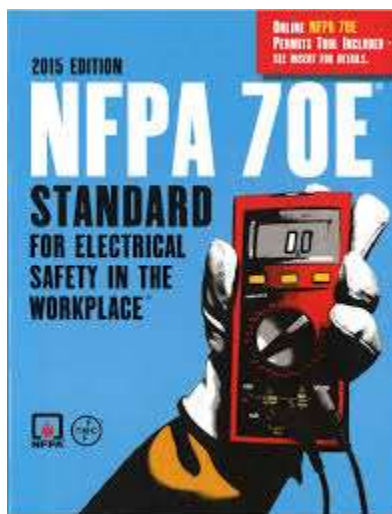


NFPA 70e

Electrical Arc Flash



By: Travis Roethle

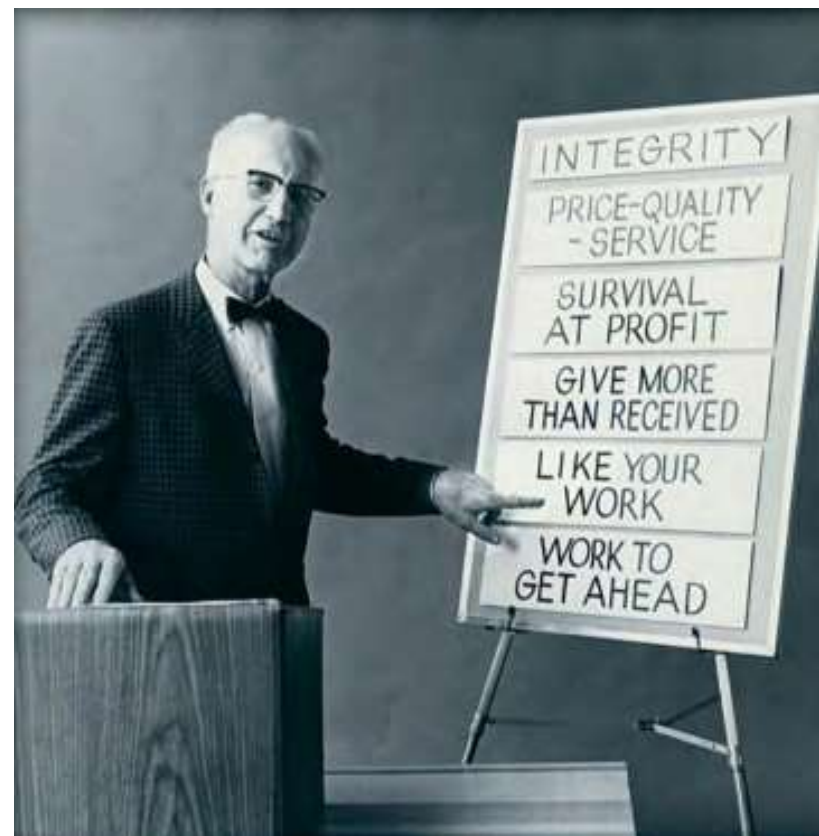
Personal Background

- Safety Specialist at Pieper Electric northern branches
- Graduated from University of Wisconsin Whitewater with Bachelor's degree in Occupational Health & Safety
- Perform Audits, various training topics, and accident management



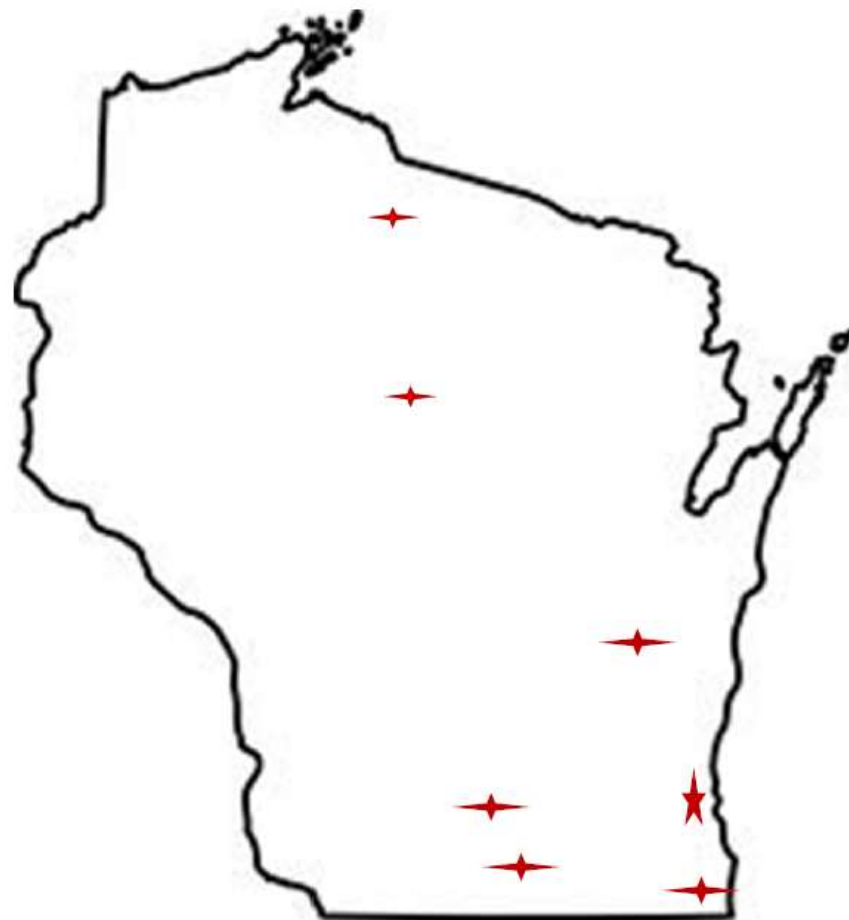
Pieper Electric

- Started in 1947 by Julius Pieper out of his old truck
- Dick Pieper bought the company from his dad in 1960
- Started a sister company in Georgia in the 1980's
- Employee owned since 1990
- Give 10% profits back to charities in the communities we work



Pieper Electric

- Locations:
 - New Berlin, Madison, Janesville, Fox Valley, Green Bay, Kenosha/Illinois, Fond Du Lac, Merrill, & Park Falls
- Services:
 - -Electrical, Low Voltage, Mechanical, Automation



Learning Objectives

- Background of NFPA 70e and why we have to follow it
- What an Arc Flash Analysis is and what everything on the label means
- Personal Protective Equipment that needs to be worn and when

Statistics

- Electrocution is part of the focus 4 hazards
- Focus 4 hazards account for approximately 60% of all construction fatalities
- Electricians account for the majority
 - Approximately 100 – 350

Statistics

- 3600 electrical related disabling injuries occur every year
- 4000 electrical related non-disabling injuries each year
- $\frac{1}{2}$ of all electrical related fatalities are at less than 600 volts

Arc Flash Incidents

- Estimated 5-10 arc flash incidents per day
- Estimates as to the cost of a major injury where >50percent of body burned (skin grafts, therapy) and related costs (replacement worker, rehabilitation, etc.) average between 1.0 and 4 million dollars.
- And then the social costs

NFPA 70E Article 100

Definitions

- Arc Flash Hazard Definition?
- Arc Flash Hazard: The passage of electric current between two conducting metals through an ionizing gas or vapor, usually air. It is initiated by a flashover, or from the introduction of some conductive material such as a screwdriver. The arc flash produces intense heat and light.



