Wednesday, May 27, 2020

1:00 pm - 3:00 pm

CWEA Electrical / Instrumentation Technician - Grade 2 Certification Training Webinar

Learning Objective(s):
After participating in this session, attendees will be able to:

- Identity what to study.
- Describe what they need to learn before the test.
- Discuss how to take the exam.

CWEA Contact Hours: 2.4 towards Electrical / Instrumentation Technician Certification

Introducer: Roy Reynolds, Mechanical Maintenance Supervisor, Orange County Sanitation District

Roy Reynolds has 28 years of experience in the wastewater field. The last 18 years he has been a Maintenance Supervisor at Orange County Sanitation District in Southern California. He served in the U.S. Navy, assigned to the Seabees stationed in San Diego, before the Battalion moved to Port Hueneme California. He has been active in the CWEA sitting on many of the Local and State committees related to Maintenance and Certification. Currently serving the CWEA as the SARBS TCP Committee Chair.

Speaker: Ralph Stevens, Principal, Water- CMRP, CESCP, PinnacleART

Ralph Stevens has over 35 years in Water/Wastewater in plants from 1MGD to 900MGD, Certifications include: CMRP Certified Maintenance and Reliability Professional, CESCP Certified Electrical Safety Compliance Professional, CWEA Grade 4 E&I, WWTPO Grade 3, NWEA Mechanical Grade 3. Started out as an Electrician in the Deep Tunnel Chicago ended up in Leadership. Ralph is a strong believer in Reliability Centered Maintenance and Thinking thru Troubleshooting. Looking to give back to our industry and help all I can

Plant Maintenance
Electrical/Instrumentation Technologist

RALPH STEVENS CMRP, CESCP
CWEA Instructor
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Agenda

1. Work Habits
2. Safety
3. Electrical
4. Instrumentation
5. Tools & Equipment
6. Open Discussion

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How do I pass?

1. Study Materials
2. Math
3. Definitions
4. Common Abbreviations

3

Safety

4

Skill Set 2 – Safety

3. The NEC identifies environments that contain flammable vapors and gases as which class of hazardous locations?
   a. Class III
   b. Class II
   c. Class I
   d. Class IV

4. Which of the following reduces high voltages and currents to safe values for measurements?
   a. Auto transformer
   b. Megohmmeter
   c. Instrument transformer
   d. Variable transformer

5. On a MSDS the section that gives the safe exposure limits, based on OSHA guidelines, is:
   a. Chemical identity
   b. Control measures
   c. Safety precautions
   d. Hazardous information and ingredients

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Skill Set 2 – Safety

1. Rubber safety gloves should be tested how often?
   a. Every 12 months
   b. Every 9 months
   c. Every 6 months
   d. Every 4 months

2. Rubber safety blankets should be tested how often?
   a. Every 6 months
   b. Every 12 months
   c. Every 9 months
   d. Every 18 months

3. What is the interrupting current of a GFIC receptacle?
   a. 20 VAL
   b. 5-6 MA
   c. 10 UDL
   d. 10 MA

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Electrical

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Skill Set 3 – Electrical

Important Terms to Know and Understand:

1. **Power source**: provides the electromotive force to drive current (move electrons) through the circuit conductors.
2. **Resistors**: provide resistance to the flow of current through these components
3. **Capacitors**: energy storage components that take and retain a charge
4. **Solenoid switch**: an electromechanical device that can be actuated by applying an electrical current
5. **Transformer**: a device for stepping up or stepping down voltage. It utilizes a pair of coils with different numbers of windings. Current flowing through one coil induces current in the adjacent coil.

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Skill Set 3 – Electrical

1. The relationship between an electric current and a magnetic field is called:
   a. Matter
   b. Atoms
   c. Electromagnetism
   d. Element

2. An on-off switch with overload relays is called a:
   a. Magnetic starter
   b. Manual starter
   c. Reversing starter
   d. Combination starter

3. The amount of potential difference a layer of insulation can withstand without breaking down is called:
   a. Resistance
   b. Voltage drop
   c. Dielectric strength
   d. Ampacity

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Skill Set 3 – Electrical

4. What is the name of the property of a coil of wire that opposes any change in the current in the coil?
   a. Inductance
   b. Resistance
   c. Impedance
   d. Watts

5. What device changes alternating current to a different combination of potential difference and current?
   a. Generator
   b. Capacitor
   c. Alternator
   d. Transformer

6. How does the power going into a transformer compare to the power coming out?
   a. Lower
   b. Equal
   c. Double
   d. Higher

