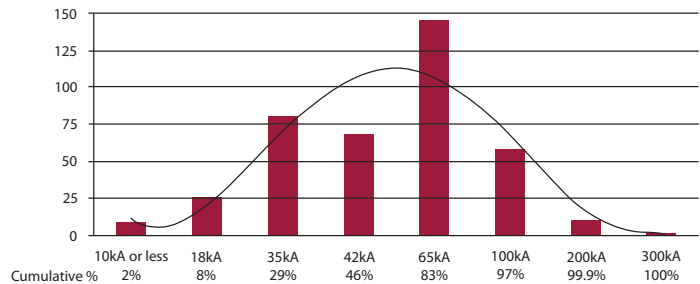
Understanding the available fault current levels in the industries served

Industries vary regarding their degree of available fault current knowledge and consistency in defining equipment SCCR specifications. This can be challenging when attempting to gather available fault current data. There are several methods to gather the necessary data when formulating a baseline for establishing an available fault current level. The more methods applied, the higher the probability for increased accuracy:

- Review available transformer supply data by industry
- Analyze actual customer assembly SCCR specifications
- Survey customers
- Collect field intelligence at various jobsites

Define an equipment SCCR that meets the vast majority of applications

Equipment manufacturers must be competitive in both cost and features. It may be feasible to design an industrial control panel to meet the highest expected available fault current, and also achieve competitive attributes. However, this may not be possible in some cases. Many OEMs will need to implement an equipment SCCR design that meets 80% to 90% of the available fault current levels they encounter, and develop an alternative design to meet the maximum expected available fault current level.



Example of industry fault currents.

A distribution chart is a useful analytical tool for understanding the common available fault currents at the secondary of substation transformers. The example above shows a "bell curve" that displays the range of transformer fault current levels that may be found in an industry. A cumulative percentage is applied, and from this it is determined in this example that assembly SCCR designs standardized at 65kA will cover 83% of the applications. If possible, a backup design is desirable to accommodate installations where the available fault current is 200kA and covers virtually all the market. If a 200kA design is deemed prohibitive, then a 100kA design could be implemented to cover 97% of the market. Fortunately, some panel designs may reach SCCR of 200kA at the same cost as 5kA or 10kA designs.

Contrast and compare designs at targeted equipment SCCR levels

The objective in this step is to define and prioritize equipment design attributes such as material costs, enclosure size, installation, minimized downtime, etc., and compare these attributes when designing to various targeted equipment SCCR levels.

Using data from the previous example, assume a manufacturer decides to review a common panel design for available fault current levels of 65kA, 100kA and 200kA. The research of locating component SCCRs can be challenging. To solve this, Eaton has developed the SCCR Protection Suite tool that contains listings of SCCR component solutions grouped by SCCR level. This guide significantly reduces searching efforts by placing all Eaton SCCR solutions in a single resource, and is searchable by desired SCCR level, system attributes and component preferences.

There are five levels of protection in the SCCR Protection Suite:

- **Ultimate** — solutions for 200kA+ applications
- **Premium** — solutions for 100kA+ applications
- **High** — solutions for 65kA+ applications
- **Mid-Level** — solutions for 35kA+ applications
- **Basic** — solutions for 18kA+ applications

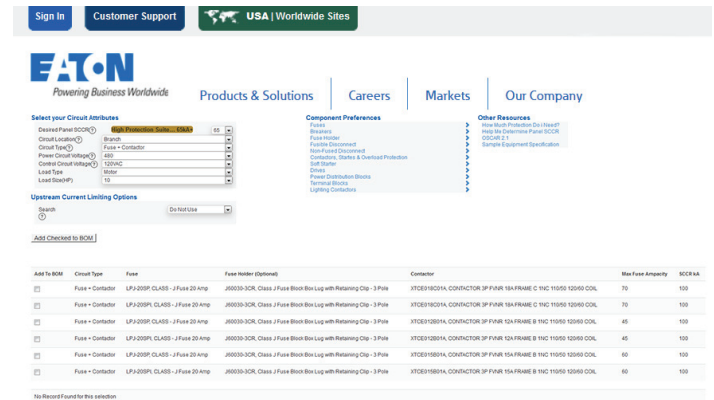
Selecting components using the SCCR Protection Suite tool not only reduces searching time, but also provides all available SCCR solutions, reducing the chance of using oversized components in achieving the desired equipment SCCR.

Evaluate “last minute” design options for high available fault current applications

Last minute solutions are designed to minimize the impact on a standard SCCR design while solving the need for a high fault current solution. There are several types of last minute design solutions:

- Modification within a standard design to increase the panel’s assembly SCCR
- The addition of external assemblies/components to raise assembly SCCR
- The addition of external assemblies/components that lower the available fault current level.