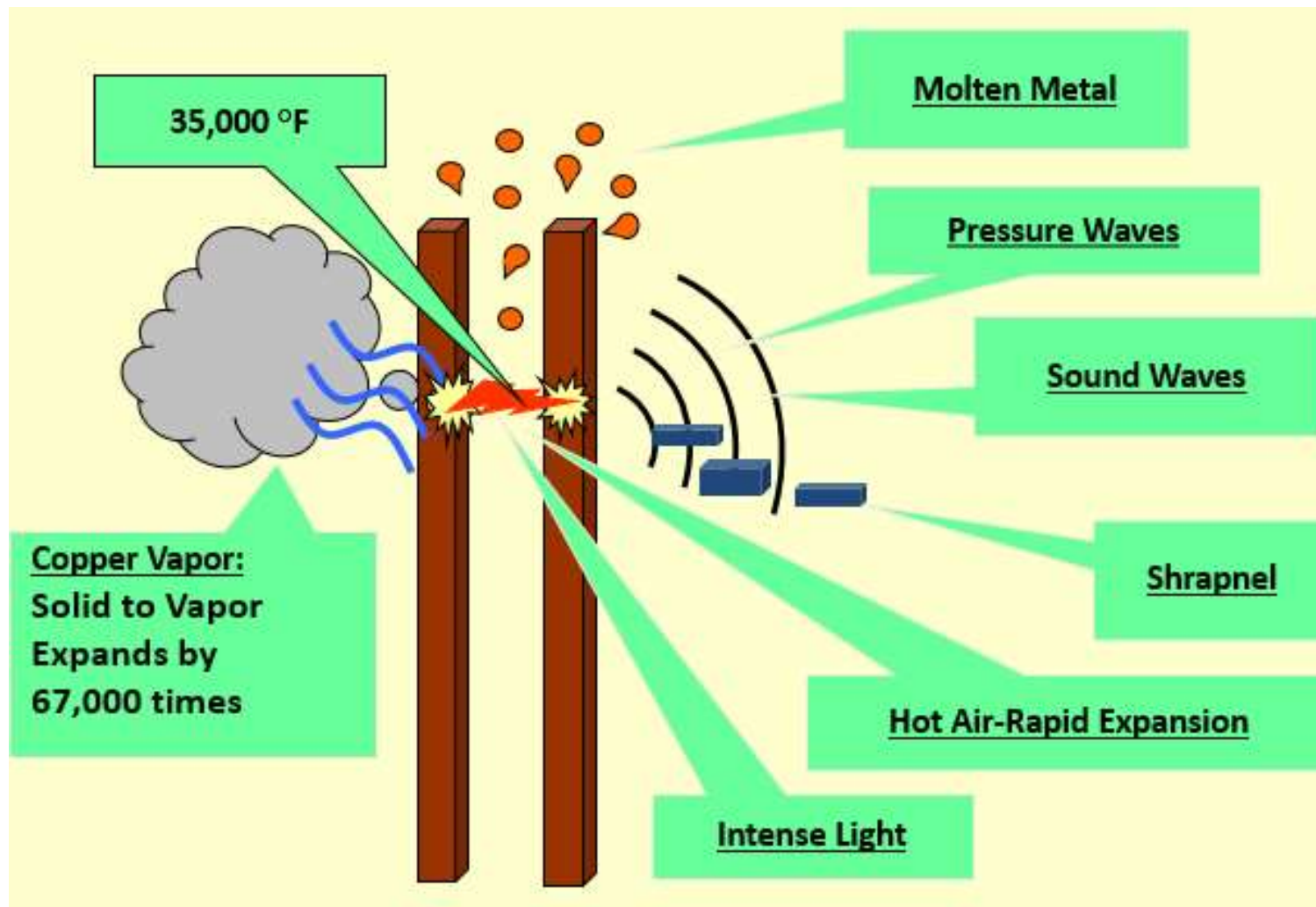
NFPA 70e Requirements

- Covers electrical safety-related work practice
 - Installation, Inspection, operation, maintenance, and demolition of electrical conductors, equipment, signaling, and communication conductors, equipment, and raceways.

Hazards in 70e

- Electrical hazards are broken into 3 categories
 - Shock Hazards
 - ARC Flash
 - ARC Blast

Arc Flash Hazards



Arc Flash

Heat:

- An arc can have a temperature of 35,000 F
 - The suns outer layer that we can see is 11,000 F
- Serious/fatal burns can occur at distances of more than 10 feet from source

Light:

- Ultraviolet radiation from the flash
- Can develop cataracts

Arc Blast

- Heating of air and vaporization of metal
 - Pressure wave that can damage hearing, concussions, and memory loss
 - Flying metal parts/shrapnel

Burn Injury Basics

- 1st degree: Skin becomes red, no blister
- 2nd degree: Skin blisters, epidermis must regenerate (100 microns in depth)
- 3rd degree: Full thickness of skin is destroyed, skin cannot regenerate, scar tissue forms (1,000 to 2,000 microns in depth)
- 4th degree: Muscle and bone are destroyed



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05/27/03 M01 C47 10:51:24



Training

- Employers must train employees on safety-related work practices
 - To be able to tell live parts from non live parts
 - To understand specific hazards associated with electrical energy
 - In safety related work practices and procedural requirements
 - To identify and understand the relationship between electrical hazards and possible injury
 - In methods of release of victims from contact with exposed energized conductors or parts

Training Continued

- Decision Making
- How to use testing equipment
- Retraining must be done every 3 years to update the new standard
- Training must be documented.

NFPA 70e

- Shutting off power before any work is done is the preferred method of compliance
- 99% of work can be done de-energized
- 1% is the exception to the rule
 - Hospitals???
 - Diagnostic Testing
 - Line Work
 - Operational/Production limitations

Other exemptions to Energized Work

- Less Than 50 volts
 - Energized electrical equipment operating at 50 volts shall not be required to de-energize
- Testing
- Trouble shooting
- Voltage Measuring
- Visual inspection that does not cross the restricted approach boundary



Energized Electrical Work Permit

In accordance with the NFPA 70E and OSHA, it is unlawful to work on exposed energized electrical equipment unless voltage testing/measuring troubleshooting or if it is critical for life safety. Energized work can be performed only when approved by (obtained signatures from) a dept supervisor/project manager and branch manager or V.P. or Pieper President and Owner – Customer–or G.C. Rep. (part 6 of this form). All signatures must be obtained before energized work is done. All parts of this permit must be filled out before energized work begins.

Note: Permit is not required for opening junction boxes, gutters or similar enclosures, testing, voltage measuring, or troubleshooting; however, appropriate PPE and voltage rated tools and instruments are required for these tasks.

Permit must be completed for all other energized tasks in hazard/risk categories 1 or greater.

STEP 1. Qualified persons (electricians) doing the work must fill out the permit shown below.

Job Location: _____ Date task is to be completed _____

1.) Circuit/Equipment Description/ work to be done:

What are the hazards you face when doing this work? _____

2.) Reason the equipment cannot be de-energized or work deferred until the next scheduled outage:

3.) Detailed job description – Sequence of SAFE work procedures- see P707-“Procedures” for details.

*If work is 600V or higher, two workers are needed to complete the task safely.
Number of qualified persons to do this work safely _____

4.) Shock Hazard Analysis:

Voltage: _____ Any possible backfeeds? _____

Were the one line drawings or schematics reviewed; if no, why not? _____

What is the task Arc Flash PPE Category? [From NFPA 70E table 130.7(C)(15)(A)(b) or 130.7(C)(15)(B) and/or Pieper category/class rating laminated chart] _____

5.) Flash Protection Boundary/Arc Flash Boundary (AFB)

Limited Approach Boundary shall be a minimum of 3 ft. 6 in. unless Arc Flash Boundary from analysis (label on panel or equipment) is larger. The greater of the two distances will be used as the boundary to keep unprotected people away.

