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Vladimir Tsirkin

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Abstract title: The Leading Method for Restraining Electric Arcs
השיטה המובילה בשוק לריסון קשתות חשמליות

An electrical arc, or arc discharge, is a high-power discharge between two or more conductors that causes a breakdown of the air (or other gas) between them. It is a type of electrical explosion which instantly vaporizes conductive components and propels the molten metal in all directions.
Arc flash incidents can cause injury and even death to personnel in the vicinity of the event, catastrophic damage to equipment, and severe financial losses due to lost production, repair and replacement costs, increased insurance costs, and possible legal actions.

To protect your low voltage switchgear investment, your company, and your employees, there now exist several mitigation strategies by which the effects of an arc flash event can be greatly reduced. To verify the efficacy of these new arc flash mitigation systems, new technical standards have recently been released. The latest of these is IEC TS 63107: *Integration of internal arc-fault mitigation systems in power switchgear and controlgear assemblies (PSC-Assemblies) according to IEC 61439-2*.

Closing the arc flash safety verification gap
The overall standard for low voltage switchgear (LVS), IEC 61439-1/2, prescribes mandatory requirements for LVS design verification. It does not, however, address arc flash prevention or mitigation.
Recognizing the growing need to verify new arc flash mitigation technologies, the International Electrotechnical Commission (IEC) first issued IEC TR 61641—*Enclosed low-voltage switchgear and controlgear assemblies – Guide for testing under conditions of arcing due to internal fault*—as an addendum to IEC 61439. IEC TR 61641 describes methods for testing various passive arc flash systems such as barriers, reinforced panels, arc flaps, arc chimneys, and even full insulation of live parts (arc ignition protected zones).
As it is a “technical report” (TR), IEC TR 61641 is advisory only; compliance is not mandatory. What’s more, it applies to only normal (doors closed) operation, not maintenance (doors open) operations, plus it covers only passive arc flash mitigation systems, and does not specifically relate to active ones. A *passive* arc flash mitigation system only lessens the damage or directs the arcing from a full-discharge arc event

in a dedicated direction. An *active* arc flash mitigation system is designed to sense an arc at its onset and reduce the energy it releases.
As a further step towards addressing this arc flash verification need, is the IEC launched IEC TS 63107 in May 2020. This new Technical Specification (TS) states requirements for integration and testing an Internal Arc-fault Mitigation System (IAMS) in low-voltage switchgear and controlgear assemblies.

What is an IAMS?
According to IEC, "*an IAMS consists of an IACD (Internal Arc-fault Control Device) and an IARD (Internal Arc-fault Reduction Device). An IACD uses the effects of an arc, e.g. light, gas pressure, change of current, and/or voltage to detect an arc inside the switchgear to generate a trigger signal for an associated IARD. An IARD reduces the arc energy below the level which would be released if an IARD was not present and the fault would be interrupted by the conventional short-circuit protective device (SCPD).*"
An IARD can be built using a variety of technologies and strategies. These may include using upstream circuit breakers (SCPDs) to interrupt the power source, along with a parallel connection of a low-impedance current path and an arc quenching device (AQD), or using an Internal Arc Limiting Device (IALD) in series.
Eaton's ARCON 3G IAMS system, is offering, sensors that detect the light emitted by the fault and the rapid current rise in generates. The central processing unit signals the quenching device, which creates a bolted short-circuit on three poles parallel to the location of the fault. The short circuit reduces the voltage required for the arc fault to nearly null, quenching it within 2 ms of its initiation—well before its maximum destructive force can be achieved.

Why are IEC TS 63107 integration tests important?
The IEC TS 63107 integration test is designed to prove that a chosen IAMS and the switchgear into which it will be integrated work perfectly together. The specification describes how to perform all the necessary tests. It also offers a series of guidelines to help OEMs properly incorporate an IAMS into an LVS.
In general, the IEC 61439 series includes tests for construction (degree of protection, protection against electric shock, internal connection, etc.) and performance (dielectric properties, verification of temperature rise, short-circuit withstand strength, mechanical operation, and electromagnetic compatibility). IEC TS 63107 requires additional temperature rise and short circuit tests on the IAMS (including its AQDs) installed within in the LVS, plus verification of performance of the IAMS device, including repowering scenarios.