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Skill Set 3 – Electrical

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Skill Set 3 – Electrical

7. In a three-wire control circuit, when a power failure occurs:
   a. The interlock contact will close the circuit
   b. The operator can restart the motor automatically
   c. The motor can restart unexpectedly
   d. The operator must restart the motor manually

8. Shielding protects an analog meter from:
   a. Damage due to careless handling
   b. Harmful UV rays
   c. Over-current and surges
   d. Stray magnetic fields

9. An ammeter should be connected:
   a. Across the line
   b. Around an inductor
   c. In parallel with the load
   d. In series with the load

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Skill Set 3 – Electrical

1. The frame, the core, the winding, and the end plates are all parts of the:
   a. Rotor
   b. Stator
   c. Alternator
   d. Induction motor

2. Two sources of power, one AC and one DC, are required for running a(n):
   a. Induction motor
   b. Squirrel-cage motor
   c. Synchronous motor
   d. Wound-rotor motor

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Skill Set 3 – Electrical

1. What kind of starter provides full-voltage starting?
   a. Across-the-line
   b. Synchronous start
   c. Reactor starter
   d. Reduced-voltage start

2. The choice between across-the-line starting and reduced-voltage starting depends in part on the size of the:
   a. Starter
   b. Wire size
   c. Motor
   d. Breaker

3. A reversing starter reverses a three-phase motor by interchanging:
   a. Main contacts
   b. Two of the line leads
   c. All of the line leads
   d. Control voltage

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Skill Set 3 – Electrical

4. What kind of protection is provided in a manual across-the-line three-phase motor control?
   a. Overload protection only
   b. Ground-fault protection only
   c. Short-circuit protection only
   d. All of the above

5. Which of the following is a sign of overheating rotor bars?
   a. Reduced starting torque
   b. Noise
   c. Discoloration
   d. All of the above

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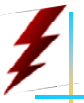

Skill Set 3 – Electrical

1. What is the current in amperes of a 120-volt circuit with a resistance of 60 ohms, using Ohm's Law?
   a. 0.5 amperes
   b. 2.0 amperes
   c. 30 amperes
   d. 10 amperes

2. What is the current for a 120-volt circuit with a 1440-watt load?
   a. 0.083 amperes
   b. 10 amperes
   c. 12 amperes
   d. 15 amperes

3. What is the current of a circuit that consumes 625 watts through a 12.75-ohm resistor?
   a. 3.8 amperes
   b. 7 amperes
   c. 49 amperes
   d. 175 amperes

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Skill Set 3 – Electrical

4. What is the ampere load of a single-phase half-horsepower 115-volt motor, if the motor has an efficiency rating of 92% and a power factor of 80%?
   a. 9.5 amperes
   b. 2.4 amperes
   c. 4.4 amperes
   d. 78.1 amperes

5. A 230-volt single-phase circuit has a 12-kilowat power load and operates at 84% power factor. What is the current?
   a. 43 amperes
   b. 52 amperes
   c. 62 amperes
   d. 70 amperes

6. A 115-volt, 2-KVA, single-phase generator operating at full load will deliver how many amperes?
   a. 0.23
   b. 17.4
   c. 57.5
   d. 230

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Skill Set 3 – Electrical

7. A wet well measures 30 feet deep, 25 feet wide and 35 feet long. What is the capacity in gallons?
   a. 3,509,000 gal
   b. 19,635,000 gal
   c. 26,250,000 gal
   d. 196,350 gal

8. What is the amp-load of a three-phase, 0.5-hp, 230-volt motor with an efficiency rating of 92% and a power factor of 80%?
   a. 1.27 amps
   b. 1.19 amps
   c. 2.55 amps
   d. 4.41 amps

9. A three-phase, 460-volt motor draws a current of 52 amperes. The motor has an efficiency rating of 94% and a power factor of 80%. What is the horsepower?
   a. 24.1 hp
   b. 41.7 hp
   c. 50.0 hp
   d. 73.8 hp

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Skill Set 3 – Electrical

1. Which of the following wiring methods is not approved for use in Class I, Division I locations:
   a. Rigid conduit
   b. Steel IMC conduit
   c. Electrical metallic tubing
   d. Type MI cable with proper termination fittings

2. Electrons flowing from one place to another make?:
   a. Current
   b. Track
   c. Circuit
   d. Channel

3. Between two objects, the development of static charges creates a:
   a. Potential difference
   b. Battery
   c. Thermocouple
   d. Resistance