6.) Authorizations/Approvals

For all tasks, ALL signatures are required prior to doing the task.

(A) Pieper Foreman/Electrician _____ Date: _____

(B) Any Pieper Project Manager/ Dept Supervisor _____ Date: _____

(C) Any Branch Manager _____ Date: _____

(D) Pieper Safety Manager (414-788-4403) _____ Date: _____

(E) Any Leadership Team Member* _____ Date: _____

(F) Owner – Customer – G.C. Rep _____ Date: _____

7.) Personal protective equipment required to safely perform task:

PPE	FR Clothing	Tools
Hard Hat <input type="checkbox"/>	Hazard/risk category 1 (4 Cal. Min) <input type="checkbox"/>	Voltage Rated Tools <input type="checkbox"/>
Safety Glasses Low IR <input type="checkbox"/>	Hazard/risk category 2 (8 Cal. Min) <input type="checkbox"/>	Rubber Blankets <input type="checkbox"/>
Face Shield <input type="checkbox"/>	Hazard/risk category 3 & 4 (40 Cal. Min) <input type="checkbox"/>	PVC Sheeting (1 KV) <input type="checkbox"/>
Rubber Gloves <input type="checkbox"/>		Floor Mats <input type="checkbox"/>
(V rated) <input type="checkbox"/>		Non-conductive <input type="checkbox"/>
Leather Protectors <input type="checkbox"/>		Fish Tape <input type="checkbox"/>
Ear Plugs <input type="checkbox"/>		
Restrict Access of Unqualified Persons	Lockout/Tagout	Other
Barricades <input type="checkbox"/>	Notify Affected People <input type="checkbox"/>	Workers, remove <input type="checkbox"/>
Cones <input type="checkbox"/>	Test, verify absence <input type="checkbox"/>	conductive articles <input type="checkbox"/>
Warning Tape <input type="checkbox"/>	of Voltage <input type="checkbox"/>	Temporary Lighting <input type="checkbox"/>
Signs <input type="checkbox"/>	Install and Remove <input type="checkbox"/>	Fall Protection <input type="checkbox"/>
Monitor <input type="checkbox"/>	Grounds <input type="checkbox"/>	Mechanical Hazards <input type="checkbox"/>
		Stored Energy <input type="checkbox"/>

Plan prepared by: _____ DATE: _____

8.) Job Briefing – Before proceeding with this work, employee in charge shall conduct a job briefing with the employees involved. Discuss hazards, write out work procedures, special precautions, energy source controls, emergency communication numbers, and personal protective equipment requirements.

Date of briefing: _____ present sign: _____

STEP 2 Turn in Energized work permit forms to the Safety Department after work is complete. The purpose of this permit is to raise awareness of the hazards of working on energized circuits to our customers/GCs and electricians and is considered to be a written plan. In signing this permit, a customer/GC is being made aware of the plan. According to OSHA's multi-employer work rule, a customer/GC can be cited for allowing energized work whether this permit is signed or not. Signing this permit does not add any more or any less legal obligations to Pieper Electric, Inc or our customers.

Mike Kelliher* 715-539-2877
Mike Wierba* 262-705-6525

Dave Scitsmier* 414-788-1816
Eric West* 414-788-4407

Rick Para* 414-788-4132
Harry Becker* 414-588-7119

Energized Work Permit

- Qualified persons (electricians) doing energized work must fill out the permit.
- Must include:
 - Job Location
 - Date of task
 - Circuit/Equipment Description/work to be done
 - What are the hazards you face when doing this work?

Energized Work Permit

- Must include:
 - Reason equipment cannot be de-energized or work deferred until next scheduled outage:
 - Detailed job description
 - If work is 600V or higher, two qualified workers are needed to complete the task safely. Number of persons?
 - Shock Hazard Analysis
 - Voltage
 - Any possible backfeeds
 - One line drawings or schematics reviewed?
 - What is the task Hazard Risk Category?

Sign-offs

- Owner/Customer/GC Rep & Date
- Foreman/Qualified Electrician & Date
- Project Manager/Dept. Supervisor & Date
- Branch Manager
- President of Pieper Electric
- Safety Manager

Task Charts



	Category	Hazard Risk	Permit needed?	Arc Flash PPE
Panelboards rated 240V and below – Note 1 AFB= 19in.	Note 1			-
Opening/Removing covers (to expose bare, energized parts) or insulated cable examination with manipulation of cable	1		N	Y
In-circuit breaker (CB) or switch operation with covers on	1		N	N
In-circuit breaker (CB) or switch operation with covers off	1		N	Y
Working on energized parts, including voltage testing	Note 5		Y	Y
Removing/installing CBs or fused switches	1		Y	Y
Performing Infrared thermography or other non-contact inspections outside the restricted approach boundary			N	Q
Panelboards & equip 240V up to 600V-Note 1 AFB= 3 Feet	Note 1			-
Reading panel meter while operating switch			N	Q
Opening/Removing covers (to expose bare, energized parts) or insulated cable examination with manipulation of cable	2		N	Y
B, switch, or starter operation with covers on	2		N	N
B, switch, or starter operation with covers off	2		N	Y
Working on energized parts, including voltage testing	Note 5		Y	Y
Working on energized conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	2		Y	Y
Remove/install CBs or fused switches	2		Y	Y
Performing Infrared thermography or other non-contact inspections outside the restricted approach boundary			N	Q
4V Class MCCs – Note 3	Note 3			-
Reading panel meter while operating switch			N	Q
Opening/Removing covers (to expose bare, energized parts)	4		N	Y
Dissection/ removal (racking) of starter buckets or CBs	4		Y	Y
Working on energized parts, including voltage testing	Note 5		Y	Y
Application of safety grounds after a voltage test	4		N	Y
Performing Infrared thermography or other non-contact inspections outside the restricted approach boundary			N	Q
4V Class Switchgear (with power circuit breakers or fused switches) – Note 4	Note 4			-
Reading panel meter while operating switch			N	Q
Opening/Removing covers (to expose bare, energized parts)	4		N	Y
B, switch or starter operation with enclosure doors closed	4		N	N
B, switch or starter operation with enclosure doors open	4		N	Y
Working on energized parts, including voltage testing	Note 5		Y	Y
Working on control circuits with energized parts above 120V, exposed	4		Y	Y
Application of safety grounds, after voltage test	4		N	Y
Dissection/ removal (racking) of starter buckets or CBs	4		Y	Y
Performing Infrared thermography or other non-contact inspections outside the restricted approach boundary			N	Q
600V Class Equipment (277V-600V, nominal) – Note 2	Note 2			-
Opening/Removing/installing covers or revenue meters to expose bare, energized parts	2		N	Y
Working on energized parts, including voltage testing	Note 5		Y	Y
Application of safety grounds, after voltage test	2		N	Y
Performing Infrared thermography or other non-contact inspections outside the restricted approach boundary			N	Q
10V Class MCCs – Note 2	Note 2			-
Opening/Removing covers (to expose bare, energized parts)	2		N	Y
Dissection/ removal (racking) of starter buckets or CBs	2		Y	Y
Working on energized parts, including voltage testing	Note 5		Y	Y
Application of safety grounds, after voltage test	2		N	Y
Performing Infrared thermography or other non-contact inspections outside the restricted approach boundary			N	Q

Legend: Januar

- > Y=Yes
- > N=No (if the equipment is permitted, maintained, all the doors are closed and secure is no evidence of impending)
- > Q=Arc Flash PPE not necessary however other PPE is still required as gloves, hard hats, & safety glasses as long as Restricted Boundary is not crossed, work greater. This activity does not require opening of doors or covers.

