

BWO



NECA
PHILADELPHIA
SEPT 29-OCT 2, 2023

TESTING?

WHY?

Gary Walls




TRADE SHOW EDUCATION

1


This session is eligible for 1 Contact Hour.

For these hours to appear on your certificate, you must:

- Have your badge scanned at the door
- Attend 90% of this presentation
- Fill out the online evaluation for this session






2






Introduction

Gary Walls has been with UIS for over 34 years and has 39 years of experience in the field. He has a Bachelors of Science in Industrial Engineering Technology from Eastern Michigan University. Other credentials include NETA III, Master Electrician, ISA, CCST III. He serves on the board for Ann Arbor Electrical Apprenticeship (JATC), the Associate Membership Committee for the SEMNECA Chapter and the Membership Committee for NETA.



Gary Walls
President







3

BWO

Why?

- Safety
- Reliability
- Insurance

4

Slide 1

BW0 [@Gary Walls] What did you say the title is?
Brittany Walls, 2023-07-31T19:13:30.088

BW0 0 [@Gary Walls] Everything else is updated
Brittany Walls, 2023-07-31T19:13:44.401

BW0 1 [@Gary Walls] That was the last thing I had to update. No it should be all set. Look it over. Do you want me to submit?
Brittany Walls, 2023-07-31T19:21:22.398

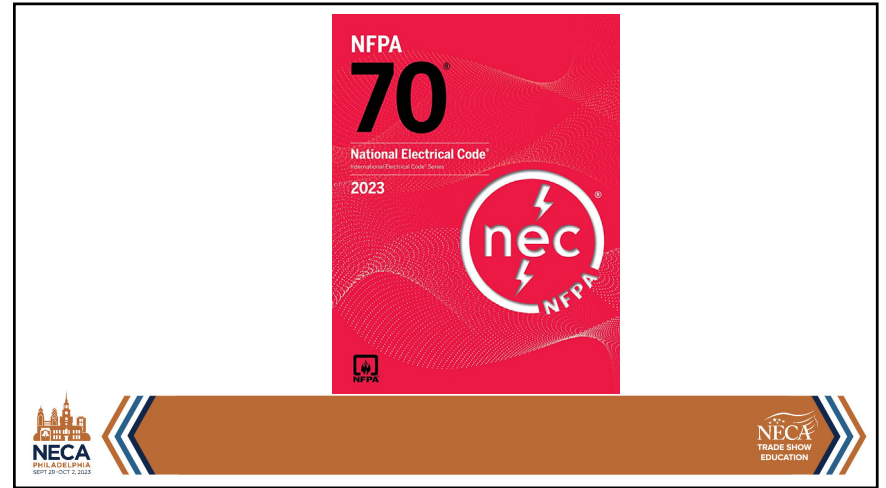
BW0 2 [@Gary Walls] What is your presentation title?
Brittany Walls, 2023-07-31T19:28:39.145

Slide 4

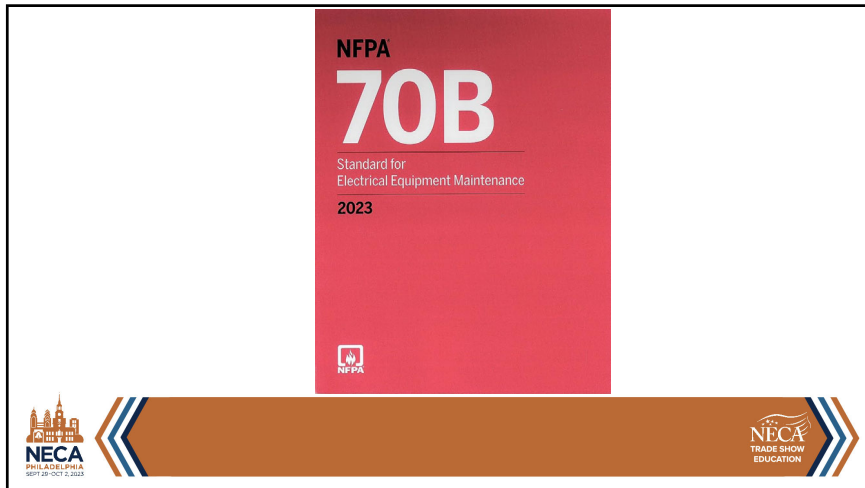
GW0 NECA
Gary Walls, 2023-08-01T14:32:45.209



