Section 41.
Supply and communications systems—Rules for employers

410. General requirements

A. General

1. The employer shall inform each employee working on or about communications equipment or electric supply equipment and the associated lines, of the safety rules governing the employee's conduct while so engaged.

   When deemed necessary, the employer shall provide a copy of such rules.

2. The employer shall provide training to all employees who work in the vicinity of exposed energized facilities. The training shall include applicable work rules required by this Part and other mandatory referenced standards or rules. The employer shall ensure that each employee has demonstrated proficiency in required tasks. The employer shall provide retraining for any employee who, as a result of routine observance of work practices, is not following work rules.

3. Effective as of January 1, 2009, the employer shall ensure that an assessment is performed to determine potential exposure to an electric arc for employees who work on or near energized parts or equipment. If the assessment determines a potential employee exposure greater than 2 cal/cm^2 exists (see Neal, Bingham, and Doughty [B59]), the employer shall require employees to wear clothing or a clothing system that has an effective arc rating not less than the anticipated level of arc energy.

   When exposed to an electric arc or flame, clothing made from the following materials shall not be worn: acetate, nylon, polyester, or polypropylene.

   The effective arc rating of clothing or a clothing system to be worn at voltages 1000 V and above shall be determined using Tables 410-1 and 410-2 or performing an arc hazard analysis.

   When an arc hazard analysis is performed, it shall include a calculation of the estimated arc energy based on the available fault current, the duration of the arc (cycles), and the distance from the arc to the employee.

   EXCEPTION 1: If the clothing required by this rule has the potential to create additional and greater hazards than the possible exposure to the heat energy of the electric arc, then clothing with an arc rating or arc thermal performance value (ATPV) less than that required by the rule can be worn.

   EXCEPTION 2: For secondary systems below 1000 V, applicable work rules required by this part and engineering controls shall be utilized to limit exposure. In lieu of performing an arc hazard analysis, clothing or a clothing system with a minimum effective arc rating of 4 cal/cm^2 shall be required to limit the likelihood of ignition.

   NOTE 1: A clothing system (multiple layers) that includes an outer layer of flame resistant material and an inner layer of non-flame resistant material has been shown to block more heat than a single layer. The effect of the combination of these multiple layers can be referred to as the *effective arc rating.*

   NOTE 2: It is recognized that arc energy levels can be excessive with secondary systems. Applicable work rules required by this part and engineering controls should be utilized.

4. Employers shall utilize positive procedures to secure compliance with these rules. Cases may arise, however, where the strict enforcement of some particular rule could seriously impede the safe progress of the work at hand; in such cases the employee in charge of the work to be done should make such temporary modification of the rules as will accomplish the work without increasing the hazard.

5. If a difference of opinion arises with respect to the application of these rules, the decision of the employer or the employer's authorized agent shall be final. This decision shall not result in any employee performing work in a manner that is unduly hazardous to the employee or to the employee's fellow workers.

B. Emergency procedures and first aid rules

1. Employees shall be informed of procedures to be followed in case of emergencies and rules for first aid, including approved methods of resuscitation. Copies of such procedures and rules should be kept in conspicuous locations in vehicles and places where the number of employees and the nature of the work warrants.
2. Employees working on communications or electric supply equipment or lines shall be regularly instructed in methods of first aid and emergency procedures, if their duties warrant such training.

C. Responsibility

1. A designated person shall be in charge of the operation of the equipment and lines and shall be responsible for their safe operation.
2. If more than one person is engaged in work on or about the same equipment or line, one person shall be designated as in charge of the work to be performed. Where there are separate work locations, one person may be designated at each location.

Table 410-1—Clothing and clothing systems—voltage, fault current, and maximum clearing time for voltages 1 to 46 kV ①

(See Rule 410A3.)