How is the integration test performed?
Inside the switchgear, there can be areas that are protected by the IAMS and other areas that are unprotected. The protected areas must be verified for arc fault detection, mitigation and extinguishing. Further functional tests must be performed to show that that IAMS and SCPD do not generate unwarranted tripping of circuit breakers or other unintended operations.
The verification test must simulate defined and documented worst-case conditions for an arc flash event. To determine the worst-case scenario, an analysis must be made, taking into account the characteristics of the IACD and the IARD, the positions of the

sensors, and possible arc locations. For the test, an arc should be ignited at the point in the IAMS-protected area where an arc fault is most likely to occur. The ignition points are detailed in chapter 10 of IEC TS 63107.
If circuit breakers are installed as the SCPDs, a test for unintended operation of the IAMS must be carried out using the highest possible let-through energy, that is, with the rated short circuit current and the rated short-time current at the corresponding rated operational voltage.
The results of Eaton's TS 63107 test of ARCON 3G with xEnergy Main
Recently, Eaton performed a successful TS 63107 verification of its ARCON 3G Arc Fault Protection System integrated with its xEnergy Main low voltage switchgear assembly.

EATON launches ARCON® 3G
State of the art arc fault protection system convinces with a total arc mitigation time of **less than 2 ms**

The energy management company EATON successfully continues its decades of work in the field of personnel and assembly protection with the ARCON® 3G. The new arc fault protection system builds up on the experience of previous generations. As ARCON® 3G, it convinces with new functions, improved user friendliness, compliance with the latest applicable standards as well as a modular approach that can only be described as state of the art. With a total arc mitigation time of less than 2 milliseconds the ARCON® 3G guarantees the highest degree of personnel and assembly protection.

Arc fault events, which can have serious consequences for personnel and facilities, can mostly be traced back to working under voltage. According to statistics, two thirds of all accidents occur in the course of service or maintenance work, for example when a tool is suddenly turned into a conductive foreign body. The consequence is an almost explosive expansion of the arc fault, which can result in the ejection and deformation of equipment parts as well as in fires. It has been proven that, depending upon selectivity, up to 300 ms may pass before the main switch identifies the fault and severs the connection. For a person standing in front of the device this can be life-threatening. Furthermore, a fire caused by an arc fault may not only lead to significant damage of the installation itself: Should it spread, then adjacent infrastructure elements could also be affected. For operators this means revenue losses due to downtime as well as corresponding component repair or replacement costs. "Our ARCON® 3G arc fault protection system protects man and machine, even if the system is in a non-operational state. For example when a technician is working on it," confirms Reinhard Mörzinger, Product Manager Enclosures and Components at Eaton, "this allows us to guarantee the highest degree of personnel and assembly protection." The system continuously monitors itself and also triggers an alert in case of a change in state. Such events are highlighted on a multilingual display, a corresponding notification can also be submitted to a control center by means of a hard-wired line.

Modular for every application

As a result of its modular build, ARCON® 3G can be used and expanded in numerous ways. In its basic version the solution serves as an arc fault monitoring system and is connected to the circuit breakers. This ensures improved personnel protection without the necessity of additional parameterization. The next level provides enhanced arc fault protection, which is achieved by means of connection to the circuit breakers, the ignition module as well as to an arc quenching device, also supplied by Eaton. This facilitates comprehensive personnel and assembly protection; the corresponding setup is entered via the display. In comparison to the previous configurations, the complex arc fault protection not only covers one, but up to five zones. The connection scheme corresponds to that of the enhanced arc fault protection system and is configured by means of a software solution.

Changing of the guard

“The development of ARCON® 3G was preceded by a thorough analysis of its predecessor ARCON® 2.0, numerous aspects were addressed in order to ensure a state of the art and future-proof solution.” According to the Product Manager Enclosures and Components this immediately manifests itself in the high-quality stainless-steel housing that enables best electromagnetic compatibility. With an ambient temperature range suitable for operation from -40 to +70 °C, the ARCON® 3G is furthermore ideal for multiple utilization scenarios, including the process industry or data centers. The low mounting depth is another striking and immediately visible feature. Together with the separately executed display module, which simultaneously complies with the protection rating IP55 in accordance with the xEnergy series, this results in maximum flexibility with regard to installation in the switchgear assembly. This flexibility extends to the ignition module, also executed separately, which allows for placement of the master independent of the incoming section. An individual supply voltage for the light detection modules is not required.

With the continuous self-monitoring function and a total arc mitigation time of less than two milliseconds, ARCON® 3G is the undisputed leader with regard to personnel and assembly protection. Due to the modular approach, the arc fault protection system is suitable for every scenario, including highly complex applications that comprise multiple zones.