Modification within a standard design



This is typically achieved by part substitution or the addition of components within the panel that result in a higher equipment SCCR. The objective is to identify and resolve “weak links” with minimal disruption to the standard design. This can be accomplished by either substituting weak links with higher SCCR components, or introducing a current-limiting solution as permitted by UL 508A. An example of applying a current-limiting solution would be to replace a standard feeder circuit breaker with a current-limiting circuit breaker or fuse that raises the SCCR of a branch circuit components in the panel. Eaton’s SCCR Protection Suite provides visibility to such solutions, and also determines if a current-limiting solution is able to improve the SCCR for any component SCCR solution. UL 508A must be followed when implementing current-limiting solutions.

Addition of external assemblies/components to raise equipment SCCR

It may be possible to standardize an industrial control panel design such that a higher assembly SCCR can be applied to the industrial control panel if it is fed by a current-limiting breaker or fuse. This type of solution greatly improves manufacturing efficiency and increases total flexibility in the field should it be discovered that the available fault current is larger than the industrial control panel’s SCCR. This type of solution is also achieved by applying the current-limiting rules per UL 508A. The components inside the standardized panel design must be coordinated in conjunction with an external current-limiting overcurrent protective device. The industrial control panel SCCR marking must also be updated to reflect this field addition. More planning may be involved during the panel design, but the major benefit is that no changes inside the panel will be required in order to achieve the higher assembly SCCR.

**SHORT-CIRCUIT CURRENT:
100kA RMS SYMMETRICAL,
600V MAXIMUM,
WHEN PROTECTED BY A
200A CLASS J FUSE**

Addition of external equipment/components that lower available fault current levels

The third option is to install equipment or components ahead of the control panel that effectively lower the available fault current. One example is a transformer. Transformers can only deliver a limited amount of fault current on the secondary based on its size and impedance (even if we assume infinite fault current from the upstream power network). Thus, a properly sized transformer for the application could partially resolve or completely resolve an inadequate equipment SCCR situation by limiting the available fault current to the equipment.

One, some, or all of these solutions may be beneficial to prepare for a high available fault current situation. Proper design planning is a significant factor in delivering a solution that meets equipment SCCR needs while retaining a competitive edge. Eaton has the tools and solutions to assist in analyzing and developing solutions that achieve this goal.

Choose the option that best meets the objectives

Having analyzed all equipment SCCR options, determine the solution that delivers the required protection while maintaining competitiveness in your marketplace. There is no single solution that will work best for every scenario, as needs and the types of equipment SCCR solutions vary based on applications and industries served. However, a solid equipment SCCR plan enables regulatory and code compliance, maintains competitiveness, and can be a product differentiator.

A comparison worksheet is provided in the appendix to assist with documenting and analyzing these solutions.

Validate and document your equipment SCCR analysis

Once you have determined the options and solutions that will meet your equipment SCCR needs, it is important to verify and document the analysis. Surveys of OEMs show that four out of ten struggle to some degree when interpreting and/or applying the UL 508A standard for equipment SCCR. Verification can be accomplished by third party applications such as Eaton's OSCAR SCCR Compliance application that was developed specifically to calculate an industrial control panel's SCCR and identify the weak links limiting the equipment SCCR.

It is also beneficial to document the equipment SCCR analysis for your industrial control panel designs. Inspectors or your clients may request to see an explanation of how the industrial control panel's equipment SCCR was determined. Documentation of the equipment SCCR analysis is also a feature in the OSCAR SCCR Compliance application that provides an excel spreadsheet detailing the components and component SCCR used in an industrial control panel's design.

Exceeding your clients' expectations

Regulations require that your customers provide a safe work environment for their employees, whether it's a commercial setting, manufacturing floor, educational facility, hospital, or other. Protection against short-circuit events is one aspect of providing a safe working environment. As stated above, some may not be familiar with available fault current levels or equipment SCCR, but protection from short-circuits is still required. Equipment SCCR levels can impact a facility in several ways, both short and long term. Helping your client understand and plan for these can often exceed their expectations, which may strengthen a healthy business relationship.

Some of these factors include:

- **Safety** — Safety is a top priority for many organizations, with an end goal to provide a safe working environment for personnel and achieving regulatory compliance. Making clients aware of available fault current levels and equipment SCCR requirements can open communication and uncover the protection level needed for a safe working environment.
- **Quality** — This may seem unrelated to equipment SCCR or safety, but protection from a short-circuit event is only as good as the accuracy of its calculation and application of solutions to mitigate its impact. Use of the Eaton's OSCAR SCCR Compliance application enhances the quality of equipment SCCR calculations as well as documenting the analysis. For more information about the online OSCAR SCCR Compliance application, see oscar.eaton.com.
- **Sustainability** — When evaluating equipment SCCR protection for a particular situation, consider maintainability so that changes occurring five, ten, twenty or thirty years after an equipment installation do not affect the assembly's ability to withstand the prevailing available fault current levels. For example, replacement of an electrical distribution system with a more efficient system may inadvertently increase available fault current levels, and could impact personnel safety. Built-in safety factors to the equipment SCCR improve the likelihood of sustainability for your customer.
- **Versatility** — Change is inevitable, especially on the manufacturing floor. Upgrades, maintenance, equipment relocation, and other factors may result in costly changes to maintain equipment SCCR code compliance. A solid equipment SCCR solution minimizes these risks and saves your customers the time and expense should these factors not be considered.
- **Cost effectiveness** — Effective equipment SCCR solutions avoid unnecessary oversized components and inflated material costs. Eaton's SCCR Protection Suite tool assists OEMs in locating cost-effective component SCCR solutions.