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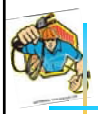

Skill Set 3 – Electrical

4. Magnetic starters are designed to allow what % FLC?:
   a. 85
   b. 115
   c. 125
   d. 100

5. Metals are good conductors because they have many:
   a. Insulators
   b. Free electrons
   c. Resistors
   d. Inductors

6. The main reason for wire insulation failure is:
   a. Heat, Moisture and Dirt
   b. Wrong application
   c. Failure to test
   d. Water damage

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Skill Set 3 – Electrical

7. A holding tank requires chlorination to 2.5 ppm. The tank holds 3.5mg How many pounds of chlorine will be needed?
   a. 8.75 lbs.
   b. 50 lbs.
   c. 73 lbs.
   d. 182 lbs.

8. What is the correct name for "voltage" or electromotive force?
   a. Element
   b. Electron
   c. Circuit
   d. Potential difference

9. A rate of flow of one coulomb per second is called one:
   a. Ampere
   b. Joule
   c. Volt
   d. Ohm

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Skill Set 3 – Electrical

10. What is the most important feature for adequate equipment grounding?
    a. Insulation
    b. Low-impedance path
    c. Low current
    d. Over-current devices

11. What is the unit of measurement for capacitive reactance?
    a. Volts
    b. Ohms
    c. Amps
    d. Power factor

12. Power companies use AC generators instead of DC generators because AC can be sent over long distances:
    a. At high cost
    b. At low cost
    c. Slower
    d. Faster

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Skill Set 3 – Electrical

13. The National Electrical Code defines a qualified person as someone who?
    a. Has been on the job one year.
    b. Is a supervisor or manager.
    c. Is certified by a testing laboratory.
    d. Is familiar with equipment operations and hazards.

14. The insulation in a capacitor is called?
    a. Condenser
    b. Farad
    c. Dielectric
    d. Higher

15. What kinds of bearings are used when a motor is to be mounted horizontally?
    a. Radial
    b. Thrust
    c. Angular
    d. Antifriction

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Skill Set 3 – Electrical

16. Wires and cables can be classified according to their:
    a. Color
    b. Size
    c. Covering
    d. Shape

17. With what kind of equipment makes a PM effective?
    a. Any condition
    b. In need of overhaul
    c. Up to standard
    d. Not up to standard

18. How can Cathodic Protection can be achieved?
    a. Impressed Current
    b. Galvanic Anodes
    c. Both A and B
    d. Electrolyte soil and water

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Skill Set 3 – Electrical

19. The most important requirement for good maintenance of motor starters is:
    a. Good record keeping
    b. Safety of personnel
    c. Proper lubrication
    d. Clean, dry insulation

20. The service life of a UV lamp depends on:
    a. Suspended solids in the water
    b. Frequency of On/Off cycles
    c. Operating temperature of the lamp electrodes
    d. All of the above

21. Which items are primary sources of unsatisfactory AC brush and ring performance?
    a. Improper load or service condition
    b. Poor design
    c. Poor care/condition of the motor unit
    d. All of the above

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Skill Set 3 – Electrical

22. Commonly used instead of fuses in industrial power distribution systems are:
    a. Disconnects
    b. Motor starters
    c. 51 relay
    d. Circuit breakers

23. Distribution protection usually consists of two elements, protection of both:
    a. Equipment and circuit
    b. Personnel and equipment
    c. Wire and control relay
    d. Ground fault and current

24. What are the types of AC waveforms:
    a. AC, DC and ASE
    b. Sine, Square and Saw tooth
    c. Zero, 180 and 360
    d. Zero, 90 and 180

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Skill Set 3 – Electrical

25. A power-installation drawing shows:
    a. Power outlets
    b. Lighting receptacles
    c. Plug receptacles
    d. Computer terminal locations

26. Dual-voltage motors are:
    a. Always Delta-connected
    b. Always Y-connected
    c. Either Y- or Delta-connected
    d. Neither Y- or Delta-connected

27. A parking lot has a bank of ten 400w lights that operate 10hrs a day and a 150w sign that operates all day. What is the electric cost for 30 days @ $0.095 per kilowatt hour?
    a. $21.66
    b. $114.00
    c. $124.26
    d. $216.60

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Electrical Checklist

1. What is the proper way to test motor insulation?
2. Who many Watts in one horsepower?
3. How do we size a motor?
4. What is a balanced power system?
5. What is grounded vs. grounding?

