

# Chargers and Charging Process

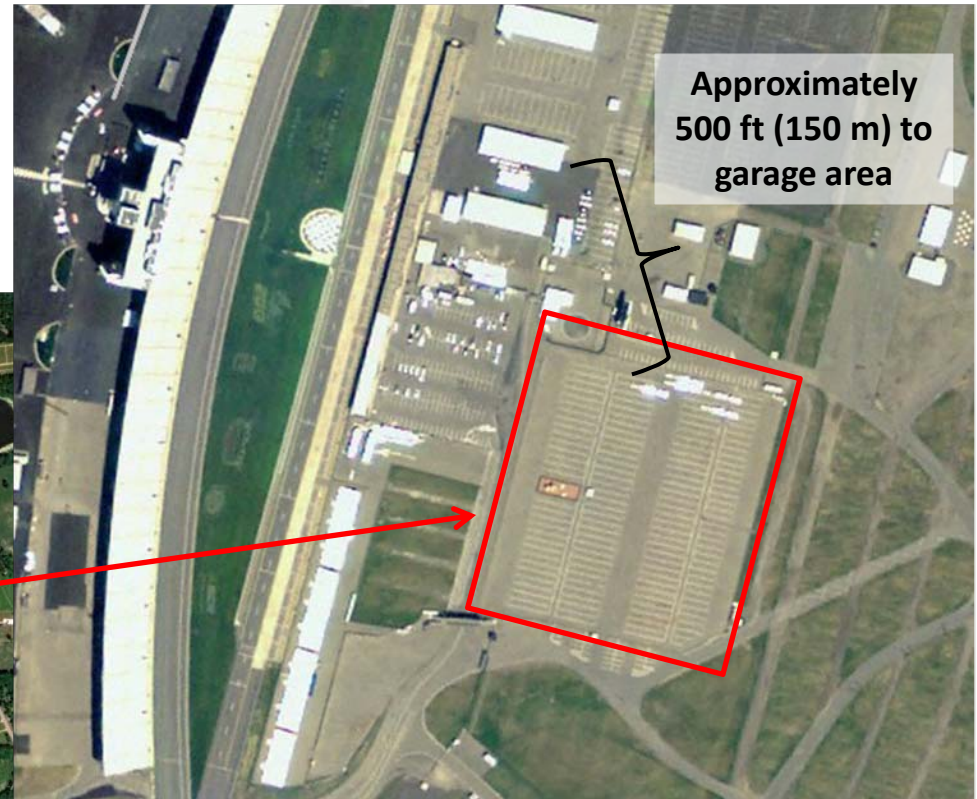
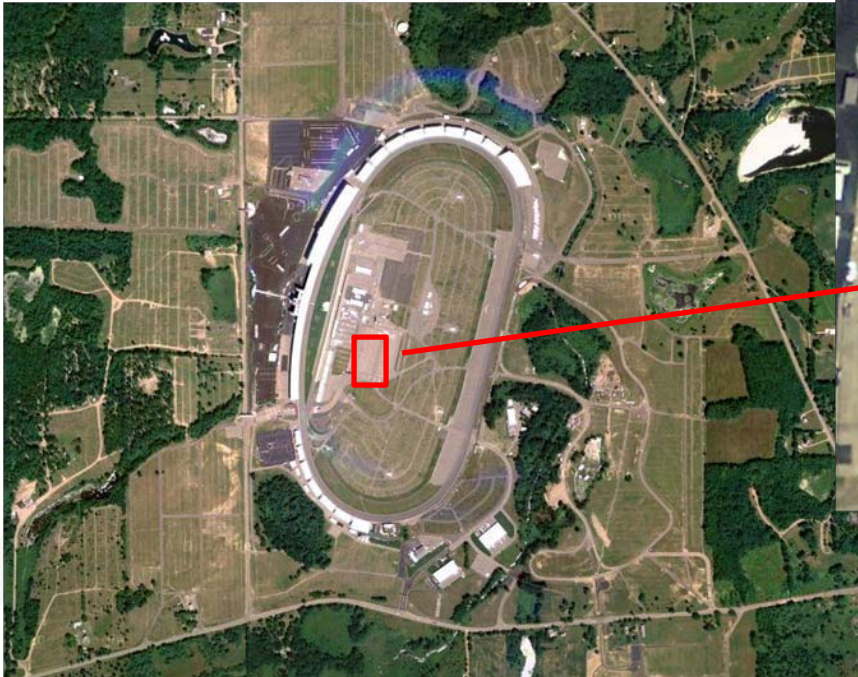
Jody J. Nelson, Sr. Advisor, Energy Storage Technologies

## Overview

- Identify the charging area and capabilities
- Change in charger connector specification
- Competition ac outlet configuration
- Event rules for chargers
- Required charger specifications

## MIS Charging Area

Location of the charging area will be in the RV park section of the inner track area



## MIS Charging Area



MIS has the facility to provide 128 RV electrical outlets with sufficient spacing between adjacent electrical outlets



## RV Outlets



Two single phase receptacles are available at MIS:

