



NECA'S System Approach to Electrical Safety for NFPA 70E



NECA's Systems Approach to NFPA 70E

- Easy to understand NFPA 70E employer requirements,
- Provides Supervisors with key on the job information,
- De-energize the systems as the first choice; remove the hazard,
- Apply lockout/tag-out and verify the absence of voltage (use appropriate PPE),
- Perform the justified energized electrical work using safe work practices while wearing appropriate PPE,
- Select the right clothing and rubber protective goods to stay safe!

NECA's Systems Approach to NFPA 70E

- Supervisor's Guide to Jobsite Safety
- NFPA 70E Guide to Decision Making - "Energized vs. De-energized Work"
- Guide to NFPA 70E Employer (Contractor) Responsibilities
- NFPA 70E Lockout/Tagout Guide
- NFPA 70E Personal Protective Equipment (PPE) Selector
- NECA Guide to Policies and Best Practices for NFPA 70E



NECA's Systems Approach to NFPA 70E

- NECA Standing Policy 19 addresses Safety Programs and Safe Workers and includes the language as follows "to achieve zero injuries in the workplace, members must strive for zero energy work environments as the normal and best practice, whenever achievable."
- The NFPA 70E Systems Approach
 - Remove or eliminate the hazard as the first choice
 - Establish an electrically safe work condition
 - Properly apply lockout and tag-out
 - Exercise proper determination of what energized work is justified in accordance with OSHA regulations and NFPA 70E.



NECA's Systems Approach to NFPA 70E

- Remove the Hazard
- LOCKOUT/TAGOUT
- Justified Energized Work
- Energized Electrical Hot Work Permit
- PPE Selection
- Policies and Best Practices

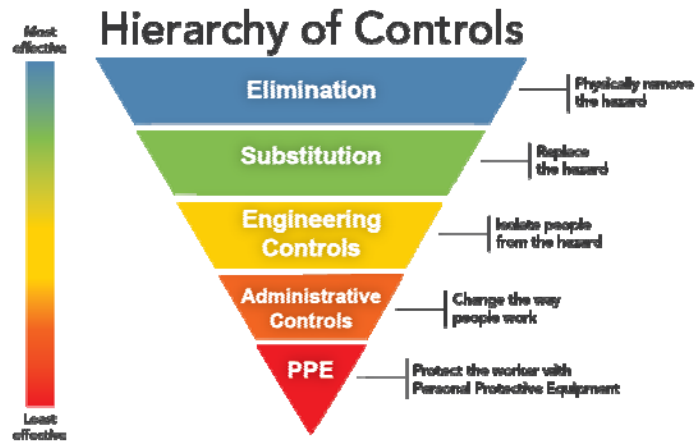


Removing the Hazard

- OSHA
 - Engineering – Engineer the hazard out.
- Administrative Control
 - Limit Exposures
 - Permits
 - Procedures
- Personal Protective Equipment
 - Wear protection for the body parts that are exposed to the hazard



Removing the Hazard



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Removing the Hazard

- Mitigation
 - Personnel trained in First Aid/Basic Life Support/AED/CPR
 - Emergency contact numbers and procedures for summoning help
 - List of healthcare and emergency facilities
 - Secure the area!

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Establish an Electrical Safe Work Condition

- Energized electrical conductors and circuit parts shall be put into an electrically safe work condition before an employee performs work in any of the following conditions exist:
 1. The employee is within the limited approach boundary.
 2. The employee interacts with equipment where conductors or circuit part are not exposed but an increased likelihood of injury from an exposure to an arc flash exists.



