

Quiz: Electrical Hazards

1) _____ provides guidelines and requirements regarding what to do in order to create safe work environments and practices.

- a) NFPA 70E
- b) OSHA
- c) NFPA 70
- d) NEC
- e) IFC

OSHA

Explanation

OSHA provides the guidelines for what to do in order to create safe work environments and practices. NFPA 70E and NFPA 70 (NEC) provide guidance on how to meet the guidelines established by OSHA. The IFC (International Fire Code) provides regulations for fire prevention and fire protection systems.

2) _____ provides guidelines and requirements regarding how to fulfill OSHA's guidelines and be consistent with the National Electrical Code.

- a) NFPA 70E
- b) OSHA
- c) ANSI
- d) ASTM
- e) IFC

NFPA 70E

Explanation

NFPA 70E is the Standard for Electrical Safety in the Workplace. It, along with NFPA 70 (National Electrical Code) provide guidance on how to meet the requirements established by OSHA.

3) The National Electrical Code is also known as _____.

- a) NFPA 70E
- b) OSHA
- c) NFPA 70
- d) ANSI
- e) IFC

NFPA 70

Explanation

NFPA 70 (National Fire Protection Association) is a foundation for safe electrical design, installation, and inspection to protect people and property from electrical hazards, and is also known as the National Electrical Code (NEC).

4) A worker who has training, skills, and knowledge related to construction, operation, and installation of electrical equipment and the hazards involved, and who has successfully demonstrated their ability to solve problems relating to the work being done is considered a(n) _____ person.

- a) qualified
- b) competent
- c) authorized
- d) approved
- e) designated

qualified

Explanation

It is important to understand terminology as it applies to OSHA guidelines. A "qualified" person has training, skills, knowledge, and demonstrated ability to solve problems and competently complete the work tasks at hand. This designation is different from "competent" person and "authorized" person. A "competent" person is one who is capable of identifying existing and predictable hazards in a workplace, and is authorized to take corrective measures to correct or prevent them. An "authorized" person has been assigned or approved to perform a specific task, and has the authority to take corrective actions. The word "designated" is not a word to describe a worker's specific status or ability, however one can be designated as a qualified, authorized, or competent person.

- 5) True or False: Covering a large PV Array during daylight conditions is an effective way to eliminate electrical hazards associated with the array.

False

Explanation

It is impossible to reliably and adequately cover a large ground-mounted PV array. Even if it were, it would still be possible for the array to produce a lethal voltage and current level.

- 6) True or False: During installation, it is common for circuits to be energized, so caution must be exercised.

False

Explanation

During installation, workers should never be working on energized circuits. Workers should only access energized circuits during testing, commissioning, and troubleshooting of PV systems.

- 7) While troubleshooting a ground fault on a PV array, a worker comes in contact with the PV rack. What type of electrical hazard is the worker exposed to?

- a) falling
- b) wires
- c) arc flash
- d) shock
- e) arc fault

shock

Explanation

During a ground fault condition, racking systems and other metal parts of PV systems that are normally not energized may become energized, creating a risk of electric shock.

- 8)** A worker must open a transformer cabinet to perform testing on energized circuits. What is the main electrical hazard that the worker will be exposed to?
- a) falling
 - b) arc flash
 - c) circuit breakers
 - d) wires
 - e) ground fault

arc flash

Explanation

When performing any kind of work, including testing, on energized electrical equipment, there is a risk of arc flash.

- 9)** True or False: An unqualified worker who has continuous guidance and escort from a qualified worker, and who is wearing the appropriate PPE, is allowed to cross the restricted approach boundary.

False

Explanation

Only qualified workers are permitted to cross the restricted approach boundary.

- 10)** True or False: An unqualified worker who has continuous guidance and escort from a qualified worker, and who is wearing the appropriate PPE, is allowed to cross the limited approach boundary.

True

Explanation

An unqualified worker is allowed to cross the limited approach boundary, but only with continuous guidance and escort from a qualified person. Unqualified workers are never permitted within the restricted approach boundary.

11) Shock hazard boundaries can be determined by using _____.

- a) NEC tables
- b) NFPA 70E tables
- c) ASTM tables
- d) ANSI tables
- e) OSHA tables

NFPA 70E tables

Explanation

NFPA 70E contains tables which define shock hazard boundaries based on system voltage.

12) An arc flash boundary is the distance at which a worker could be exposed to a minimum of _____ or worse.

- a) first degree burns
- b) shock
- c) third degree burns
- d) second degree burns
- e) ventricular fibrillation

second degree burns

Explanation

Arc flash boundaries are defined as the distance from the source of an electrical arc at which a worker could be exposed to a minimum incident energy level of $\geq 1.2 \text{ cal/cm}^2$, which would result in a minimum of second-degree burns.

13) NFPA 70E allows arc flash boundaries and corresponding PPE to be determined by either _____ method or _____ method.

- a) energy level risk (tables)
- b) incident energy analysis
- c) arc flash PPE category (tables)
- d) estimated arc flash risk

incident energy analysis, arc flash PPE category (tables)

Explanation

It is acceptable to use either of these methods for determining arc flash boundaries and required PPE. The incident energy analysis method may be used by an engineer to determine the incident energy available in an arc-flash situation, and corresponding PPE levels based on incident energy levels. NFPA 70E tables can also be used to determine exposure levels and corresponding PPE, but the task at hand must fall into one of the categories in the table. Not all DC PV circuit configurations may be covered by the tables, in which case an incident energy analysis must be completed.

14) Arc flash risk on the DC side of PV systems is of special concern on systems with central inverters, due to _____.