1. Standard 120 V, 60 Hz outlet
  - 15 A continuous
2. NEMA 14-50R
  - 40 A continuous
  - 240 V
  - 3Pole, 4Wire
  - Straight blade
  - Self-grounding

# NEMA 14-50 Plug Requirement

## Old Requirement:

~~All PIAXP vehicles that need to charge from the electrical grid must use a SAE J1772-compatible charging cord and vehicle receptacle, either Level 1 or Level 2. No charging can take place above J1772 Level 2 rates.~~

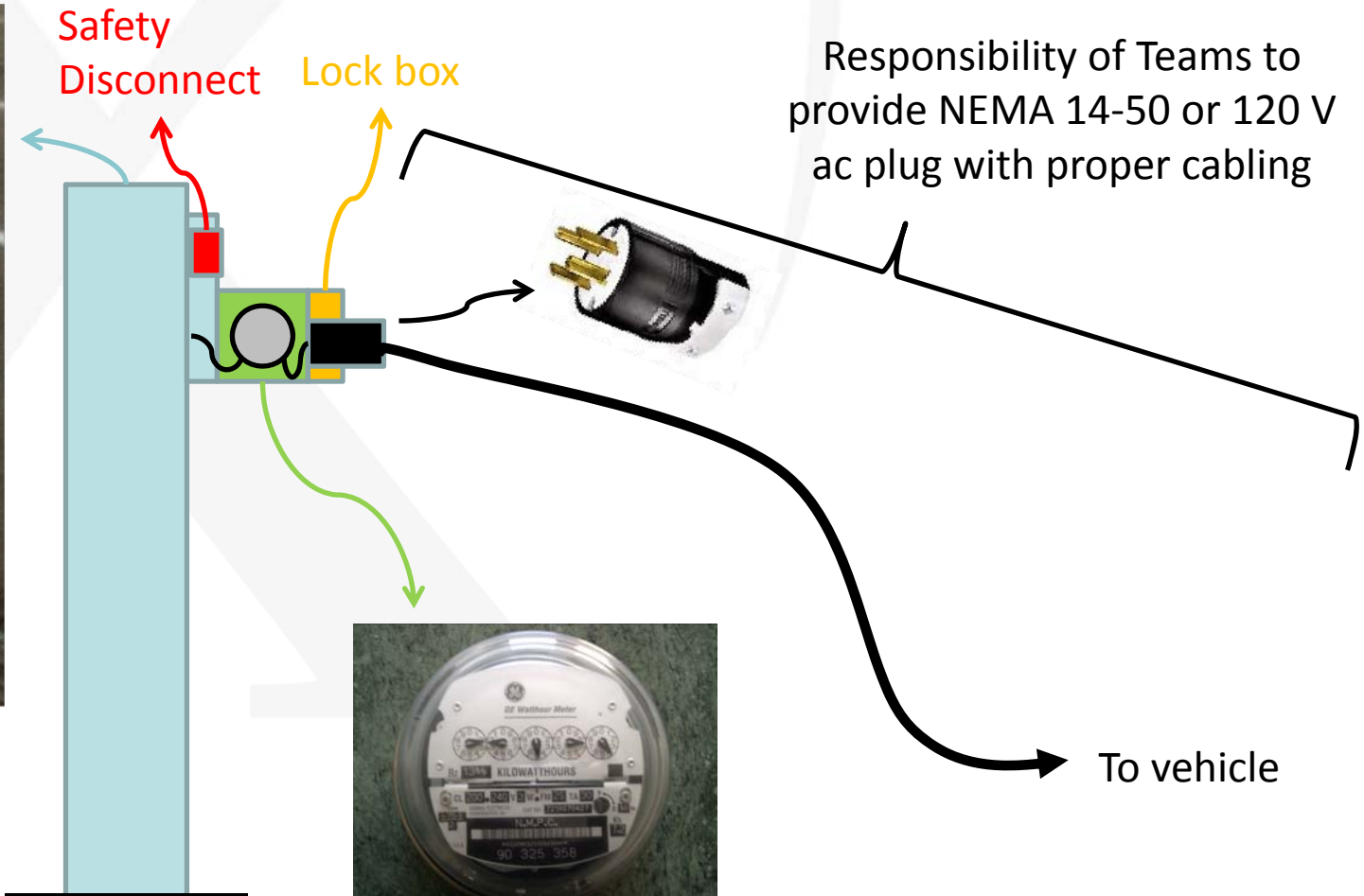
## New Requirement:

Teams will no longer be required to meet SAE J1772. However, Teams will be required to provide their own charger with a **NEMA 14-50 plug or standard 120 V, 60 Hz, 15 A plug**. Input voltage and current for the NEMA 14-50 plug will be limited to 240 VAC and 40A continuous.