6. Electrical Questions????

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Instrumentation

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Skill Set 4 – Instrumentation

Case study: You receive a trouble call that the magnetic flow meter for a centrifugal pump is not operating properly. When you arrive to inspect the pump, instrumentation on the control panel indicates that the electric motor is receiving power and that the pump discharge pressure and flow are zero. Discuss possible problems and the diagnostic approach to take.

1. Determine whether motor is turning or not
2. Determine whether pump shaft is turning or not
3. Determine if valves on the suction and discharge piping are open or closed
4. Check to see if pump casing is hot (indicates spinning pump with no water flow)
5. Check to see if a pressure gauge is installed and whether it reads positive pressure.
6. Check to see if water is flowing and instrumentation is faulty.
7. Check for 4 – 20 ma signals from the mag-meter and pressure sensor loops.

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Skill Set 4 – Instrumentation

1. Offset is the difference between the actual maintained value of the measured variable and:
   a. The set point
   b. The span
   c. Zero
   d. The level

2. Another name for built-in error that usually occurs in a proportional control system is:
   a. Deadband
   b. Offset
   c. Set point
   d. Span

3. An automatic controller always compares a measured variable to:
   a. Zero
   b. Span
   c. Reset
   d. Set point

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Skill Set 4 – Instrumentation

4. The drawing that provides a view of the entire system in process control is the:
   a. P&ID drawing
   b. I/P drawing
   c. Element drawing
   d. Primary drawing

5. Name the three most common mediums of data transmission.
   a. Twisted pair, radio, fiber optics
   b. Phone, telemetry, radio
   c. Cable, phone, radio
   d. Coax, phone, fiber optics

6. The abbreviation SCADA stands for:
   a. Safety Control and Data Answering
   b. Supervisory Control and Data Acquisition
   c. System Computer and Digital Analog
   d. Self Contained and Data Acquisition

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Skill Set 4 – Instrumentation

7. The RS232C standard applies to what type of digital transmission?
   a. Balanced
   b. Fiber Optic
   c. Parallel
   d. Serial

8. Where is a computer's start-up program usually stored?
   a. In RAM
   b. In ROM
   c. On disk
   d. On magnetic tape

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Skill Set 4 – Instrumentation

1. The difference between the measurement signal and the set point is called the:
   a. Gap
   b. Error
   c. Feedback
   d. Span

2. The signal pressure is usually directly proportional to the process:
   a. Span
   b. Level
   c. Variable
   d. Loop

3. Each device connected to a network works thru a:
   a. Controller
   b. Data packet
   c. Node
   d. Token

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Skill Set 4 – Instrumentation

4. A CDU (command and display unit) computer screen that senses finger pressure is:
   a. A digitizer
   b. An intelligent terminal
   c. A scanner
   d. A touch screen

5. To simulate an RTD input, you use a:
   a. Digital VOM
   b. Potentiometer
   c. Resistance decade box
   d. Wally box

6. The specific value at which an automatic control holds a process variable is called the:
   a. Span
   b. Variable
   c. Control point
   d. Set point

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Skill Set 4 – Instrumentation

7. Which element makes a programmable logic controller system flexible?
   a. Memory
   b. I/O
   c. Program
   d. Power supply

8. A tag number with a code reading FRC identifies a:
   a. Field recording controller
   b. Flow recorder controller
   c. Temperature controller
   d. Pressure recorder

9. The most commonly used type of diagram in process control is?
   a. A loop diagram
   b. An installation drawing
   c. A piping and instrument drawing
   d. A location drawing

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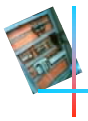

Skill Set 4 – Instrumentation

10. A signal from a measuring device to the controller is called:
    a. Zero
    b. Correcting
    c. Span
    d. Feedback

11. In a closed loop control system, the control process of measuring, comparing, computing and connecting goes on:
    a. Continually
    b. Intermittently
    c. Never
    d. Whenever the operator takes some action

12. A control system in which the output is regulated only by changes from the outside the process is called:
    a. Open loop
    b. Closed loop
    c. Set point
    d. Measuring

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Skill Set 4 – Instrumentation

13. A common converter used in process control is the I/P converter, which converts _____ signals to _____ signals.
    a. Zero, span
    b. Analog, digital
    c. Current, pneumatic
    d. Linear, nonlinear

14. Time lag can be defined as the time between:
    a. Turning an instrument on and off
    b. A high reading a low reading
    c. A proportional reading, and an inverse reading
    d. Input to an instrument and output from an instrument

15. Local I/O expansion involves the addition of:
    a. A second processor
    b. A shift register
    c. Data-handling capabilities
    d. I/O points within the rack

