



UL-CERTIFIED CONTROL PANEL FOR THE NORTH AMERICAN MARKET

Arc flash study

on a 3-axis CNC machine from bavius technologie gmbh

SIEMENS

At a glance

Between industrial health and safety and technical requirements

In late 2019, the German high-performance machining specialist bavius gmbh ordered a control panel from Siemens. It would be used in a production facility in the U.S. and contain the electrical equipment to control a 3-axis CNC machine. The panel was configured to comply with applicable U.S. regulations and UL standards. The Siemens plant WKC in Chemnitz manufactured the control panel and applied a UL label. That wasn't all, though: U.S. legislation requires plant operators to determine potential arc flash risks and to attach a label with the appropriate warnings. After all, arc flashes can be deadly.

Minimizing risk for everyone involved

An arc flash can be caused by a short circuit or when live components are separated, for example. It releases a lot of energy that can cause metal to vaporize, release explosive pressure waves, burn your skin, and damage your eyes or hearing. That's why it's important to minimize the risk of an arc flash at the system level in the engineering process and at the organizational level in terms of health and safety requirements. It is mandatory to wear the appropriate Personal Protective Equipment (PPE) when performing maintenance work on live components. The choice of PPE will depend on the amount of energy that could be released. More and more frequently, plant operators are delegating the job of performing this labor-intensive calculation to the manufacturer, as happened in this case. bavius turned to Siemens to fulfill the U.S. requirements for arc flash analyses that have been in force since 2018.

“Siemens’ comprehensive understanding of the North American market enabled the company to deliver a ready-to-use control panel that met all the requirements of the UL market. Having one central contact to handle all our questions and help clarify the data for the arc flash calculations allowed the project to proceed swiftly and smoothly.”

Remo Vogel, electrical engineer,
bavius technologie gmbh

UL-certified control panel and calculations from a single source

Siemens has extensive experience in providing services for utility companies and many years of expertise in performing electrical network calculations, and so the company was able to offer bavius an immediate one-stop solution. Working closely with their colleagues who manufacture the control panels, the network consulting team used real data to perform a standards-compliant arc flash analysis. The result: There's no increased risk of an arc flash when the control panel is used in the local power network. All that's needed is PPE to protect against electric shock if work has to be done on or near live components. That satisfies all the requirements: There's nothing more that the machine manufacturers or operators need to do. The control panel could be delivered to the U.S. along with the legally prescribed warning label and manufacturer-compliant specifications.


bavius
bavius technologie gmbh

bavius has been one of the world's leading manufacturers of multi-axis high-performance machining centers for more than 30 years. It offers standardized machine concepts with a modular design that's flexible enough to find optimal solutions for all machining requirements. Its customers include the international aerospace, automotive, and rail industries, in addition to metal construction and mechanical engineering companies.



3-axis CNC machine

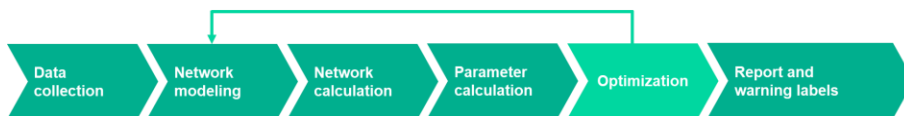
Finding the solution

An arc flash is caused when a flashover to other conducting components or individuals occurs: for example, if insulation between two phases is damaged, or if there's an insufficient distance between short-circuit currents. These conditions lead to contact in the air or via other gases and the release of high volumes of heat energy. A plasma develops consisting of hot gas, melted conductors, and small pieces of shrapnel. The mass glistens, releases poisonous gases, and may explode. Serious skin burns can be prevented by maintaining a reasonably safe distance and wearing the appropriate protective clothing.

Arc flash study by Siemens experts

Under normal conditions, device type-testing ensures that there's no arc flash risk. If it's necessary to open the enclosure, turn off protective systems, or perform maintenance work in or near live devices, it's important to wear the appropriate PPE if the worker will be within the arc flash boundary. An arc flash calculation will determine the incident energy, the safe distance (arc flash boundary), and the protective equipment required.

That's precisely what the experts at Siemens did for bavus in 2020 in compliance with the standards and based on a previous risk analysis by the plant operator.