- Notes:
- Maximum of 25ka short circuit available; maximum of 0.03s fault clearing time.
 - Maximum of 65ka short circuit available; maximum of 0.03s fault clearing time. AFB= 5 feet
 - Maximum of 42ka short circuit available; maximum of 0.33s fault clearing time. AFB= 14 feet
 - Maximum of 35ka short circuit available; maximum of 0.5s fault clearing time. AFB= 20
 - An Energized Electrical Work not necessary for testing, voltage measuring or troubleshooting

FPN No. 1: Both larger and smaller short-circuit currents could result in available arc-flash energies. If the short-circuit current increases or decreases in the opening time of overcurrent protective device, the energy will increase. If the available circuit current decreases, result longer opening time for the overcurrent protective device, arc-flash energy also increase.

FPN No. 2: Task chart may be used when available short circuit current

Special note A:
When working on control circuits energized conductors, 120 volts or without any other exposed energized equipment over 120 volts including hinged covers to gain access, Arc not required, shock protection is not however for 120v work..

For tasks not on this chart refer to 2015 or Safety Dept
For DC-related tasks, refer to NFI or Safety Dept.

Pieper Electric, Inc. will not install, remove, pull wire to or from, terminate conductors on, or install conduit into or from a bus duct switch, panel board, disconnect switch, MCC, or other electrical equipment that have exposed, energized line and/or load sides.

PIEPER ELECTRIC / NFPA-70E PROCEDURES

- De-energize power source and apply Lockout / Tagout devices. (See lockout / tagout procedure)
- When not possible to work de-energize. Alert supervisor and follow NFPA-70E guidelines. It is mandatory to fill out an energized work permit, unless voltage measuring, testing, troubleshooting, thermography and/or visual inspections if Restricted Boundary or Arc Flash Boundary (whichever is larger) is not crossed.
- Use task chart to determine category rating and chart below for proper P.P.E. (If work is to be performed immediately after a transformer, be aware the class rating may be higher than noted. If in question, call for an analysis.)
- Limited Approach Boundary shall be minimum 3 ft. 6 in. unless Arc Flash Boundary from analysis is larger; then the larger of the two distances will be used to keep unprotected people away- with whatever means necessary.
- When working within the Restricted Approach Boundary, voltage-rated tools and voltage-rated gloves are required.

Category	Minimum Arc Rating (cal/cm ²)	Non-melting or Untreated Natural Fiber Clothing	Plus FR Clothing	Plus FR Equipment
0	0	Long-Sleeved Shirt, long pants		Hard hat, arc-rated or low IR –rated safety glasses or regular safety glasses, voltage rated rubber gloves with leather protectors
1	4	T-shirt Long pants	Long-sleeve shirt Long pants Or coveralls	Hard hat, safety glasses or goggles, hearing protection, arc-rated face shield, voltage rated rubber gloves with leather protectors, leather footwear
2	8	T-shirt Long pants	Long-sleeve shirt Long pants Or coveralls	Hard hat, safety glasses or goggles, hearing protection, arc-rated face shield, balaclava, voltage rated rubber gloves with leather protectors, leather footwear
3	25	Go to category #4	Go to category #4	Go to category #4
4	40	T-shirt Long pants	Flash suit jacket Flash suit pants	Hard hat, flash suit hood, safety glasses or goggles, hearing protection, rubber gloves with leather protectors, leather footwear

January/ 2015

For an accurate analysis call: Roger Porter 414-831-2321

All reference material and charts taken from NFPA-70E 2015.
Refer to NFPA-70E and PPE required charts for appropriate PPE.
Lockout / tagout must be done on all work performed. Unless otherwise specified in NFPA-70E.
All work is considered "Energized work" until verified de-energized.

PPE Required

- Regular PPE
- Restricted Access of Unqualified Persons
- AR Clothing
- Lockout/Tagout
- Tools
- Other
- Who the permit was prepared by.

Job Briefing

- Required before the start of each job
- Needs to cover:
 - Hazards associated with job
 - Work procedures involved
 - Special precautions
 - Energy sources controls
 - PPE
 - Go over rest of energized work permit

Testing Equipment

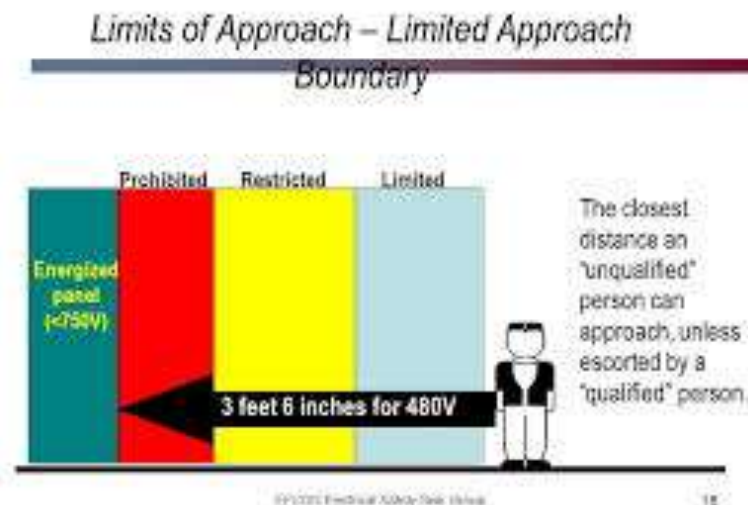
Testing Instruments

- Qualified people
- Equipment must be rated for equipment they are testing
- Tested on a known source before use
 - Live, Dead, Live



Limited Approach Barrier

- No unqualified person allowed
- Unless escorted by qualified person, but cannot cross into restricted approach boundary
- 3'6" anything under 750V and fixed circuit
- Unless Restricted Approach Boundary is greater



Restricted Approach Boundary

- Cannot approach or take any conductive object closer to exposed energized conductors unless:
 - The qualified person is insulated or guarded
 - The energized conductors are insulated
 - The qualified person is insulated from any conductive object

Arc Flash Risk Assessment

- Determine if an arc flash hazard risk exists, if an arc flash hazard exists, the risk assessment shall determine:
 - Safety-related work practices
 - The arc flash boundary
 - PPE to be used within arc flash boundary
- Take into consideration the design of the overcurrent protection device and its opening time, including maintenance

Arc Flash Boundary

- Distance when PPE is needed and boundaries placed to prevent incurable burns if an arc flash occurs.
- It should be the distance at which incident energy equals 1.2 cal/cm^2



WARNING

Arc Flash and Shock Hazard Appropriate PPE Required

0' - 3"	Flash Hazard Boundary
0.1	cal/cm ² Flash Hazard at 18 Inches
#0	PPE Level
	Non-melting, flammable materials, long sleeve cotton shirt, long pants, eye protection, ear protection, V.R. rubber / leather gloves

0.48	kV Shock Hazard when cover is removed
3' - 6"	Limited Approach
1' - 0"	Restricted Approach - Class 00 Voltage Gloves
0' - 1"	Prohibited Approach - Class 00 Voltage Gloves

Equipment Name: CP BOILER #1 (Fed by: DIS SG1 #7B)

Refer to NFPA-70E and IEEE-1584. Refer to onelines for effective date. Any changes to the electrical system after said date may change the noted Arc Flash Hazard potential. FAILURE TO COMPLY COULD CAUSE SERIOUS INJURY OR DEATH. LABELS MUST NOT BE REMOVED, COVERED, OR ALTERED!