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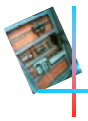

Skill Set 4 – Instrumentation

16. The small region of an instrument range where input changes cause no corresponding output change is called:
    a. Range
    b. Dead band
    c. Span
    d. Linear

17. Instrument error is usually expressed as:
    a. Percent
    b. Span
    c. Zero
    d. Linear

18. Name two types of Energy:
    a. AC and DC
    b. Battery and Power
    c. Potential and Kinetic
    d. Resistance and Power

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Skill Set 4 – Instrumentation

19. In supervisory control, the computer plays a(n):
    a. Analog role
    b. Inactive role
    c. Active role
    d. Plotter role

20. The CPU of a microcomputer is a(n):
    a. ALU
    b. Microcontroller
    c. Microprocessor
    d. Printed circuit assembly

21. Communicating process data to and from the SCADA computer is the purpose of the:
    a. Conditioning system
    b. Transmitting system
    c. Control system
    d. Interface system

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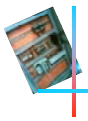

Skill Set 4 – Instrumentation

22. A computer program operates under the control of a(n):
    a. Operating system
    b. Controller system
    c. Interface system
    d. Process system

23. The configuration in which individual computers are connected for the purpose of communication is a:
    a. CPU
    b. BIU
    c. Network
    d. Loop

24. The abbreviation LAN stands for:
    a. Level Alarm Network
    b. Loop Alarm Neutral
    c. Local Alarm Network
    d. Local Area Network

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Skill Set 4 – Instrumentation

25. Whole circuits manufactured with all components in place and ready to work are called:
    a. Semiconductor circuits
    b. Microprocessor circuits
    c. Rectifier circuits
    d. Integrated circuits

26. What is the psi if the height of a column of water is 55.4 inches?
    a. 2 psi
    b. 4.1 psi
    c. 27 psi
    d. 55.4 psi

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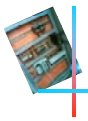

Skill Set 4 – Instrumentation

27. A circle has a circumference of 393 feet. What is the diameter?
    a. 63 feet
    b. 98 feet
    c. 125 feet
    d. 197 feet

28. 77°F is equal to how many degrees Celsius?
    a. 81°C
    b. 60°C
    c. 43°C
    d. 25°C

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Instrumentation Checklist

1. What is Process?
2. What is a Control Loop?
3. What is a Transducer?
4. What is Process measurement?
5. What is a Transmitter?

6. Instrumentation Questions ?????

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Tools & Equipment

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Skill Set 5 – Tools & Equipment

3. What Category rating on a meter would be used on service drop?
   a. Cat. 4
   b. Cat. 2
   c. Cat. 3
   d. Cat. 1

4. What Category rating on a meter would be used on protected electronic equipment?
   a. Cat. 2
   b. Cat. 1
   c. Cat. 3
   d. Cat. 4

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Skill Set 5 – Tools & Equipment

1. The supply of spare parts, tools, and test instruments should be monitored by the:
   a. Supervisory control operation
   b. Limited control operation
   c. Computer control operation
   d. Inventory control operation

2. Which of the following is the best choice of work clothing fabric when working with electricity?
   a. Cotton
   b. Nomex
   c. Nylon
   d. Polyester

3. The best combination of gloves to wear when performing electrical work is:
   a. Leather over rubber
   b. Leather over cotton
   c. Synthetic over rubber
   d. Synthetic over cotton

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Skill Set 5 – Tools & Equipment

4. Which of the following is a function of the tag and lockout disconnect switch?
   a. Give instructions for the work to be performed
   b. Identify the individual who placed the lock
   c. List all affected sub systems
   d. Prevent accidental startup

5. What is the best protection against the risk of infections and infectious diseases:
   a. Immunization program
   b. PPE
   c. Personal hygiene
   d. Safety courses

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General Infomation

1. The Power system electrical components are:
2. The Source Power- PG&E
3. The Power System- Main Fuse box
4. The Control System- Floats/Switches

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General Information

1. NFPA 70E is the Standard for Electrical Safety in the Workplace
2. NFPA 70B is the Recommended Practice for Electrical Equipment Maintenance
3. NFPA 79 is the Electrical Standard for Industrial Machinery
4. NFPA 70 is the Electrical Code

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General Information

1. Remember to think about prior years
2. Most questions based on last years info.
3. Use the study guides
4. Study your Math
5. Study in a group

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Open Discussion

Be Ready, Study!
Good Luck!

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