


ATTACHMENT SUMMARY


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**WORKSHOP ON
EMERGENCY RESPONDER
PERSONAL PROTECTIVE EQUIPMENT (PPE)
FOR HYBRID AND ELECTRIC VEHICLES**

**TUESDAY 1 MAY 2012
QUINCY, MASSACHUSETTS**




NFPA Headquarters
One Batterymarch Park
Quincy, MA USA



**Workshop on Emergency Responder
PPE for Hybrid and Electric Vehicles**


1) Review of Workshop
Goals, Objectives, and Deliverables



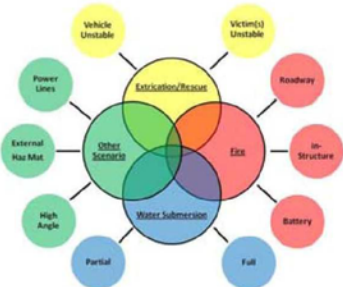
**Workshop on Emergency Responder
PPE for Hybrid and Electric Vehicles**

- Goal: Develop guiding principles and recommended action steps for minimizing the risk to emergency responders due to hazards involving electrically energized equipment in EVs.
- Objectives:
 - Summarize and document emergency responder tasks, PPE (both electrical and FF/rescue), electrical hazards, available guidance
 - Identify hazards of interest;
 - Analyze risk of identified hazards, and clarify priorities;
 - Establish guiding principles and recommended action steps.

**Workshop on Emergency Responder
PPE for Hybrid and Electric Vehicles**



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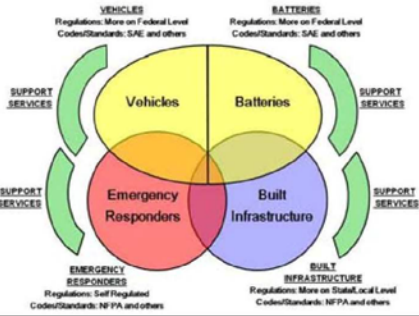
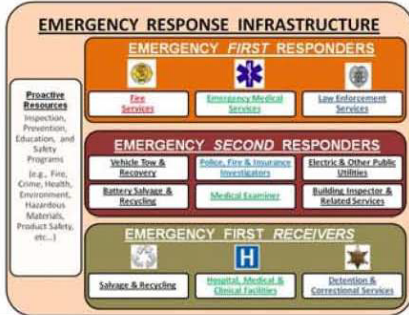


Figure A(1):Presentation by C. Grant on “Workshop Goal, Objectives, & Deliverables”

Workshop on Emergency Responder PPE for Hybrid and Electric Vehicles



Workshop on Emergency Responder PPE for Hybrid and Electric Vehicles

- Voltage – the electromotive force or potential difference, measured in volts. Voltage is the “pressure” that pushes an electrical charge through a conductor.
- Amperage or Current – The amount of electrical charge flowing past a given point per unit of time, measured in amperes or amps. Amperage is the measure of electrical current flow.

Clarification of “Voltage” & “Amperage”

Generally recognized vehicle electrical current classes are:

- Low - up to and including 30 Volts DC or 15 Volts AC
- Intermediate - greater than 30 Volts DC or 15 Volts AC and less than and including 60 Volts DC or 30 Volts AC
- High – greater than 60 Volts DC or 30 Volts AC

Vehicle Voltage Levels

“High Voltage” per Article 490 of NEC is voltage exceeding 600 volts

Voltage Levels for Built Infrastructure

Workshop on Emergency Responder PPE for Hybrid and Electric Vehicles

Estimated Effect of 60 Hz AC Current on Humans

Millicurrents	Observable Effect
150/200*	Common fuse or circuit breaker opens
1000	Current used by a 250-watt light bulb
500	Severe burns
300	Breathing stops
100	Heart stops beating (ventricular fibrillation threshold)
50	Sublethal possible
20	Muscle contraction (paralysis of respiratory muscles)
16	Maximum current an average man can release “grasp”
5	20/12 mill amp
2	Mild shock
1	Threshold of sensation (barely perceptible)

