

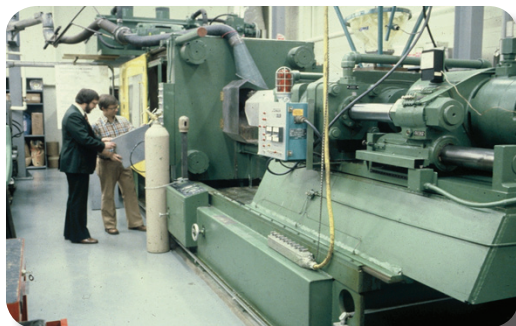
# 2014 NATIONAL ELECTRICAL CODE® & NFPA 70E/ARC FLASH ELECTRICAL SAFETY WITH ARC FLASH ANALYSIS WORKSHOP

Gain an understanding of the 2014 NEC's latest additions, revisions and changes. Learn the precautions needed when working with and around electricity. People and property need to be safeguarded from the hazards. The course also covers grounding and bonding and the rules to minimize the risk of electricity as a source of electric shock and as a ignition source of fires and explosions.

With Introduction to Arc Flash Analysis, keep your employees safe and OSHA compliant with electrical safety training. According to the US Department of Labor, electrocution is a main cause of on-the-job deaths of industrial workers. OSHA has increased its penalty structure seven-fold for violations. This is the time to train new employees and give seasoned employees a refresher. Statistically, a journeyman electrician between the ages of 30 and 39 with roughly 20 years of on-the-job experience is at the greatest risk of injury or death.

After this course, the participant will know how to:

- apply NEC rules and standards
- meet government electrical safety standards
- install, test, and inspect industrial, commercial, institutional, and residential power systems
- minimize electrical risks



## CLASS FORMAT:

Classroom

## STANDARD CLASS SIZE:

NTT recommends a class of no more than 35 participants to obtain the best results.

## NTT TO PROVIDE:

- Four-days (32 contact hours) of on-site instruction
- Day 1 & 2—National Electrical Code®
- Day 3 & 4—NFPA 70E/Arc Flash Electrical Safety with Arc Flash Analysis Workshop
- Textbooks
- Classroom consumables
- Completion certificates
- Shipping and instructor travel logistics

## CLIENT PROVIDES:

- Classroom of 500 square feet or greater
- Projection screen, white board and/or flip chart(s)

## WHO SHOULD ATTEND:

- Engineers
- Linemen
- Communications workers
- Safety personnel
- Inspectors



# 2014 NATIONAL ELECTRICAL CODE® & NFPA 70E/ARC FLASH ELECTRICAL SAFETY WITH ARC FLASH ANALYSIS WORKSHOP

- Article 393—Low Voltage Suspend Ceiling Power Distribution Systems
- Article 646—Modular Data Centers
- Article 728—Fire Resistant Cable Systems
- Article 750—Energy Management Systems
- Symbol requirements for controlled receptacles
- DC voltage requirements expanding
- Increasing the voltage threshold from 600 volts to 1,000 volts
- Electrical Safety labeling requirements changing and new sections added
- Increased requirements for GFCIs in laundry areas, facilities like car washes, and generator receptacles
- AFCI requirements expanding into laundry rooms and kitchens as the NEC move towards whole-house protection
- New section on Ground Fault Protection of equipment
- Exception for XHHW-2 conductors for specified temperature corrections for ampacity values
- Mounting of luminaires
- Increasing receptacle requirements in health care facilities
- Deleting the term “Emergency Systems” in health care facilities
- Moving several definitions from individual articles to Article 100
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**OSHA has strict training requirements to protect both qualified and unqualified persons who face a risk of electrical hazards that have not been reduced to a safe level. A person can be considered qualified for some tasks and unqualified for others. The employer determines if an employee is qualified or not. Training alone does not make one qualified.**

This training is for anyone who works on or near exposed energized components operating at 50 volts up to 600 volts nominal. Additional training may be required in regards to specific work methods and recognition of hazards associated with specific equipment and work methods. Additional training may also be required for voltages above 600 volts nominal. The Definition of a

Qualified Person from NFPA 70E:

A Qualified Person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method, and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method. Such persons shall also be familiar with the proper use of the special precautionary techniques, personal protective equipment, including arc flash, insulating and shielding materials, insulated tools and test equipment. Such persons permitted to work within the Limited Approach Boundary of exposed live parts operating at 50 volts or more shall, at a minimum, be additionally trained in all of the following:

- The skills and techniques necessary to distinguish exposed energized parts from other parts of electrical equipment.
- The skills and techniques necessary to determine the nominal voltage of exposed live parts.
- Approach distances and the corresponding voltages to which the Qualified Person will be exposed.
- The decision-making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.