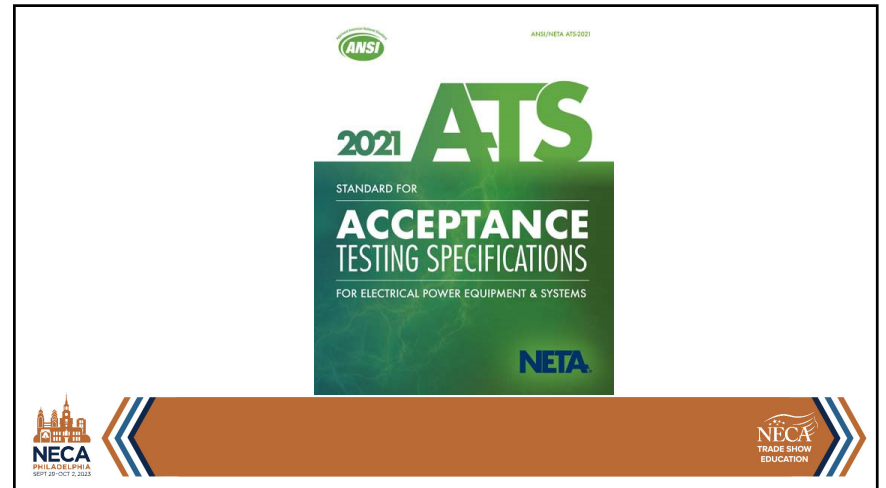
5



6



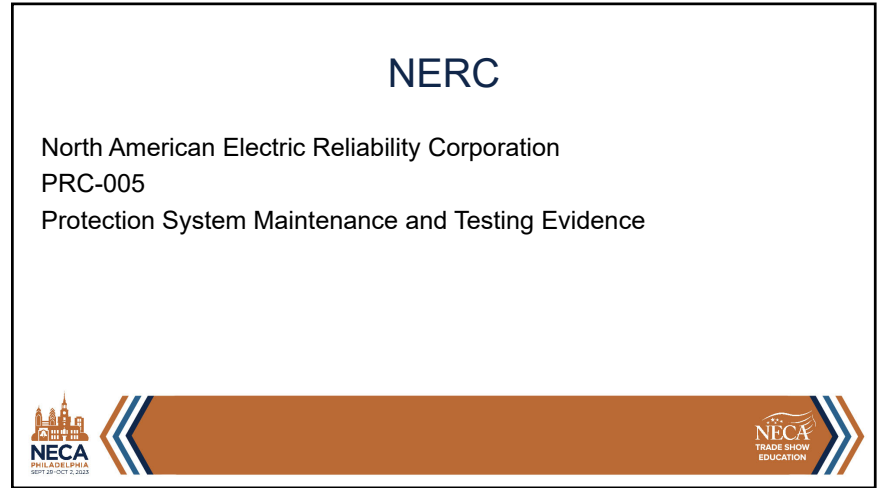
7



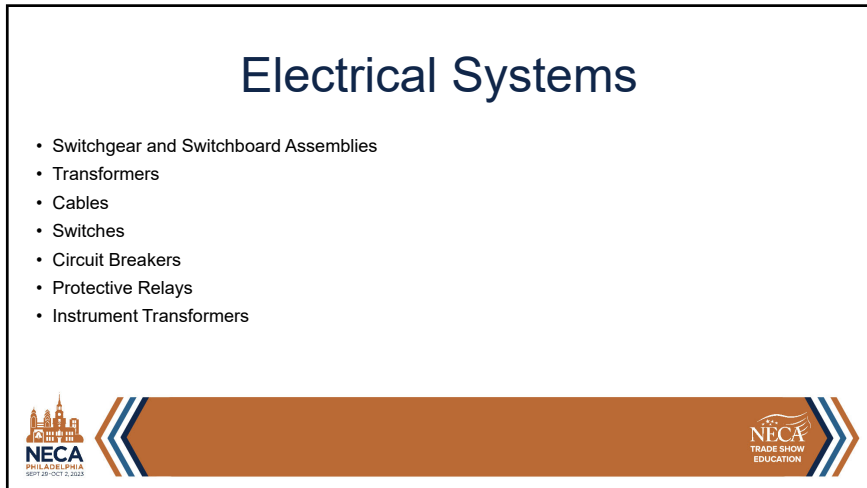
8



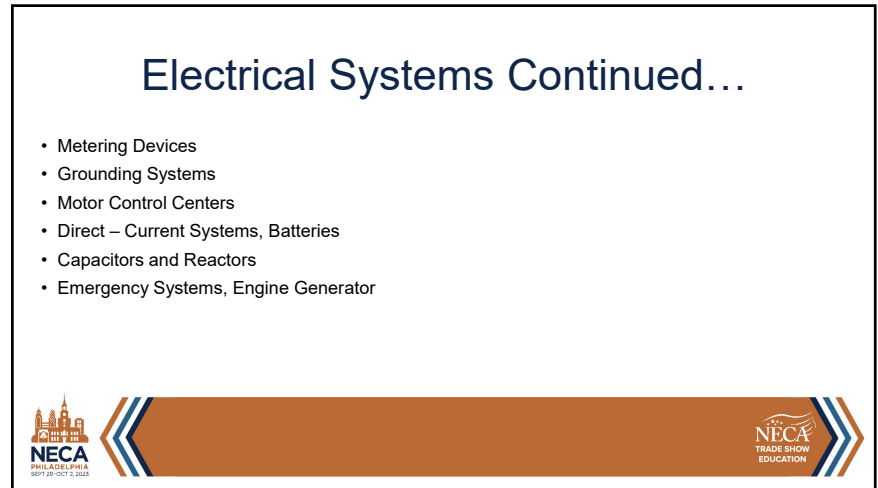
9



10



11



12

NFPA70 Electrical Code

N 110.17 Servicing and Maintenance of Equipment.

Servicing and electrical preventive maintenance shall be performed by qualified persons trained in servicing and maintenance of equipment and shall comply with the following:

- (1) The servicing and electrical preventive maintenance shall be performed in accordance with the original equipment manufacturer's instructions and information included in the listing information, applicable industry standards, or as approved by the authority having jurisdiction.
- (2) The servicing and electrical preventive maintenance shall be performed using identified replacement parts that are verified under applicable product standards. The replacement parts shall comply with at least one of the following:
 - a. Be provided by the original equipment manufacturer
 - b. Be designed by an engineer experienced in the design of replacement parts for the type of equipment being serviced or maintained
 - c. Be approved by the authority having jurisdiction.



13

NFPA70 Electrical Code

235.356 Inspections and Tests.

(A) Pre- Energization and Operating Tests.

- (1) Instrument Transformers.
 - (2) Protective Relays.
 - (3) Switching Circuits
 - (4) Control and Signal Circuits.
 - (5) Metering Circuits.
 - (6) Acceptance Tests.
 - (7) Relays and Metering Utilizing Phase Differences.
- (B) Test Report.



14

NFPA70 Electrical Code

240.67 Arc Energy Reduction.

C) Performance Testing.

The arc energy reduction protection system shall be performance tested by primary current injection testing or another approved method when first installed on site. This testing shall be conducted by a qualified person(s) in accordance with the manufacturer's instructions.



15

NFPA70 Electrical Code

495.48 Substation Design, Documentation, and Required Diagram.

(A) Design and Documentation.