Human Body Reaction to Shock Hazards

Shock Hazard Levels

Effect of Current	AC Current in Amperes-Hour	AC Current in Amperes-Minutes
Perception threshold (tingling sensation)	0.0010	0.0007
Slight shock-not painful (no loss of muscle control)	0.0014	0.0012
Shock-painful (no loss of muscle control)	0.0080	0.0060
Shock-severe (muscle control loss, breathing difficulty- onset of “let go” threshold)	0.0250	0.0150
Possible ventricular fibrillation (2-second shock)	0.1000	0.1000
Possible ventricular fibrillation (1-second shock)	0.2000	0.2000
Heart muscle activity ceases	0.3000	0.3000
Tissue and organ burn	1.5000	1.5000

Workshop on Emergency Responder PPE for Hybrid and Electric Vehicles

2) Presentation of Emergency Responder EV Tactics



Workshop on Emergency Responder PPE for Hybrid and Electric Vehicles

3) Panel on Emergency Responder Concerns



Workshop on Emergency Responder PPE for Hybrid and Electric Vehicles

4) Presentation on Available EV Emergency Responder Guidance



Figure A(2):Presentation by C. Grant on “Workshop Goal, Objectives, & Deliverables”

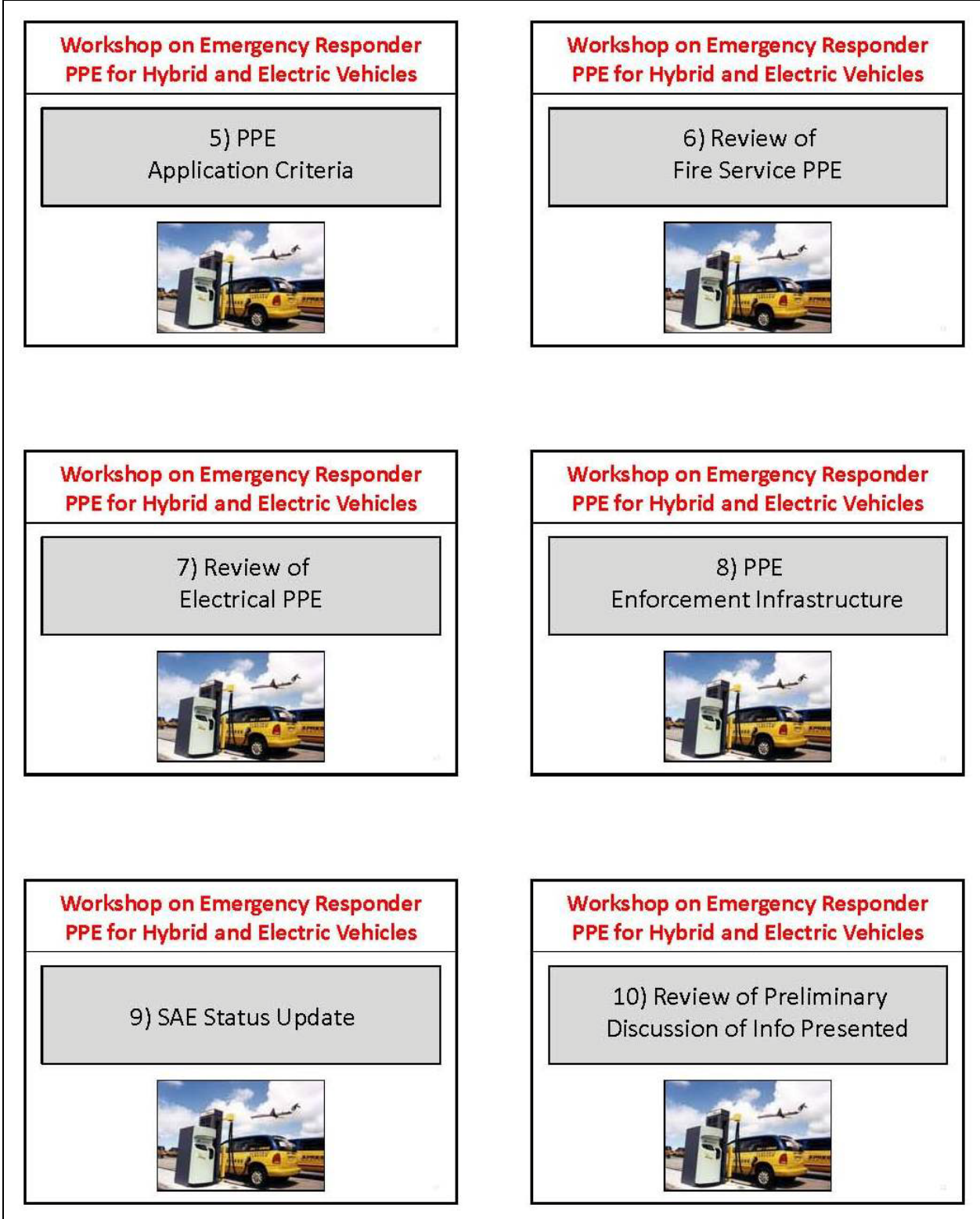


Figure A(3):Presentation by C. Grant on “Workshop Goal, Objectives, & Deliverables”