WARNING

Arc Flash and Shock Hazard Appropriate PPE Required

6' - 1"
11.9
#3

Flash Hazard Boundary
cal/cm² Flash Hazard at 18 Inches
PPE Level
Non melting undergarments, FR shirt FR pants plus FR
coverall, plus flash suit hood, eye protection, ear protection,
V.R. rubber / leather gloves and leather shoes

0.24
3' - 6"
0' - 0"
0' - 0"

kV Shock Hazard when cover is removed
Limited Approach
Restricted Approach - Class 00 Voltage Gloves
Prohibited Approach - Class 00 Voltage Gloves

Equipment Name: DISC PNL F2 (Fed by: BK #1-SWGR #1)

Refer to NFPA-70E and IEEE-1584. Refer to onelines for effective date. Any changes to the electrical system after said date may change the noted Arc Flash Hazard potential. FAILURE TO COMPLY COULD CAUSE SERIOUS INJURY OR DEATH. LABELS MUST NOT BE REMOVED, COVERED, OR ALTERED!



WARNING

Arc Flash and Shock Hazard Appropriate PPE Required

11' - 9"
24.9
#3

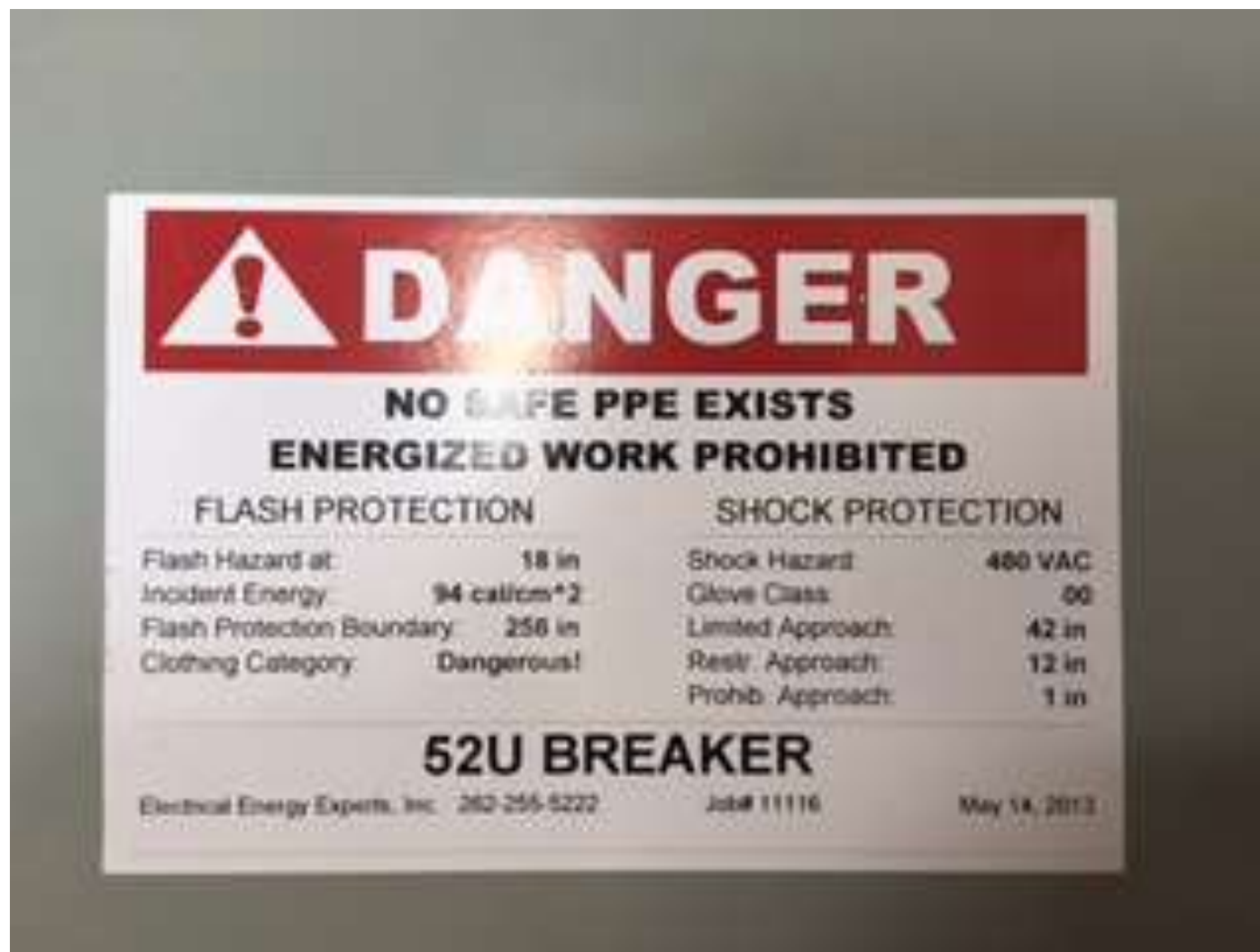
Flash Hazard Boundary
cal/cm² Flash Hazard at 18 Inches
PPE Level
Cotton underwear with FR shirt & FR pants plus FR
coverall, plus eye/ear protection flash suit hood,
rubber/leather gloves, and leather shoes

0.208
3' - 6"
0' - 0"
0' - 0"

kV Shock Hazard when cover is removed
Limited Approach
Restricted Approach - Class 00 Voltage Gloves
Prohibited Approach - Class 00 Voltage Gloves

Equipment Name: PNEL.

Refer to NFPA-70E and IEEE-1584. Any changes to the electrical system may change the noted Arc Flash Hazard potential. **FAILURE TO COMPLY COULD CAUSE SERIOUS INJURY OR DEATH. LABELS ARE NOT TO BE REMOVED, COVERED, OR ALTERED.**

A safety label for a 52U Breaker. The label is white with a red header containing a warning symbol and the word "DANGER". Below the header, it states "NO SAFE PPE EXISTS" and "ENERGIZED WORK PROHIBITED". The label is divided into two columns: "FLASH PROTECTION" and "SHOCK PROTECTION". The flash protection section lists: Flash Hazard at 18 in, Incident Energy 94 cal/cm², Flash Protection Boundary 256 in, and Clothing Category Dangerous!. The shock protection section lists: Shock Hazard 480 VAC, Glove Class 00, Limited Approach 42 in, Restr. Approach 12 in, and Prohib. Approach 1 in. At the bottom, it identifies the equipment as "52U BREAKER" and provides contact information for Electrical Energy Experts, Inc. (260-256-5272), Job# 11116, and the date May 14, 2013.

! DANGER

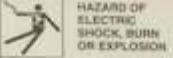
**NO SAFE PPE EXISTS
ENERGIZED WORK PROHIBITED**

FLASH PROTECTION		SHOCK PROTECTION	
Flash Hazard at:	18 in	Shock Hazard	480 VAC
Incident Energy	94 cal/cm ²	Glove Class	00
Flash Protection Boundary	256 in	Limited Approach:	42 in
Clothing Category:	Dangerous!	Restr. Approach:	12 in
		Prohib. Approach:	1 in

52U BREAKER

Electrical Energy Experts, Inc. 260-256-5272 Job# 11116 May 14, 2013

P-105A EFFLUENT PUMP



- HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION**
- Never operate switch with door open.
 - Turn off switch before removing or installing tubes or making tube connections.
 - Always use a properly rated voltage sensing device at all line and load bus steps to confirm switch is off.
 - Turn off power supplying switch before doing any other work on or inside switch. Failure to follow these instructions will result in DEATH or serious injury.

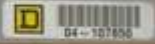


DO NOT REMOVE COVERS

CAUTION
LIVE BUS
480V 3Ø
DO NOT TOUCH

M.D.
L.W.
M.S. Co
V10/11

Electrical
Hazard
CAUTION



460V 3Ø
7.5 H.P.