Lockout/Tagout (LOTO)

- OSHA – De-energizing Equipment
 - Determine safe procedures
 - Disconnect all energy sources
 - Control devices and Interlocks cannot be used for de-energizing and lockout/tagging procedures.
 - Release stored electrical energy
 - Release stored non-electrical energy
 - Apply Locks and Tags
 - Verify de-energization



Lockout/Tagout (LOTO)

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 - Release stored electrical energy
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 - Apply Locks and Tags
 - Verify de-energization
 - **Install Temporary protective grounds**



Lockout/Tagout (LOTO)

- Verification – Test for the Absence of Voltage
 - Check proper operation of voltage detector on known circuit
 - Test for Voltage
 - Verify proper operation on a known circuit



Must be met before any circuit or equipment is considered de-energized



Lockout/Tagout (LOTO)

- Protective Grounding per NFPA 70E
 - Reasons
 - Prevents possible induced voltage(s)
 - Used to facilitate protective overcurrent devices
 - Provides path to ground for fault currents
 - Considerations
 - Placement
 - Capacity
 - Impedance



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Lockout/Tagout (LOTO)

- Re-energizing Circuits or Equipment
 - Verify the task is complete
 - Remove all tools, equipment and unused materials
 - Remove all protective grounds
 - Notify all personnel
 - Remove Lockout/Tagout device(s)
 - Notify Operations and Owners Equipment is operational
 - Return Disconnecting means to "On" position

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Lockout/Tagout (LOTO)

- Complex Lockout/Tagout *NFPA 70E Annex G*
 - Multiple energy sources
 - Multiple crews
 - Multiple Crafts
 - Multiple Locations
 - Multiple employers
 - Unique disconnecting means
 - Complex switching sequences
 - Lockout/tagout continues for more than one shift



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Lockout/Tagout (LOTO)

- Training
 - Recognition of LOTO devices
 - How to install LOTO devices
 - Employer's Responsibilities
 - Employee's Responsibilities
 - Person in Charge Responsibilities
 - Authorized and Unauthorized removal of a LOTO device
 - Enforcement of Procedures



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Lockout/Tagout (LOTO)



- Training
 - Simple lockout/tagout
 - Complex lockout/tagout
 - Single line and circuit drawings
 - Alerting techniques
 - Release of stored energy
 - Personnel accounting methods
 - Temporary protective grounds
 - Safe use of test instruments



Justified Energized Work

- OSHA
 - Creates a greater hazard
 - Explosive Atmosphere
 - Life Safety
 - Continuous Process
 - Infeasible
 - Voltage Testing
 - Amperage Testing
 - Troubleshooting



Justified Energized Work

- NFPA 70E
 - Additional Hazards or Increased Risk
 - Permitted where de-energizing introduces additional hazards or increased risk
 - Infeasibility
 - It is infeasible to de-energize due to equipment design or operational limitations
 - Less than 50 Volts
 - No increased exposure to electrical burns or arcs



Justified Energized Work

- Safety-related Work Practices
 - Consistent with electrical hazards and the associated risk
 - Risk Assessments –
 - Identifies Hazards
 - Estimates severity of injury or damage to health
 - Estimates the “Likelihood” of injury or damage to health
 - Determines Protective Measures



Justified Energized Work

- “Qualified Person”
 - Only “person” permitted to work on conductors or circuits that are not in an “electrically safe working condition”.
- Types of Assessments
 - Shock Risk Assessment
 - Arc Flash Risk Assessment



Justified Energized Work

- Shock Risk Assessment
 - Determine the voltage
 - Determine the boundary requirements
 - Determine the Personal Protective Equipment (PPE)
- Shock Protection Boundaries
 - Limited approach boundary
 - Restricted approach boundary
 - AC Voltages – NFPA 70E Table 130.4(D)(a)*
 - DC Voltages – NFPA 70E Table 130.4(D)(b)*



Justified Energized Work

- Arc Flash Risk Assessment
 - Determine if Arc flash hazard exists
 - Appropriate safety-related work practices
 - Determine Arc Flash Boundary
 - Personal Protective Equipment with the arc flash boundary



Justified Energized Work

- Normal Operation
 - Equipment is properly installed
 - Equipment is properly maintained
 - Equipment doors are closed and secured
 - Equipment covers are in place
 - No evidence of impending failure