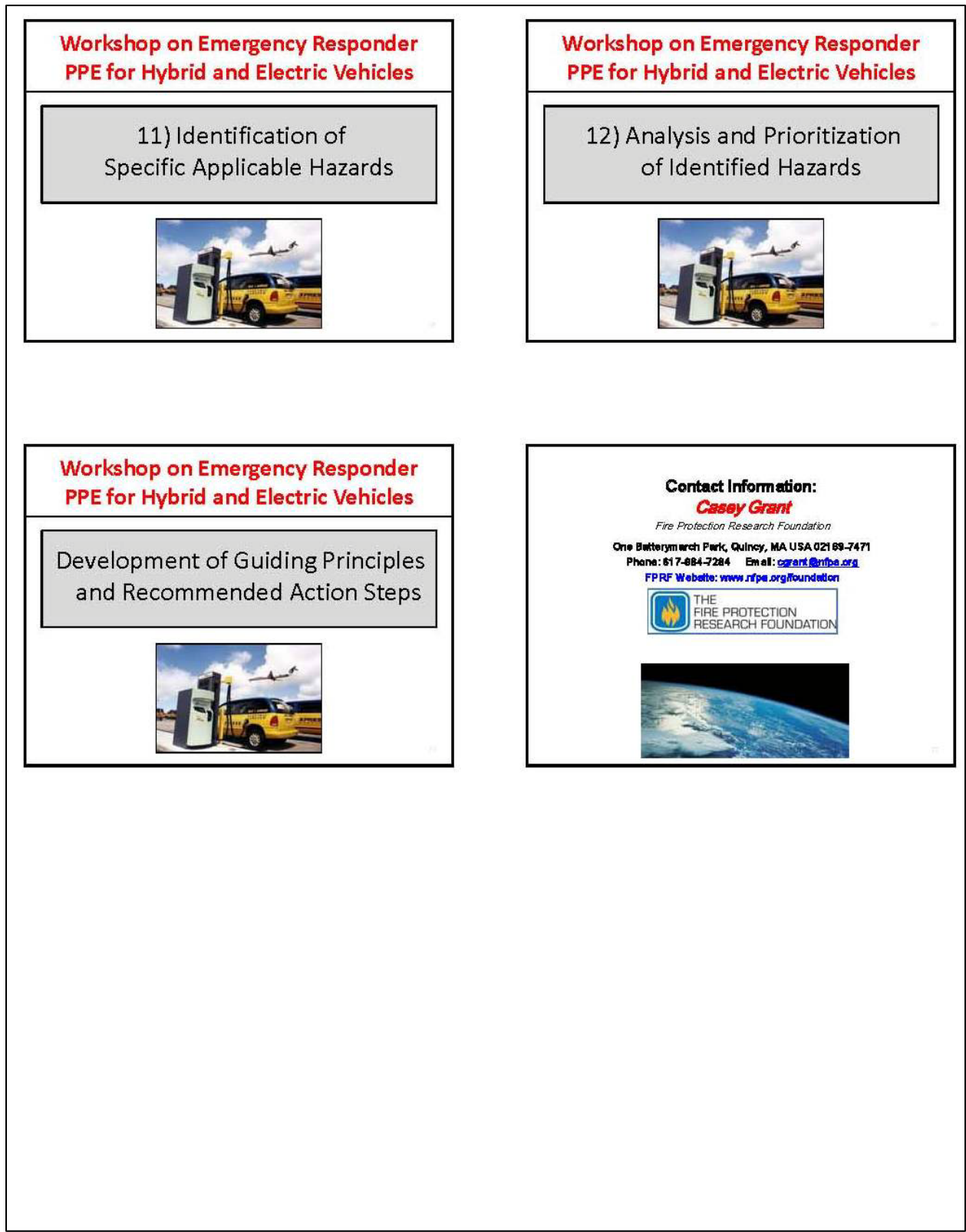


Figure A(4):Presentation by C. Grant on “Workshop Goal, Objectives, & Deliverables”

Extrication Operations and PPE



The Purpose of Today's Discussion....



Defining PPE Needs Based on Hazards

- Fluids
- Traffic
- Weather Conditions
- Sharp Metal
- Thermal Hazards
- Flying Objects



Types of PPE Currently Utilized



Crashes Involving HEVs and EVs

• How can we address high voltage electrical concerns?

• How does electrical PPE fit into the crash/ extrication environment?



Electrical PPE Key Considerations



Hazard protection vs. Operating conditions



Figure B(1): Presentation by J. Emery and C. Pepler on "Emergency Responder EV Tactics"

Defining the Extrication Environment

Goals Overview



1. Removal of vehicle from around entrapped patients
2. Minimize movement of patient to prevent further injury

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Initial Response Procedures

Identify

Immobilize

Disable

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Initial Response Procedures

Identify



Conventional vs. Alternative Fuel

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Initial Response Procedures

Immobilize



Chock Wheels



Place in Park



Engage Parking Brake

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Initial Response Procedures

Disable



Turn Ignition Off



Secondary Methods as Required



Disconnect 12V Battery