- a) many modules in series
- b) many inverters
- c) many smaller arrays
- d) many strings in parallel

many strings in parallel

Explanation

Arc flash risk is highest when available fault currents (and corresponding incident energy levels) are highest. On DC sides of PV systems utilizing central inverters, a large number of PV strings will eventually be paralleled for input into the inverter. Currents are incrementally increased at combiner boxes and recombiner boxes, which may see hundreds or thousands of amps. In the event of a fault on the dc side of the array, each combiner box will feed the fault to other combiner boxes through the associated inverter's recombiner if the recombiner switch (or switches) are not disconnected.

- 15)** One effective strategy to reduce arc flash hazard levels on the DC side of a large-scale PV system is to _____.
- a) use string inverters to reduce the number of parallel-connected strings
 - b) keep the system energized to avoid system downtime
 - c) use central inverters with many combiner boxes
 - d) connect strings in series to reduce incident energy levels
 - e) wear category 3 PPE, even if calculated system incident energy levels exceed the rated incident energy levels for category 3 PPE

use string inverters to reduce the number of parallel-connected strings

Explanation

String inverters reduce the numbers of parallel-connected strings, keeping available fault current levels considerably lower than they would be in a central inverter system. Since string inverters typically rely on their own individual internal combiner boxes, which generally accept no more than 9-12 strings, there is never a location on the DC side where large quantities of strings are wired in parallel which would create high current levels.

- 16)** True or False: It is acceptable to use the same rubber insulating gloves that you would use to work on energized electrical equipment to do other electrical tasks such as pulling wires or bending conduit.

False

Explanation

Rubber insulating gloves must be treated with care and only used for specific tasks when exposed to energized equipment and related shock and arc flash hazards. Gloves must be periodically tested and recertified, and must be taken out of service after an event which may compromise their effectiveness.

- 17)** Which of the following is NOT the responsibility of an employer as part of an energy-control program that uses lockout / tagout?
- a) provide equipment necessary to execute LOTO
 - b) apply the lockout/tagout device to the energy-isolating device
 - c) establish, document, and implement a LOTO program
 - d) provide training to employees
 - e) audit the execution of the procedures at least annually

apply the lockout/tagout device to the energy-isolating device

Explanation

It is the responsibility of a qualified or competent employee to apply lockout/tagout devices to energy-isolating devices. It is the responsibility of employers to ensure that workers are properly trained and that proper equipment is provided.

- 18)** True or false: It is acceptable to use tagout without a lock if equipment has no means for allowing a lock to be applied, or if the employer can demonstrate that a tag provides an equivalent level of safety as a lock.

True

Explanation

It is acceptable to use tagout without a lock if equipment has no means for allowing a lock to be applied, or if the employer can demonstrate that a tag provides an equivalent level of safety as a lock.

19) Organize the following steps of a lockout/tagout procedure into their correct order using 1 as the first step and 10 as the final step.

- a) ___ notify affected employees
- b) ___ isolate equipment from power sources (open disconnects, remove fuses, etc.)
- c) ___ verify locked out/tagged out circuit is de-energized
- d) ___ apply lockout/tagout devices
- e) ___ verify multimeter is functioning correctly on known voltage source
- f) ___ identify all power sources
- g) ___ re-verify multimeter on known voltage source

2 notify affected employees

3 isolate equipment from power sources (open disconnects, remove fuses, etc.)

6 verify locked out / tagged out circuit is de-energized

4 apply lockout / tagout devices

5 verify multimeter is functioning correctly on known voltage source

1 identify all power sources

7 re-verify multimeter on known voltage source

20) A lock must be removed from equipment by _____.

- a) the supervisor of the worker who installed it
- b) a supervisor who is in the vicinity when it's time to reenergize the equipment
- c) the same person who installed it
- d) the employer of the worker who installed it
- e) a different person from who installed it

the same person who installed it

Explanation

A lock can only be removed by the same person who installed it. Each qualified employee has their own unique lock and key, which is labeled with the employee's name and phone number.

- 21)** When wiring PV source circuits in a combiner box, the source circuit homeruns should be:
- a) connected to the series strings
 - b) connected to the inverter
 - c) locked and tagged out
 - d) pulled in last
 - e) connected to the PV array

locked and tagged out

Explanation

Locking and tagging out the source circuit homeruns at the array ensures that no DC power source is connected to the combiner box when it is being wired.

- 22)** Which type of multimeter is necessary for testing inside of an exterior service entrance?
- a) CAT I
 - b) CAT II
 - c) CAT III
 - d) CAT IV
 - e) CAT V

CAT IV

Explanation

Any exterior conductor runs require a CAT IV meter. Additionally, CAT IV meters are required for work in service entrances.

- 23)** What is the most dangerous electrical task for a PV technician?
- a) pulling wires
 - b) connecting modules in series
 - c) wiring a combiner box
 - d) wiring an inverter
 - e) testing procedures on energized circuits

testing procedures on energized circuits

Explanation

Testing procedures on energized circuits expose workers to shock and other potentially life-threatening risks. During PV installation, workers should not be working on energized circuits. Work on energized circuits should only take place during commissioning, testing, and troubleshooting. No energized work should be performed while pulling wires, connecting modules, or wiring a combiner box or inverter.

- 24)** It is important to use a _____ to confirm that no current is present before opening a non-load-break rated device.
- a) volt meter
 - b) utility meter
 - c) NEM meter
 - d) clamp-on amp meter

e) smart meter

clamp-on amp meter

Explanation

Clamp-on amp meters are used to safely check current levels in conductors without having to disconnect or deenergize them.

25) On a grid-connected PV system, which of these is the AC power source:

a) utility grid

b) PV array

c) inverter

d) transformer

e) inverter combiner panel

utility grid

Explanation

On the AC side of a grid-connected PV array, the AC source is the utility grid. The inverter is not a source, but it may have residual energy that needs to be considered.