FIELD SERVICES DIVISION
1-800-434-2001

File #	
Job No.	Date
Work Done	

91000000

PPE

- Make sure the PPE you select is rated for the work you are doing
 - The rating of these products are when they are manufactured
- These PPE requirements protect against electrical shock and arc flash burns. They do not protect against arc blast physical injuries.



PPE

- This is what happens when you wear the wrong PPE and a small arc flash occurs
- This man was wearing prescription metal frame safety glasses.



Glove Testing

- Air check before each use
- Sent out and certified semi-annually
 - SAF-T-GUARD - Illinois
 - Electrical Testing Lab - Wisconsin

Gloves



ASTM Labeling Chart			
Natural Rubber Electrical Insulating Gloves			
Class Color	Proof Test Voltage AC/DC	Max. Use Voltage AC/DC	Insulating Rubber Glove Label
00 Beige	2,500 / 10,000	500 / 750	10 ASTM D120 CLASS 00 TYPE 2 MAX USE VOLT 900V AC
0 Red	5,000 / 20,000	1,000 / 1,500	10 ASTM D120 CLASS 0 TYPE 2 MAX USE VOLT 1000V AC
1 White	10,000 / 40,000	7,500 / 11,250	10 ASTM D120 CLASS 1 TYPE 2 MAX USE VOLT 7500V AC
2 Yellow	20,000 / 50,000	17,000 / 25,500	10 ASTM D120 CLASS 2 TYPE 2 MAX USE VOLT 17000V AC
3 Green	30,000 / 60,000	26,500 / 39,750	10 ASTM D120 CLASS 3 TYPE 2 MAX USE VOLT 30000V AC
4 Orange	40,000 / 70,000	36,000 / 54,000	10 ASTM D120 CLASS 4 TYPE 2 MAX USE VOLT 36000V AC

Proper PPE

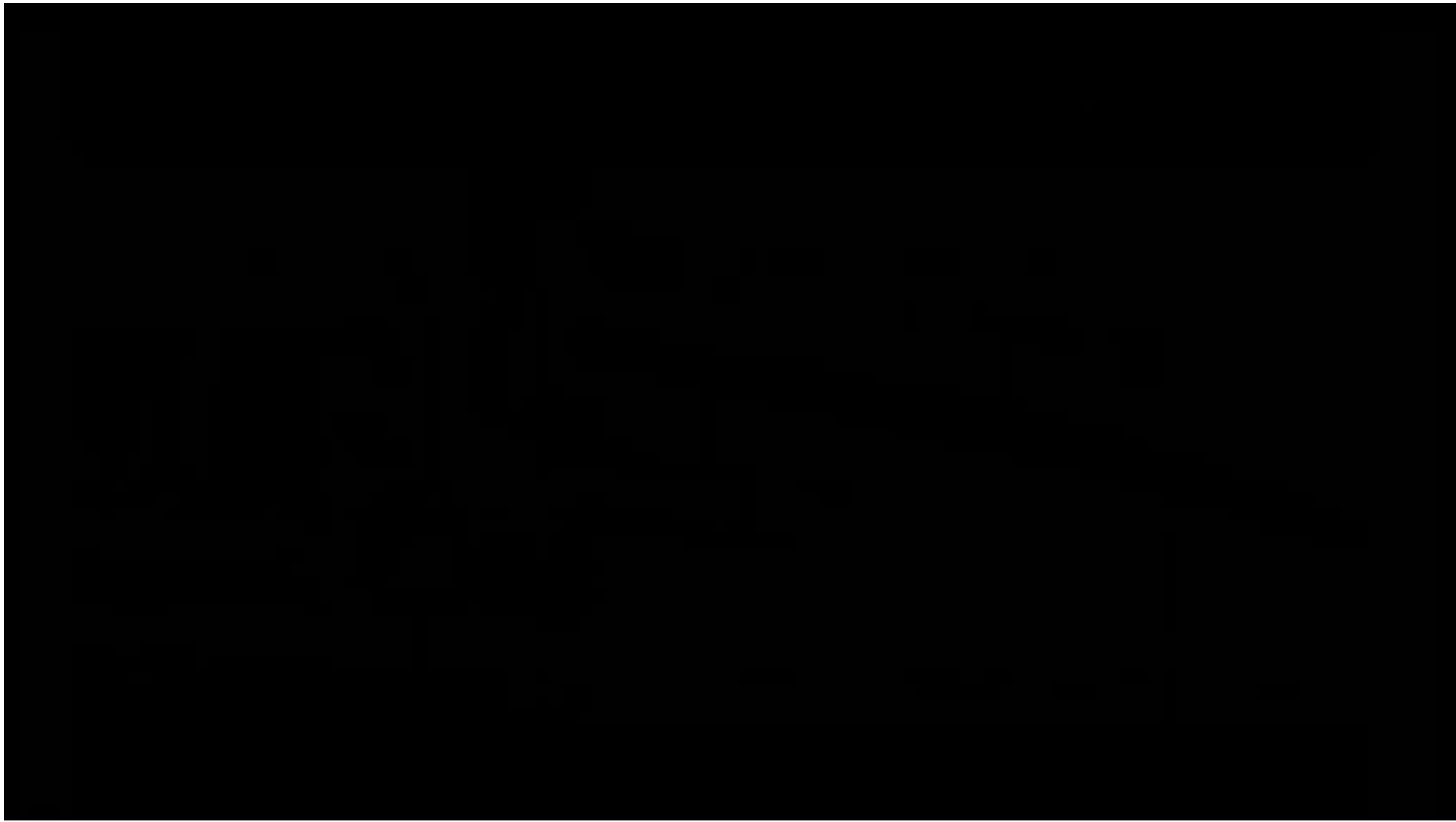
- Never wear clothing made from:
 - Synthetic materials
 - Acetate
 - Nylon
 - Polyester
 - Rayon
 - Any of these combined with cotton
- Conductive jewelry (wastebands, rings, bracelets, keys, metal frame glasses) cannot be worn within restricted approach boundary