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When Extrication is Required

Tools Used



Halligan Bar



Ram



Spreader



Cutter



SawZall

Hazards:
Heavy & Sharp

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Figure B(2): Presentation by J. Emery and C. Pepler on "Emergency Responder EV Tactics"

When Extrication is Required

Methods Used



Door Pop



Roof Flap or Removal

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When Extrication is Required

Methods Used



Dash Roll





Dash Lift

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When Defining PPE We Must Consider That:

Extractions are a full-body contact activity






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Extrication Scenario



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Conclusion

Selection of PPE must consider both:

- Electrical concerns
- Traditional hazards

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Figure B(3):Presentation by J. Emery and C. Pepler on “Emergency Responder EV Tactics”

**Analysis of current manufacturer guidance regarding
Electrical PPE Requirements
and
Manual Service Disconnects**



John Cannon
Project Manager,
Training Development
NFPA



15 Manufacturers Sampled for This Survey

- BMW
- Chrysler (Dodge)
- Ford (Lincoln, Mercury)
- General Motors (Buick, Cadillac, Chevrolet, GMC, Saturn)
- Honda
- Hyundai
- Kia
- Mazda
- Mercedes-Benz (Smart)
- Mini
- Mitsubishi
- Nissan (Infiniti)
- Tesla
- Toyota (Lexus)
- Volkswagen