Justified Energized Work

- Energized Electrical Work Permit
 - When work is performed with the restricted approach boundary
 - When employee interacts with equipment that has an increased likelihood of injury from arc flash hazard
- Exemptions
 - Testing, troubleshooting, voltage testing
 - Thermography where RAB is not crossed
 - Access and Egress where no electrical work is performed and RAB is not crossed
 - Housekeeping where RAB is not crossed



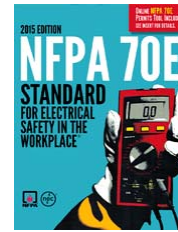
Justified Energized Work

- Prepare an **Electrical Energized Work Permit** which includes
 - Description of work
 - Justification for working energized
 - Description of safe work practices
 - Results of shock risk assessment
 - Results of arc flash risk assessment
 - Means to restrict access of unqualified
 - Evidence of Job Briefing
 - Energized work approval
 - Supervisor and company
 - Owner or owner's representative



PPE Selection

- Either:
 - Incident Energy Analysis Method or
 - Arc Flash PPE Categories Method



But not both!

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PPE Selection

- Incident Energy Analysis Method (*See NFPA 70E Annex D*)
 - Based on working distance from employee's face and chest
 - Basic Equations for calculating must include:
 - Amperage
 - Voltage
 - Impedance
 - Distance
 - Maximum MVA during bolted fault
 - MVA rating of the transformer
 - Time of arc exposure

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PPE Selection

- ARC Flash PPE Categories (See NFPA 70E Annex H)

- NFPA 70E Table Method

- Table 130.7(C)(15) (A)(a)
- Table 130.7(C)(15)(A)(b)
- Table 130.7(C)(15)(B)
- Table 130.7(C)(16)

- Simplified Two-Category Clothing Approach

Task	Equipment Condition*	Arc Flash PPE Required
Reading a panel meter while operating a motor switch	Any	No
Normal Operation of a circuit breaker (CB), switch, contactor or starter	All of the following: <ul style="list-style-type: none"> The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured There is no evidence of impending failure 	No
Voltage testing on individual battery cells or individual multivolt units	All of the following: <ul style="list-style-type: none"> The equipment is properly installed The equipment is properly maintained Covers for all other equipment are in place and secured There is no evidence of impending failure 	No
Removal or installation of covers for equipment such as terminals, junction boxes, and cable trays that does not require bare energized electrical conductors and	All of the following: <ul style="list-style-type: none"> The equipment is properly installed The equipment is properly maintained There is no evidence of impending failure 	No



PPE Selection

- Table 130.7(C)(15)(A)(a) Arc-Flash Hazard Identification for Alternating Current (ac) and Direct Current (dc) Systems

- Task
- Equipment Condition
- Arc Flash PPE Required? Yes or No

TASKS THAT DO NOT REQUIRE PPE - Excerpts from Table 130.7 (C)(15)(A)(a) Arc Flash Hazard Identification

Task	Equipment Condition*	Arc Flash PPE Required
Reading a panel meter while operating a motor switch	Any	No
Normal Operation of a circuit breaker (CB), switch, contactor or starter	All of the following: <ul style="list-style-type: none"> The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured There is no evidence of impending failure 	No
Voltage testing on individual battery cells or individual multivolt units	All of the following: <ul style="list-style-type: none"> The equipment is properly installed The equipment is properly maintained Covers for all other equipment are in place and secured There is no evidence of impending failure 	No
Removal or installation of covers for equipment such as terminals, junction boxes, and cable trays that does not require bare energized electrical conductors and	All of the following: <ul style="list-style-type: none"> The equipment is properly installed The equipment is properly maintained There is no evidence of impending failure 	No



PPE Selection

- Table 130.7(C)(15)(A)(b) *Arc-Flash PPE Categories for Alternating Current (ac) Systems*
- Table 130.7(C)(15)(B) *Arc-Flash PPE Categories for Direct Current (dc) Systems*