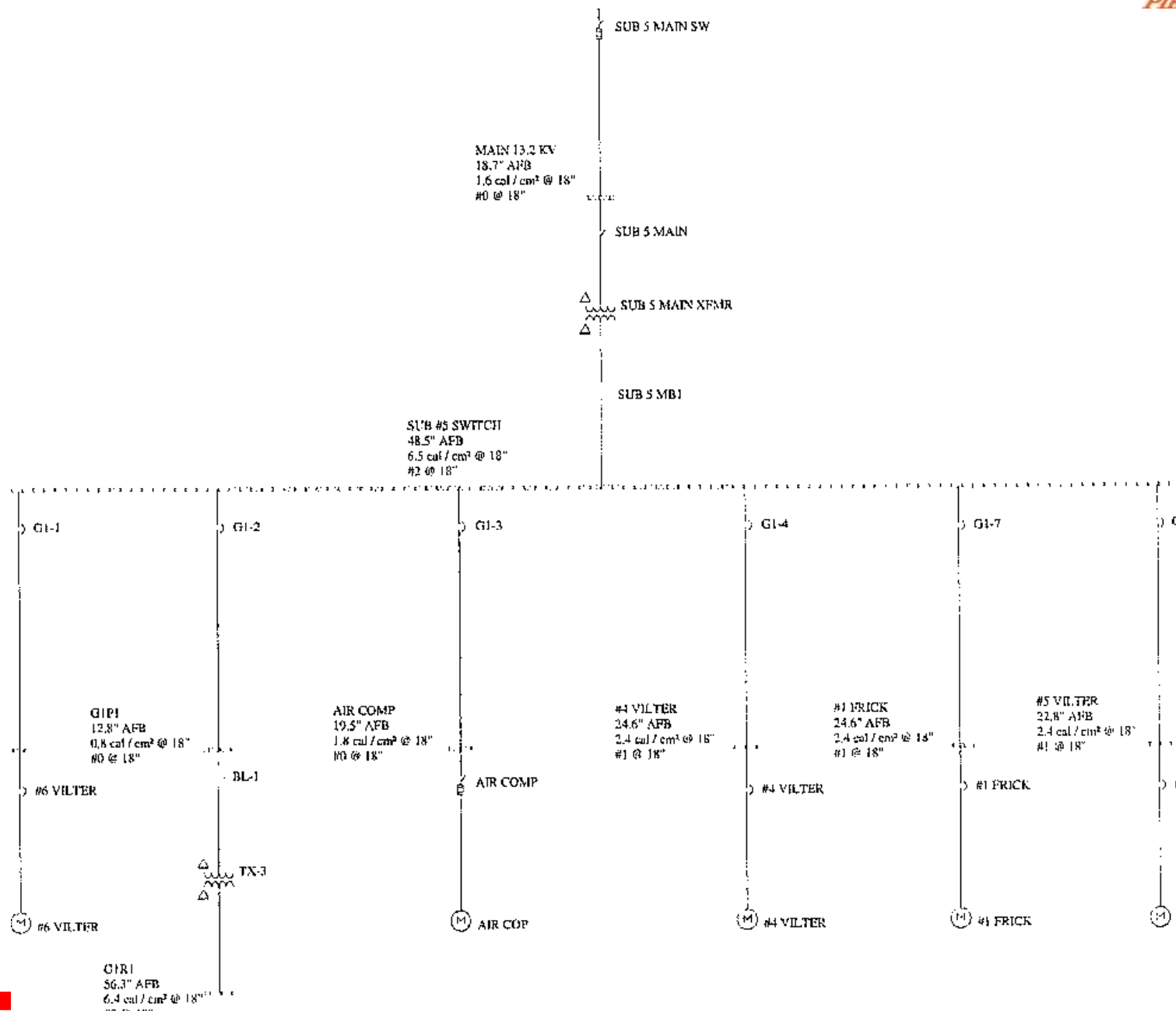
ARC Flash Experiment

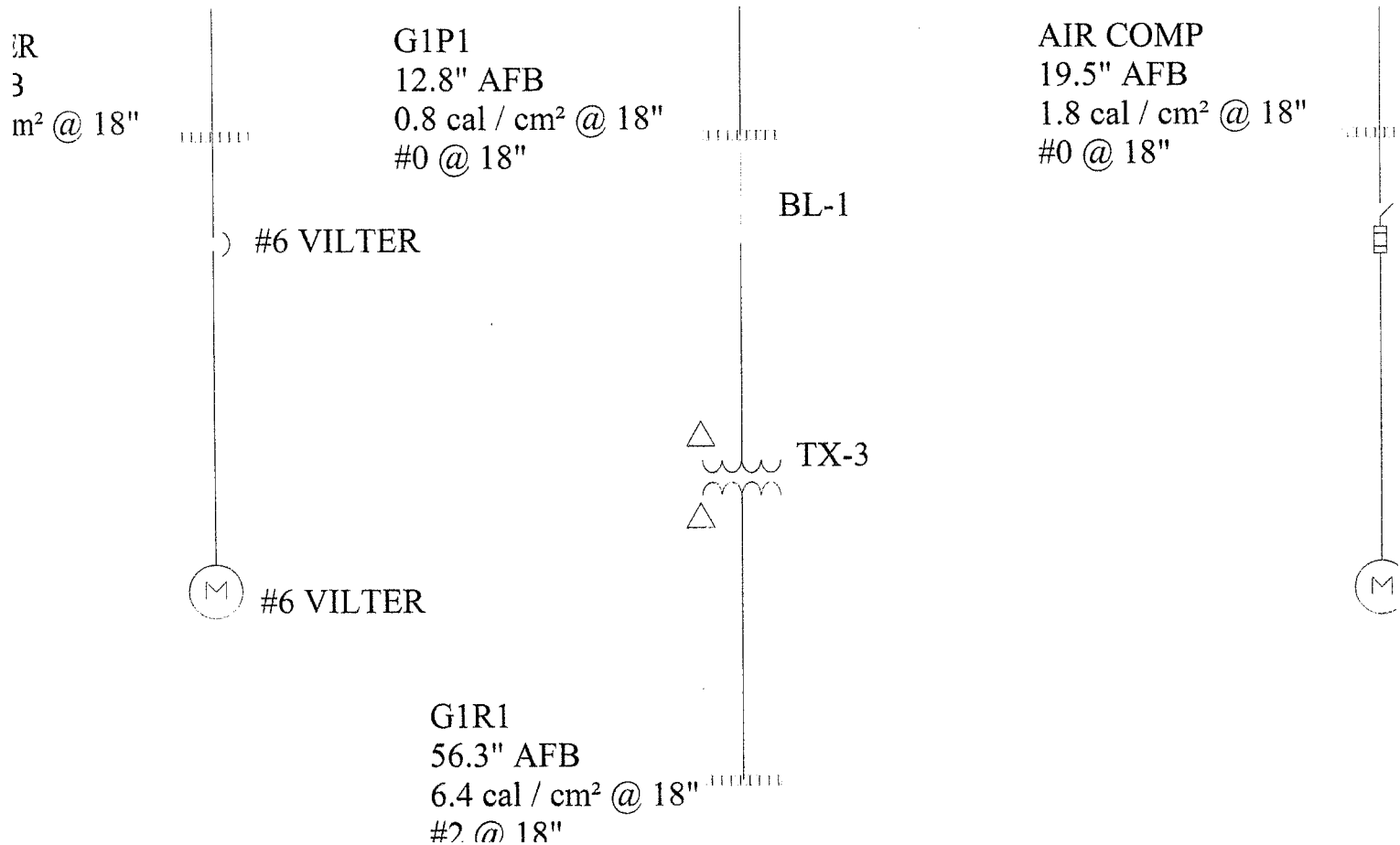


Tools

- Conductive tools, materials, and equipment shall not be used when accidental contact of energized electrical conductors or circuit parts can occur.
- Voltage rated tools need to be brought in to the safety department anytime there is physical damage (usually yellow poking through red)









10/08/2003

Recap

- Deenergize when possible
- If you can't deenergize:
 - Calculate the arc flash boundary and barricade
 - Put on Proper PPE: cotton undergarments rubber gloves, leather protectors, hardhat with yellow face shield, safety glasses, FR coveralls, hearing protection
 - Acquire rated tools
 - Apply lockout/tagout device
 - Apply ground connecting devices rated for the available fault duty
 - Test adequately rated voltmeter.
 - Test with adequately rated voltmeter.



