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# Arc-resistant construction for outdoor distribution circuit breakers

Siemens is expanding the SDV7 family of outdoor substation type distribution circuit breakers to include an option for arc-resistant construction. The family now includes:

- Non arc-resistant type SDV7-SE circuit breakers with stored-energy operating mechanism
- Arc-resistant type SDV7-SE-AR circuit breakers with stored energy operating mechanism
- Non arc-resistant type SDV7-MA circuit breakers with magnetic-actuator operating mechanism
- Arc-resistant type SDV7-MA-AR circuit breakers with magnetic-actuator operating mechanism.

The option for arc-resistant construction is being offered in response to desires expressed by utility firms for an arc-resistant circuit breaker, tested to the requirements of the ANSI/IEEE C37.20.7 guide for internal arcing tests of metal-enclosed switchgear.



One of the first consequences of the OSHA regulations was that the National Electrical Code® (NEC®) NFPA 70® became mandatory in most areas of the country. This impacted industrial, residential, and commercial installations and led to the introduction of third-party listed products (for example, UL-Listed products) for such markets. However, utility installations are not subject to the NEC when the utility is acting in its role as a distributor or generator of electric power. So, the impact of OSHA on utility customers was not immediate in the early years after the OSHA legislation was enacted.

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The concept of arc-resistant outdoor circuit breakers is new to some utility users in the distribution segment of the utility industry, but is not new to personnel in the generation segment of the utility industry. Some of our utility distribution customers ask why they should specify arc-resistant outdoor distribution circuit breakers. This paper addresses that issue.

Data from the National Institute for Occupational Safety and Health (NIOSH) [www.niosh.gov](http://www.niosh.gov) for the 1992-2000 period reports that approximately 300 persons per year were killed in workplace incidents over this period. Each of these fatalities naturally received significant media coverage, increasing the awareness of the public of the hazards to which workers were exposed.

The public awareness of the hazards to which workers are exposed in the workplace is growing. This awareness actually began long ago, with the creation of the Occupational Safety and Health Administration (OSHA) as a result of the Williams-Steiger Occupational Safety and Health Act of 1970. This gave the Federal Government the authority to establish and enforce regulations for worker safety.

In recent years, OSHA has been more active in enforcing the regulations, even in the utility arena. In particular, 29CFR 1910.269 applies to utilities, along with various other parts of the OSHA regulations. A few excerpts from the OSHA regulations are:

#### **1910.269(a)(1)(i)**

*This section covers the operation and maintenance of electric power generation, control, transmission, and distribution lines and equipment.*

#### **1910.269(a)(1)(ii)(B)**

*To electrical installations, electrical safety-related work practices, or electrical maintenance considerations covered by Subpart S of this Part.*

**Note 1:** *Work practices conforming to 1910.332 through 1910.335 of this Part are considered as complying with the electrical safety-related work practice requirements of this section identified in Table 1 of Appendix A-2 to this section, provided the work is being performed on a generation or distribution installation meeting 1910.303 through 1910.308 of this Part. This table also identifies provisions in this section that apply to work by qualified persons directly on or associated with installations of electric power generation, transmission, and distribution lines or equipment, regardless of compliance with 1910.332 through 1910.335 of this Part.*

**Note 2:** *Work practices performed by qualified persons and conforming to 1910.269 of this Part are considered as complying with 1910.333(c) and 1910.335 of this Part.*

**1910.269(a)(1)(iii)**

*This section applies in addition to all other applicable standards contained in this Part 1910. Specific references in this section to other sections of Part 1910 are provided for emphasis only.*

These provisions suggest that the rules that OSHA applies in general industry also apply to utilities.

Section 1910.132 in subpart I of the OSHA regulations requires that the employer provide personal protective equipment (PPE) appropriate for the hazards involved.

**1910.132(d)(1)**

*The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall:*

**1910.132(d)(1)(i)**

*Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment;*

In turn, 1910.335, Safeguards for Personnel Protection requires the following:

**1910.335(a)(1)(i)**

*Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.*

**Note:** *Personal protective equipment requirements are contained in subpart I of this part.*

The reference to subpart I in 1910.335(a)(1)(i) includes the information in 1910.132(d), which is part of subpart I.