- (1) Clearances and exits
- (2) Electrical enclosures
- (3) Securing and support of electrical equipment
- (4) Fire protection
- (5) Safety ground connection provisions
- (6) Guarding live parts
- (7) Transformers and voltage regulation equipment
- (8) Conductor insulation, electrical and mechanical protection, isolation, and terminations
- (9) Application, arrangement, and disconnection of circuit, breakers, switches, and fuses
- (10) Provisions for oil-filled equipment
- (11) Switchgear
- (12) Overvoltage (surge) protection equipment



16

NFPA70 Electrical Code

Substation Design, Documentation, and Required Diagram. (Continued)

(B) Diagram.

A permanent, single-line diagram of the switchgear shall be provided in a readily visible location within the same room or enclosed area with the switchgear and shall clearly identify the following:

- (1) Interlocks
- (2) Isolation means
- (3) All possible sources of voltage to the installation under normal or emergency conditions



NFPA 70B

3.3.61 Acceptance Tests.

Test that are performed on new equipment prior to energization to determine whether the equipment complies with the purchase and design specifications.

4.2 Electrical Maintenance Program (EMP)

The equipment owner shall implement and document an overall EMP that directs activity appropriate to the safety and operational risks.



NFPA 70B

Chapter 6 Single –Line Diagrams and System Studies

Single –Line Diagrams: Up-to-Date single-line diagrams shall be the primary reference for system studies.



Table 9.2.1 Maintenance Intervals

Product	Scope of Work	Equipment Condition Assessment		
		Condition 1	Condition 2	Condition 3
All equipment	Visual inspection	12 months	12 months	6 months
Battery Cells	Visual inspection	60 months	36 months	12 months
	Cleaning	60 months	36 months	12 months
	Lubrication	60 months	36 months	12 months
Breakers	Mechanical	60 months	36 months	12 months
	Electrical testing	60 months	36 months	12 months
	Visual inspection	60 months	36 months	12 months
	Cleaning	60 months	36 months	12 months
	Lubrication	60 months	36 months	12 months
Cable trays	Mechanical	60 months	36 months	12 months
	Visual inspection	60 months	36 months	12 months
	Cleaning	60 months	36 months	12 months
	Lubrication	60 months	36 months	12 months
Electric vehicle power systems	Mechanical	60 months	36 months	12 months
	Visual inspection	60 months	36 months	12 months
	Electrical testing	60 months	36 months	12 months
Electricity equipment	Electrical testing	60 months	36 months	12 months
Fuses	Visual inspection	60 months	36 months	12 months
	Cleaning	60 months	36 months	12 months
	Lubrication	60 months	36 months	12 months
	Mechanical	60 months	36 months	12 months
	Electrical testing	60 months	36 months	12 months
GFCIs	Visual inspection	12 months	12 months	6 months
	Cleaning	60 months	36 months	12 months
	Lubrication	60 months	36 months	12 months
	Mechanical	60 months	36 months	12 months
Grounding and bonding	Visual inspection	12 months	12 months	6 months
	Cleaning	60 months	36 months	12 months
	Lubrication	60 months	36 months	12 months
High-voltage circuit breakers	Mechanical	60 months	36 months	12 months
	Visual inspection	12 months	12 months	6 months
	Electrical testing	12 months	12 months	6 months
Lighting	Maintenance and repair	60 months	36 months	12 months
	Visual inspection	60 months	36 months	12 months
	Cleaning	60 months	36 months	12 months

2023 Edition. (continued)
 *Based on age + condition. **See additional and specific trade conditions. ***Section 9.2.1.1.1. **New install.