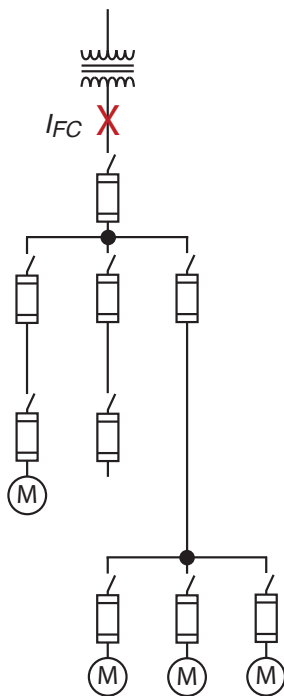
Help and support resources

Eaton is a global leader in power management solutions. Eaton's product offering includes fuse and circuit breaker overcurrent protective devices, industrial control and automation, and many other products used in facilities worldwide. As the leader in circuit protection, Eaton continues to deliver the right protection solutions to our customers. For more information on the solutions mentioned above, or any of Eaton's products and services, please contact your local Eaton representative.

Appendix A

“Worst case” available fault current calculation

In this example, the circuit is fed by a 2000kVA substation transformer with 5.75% rated impedance and a 480V secondary. Currently 50% of the loads are motors, but the facility management anticipates that may increase to 75%. Thus 75% will be used when determining the impact of motor loads on the available fault current.



2000kVA Substation transformer
5.75% Impedance
480V Transformer secondary

$$I_{sc\ trans} = \frac{kVA \times 1000}{V \times 1.732 \times Z} = \frac{2000 \times 1000}{480 \times 1.732 \times 0.0575 \times 0.9} = 46,487A$$

$$I_{sc\ motors} = \text{Total motor FLA} \times 4 = \frac{2000 \times 1000}{480 \times 1.732} \times 75\% \times 4 = 7217A$$

$$I_{fc} = I_{sc\ trans} + I_{sc\ motors}$$

$$I_{fc} = 46,478 + 7217 = 53,704A$$

Fault Capacity = 54kA

Minimum Acceptable SCCR = 55kA

A minimum acceptable SCCR for new equipment is established at 55kA.

This ensures all properly rated equipment located at any point downstream of the transformer will have sufficient SCCR, regardless any equipment relocations or upgrades to the electrical distribution system.

Loads are 75% Motors

Appendix B

Equipment SCCR design comparison worksheet

Record evaluation parameters for:

- Machine/equipment name: _____
- Analysis performed by: _____
- Date analysis performed: _____
- Equipment target SCCR value (kA): _____
 - Top 80% SCCR value is the short-circuit current rating that meets 80% to 90% of the applications in the industry served.
- Worst case SCCR value (kA): _____
 - Highest SCCR value is the largest short-circuit current rating in the industry served.
- Other target SCCR value (kA): _____
 - Other target SCCR value is any other desired SCCR rating that is to be compared.

Use Eaton's SCCR Protection Suite tool (www.eaton.com/sccr) to locate component solutions that meet the various equipment target SCCR levels. Use the online OSCAR SCCR Compliance application (oscar.eaton.com) to create an industrial control panel one-line diagram, determine the equipment SCCR, and modify component selections to improve the equipment's SCCR. Use the attributes of the component solutions from the final one-line diagrams to complete the table below.

In the table below, record the evaluations according to the priority and the equipment SCCR level. Record any notable observations in the column to the right. Record fault reduction options for each equipment SCCR level, and indicate their impact on design priorities.

Once all design priorities have been evaluated, use the Notes fields to record any differentiating information between equipment SCCR levels if applicable. Use the "Design Selected" field to indicate the selected equipment SCCR.

| Priority | Top 80% SCCR: | Highest SCCR: | Other SCCR: | Observations |
|---------------------------------------|---------------|---------------|-------------|--------------|
| 1) | | | | |
| 2) | | | | |
| 3) | | | | |
| 4) | | | | |
| 5) | | | | |
| 6) | | | | |
| Fault Reduction Options (External) | | | | |
| Notes | | | | |
| Design Selected | | | | |

Notes:

Eaton
Electrical Sector
1000 Cherrington Pkwy
Moon Township, PA 15108
United States
www.eaton.com

Eaton's Bussmann Business
114 Old State Road
Ellisville, MO 63021
United States
www.bussmann.com

© 2015 Eaton
All Rights Reserved
Printed in USA
Publication No. 10368
February 2015

Eaton is a registered trademark.
All other trademarks are property
of their respective owners.