- Equipment
- Arc-Flash PPE Category
- Arc-Flash Boundary

DETERMINING ARC FLASH HAZARD PPE CATEGORIES DIRECT CURRENT
Excerpt from Table 130.7 (C)(15)(B)

Equipment	Arc Flash PPE Category	Arc-Flash Boundary	Rubber-insulated Gloves (Minimum)
Storage batteries, dc switchboards, and other dc supply sources 100 V > Voltage < 250 V Parameters: Voltage, 250 V Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)	1	600mm (3 ft.)	Class 00*
Short-circuit current < 4 kA	2	1.2m (4 ft.)	Class 00*
4 kA < short-circuit current < 7 kA	3	1.8m (6 ft.)	Class 00*
7 kA < short-circuit current < 15 kA	4	2.4m (8 ft.)	Class 00*
Storage batteries, dc switchboards, and other dc supply sources 250 V > Voltage < 600 V Parameters: Voltage, 600 V Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)	1	600mm (3 ft.)	Class 00*
100 V > Voltage < 250 V Parameters: Voltage, 250 V	2	1.2m (4 ft.)	Class 00*
Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)	3	1.8m (6 ft.)	Class 00*
7 kA < short-circuit current < 10 kA	4	2.4m (8 ft.)	Class 00*



PPE Selection

- Table 130.7(C)(16) *Personal Protective Equipment (PPE)*
 - PPE Category 1 – Minimum Arc Rating of 4 cal/cm²
 - PPE Category 2 – Minimum Arc Rating of 8 cal/cm²
 - PPE Category 3 – Minimum Arc Rating of 25 cal/cm²
 - PPE Category 4 – Minimum Arc Rating of 40 cal/cm²



PPE Selection

RISK ASSESSMENT & PPE SELECTION

GLOVES: RUBBER AND SALCOR® PROTECTIVE EQUIPMENT

Rubber insulating gloves are available in six ASTM defined voltage classes. Rubber insulating sleeves are available in Class 00 through 4. The chart below identifies the class, proof test voltage and maximum allowable exposure voltage.



Class Color	Proof Test Voltage AC / DC	Max. Use Voltage* AC / DC	Rubber Molding Products Label	Insulating Rubber Glove Label	Insulating Rubber Dipped Sleeve Label
00 Beige	2,500 / 10,000	500 / 750			
0 Red	5,000 / 20,000	1,000 / 1,500			
1 White	10,000 / 40,000	7,500 / 11,250			
2 Yellow	20,000 / 50,000	17,000 / 25,500			
3 Green	30,000 / 60,000	26,500 / 39,750			
4 Orange	40,000 / 70,000	30,000 / 54,000			

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PPE Selection

- Other Protective Equipment
 - Insulated tools
 - Fuse handling equipment
 - Ropes and handlines
 - Fiberglass-reinforced plastic rods
 - Portable ladders
 - Protective shields
 - Rubber insulating equipment
 - Voltage-rated plastic guard equipment
 - Physical or mechanical barriers



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PPE Selection

- Alerting Techniques
 - Safety Signs and Tags
 - Barricades
 - Attendants
 - Look-Alike Equipment



NFPA 70E® Policies and Best Practices

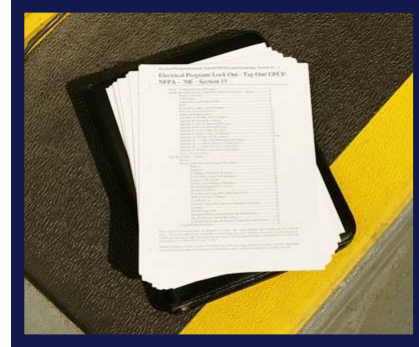
• Overview

- Understand Compliance Requirements
- Provide guidelines for a safe work environment
- Effectively communicate policies to employees and customers
- Express company commitment to the rules
- Establish Written Policies
- Develop Best Practices for working around electricity
- Determine what additional policies may be needed by a company



Policies

- Policies are clear, simple statements on how a company conducts:
 - Services
 - Actions
 - Business
- Reflect values, approaches and commitments
- Helps to create the safety culture by which all employees can foster.