Stages of an arc flash analysis

Applied standards

The advisers at Siemens performed the arc flash study in accordance with all current standards relevant to the U.S. market. For control panels in the U.S., Section 110.16 of the National Electrical Code (NEC) states that a warning must be provided not just about the risk of arc flash but also about the levels of energy that may be released and the appropriate safe distances that need to be observed. The National Fire Protection Association (NFPA) defines three distances in NFPA 70E:



- Arc flash boundary: The distance at which a worker will receive second-degree burns in the event of an arc flash incident without the appropriate arc-rated personal protective equipment
- Limited approach boundary: The outer boundary at which a worker may be exposed to a shock hazard
- Restricted approach boundary: The outer boundary at which a worker may be at an elevated risk of electric shock

While standards like NFPA 70E define the required protective clothing in terms of the incident energy, IEEE 1584-2018 includes a procedure to calculate both the incident energy and the arc boundaries. The incident energy depends on numerous factors, including short-circuit current, arc flash current and duration, plant geometry, electrode spacing, and working distance.

From data collection to warning label

To perform the incident energy calculation, the consultants used the standards-compliant software PSS®SINCAL, the software tool from Siemens for analyzing and designing all types of power supply networks. But before the team could start network modeling, they had to gather and process device data and data from the power network in the factory, a complex undertaking. They had to contact the utility company on-site several times.

After gathering and modeling the data, within one week the network designers were able to calculate the short-circuit current, arc duration, and finally the incident energy on the basis of real values: At 0.4 calories per square centimeter (cal/cm²) at a working distance of 18 inches, the energy level was below the threshold of 1.2 cal/cm² and therefore within the acceptable residual-risk range. Based on NFPA 70E, this means that there's no risk of second-degree burns if an arc flash occurs. Even so, appropriate measures and clothing to protect against electric shock are still required. All this information was made available to the machine builder along with a report and a detailed warning label for forwarding to its customers when the control panels were delivered.

 WARNING 	
Shock Hazard Appropriate PPE Required	
Arc Flash Boundary	9 in
Incident Energy	0.4 cal/cm ²
Working Distance	18 in
PPE based on latest edition of NFPA 70E	
Limited Approach Boundary	42 in
Restricted Approach Boundary	12 in
Bus: PBZ SC 120053, Rated Voltage: 0.48 kV	

These documents assist plant operators when they're performing the risk assessment that's required by occupational health and safety legislation prior to all activities. A risk analysis for employees is a key element of the work permit for activities involving live equipment.

Optimization measures to reduce risk

The arc flash assessment for bavivus was performed once the control panel was completed. If a low risk class must be achieved in accordance with the specifications, however, it's preferable to perform arc flash calculations in the design stage. This enables the machine and plant builders to optimize the construction process and the choice of components they'll use to minimize the arc flash risk. Siemens is happy to use available design data to perform arc flash calculations as early as the design stage.

Added value for customers and end customers

- Control panel and service from a single source
- Improved safety for maintenance employees
- All applicable regulations, standards, and specifications are observed
- Safe to work on live components and while the system is operating
- Proof that boundary values are observed
- Lower overall risk for everyone involved

About us

Siemens PTI: Consulting and planning for power supply networks

From strategic advisory services and technical consultancy to state-of-the-art planning and analysis software: Siemens Power Technologies International (PTI) provides an end-to-end portfolio that masters the challenges that energy systems face, today and in the future. Our strategic consultants help optimize value by providing guidance in the fields of business transformation and infrastructure development and offering market and transaction advisory services. Drawing on more than 60 years of international experience and continuous innovation in power system planning, our experts address the full scope of analysis, design, and optimization studies for international utility companies. The latest user requirements and our project experience are continuously informing the Siemens PSS® software portfolio for power system planning, simulation, and model management.

Siemens WKC

The Siemens-Werk für Kombinationstechnik in Chemnitz (WKC) has a long tradition of constructing control panels for machine tools and other sectors in the mechanical engineering and plant construction industry around the world, including logistics and automotive companies. Its products and services include the entire range of application engineering, from material logistics and the assembly of electrical equipment to testing and preliminary commissioning. The specific scope of services is determined on an order-by-order basis by the customer. WKC is also an acknowledged center of competence for air-conditioning in control panels, operates its own heat laboratory with the appropriate load testing capabilities, and is a certified UL Panel Shop.

For more information, please get in touch with us using the contact form on our web page: www.siemens.com/controlpanel/arc-flash

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