Electrical PPE Requirement for removal of Manual Service Disconnect (MSD)		
REQUIREMENT	NUMBER OF MANUFACTURERS (of 15)	NOTES
Electrical PPE NOT REQUIRED	4	
Electrical PPE REQUIRED	3	One of these manufacturer's vehicles is mechanically identical to another manufacturer's who does not require electrical PPE.
MSD NOT ADDRESSED	4	Some of the vehicles may not be equipped with a manual service disconnect.
RECOMMEND AGAINST First Responder Use of MSD	1	Only one manufacturer specifically states that the service disconnect is to be used only by trained service personnel in a service environment.
Requirement NOT CLEAR	2	Both manufacturers recommend the use of Electrical PPE in any "high-voltage situation", but do not define what constitutes a "high-voltage situation".
Recommend Electrical PPE for ALL RESPONSE SITUATIONS	1	

DEFINITIONS OF REQUIRED PPE	
<u>Manufacturer A:</u>	Insulating Gloves rated for 1000V+ Safety Glasses
<u>Manufacturer B:</u>	High Voltage Rubber Gloves Face Shield Insulated Boots Protective Raincoat and Apron <i>Additionally</i> , remove jewelry and any metallic object that can conduct electricity.
<u>Manufacturer C:</u>	Insulating Gloves rated for up to 1000V Insulated Shoes Face Shield
<u>Manufacturer D:</u>	Insulating Gloves as per DIN DVE 0680 or EN 600903 <i>Additionally</i> , Rescue crews should only disconnect if they have appropriate training and qualifications.
<u>Manufacturer E:</u>	Insulating Gloves rated for 400V+ <i>Recommended:</i> Rubber Soled Shoes, PPE Pants and Jacket (Standard or Elektra??)

Figure C(1): Presentation by J. Cannon on "EV Emergency Response Guidance"




**PPE Application Criteria
High Level Overview**

NFPA 70E
NFPA 1351
NFPA 1371

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**NFPA 70E
Standard on Electrical Safety in the Workplace**



2

**NFPA 70E
Standard on Electrical Safety in the Workplace**

- Purpose – to provide a practical safe working area for employees relative to the hazards arising from the use of electricity.




3

**NFPA 70E
Standard on Electrical Safety in the Workplace**

SCOPE

- Covered
- Not Covered



4


**NFPA 70E
Standard on Electrical Safety in the Workplace**

SCOPE

- What's Covered

Electrical safety-related work practices for employee workplaces during the following activities on the following equipment:

Activity	Equipment
Installation	Electric Conductors
Inspection	Electric Equipment
Operation	Signaling Conductors & Equip
Maintenance	Raceways
Demolition	




5

**NFPA 70E
Standard on Electrical Safety in the Workplace**

Also covered....

Safe work practices for

- (1) Installation of conductors and electricity that connect to the supply of electricity
- (2) Installations used by the electric utility (office buildings, warehouses, garages, machine shops, recreational buildings) that are not an integral part of a generating plant, substation, or control center.



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Figure D(1): Presentation by S. Corrado on “PPE Application Criteria”



Figure D(2): Presentation by S. Corrado on “PPE Application Criteria”