Developing Effective Policies

- Include key stakeholders (management, employees and customers)
- Organize brainstorming or small work group discussions
- Identify policies needed (compare)
 - Templates available
 - Similar organizations
 - Regulations & Consensus Standards
- Develop an overarching policy and specific ones as needed
- Identify and include unique elements of your company



Developing Effective Policies

- Draft, refine and write the policies. Include:
 - Title (name, version number and/or dates, and who authorized it)
 - Purpose statement (why the policy exists and what is to be achieved)
 - Description/Responsibilities (One or two sections outlining the details of the policy and what each needs to do)



Developing Effective Policies

- Have policies approved and endorsed by leadership (i.e. Board, President or CEO)
- Promote policies, look for feedback and refine your policies as needed
- Ensure all employees sign off on policies when hired and any changes made to a policy



Developing Effective Best Practices

- Best Practices support and enforce company policies
- Detailed steps to compliance
- Considered technique or method proven to be effective



Develop Effective Best Practices

- Steps
 1. Identify problem areas
 2. Identify other companies or industries that have similar processes
 3. Identify the leaders in these areas
 4. Survey companies for measures and practices and/or review accepted industry standards.
 5. Determine which practices have proven results.
 6. Implement the practices



Questions to Ensure Best Practices are Adopted

- Can the conditions needed for adoption be adequately defined?
- Are the practices feasible to perform?
- Are they currently being done by others?
- Can all comply?
- Can the benefits be clearly and quantitatively defined?



Developing Effective Best Practices

- Outline for a Best Practice
 - Title (name, version number and/or dates, and who authorized it)
 - Statement (Identifies what the practice addresses)
 - Description (Offers detailed procedures of the practice)
 - Benefits (Identifies the positive outcomes of the practice)
 - References (lists any references used in development of the practice or that offer additional information on the practice)



Model Policies

- Policy on Energized Work
- Policy on Lockout/Tagout (LOTO)
- Policy on Test instruments
- Policy on Two-person operations
- Policy on Voltage testing
- Policy on Employee/Qualified Person training
- Policy on First Aid, CPR and AED (training and use)
- Policy on Accident, Incident and Near Miss Reporting
- Policy on OSHA Inspection(s)/Investigation(s)



Best Practices

- Effective, safe decision making (first choices)
- Safety for self
- Establishing ESWC
- Verifying the absence of voltage (toggling when possible)
- Two-way communication when establishing ESWC
- Effective use of proximity testers
- Lockout and tagout
- Qualified Observer
- Contact release methods
- CPR and AED readiness

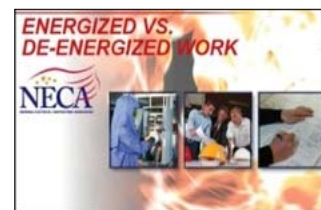


Best Practices

- Decisions on Energized Work
- Implementing Lockout/Tagout
- Use and Care of Test Instruments
- Renewal of First Aid and CPR Training
- Accident Reporting
- Handling an OSHA Inspection(s)/Investigation(s)



NECA's Systems Approach to NFPA 70E



NECA Guide to Job Briefings “NEW”



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NECA Guide to Job Briefings

- OSHA - “Information provided by the employer.”
- Covers job hazard analysis or an assessment of safety related to a specific job or task.
- Critical to understand the job briefing
- Foster critical thinking and discussion during these sessions
- Stimulate thought process for lone worker



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Key Elements of a Job Briefing

1. Hazards associated with the job or task
2. What are the work methods or procedures that must be considered?
3. Is there any special precautions to consider?
4. How are you controlling the energy source?
5. What PPE (Personal Protective Equipment) is needed to perform the task safely?
6. Emergency Response



NECA'S System Approach to Electrical Safety for NFPA 70E