N Table 9.2.2 Continued

Product	Scope of Work	Equipment Condition Assessment		
		Condition 1	Condition 2	Condition 3
Switches	Visual inspection	60 months	36 months	12 months
	Cleaning	60 months	36 months	12 months
	Lubrication	60 months	36 months	12 months
	Mechanical servicing	60 months	36 months	12 months
	Electrical testing	60 months	36 months	12 months
Switchgear	Visual inspection	12 months	12 months	6 months
	Cleaning	60 months	36 months	12 months
	Lubrication	60 months	36 months	12 months
	Mechanical servicing	60 months	36 months	12 months
	Electrical testing	60 months	36 months	12 months
	Special	60 months	36 months	12 months



25

70B-16

ELECTRICAL EQUIPMENT MAINTENANCE

V Table 9.2.2 Maintenance Intervals

Product	Scope of Work	Equipment Condition Assessment		
		Condition 1	Condition 2	Condition 3
All equipment	Infrared thermography	12 months	12 months	6 months



26

MAINTENANCE FREQUENCY MATRIX

		EQUIPMENT CONDITION		
		POOR	AVERAGE	GOOD
EQUIPMENT RELIABILITY REQUIREMENT	LOW	1.0	2.0	2.5
	MEDIUM	0.50	1.0	1.5
	HIGH	0.25	0.50	0.75



27

APPENDIX B
Frequency of Maintenance Tests (continued)

Inspections and Tests Frequency in Months (Multiply These Values by the Factor in the Maintenance Frequency Matrix)				
Section	Description	Visual	Visual & Mechanical	Visual & Mechanical & Electrical
7.1	Switchgear & Switchboard Assemblies	12	12	24
7.2	Transformers			
7.2.1.1	Small Dry-Type Transformers	2	12	36
7.2.1.2	Large Dry-Type Transformers	1	12	24
7.2.2	Liquid-Filled Transformers	1	12	24
	Sampling	-	-	12
7.3	Cables			
7.3.1	Low-Voltage, Low-Energy	-	-	-
7.3.2	Low-Voltage, 600-Volt Maximum	2	12	36
7.3.3	Medium- and High-Voltage	2	12	36
7.4	Metal-Enclosed Busways	2	12	24
	Infrared Only	-	-	12
7.5	Switches			
7.5.1.1	Air, Low-Voltage	2	12	36
7.5.1.2	Air, Medium-Voltage, Metal-Enclosed	-	12	24
7.5.1.3	Air, Medium- and High-Voltage Open	1	12	24
7.5.2	Oil, Medium-Voltage	1	12	24
7.5.3	Vacuum, Medium-Voltage	1	12	24
7.5.4	Medium-Voltage, SF ₆	1	12	24
7.5.5	Circuit Breakers	12	24	24
7.6	Circuit Breakers			
7.6.1.1	Air, Insulated Case Metal-Enclosed	1	12	36
7.6.1.2	Air, Low-Voltage Power	1	12	36
7.6.1.3	Air, Medium-Voltage	1	12	36
7.6.2	Oil, Medium- and High-Voltage	1	12	36
	Sampling	-	-	12
7.6.3	Vacuum, Medium-Voltage	1	12	36
7.6.4	SF ₆	1	12	36
7.7	Circuit Switchers	1	12	36
7.8	Network Protectors	12	12	24



28

APPENDIX B Frequency of Maintenance Tests (continued)				
Inspections and Tests Frequency in Months (Multiply These Values by the Factor in the Maintenance Frequency Matrix)				
Section	Description	Visual	Visual & Mechanical	Visual & Mechanical & Electrical
7.8	Protective Relays			
7.8.1	Electromechanical and Solid State	1	12	24
7.8.2	Microprocessor-Based	1	12	36
7.9	Instrument Transformers			
7.9.1	Current Transformers	12	12	36
7.9.2	Voltage Transformers	12	12	36
7.9.3	Coupling Capacitor Transformers	12	12	36
7.11	Metering Devices			
7.11.1	Electromechanical and Solid-State	12	12	36
7.11.2	Microprocessor-Based	12	12	36
7.12	Regulating Apparatus			
7.12.1.1	Step-Voltage Regulators	1	12	24
	Sample Liquid	-	-	12
7.12.1.2	Solution Regulators	12	12	24
7.12.2	Control Regulators	1	12	24
7.12.3	Load Tap Changers	1	12	24
	Sample Liquid	-	-	12
7.13	Grounding Systems	2	12	24
7.14	Ground Fault Protection Systems	2	12	24
7.16	Rotating Machinery			
7.16.1	AC Induction Motors and Generators	1	12	24
7.16.2	Synchronous Motors and Generators	1	12	24
7.16.3	DC Motors and Generators	1	12	24
7.16	Motor Control			
7.16.1.1	Motor Starters, Low-Voltage	2	12	24
7.16.1.2	Motor Starters, Medium-Voltage	2	12	24
7.16.2.1	Motor Control Centers, Low-Voltage	2	12	24
7.16.2.2	Motor Control Centers, Medium-Voltage	2	12	24
7.17	Adjustable-Speed Drive Systems	1	12	24
7.18	Direct-Current Systems			
7.18.1	Batteries	1	12	12
7.18.1.1	Flooded Lead-Acid	1	12	12
7.18.1.2	Vented Nickel-Cadmium	1	12	12
7.18.1.3	Valve-Regulated Lead-Acid	1	12	12
7.18.2	Battery Chargers	1	12	12