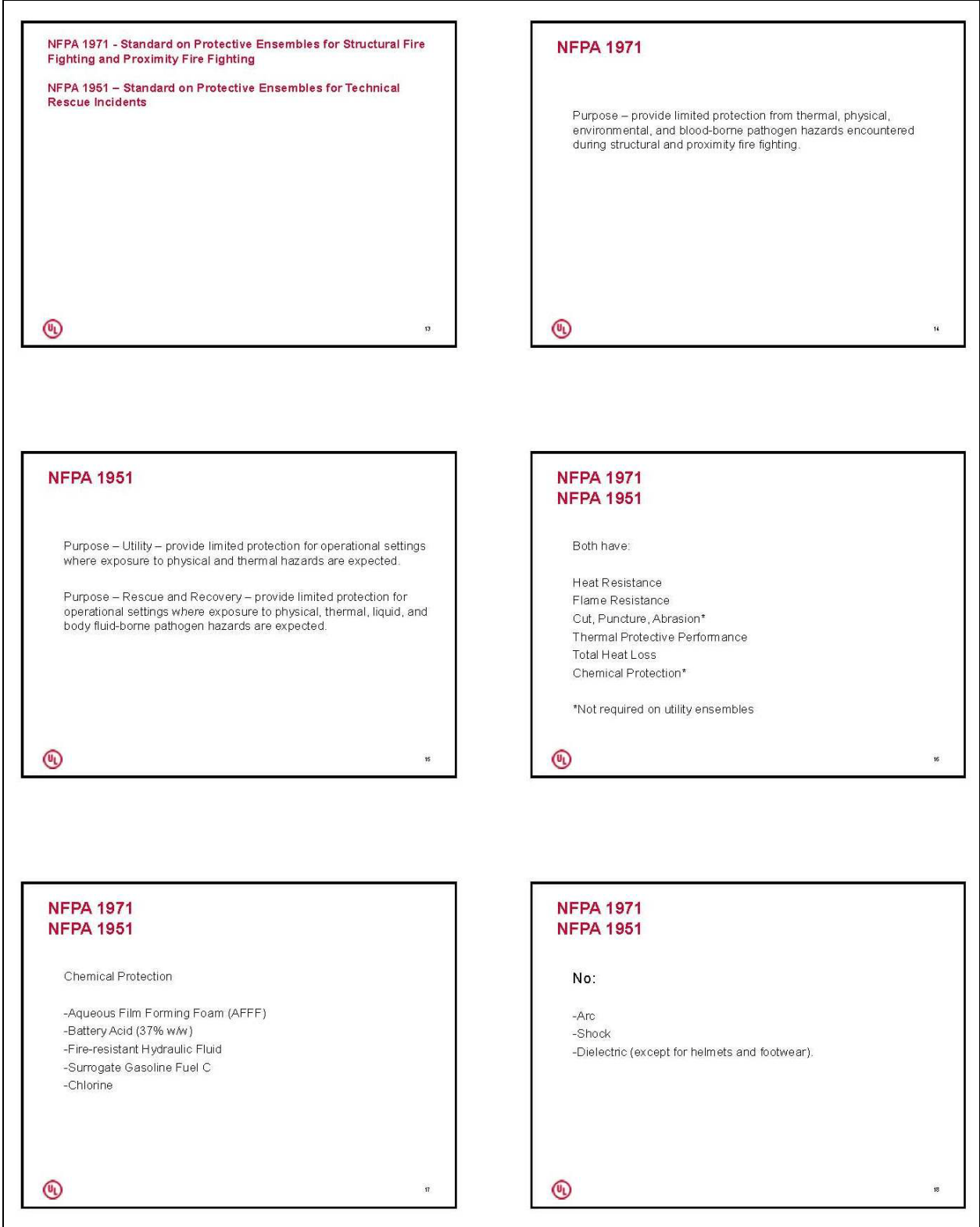


Figure D(3): Presentation by S. Corrado on “PPE Application Criteria”

Comparison

Property	70E	1971/1951
Arc Resistance	X	
Chemical Resistance	Clothing only	X
Flame Resistance		X
Shock Resistance (Dielectric) Footwear	15000 VAC 45000 VDC	14000 VAC
Shock Resistance (Dielectric) Helmets	0 VAC Class C 2200 VAC Class G 20000 VAC Class E	22000 VAC
Footwear	X	X
Eye and Face Protection	X	X
Head Protection	X	X



e

THANK YOU.



Figure D(4): Presentation by S. Corrado on “PPE Application Criteria”