

# Application of NFPA 70E to R&D Systems

# Group Members

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# (A) Shock Hazards for DC

- Based on NFPA 70E 130.2 (C)
- Table generated by workshop group
- Tools and probes that pass the Restricted Approach Boundary must be taken into account.
- Avoid any part of body in RAB

# DC Shock Boundary Table

(1)	(2)	(3)	(4)	(5)
Nominal Voltage Conductor to Ground	Limited Approach Boundary		Restricted Approach Boundary, Includes Inadvertent Movement Adder	Prohibited Approach Boundary
	Exposed Movable Conductor	Exposed Fixed Circuit Part		
< 100 V	Not specified	Not specified	Not specified	Not specified
100 V Š 300 V	3.05 m (10'0")	1.07 m (3'6")	Avoid contact	Avoid contact
301 V Š 1 kV	3.05 m (10'0")	1.07 m (3'6")	304 mm (1'0")	25 mm (0'0")
1 kV Š 5 kV	3.05 m (10'0")	1.53 m (5'0")	450 mm (1'6")	100 mm (0'4")
5 kV Š 15 kV	3.05 m (10'0")	1.53 m (5'0")	660 mm (2'2")	178 mm (0'7")
15 kV Š 45 kV	3.05 m (10'0")	2.5 m (8'0")	0.8 m (2'6")	0.44 m (1'5")
45 kV Š 75 kV	3.05 m (10'0")	2.5 m (8'0")	1 m (3'2")	0.65 m (2'1")
75 kV Š 150 kV	3.4 m (10'8")	3 m (10'0")	1.2 m (4'0")	1 m (3'2")
150 kV Š 250 kV	4 m (11'8")	4 m (11'8")	1.6 m (5'3")	1.5 m (5'0")
250 kV Š 500 kV	6 m (20'0")	6 m (20'0")	3.5 m (11'6")	3.3 m (10'10")
500 kV Š 800 kV	8 m (26'0")	8 m (26'0")	5 m (16'5")	5 m (16'5")

proposed to eliminate wiggly conductors

## (A) Shock Hazards for DC - cont.

- Recognition that DC table has to be different than AC table for DOE handbook
- We need to go back to research done on “Let go” thresholds.
- We have a need to justify the 100 volt rule. Go back to 50 volt AC rule, re-study.

# (B) Input into Ground Hooks Standards

- Length of ground hook based on Restricted Approach Boundaries for a given voltage, and must keep worker outside RAB.
- A ground hook training, testing, care, inspection process is under development.
- Refer to ASTM F711 for HV leakage across handle
- Ground hook design guidance from DOE Handbook. 2/0 wire. May be modified depending on application, e.g., use as a drain wire.

# (C) Arc Flash in R&D

- When do R&D workers need to worry about Arc Flash hazards?
- What kind of PPE is needed?
- How do we determine power x time = energy for
  - a) DC power supplies
  - b) Batteries – Have large amount of energy
  - c) Capacitors
  - d) Inductor

## (C) Arc Flash in R&D - cont.

- For arc flash boundary calculations for above systems, use proposed, conservative method based on total energy available
- Need research on arc flash energy on DC power supplies, capacitors, and inductors

## (D) Methods of Zero Energy Verification in R&D

- Discussed methods of remote and safe zero energy verification using engineering designs and personnel safety devices (ground hooks) to avoid exposing the worker to shock and arc flash hazards.

# Path Forward

- Will submit to DOE Handbook
  - DC table
  - methods of zero energy verification
  - methods of arc flash boundary calculation for R&D equipment
- Will submit to Ground Hook standards committee
  - requirements for design for shock protection