## COURSE AGENDA | DAY 1 & 2

### APPLYING THE NEC ARTICLE 90

- NEC process and definitions
- Equipment examination
- Code change introduction
- Metric and standard units

### ELECTRICAL INSTALLATIONS ARTICLE 110

- Approval
- Conductors
- Equipment
- Mechanical installations
- Mounting and cooling

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## COURSE AGENDA | DAY 1 & 2, CONTINUED

- Electrical connections
- Arc flash protection
- Spaces about electrical equipment

### BRANCH CIRCUITS AND FEEDERS ARTICLE 210

- Branch circuits
  - Review of Code changes
  - Branch circuit ratings
  - Multiwire branch circuits
  - Identification of ungrounded conductors
  - Color code for branch-circuit grounded conductors
  - Color code for branch-circuit equipment grounding conductors
- Receptacle and cord connectors
  - Replacing receptacles
  - Review of code changes
  - Dwelling units
  - Bathrooms
  - Garages and accessory buildings
- Buildings
  - Other than dwelling units
  - Required branch circuits
- Branch-circuit ratings 210.19
  - Review of code changes
  - Minimum size conductors
  - Overcurrent protection
- Feeders
  - Review of code changes
  - Minimum rating and size
  - Feeders with common neutral
  - Identifying high-leg in Delta 4-wire systems
  - Ground-fault protection of equipment

### SERVICES ARTICLE 230

- Review of Code changes

- Definitions
- Service limitations
  - Number of services
  - Conductors—outside of buildings
  - Service raceways and seals
  - Clearance from openings
- Overhead service-drop conductors
- Underground service-lateral conductors
- Service-entrance conductors
- Service Equipment
  - AIC rating
  - Identification
  - Disconnecting mMeans
  - Ground-fault protection of equipment

### CONDUCTORS AND OVERCURRENT PROTECTION ARTICLE 240

- Conductors
- Ampacity
  - Insulation ratings
  - Ambient temperature
- Overcurrent protection
  - Review of code changes
  - Protection of conductors
  - Ampere ratings

### CONDUCTORS AND OVERCURRENT PROTECTION ARTICLE 240, CONTINUED

- Location of overcurrent protection devices
  - Underground conductor
  - Grounded conductor
  - Circuit location
- Overcurrent Devices
  - Plug and cartridge fuses
  - Circuit breakers
  - CB markings

### GROUNDING & BONDING ARTICLE 250

- Review of Code changes
- Grounding terminology

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## COURSE AGENDA | DAY 1 & 2, CONTINUED

- Grounding systems
- Grounding equipment and enclosures
- Grounding means
- Bonding
  - Services
  - Bonding over 250 volts
  - Main and equipment bonding jumpers
- Grounding Electrode System—Part III
- Equipment Grounding Conductors

### WIRING METHODS ARTICLE 300

- Wiring Methods
  - Conductors of same circuit
  - Conductors of different systems
  - Protection from physical damage
  - Underground installations
  - Protection against corrosion
  - Mechanical continuity of raceways and cables
  - Length of conductors at outlet box
  - Boxes, conduit bodies, or fittings required
- Supporting conductors in a vertical raceway
- Preventing heating effects of inductive current in metallic parts
- Securing integrity of fire-resistant-rated walls
- Preventing spread of toxic fumes in an air-handling system

### WIRING MATERIALS—RACEWAYS AND BOXES ARTICLE 300

- Review of Code changes
- Raceway systems
  - Rigid metal and nonmetallic conduit
  - Electrical metallic tubing
  - Flexible metal conduit
  - Liquid-tight flexible metal and nonmetallic conduit
- Cable Assemblies
  - Metal-clad cable
  - Armored cable