Phase-to-phase voltage (kV)	Fault current (kA)	4-cal system	8-cal system	12-cal system
		Maximum clearing time (cycles)	Maximum clearing time (cycles)	Maximum clearing time (cycles)
1 to 15	5	46.5	93.0	139.5
	10	18.0	36.1	54.1
	15	10.0	20.1	30.1
	20	6.5	13.0	19.5
15.1 to 25	5	27.6	55.2	82.8
	10	11.4	22.7	34.1
	15	6.6	13.2	19.8
	20	4.4	8.8	13.2
25.1 to 36	5	20.9	41.7	62.6
	10	8.8	17.6	26.5
	15	5.2	10.4	15.7
	20	3.5	7.1	10.6

Table 410-1—Clothing and clothing systems—voltage, fault current, and maximum clearing time for voltages 1 to 46 kV ① *(continued)*

(See Rule 410A3.)

Phase-to-phase voltage (kV)	Fault current (kA)	4-cal system	8-cal system	12-cal system
		Maximum clearing time (cycles)	Maximum clearing time (cycles)	Maximum clearing time (cycles)
36.1 to 46	5	16.2	32.4	48.6
	10	7.0	13.9	20.9
	15	4.3	8.5	12.8
	20	3.0	6.1	0.1

①These calculations are based on open air phase-to-ground arc. This table is not intended for phase-to-phase arcs or enclosed arcs (arc in a box).

These calculations are based on a 15-in separation distance from the arc to the employee and arc gaps as follows: 1 to 15 kV = 2 in, 15.1 to 25 kV = 4 in, 25.1 to 36 kV = 6 in, 36.1 to 46 kV = 9 in. See IEEE Std 4-1995.

These calculations were derived using a commercially available computer software program. Other methods are available to estimate arc exposure values and may yield slightly different but equally acceptable results.

The use of the table in the selection of clothing is intended to reduce the amount or degree of injury but may not prevent all burns.

Table 410-2—Live-line tool work clothing and clothing systems—voltage, fault current, and maximum clearing time for voltages 46.1 to 800 kV ①

(See Rule 410A3.)

Phase-to-phase voltage (kV)	Fault current (kA)	4-cal system	8-cal system	12-cal system
		Maximum clearing time (cycles)	Maximum clearing time (cycles)	Maximum clearing time (cycles)
46.1 to 72.5	20	8.5	17.0	25.5
	30	5.3	10.5	15.8
	40	3.7	7.3	11.0
	50	2.8	5.5	8.3
72.6 to 121	20	8.2	16.5	24.7
	30	4.7	9.4	14.1
	40	3.1	6.2	9.3
	50	2.2	4.4	6.6
138 to 145	20	9.8	19.5	29.3
	30	5.6	11.2	16.8
	40	3.7	7.4	11.1
	50	2.6	5.3	7.9

Table 410-2—Live-line tool work clothing and clothing systems—voltage, fault current, and maximum clearing time for voltages 46.1 to 800 kV ① *(continued)*

(See Rule 410A3.)

Phase-to-phase voltage (kV)	Fault current (kA)	4-cal system	8-cal system	12-cal system
		Maximum clearing time (cycles)	Maximum clearing time (cycles)	Maximum clearing time (cycles)
161 to 169	20	9.3	18.6	27.9
	30	5.7	11.5	17.2
	40	4.0	8.0	12.0
	50	3.0	6.0	9.0
230 to 242	20	10.4	20.9	31.3
	30	6.4	12.9	19.3
	40	4.5	9.0	13.5
	50	3.4	6.8	10.1
345 to 362	20	22.6	45.3	67.9
	30	14.0	28.1	42.1
	40	9.8	19.6	29.4
	50	7.4	14.7	22.1
500 to 550	20	18.9	37.8	56.7
	30	11.7	23.3	35.0
	40	8.1	16.3	24.4
	50	6.1	12.2	18.3
765 to 800	20	43.6	87.3	130.9
	30	27.0	53.9	80.9
	40	18.9	37.8	56.7
	50	14.2	28.4	42.6

①Arc gap—calculated by using the phase-to-ground voltage of the circuit and dividing by 10. The dielectric strength of air is taken at 10 kV per inch. See IEEE Std 4-1995.

Distance from arc—calculated by using the minimum approach distance from Table 441-2 and subtracting two times the assumed arc gap length.

These calculations were derived using a commercially available computer software program. Other methods are available to estimate arc exposure values and may yield slightly different, but equally acceptable results.

The use of the table in the selection of clothing is intended to reduce the amount or degree of injury but may not prevent all burns.