29

APPENDIX B Frequency of Maintenance Tests (continued)				
Inspections and Tests Frequency in Months (Multiply These Values by the Factor in the Maintenance Frequency Matrix)				
Section	Description	Visual	Visual & Mechanical	Visual & Mechanical & Electrical
7.18.3	Rectifiers			
			12	24
7.19	Surge Arresters			
7.19.1	Low-Voltage Surge Protection Devices	2	12	24
7.19.2	Medium- and High-Voltage Surge Protection Devices	2	12	24
7.20	Capacitors and Reactors			
7.20.1	Capacitors	1	12	36
7.20.2	Capacitor Control Devices	1	12	12
7.20.3.1	Reactors (Shunt and Current-Limiting) Dry-Type	2	12	36
7.20.3.2	Reactors (Shunt and Current-Limiting) Liquid-Filled	1	12	36
	Sampling	-	-	12
7.21	Outdoor Bus Structures			
7.21.1	Emergency Systems	1	12	36
7.22.1	Engine Generator	1	2	12
	Functional Testing	-	-	2
7.22.2	Uninterruptible Power Systems	1	12	12
	Functional Testing	-	-	2
7.22.3	Automatic Transfer Switches	1	12	12
	Functional Testing	-	-	2
7.23	Communications - Reserved			
7.24	Automatic Circuit Reclosers and Line Sectionalizers			
7.24.1	Automatic Circuit Reclosers, Oil/Vacuum	1	12	24
	Sample	-	-	12
7.24.2	Automatic Line Sectionalizers, Oil	1	12	24
	Sample	-	-	12
9.	Thermographic Survey	-	12	-
10.	Electromagnetic Field Survey - As Needed	-	-	-
11.	Online Partial Discharge Survey for Switchgear	-	-	12

30

APPENDIX C Frequency of Power System Studies					
Frequency Matrix					
Circumstance	One-Line Diagram Update	Short-circuit Study	Coordination Study	Incident Energy Analysis	Load Flow Study
New installation or system modification	X	X	X	X	X
Annual data verification	X	X	X	X	X
Change in utility or source	X	X	X	X	X
Change in system impedance, configuration, or loading ¹	X	X		X	
Change in protection devices or settings	X		X	X	X
5 years since last update	X	X		X	