- Nonmetallic-sheathed cable
- Other wiring systems
  - Cable Tray Systems
  - Wireways
  - Busways
  - Auxiliary gutters
- Boxes, Conduit Bodies, and Fittings

### WIRING MATERIALS

- Review of Code changes
- Switches Article 404
- Switchboards and panelboards

### ARTICLE 408

- Panelboards
  - Number of overcurrent devices on one panelboard
  - Grounding of panelboards

### EQUIPMENT FOR GENERAL USE—ARTICLE 400

- Review of Code changes
- Flexible Cords and Flexible Cables
- Luminaires Article 410
  - Luminaires locations
  - Flush and recessed fixtures
  - Electric-discharge equipment 1000 volts or less
  - Lighting track
- Receptacles, cord connectors and attachment plugs
  - Tamper resistant receptacles
  - Grounding and non-grounding receptacles
  - Isolated-ground receptacles
  - Hospital-grade receptacles
  - GFCI-type receptacles
- Appliances Article 422
  - Installation requirements
  - Disconnecting means
  - Safety provisions
  - Markings



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## COURSE AGENDA | DAY 3 & 4

### MOTORS, GENERATORS, A/C & REFRIG- ERATION, AND FIRE PUMPS

- Motors Article 430
  - Review of Code changes
  - Ampacity and motor ratings
  - Markings on motors and multimotor equipment and controllers
  - Branch circuit—single motor
  - Motor control circuits and centers
  - Disconnecting means

### MOTORS, GENERATORS, A/C & REFRIG- ERATION, AND FIRE PUMPS, CONTIN- UED

- A/C and Refrigeration Equipment Article 440
  - Single equipment
  - Disconnecting means
  - Branch-circuit fuses or circuit breakers
  - Room A/Cs—Part VII
- Fire Pumps Article 695
  - Power source to electric-motor driven fire pumps

### TRANSFORMERS ARTICLE 450

- Transformer construction and types
- Transformer installation
- Transformer vaults

### SPECIAL LOCATIONS ARTICLE 500 AND 600

- Electrified truck parking spaces

### ARTICLE 626

- Review of Code changes
- Hazardous locations Article 500
  - Group classifications
  - Wiring methods
  - Conduit seals

- Motors and generators
- Grounding
- Intrinsically safe systems
- Service and Repair Garages Article 511
- Health care facilities
- Places of assembly

### HAZARDS OF ELECTRICITY

- Shock
  - Touch and step potential
  - How they occur
  - Magnitude of the shock
  - Voltage levels that will cause various reactions and effects to the human body
  - Understanding shock magnitude scales
- Arc
  - How the arc is developed through short circuits and ground faults conditions
  - Temperatures of the arc and the effects on bare exposed skin with the onset of a second degree burn
  - Required PPE for protection from the arc
  - How fault current has a direct relation to the size and magnitude of the arc
  - Short circuit current calculations show this relationship
- Blast
  - Pressure wave effects on the face and chest cavity
  - Effects of pressures in the ear canal
  - Destruction of equipment from a blast

### BOUNDARIES

- Shock Boundaries (at various voltage levels)
  - Limited—What it is and who can cross it
  - Restricted—The requirements to be within
  - Prohibited—How to avoid direct contact
- Flash Boundaries
  - How to determine the Arc Flash boundary with engineering labels
  - Using the tables in NFPA 70E
  - Calculation with mathematical formulas

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## COURSE AGENDA | DAY 3 & 4, CONTINUED

- How does fault current affect the boundary
- What reduces the Flash boundary
- Who can be within an Arc Flash boundary

### SELECTION AND USE OF SAFE WORK PRACTICES

- The three options required by the employer to protect the worker
- The difference between allowable options and infeasible options
- When can equipment be worked on hot
- What is an Energized Electrical Work Permit
- Who is qualified to sign and use this permit
- What is an Electrical Safe Work Condition
- How to establish a Safe Work Condition through LO/TO
- Verification of the absence of voltage
- Use of locks and tags
- Authorized Person vs. Qualified Person
- Conductive Objects and Apparel
  - Clearance distances to overhead or exposed conductors
  - Conductive objects near overhead conductors
  - Safe handling of conductive objects in the work place
  - Conductive jewelry, watches, rings and commutative devices
- Interlocks
  - What are they and who can defeat them and when
- Portable Ladders
  - Step ladders vs. extension ladders
  - Safe work practices
- Enclosed Spaces
  - Electrical components, protection of the worker
  - When must an equipment room be locked
  - Who can enter electrical equipment rooms
  - Flammable vapors and liquids near electrical components and equipment