*Arc-resistant construction of electrical equipment is intended to give an extra degree of protection to personnel in the vicinity of energized equipment, and particularly to direct the exhaust of extremely hot gases resulting from an arcing event inside the equipment away from the personnel.*

Awareness of hazards to workers also grew, particularly after 1990, at least in part due to activities of two safety committees of the IEEE Industry Applications Society. The first is the Safety, Operations, and Maintenance Subcommittee of the Industrial and Commercial Power Systems Committee (I&CPS), while the second is the Safety Committee of the Petroleum and Chemical Industry Committee (PCIC). The I&CPS Subcommittee was the driving force in creation of the IEEE Yellow Book, IEEE 902, "IEEE Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems." In turn, the PCIC Safety Committee took the concept of electrical safety to a new level with the creation of the IEEE IAS Electrical Safety Workshop. The first workshop was held in Dallas in 1992, and the nineteenth workshop took place in Daytona Beach in February, 2012, with nearly 400 persons participating.

The objective of the Electrical Safety Workshop (ESW) is to provide a forum for the exchange of ideas for preventing electrical accidents and injuries in the workplace, and to accelerate application of technology, work practices, standards, and regulations. In the time since the first ESW was inaugurated, the rate of worker injuries due to electrical causes has decreased markedly, indicating that the mission of the ESW is being accomplished.

The attendance at the ESW by members of the utility industry is growing, and with this, the recognition that use of arc-resistant outdoor substation distribution circuit breakers can reduce the level of hazards to which the utility electrical worker is exposed. For more information, see the ESW website at [www.ewh.ieee.org/cmte/ias-esw](http://www.ewh.ieee.org/cmte/ias-esw)



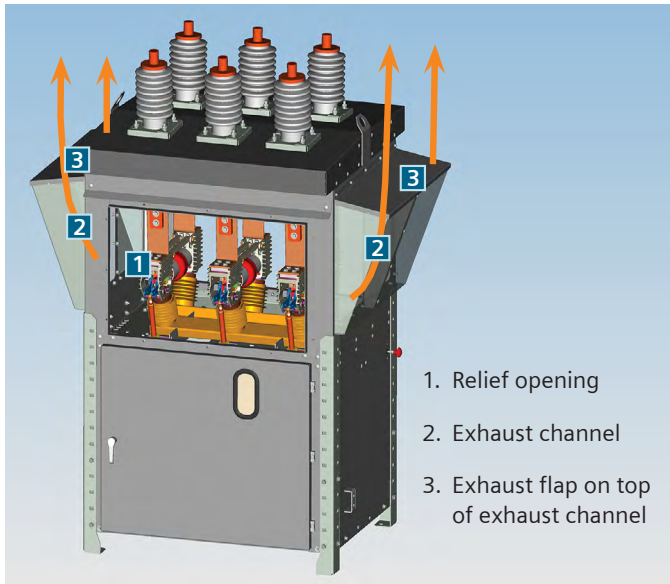


Figure 1: Type SDV7-AR arc-exhaust system

Arc-resistant construction of electrical equipment is intended to give an extra degree of protection to personnel in the vicinity of energized equipment, and particularly to direct the exhaust of extremely hot gases resulting from an arcing event inside the equipment away from the personnel. While there are other ways to protect personnel from the hazards of arcing events inside equipment, use of outdoor distribution circuit breakers that are qualified as arc resistant offers an effective means to increase the level of protection to personnel. Figure 1 shows the key elements of the arc-resistant enclosure design of the type SDV7 family of circuit breakers and the method of exhausting gases. The enclosure is provided with channels on the two sides of the enclosure. These channels have top-mounted pressure-relief flaps, designed to open in the event of an internal arcing event, and exhaust arcing byproducts upwards, away from operators. The type SDV7-AR enclosure has been tested to ANSI/IEEE C37.20.7 for accessibility type 2B, arc-resistant around the four sides, with the low-voltage compartment doors open or closed.

To comply with OSHA, the worker in the vicinity of an energized circuit breaker must use the appropriate arc-rated PPE. A higher level of PPE is necessary with non-arc-resistant equipment, which is one significant reason that utilities are beginning to require arc-resistant equipment.

While OSHA does not directly enforce NFPA 70E®, OSHA generally accepts practices that comply with NFPA 70E as being in compliance with OSHA regulations. It is understood that NFPA 70E does not (strictly) apply to electric utilities, but we are not aware of a document of comparable rigor solely for the utility industry.

For discussion of arc-resistant accessibility types, refer to [TechTopics No. 70 - Arc-resistant switchgear accessibility types](#).

**Should you have any questions about any of our products, solutions, or services, please contact your local Siemens sales representative.**

Published by Siemens Industry, Inc. 2020.

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Order no: SIDS-T40072-00-4AUS

Printed in U.S.A.

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