# Competition Configuration



RV Outlet



Safety  
Disconnect

Lock box

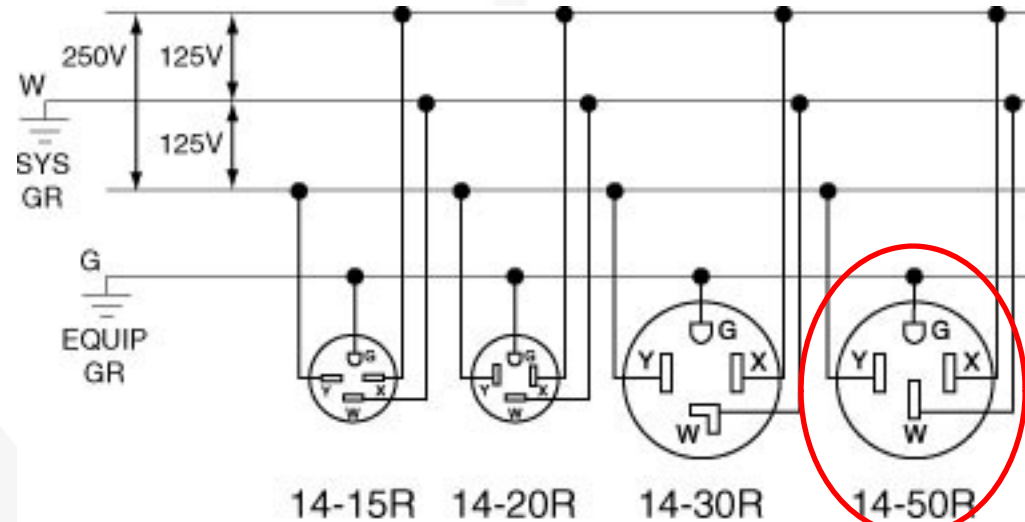
Responsibility of Teams to  
provide NEMA 14-50 or 120 V  
ac plug with proper cabling



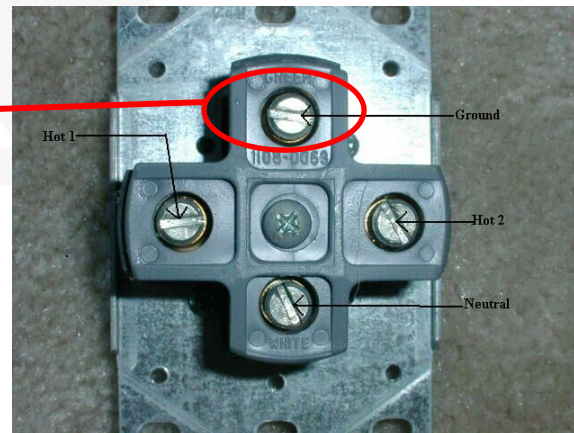
Watt-hour meter

To vehicle

# NEMA 14-50 Receptacle



Must be connected to vehicle chassis





## Event Charging Rules

- All charging for competition events shall be done at the specific charging area during designated times
- Charging shall be limited to 240 V ac, 40 A continuous for a maximum of 10-12 hours; consider we have limited time for charging
- No work can be done on any competing vehicle while it is charging
- All charging energy will be measured and will be attributed to each vehicle's energy consumption for an event stage — the only exception will be during the Shakedown event

## Event Charging Rules, continued

- No opportunity charging from the grid or other external sources will be allowed during race stages
- Teams are responsible that their charger works with meter and MIS equipment (circuit breaker/GFCI)
- The entire electrical propulsion system shall be completely isolated from the battery pack while charging from the grid (with the exception of the battery box ventilation system):
  - A separate charging switch may be used for this function, provided the voltage rating equals or exceeds that of the actual system
  - The Manual Isolation Switch may be used, provided it isolates the battery pack and charger from the rest of the system

## Charger General Requirements

- Competition organizers reserve the right to disapprove the use of any charger if they believe it poses a safety risk
- Traction battery chargers shall be production units with proper certification
- The charger must be properly connected to earth ground and the vehicle chassis and have a ground-fault interrupter circuit (GFI)
- The charger shall be fused on supply circuits to the charger and the vehicle

## Charger General Requirements, continued

- Charger, including cables, must be weatherproof; expect rainy conditions during the events
- The cable shall not exceed 25 feet in length, but long enough to properly connect to the ac source
- Cable must be appropriately sized to comprehend the full range of the electrical source – assume continuous current based on the peak rating

## Charger General Requirements, continued

- Charger must be capable of safely charging unattended overnight
- When the batteries are fully charged, the charge current shall be automatically interrupted or reduced to a safe level
- For NiMH, Li and other advanced batteries, charging equipment must work with the BMS and monitor the voltage
- Chargers must have clearly labeled and accessible on/off switch and overnight Team contact info
- Total harmonic distortion (THD) shall be below 10%

## Other Resources

For the US:

**SAE J1772** – Electric Vehicle Conductive Charge Coupler

For Europe:

**IEC 61851** – Electric vehicle conductive charging system

## Summary

- Dedicated charging area – charging can only be performed there
- NEMA 14-50 and standard 120 V/15 A receptacle will be available at MIS for charging
- Charging is limited to 240 Vac, 40 A continuous
- Watt-hr meter will be used for judged events
- Charging system must have proper safety features to monitor battery during charging and to ensure safety at all times – competition organizers have the right to refuse a charger deemed unsafe