

Focus on IFA's work

Edition 12/2013

617.0-IFA:638.22

Electrical safety: implementation of the five safety rules in control systems

Problem

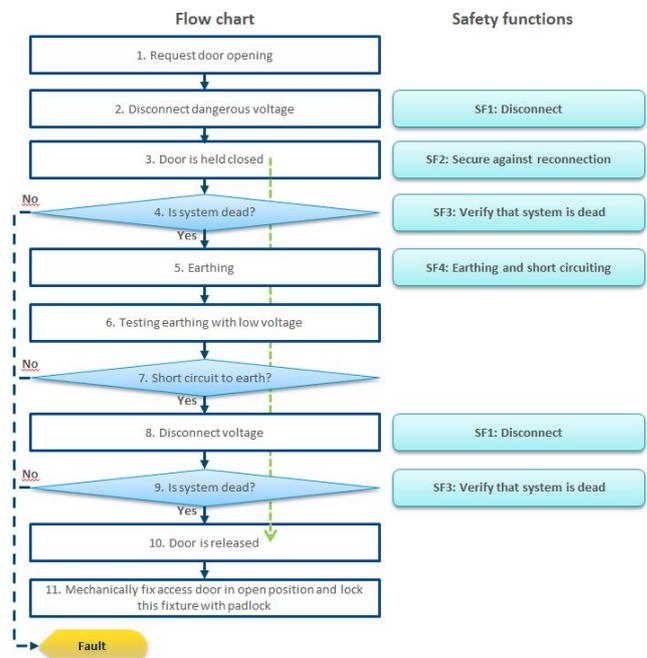
Certain electrical systems have to be maintained and cleaned by staff several times a day. Before they can be accessed, the systems have to be disconnected from the mains supply to eliminate electrical hazards to operating staff. According to the state of technology, this is accomplished with the five safety rules of DIN VDE 0105-100:

- Disconnect from the mains
- Secure against reconnection
- Verify that the system is dead
- Carry out earthing and short circuiting
- Provide protection from adjacent live parts.

In the field, these are performed exclusively by electrical specialists. Depending on the voltage and type of electrical system, all five safety rules or only those applicable to the system are observed manually. Since these actions have to be performed repeatedly, the question arises as to whether observance of the five safety rules can be automated.

Activities

An automated procedure has been devised that applies the familiar methods for achieving functional safety at machines to the protection of staff from contact with live parts.



Flow chart of the automated process for safe disconnection from the mains supply

On the basis of the applicable safety standard DIN EN ISO 13849-1, an example of an automated procedure has been implemented on a process installation in cooperation with the operator.

The core of this procedure is the five safety rules that for automatic implementation are rendered as safety functions. On the system in question, only the first four safety rules are ever relevant as the entire system is always disconnected in its entirety from the main supply.

The automated procedure requires single-fault tolerance, as is usual for protection from accidental contact under DIN 31000, according to which a single fault in the electrical equipment does not pose a hazard. An electrical cable is a good example of single-fault tolerance. The cable consists of an external cable sheath and the additionally insulated interior wires. A defect in the external cable sheath does not automatically result in an electric shock as the interior wires are individually insulated as well.

The automated procedure must satisfy the same requirements of single-fault tolerance. This is achieved with the dual-channel installation of the components used for the safety functions. If one channel fails due to a fault, the second channel ensures the demanded safety.

Results and Application

With safe control equipment and suitable components for disconnection and earthing, and given appropriate technical design, it is possible to comply with the applicable requirements of accident prevention regulation BGV A3.

The automated procedure has been realised with hardware and software complying with the methods and requirements of DIN EN ISO 13849-1. It provides the same degree of safety as the manual methods of DIN VDE 0105-100.

There are plans to use this procedure in a similar form for disconnecting high-voltage battery cells in workshops during the maintenance and servicing of electric vehicles.

Area of Application

Operators wishing to implement automated disconnection from the mains supply on their systems; manufacturers of machines and controls, and employees of test bodies.

Additional Information

- DIN VDE 0105-100: Operation of electrical installations – Part 100: General requirements (10.09). Beuth, Berlin 2009
- DIN EN ISO 13849-1: Safety of machinery - Safety-related parts of control systems – Part 1: General principles for design (12.08). Beuth, Berlin 2008
- DIN 31000 VDE 1000: General principles for the safe design of products (05.11). Beuth, Berlin 2011
- DIN VDE 0100-410: Low-voltage electrical installations – Part 4-41: Protection for safety - Protection against electric shock (06.07). Beuth, Berlin 2007
- Accident prevention regulation Electrical installations and equipment (BGV A3). Carl Heymanns, Cologne 1997

Expert Assistance

IFA, Division 5: Accident prevention – Product safety

Literature Requests

IFA, Central Division