2012-2013

Dangers & Safety Precautions when Working with Electricity

May13-22A

Iowa State University

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Introduction:

Working with electricity can be hazardous to one's health and in some cases even fatal. That is why it is important to know what to avoid and how to respond to any personal injury or emergency. Having the right knowledge can prevent injury or even death of you or your coworkers. There are various safety codes that must be followed when working in industry. Employers and employees must be compliant with these standards to avoid investigation, fines, and to minimize injury in the work force. To ensure safety of all group members in the May13-22A Electric Vehicle Charging Station project, each member must be aware of the standardized safety precautions specific to this project type.

The charging station system is designed to input 120VAC from a residential wall source and the overall system is designed to handle up to 60A. The system is designed to utilize higher voltage and amperage levels to properly charge a set of battery types and capacities. In order to construct this system, group members should be aware of the injuries that electricity can cause and the measures that may be taken to avoid such serious hazards.

The Department of Human Services has published an electrical safety manual that clearly outlines the danger of working with electricity, providing incremental amperage levels and their adverse effects within the human body. This manual denotes the effects of current in the human body as follows.

Table of Electric Current and Human Body Reactions:

Current Levels:	Incident Reaction in Human Body:
Less than 1mA	Usually doesn't affect human body
1 mA	Slight tingling sensation
5 mA	Small shock, not usually painful. Average person can let go of wire. Capable of causing strong involuntary reactions which can lead to other injuries.
6mA to 25mA (Women)	Painful shock causes loss of muscular control. Individual cannot let go of wire. If extensor muscles are stimulated, individual can be pushed away.
9mA to 30mA (Men)	Painful shock causes loss of muscular control. Individual cannot let go of wire. If extensor muscles are stimulated, individual can be pushed away.
50mA to 150mA	Extreme pain, respiratory arrest severe muscular spasms, Death is possible.
1000mA to 4300mA	Heart ceases to rhythmically pump, muscular and nerve damage, death is likely
10,000mA	Cardiac arrest and severe burns are common. Death is probable.
15,000mA	Lowest overcurrent at which a fuse or circuit breaker opens a circuit

Most Threatening Effects of Electric Shock:

- Exposure to even as little as 0.10mA has the potential of killing a human.

- Currents within the range of 16mA or greater will experience the inability to "let go" of the wire or exposed source. Prolonged exposure with this effect can cause unconsciousness, suffocation, and death.
- Currents within the range of 30mA or greater may reduce the ability to breath, which can last longer than the exposure the electrical hazard.
- Exposure to a range of 250mA and greater has the potential of causing permanent nerve damage and the possibility of a fatality. The more common range listed in the table above is 1000mA (1A) to 4300mA (4.3A) is the lower end of this spectrum of results.
- Exposure to currents larger than 5A, cause probable internal body and organ burns. This can raise body temperature and overheat the rest of your internal organs which will result in death.

Safety Precautions to be considered:

In general, as long as a worker is careful and uses common sense in their actions, they should remain safe when working with electricity. There are common workplace guidelines that should be followed to maintain safety for all individuals:

Common Safety Guidelines:

- Keep the work environment clean and organized to avoid any preventable accidents.
- Do not work alone when exposed to higher voltage and amperage levels.
- Do not attempt work when tired or distracted. This can cause carelessness and make the worker less observant potentially putting themselves or others at risk.
- Do not handle system components when system is active or energized, make sure system is turned off, de-energized, and is not storing any energy to avoid injury and damage to the system itself.
- Wear shoes that can act as insulators to prevent grounding of the body in case of exposure to energized wire or system. The shoes should have a rubber sole or base to act as a better insulator to better prevent grounding.
- Do not wear accessories that could act as a conductor. A common example of this is jewelry.
- Understand how and what parts of the system that are most likely to cause harm.
- Avoid contact with frayed wires or exposure to other surfaces that may cause potential harm.

To ensure the safety of the group members building this system and its users, the system will need to be designed to operate in a safe manner. There are additional guidelines to which this system must be designed to satisfy such constraints and to ensure protection for the user and the group members responsible for system construction. The members working to construct the system and the system users must always follow to ensure their own safety according to OSHA and the Department of Health and Safety standards:

Additional Worker Guidelines:

- Frequently inspect the electrical system to ensure system's ground connection is not blocked.
- Use well insulated tools and make sure equipment is grounded (if necessary).
- Avoid exposing oneself to wet areas when working; do not have beverages around equipment or system when working.
- Visually inspect all electrical and potentially harmful equipment. If cracked, frayed or damaged, do not use.

In the system design, a protection system circuit has been designed to monitor the conditions of current, voltage, and to monitor the battery. These sensory devices are used to monitor the conditions of the system and to automatically shut it down if a problem arises. These protections are designed to correct improper system function to avoid damage to the user, battery, and the rest of the system. Even though the projection system will be in place, human error as the user can lead to dangerous situations if the user does not follow the safety protocol:

Basic User Safety Guidelines:

- Do not store charging station in areas that can cause harm (Testing the system will reveal what conditions that are safe to operate).
- Visually inspect the electrical equipment before use, if any insulation is frayed, cracked, or broken, DO NOT USE.
- Make sure you know what you are doing before using the system. Selecting the wrong battery type or capacitance, and cause harm to both the system and yourself.
- When using, follow all safety precautions written in the user's guide (Will be written when the system testing is complete).

Electrical Safety References:

Source 1:

Colorado State University, "High Voltage Safety Manual", Referenced 10/13/2012,

This source was used to provide information about safety precautions and adverse effects of exposure to electricity of the human body.

Source 2:

OSHA, "Fact Sheet: Working Safely with Electricity", Referenced 1013/2012

This source was used to provide information about common hazards associated with exposure to work involving electricity.

Source 3:

Department of Health and Safety, "Electrical Safety: Safety and Health for Electrical Trades, Student Manual", Revised edition, Referenced 10/13/2012

This source was used to provide information about common electrical hazards, safety standards, and generally the effects of electricity on the human body.