31

Case Study #1

- K-12 System

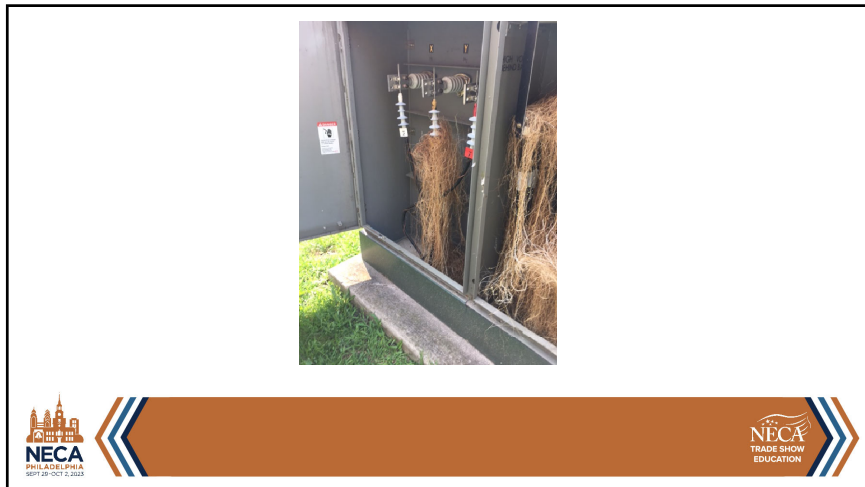
32



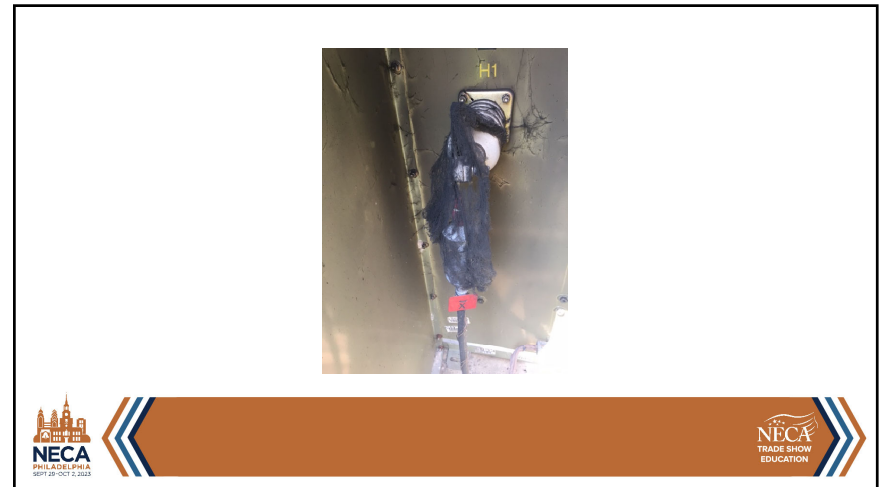
33



34



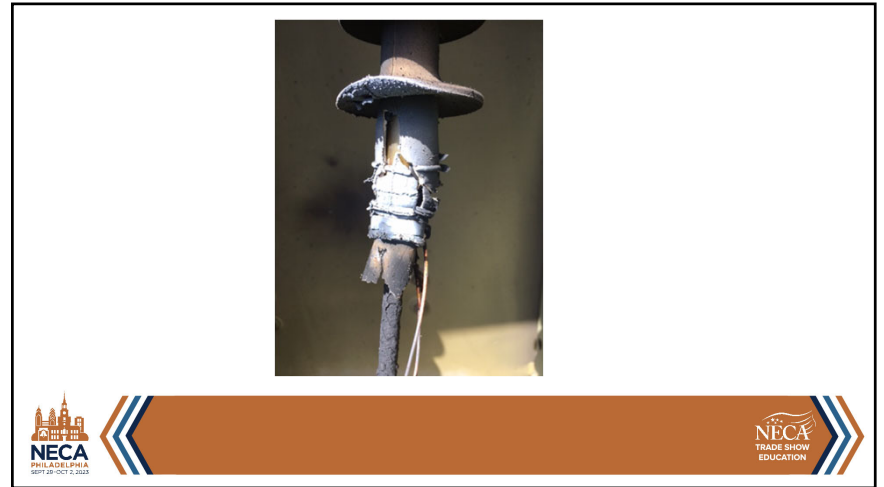
35



36



37



38

Case Study #2

- Hospital Generator System

39

Contact Information



Gary Walls
 Phone: 734-216-7229
 Email: gary.walls@teamuis.com
 Visit Booth # 1452





40

Complete the Online Evaluation