- Portable Tools and Equipment
  - Use of extension cords in the work place
  - Where are extension cords prohibited
  - GFCI protection for cords and tools; when are they required
  - Proper handling and repair of tools and cords
- Overcurrent Protective Devices
  - Fuses; determining the short circuit current of a fuse
  - Types of fuses; rejection vs. non-rejection
  - RK type fuses; what they do
  - How to determine why a fuse blows; short, overload or fault
  - Proper handling, testing and replacement of fuses
- Circuit Breakers
  - Types and operation
  - What conditions cause a breaker to trip
  - How to determine the differences
  - SSC rating of breakers and clearing times

### SELECTION AND USE OF SAFE WORK PRACTICES, CONTINUED

- Test Instruments and Tools
  - Who can use a test instrument
  - Who cannot use test meters
  - Latest standards and ratings of test instruments
  - Old style solenoid type vs. new Cat Rating type
  - What is Cat Rating
  - Cat I vs. Cat IV
  - Protection from transient voltage
  - 2009 training requirements for test instruments
  - 2009 documentation requirements for a Qualified Person using test instruments
  - Voltage sensing devices vs. test meters; using magic wands
  - Over voltage vs. transient voltage
  - Proper use and care of test instruments
  - Proper techniques in testing equipment for presence and absence of voltage
- Voltage Rated Tools and Equipment
  - Insulated vs. double insulated

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## COURSE AGENDA | DAY 3 & 4, CONTINUED

- How to recognize an insulated tool by marking and identification
- When do they need to be replaced
- Where they must be used and by whom
- When are hot sticks required
- Grounding of equipment for personal protection
- Barricades and Guarding of Exposed Energized Electrical Equipment
  - Who establishes a barricade
  - What is the distance required
  - What is an approved barricade
  - What are the required signs
  - When must an attendant be used and who can be an attendant
- Selection of Shock Protection
  - Rubber glove identification, use, care and storage
  - Sizing for rubber gloves
  - Hand fit vs. measuring tape method
  - Testing of rubber gloves and other protective requirements
  - Who tests rubber goods; when and how often
  - Types of powder not allowed in rubber gloves
  - How to clean rubber goods
- Selection of Arc Flash Personal Protective Equipment
  - How is flash protection rated
  - FR vs. ATPV rating of protection
  - How much is required
  - Simplified clothing method
  - Protective clothing matrix
  - Layering effects of clothing
  - Use and care of ATPV clothing
  - Arc shields vs. flash hoods
  - Head coverings
  - Repairing arc flash clothing
  - Requirements for hair and beard nets
- Other Personal Protective Equipment
  - Safety glasses vs. arc goggles
  - Steel toe vs. crush impact boots
  - Boots replacement

- Dielectric boots vs. electrical rated boots
- Hearing protection: foam vs. blast protection
- Non conductive vs. restrained eye wear
- Insulated vs. shielding materials; when to use them
- Applying personal protective grounds

## RISK CATEGORIES TABLES

- What are risk categories
- Reading and understanding the information on engineering labels
- Engineering Studies vs. Risk Category Tables from NFPA 70E
- Warning labels only
- 2009 Arc Flash Protection Boundary and clearing time requirements

## ARC FLASH ANALYSIS

- Calculate fault current and incident energy levels using various methods, including scientific calculators using the IEEE formulas, Excel spread sheets, and over the counter software
- Values change throughout the facility
- Changes made by the supplying utility, or changes in the load of the facility, can affect the protection characteristics of the electrical distribution system
- Proper PPE relative to the task to be done
- Job Hazard Analysis.
  - Effected persons notification
  - Proper tool selections
  - Detailed task descriptions
  - Hot work permits
  - Lockout / Tagout Procedures
  - Assign responsibility
  - Create procedures
- Create a "living" document for new tasks and used as a reference to accomplish a task that has already been analyzed