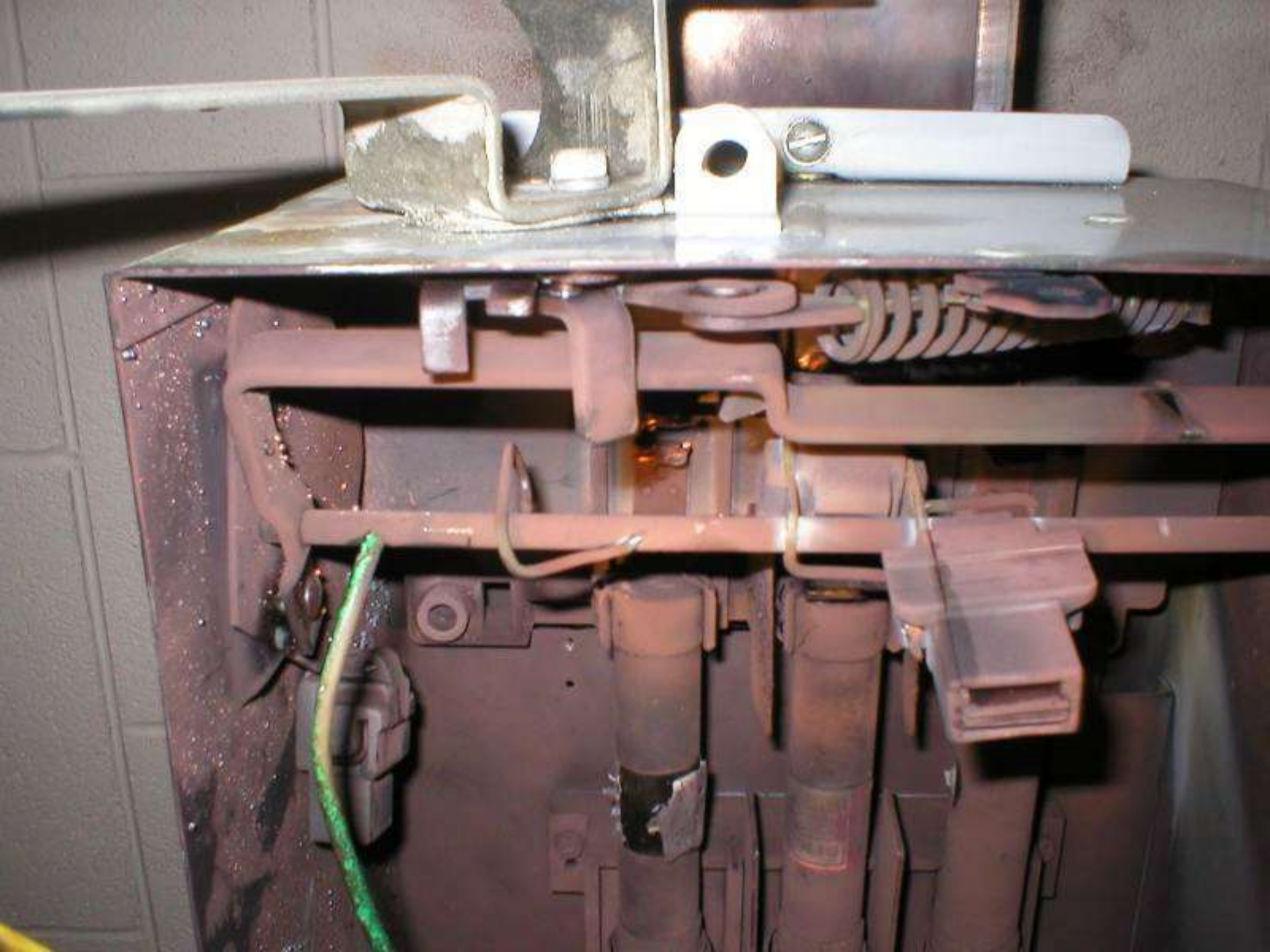


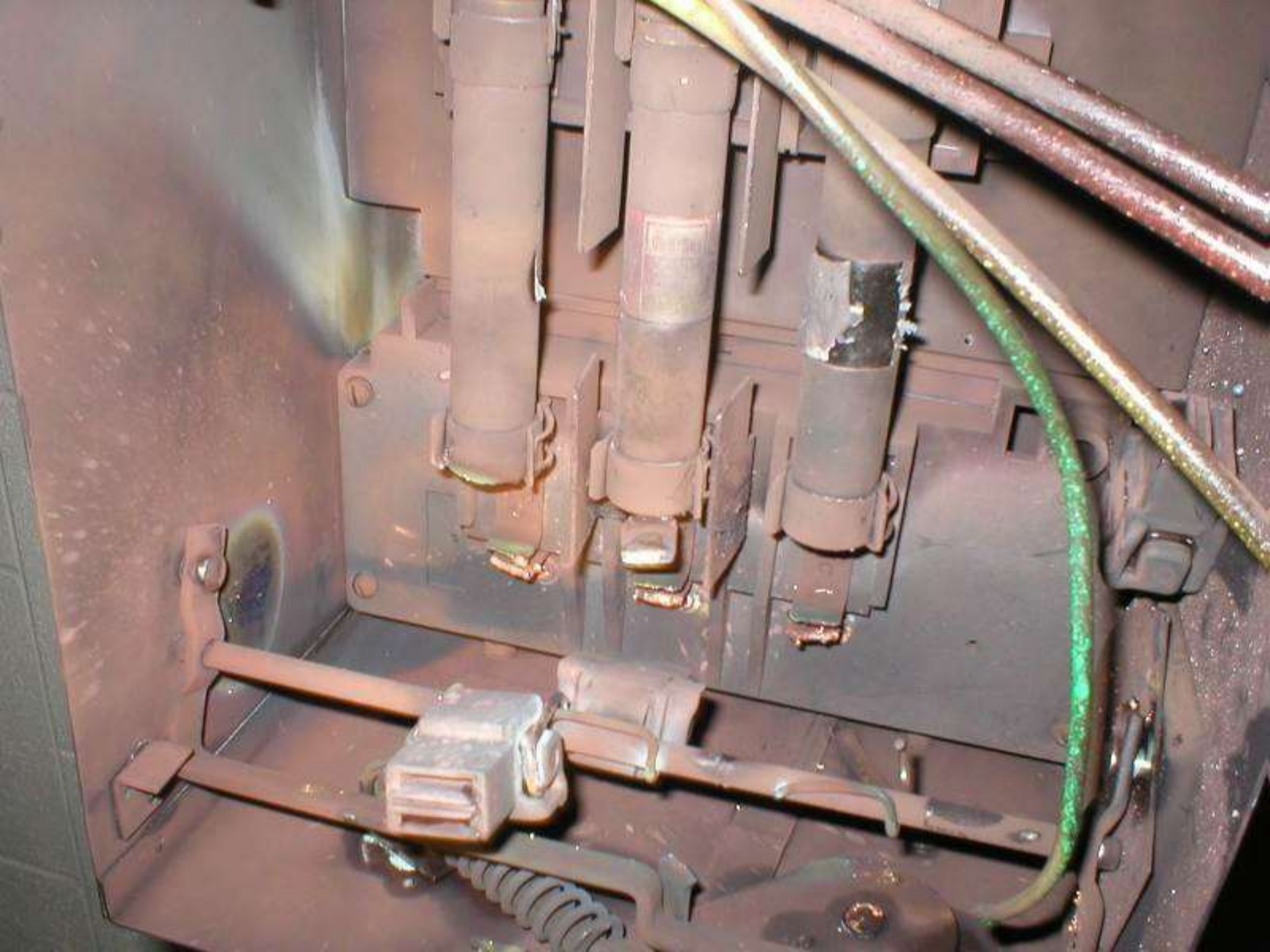
480 VOLTS THREE PHASE 30A

480 VOLTS THREE PHASE 60A













DANGER
DO NOT OPERATE
EQUIPMENT
OR
REMOVE TAG

SIEMENS

DEERHILL
PUMP
829-68-110

ON

OFF

Handwritten notes on a clipboard attached to the control panel.

Control panel with four indicator lights (two red, two green).

Control panel with a selector switch and a red emergency stop button.

Yellow warning tag attached to the control panel.

68357

WARNING

WARNING



*The following slides
contain disturbing
pictures*









