***Ewing-Foley, Inc. Continuing Education Training***

**2023 NEC Article 625, Electric Vehicle Power Transfer System**

**4-Hour Power point slide presentation**

 **Instructor Ralph Bliquez**

BRIEF COURSE DESCRIPTION

Article 625 has evolved from the requirements to charge an electric vehicle in earlier editions of the code (“EV Charging”) to the requirements for power transfer to and from the electric vehicle in the 2020 and 2023 code (“EV Power Transfer System”). The changes for consumers, electricians, manufacturers and utilities as this technology evolves are profound.

In the 2023 NEC, the scope of Article 625 covers the electrical conductors and equipment connecting an electric vehicle to premises wiring for the purposes of charging, power export, or bidirectional current flow. The different voltages (AC or DC), amperages and control equipment require unusual cords and cables that tolerate high current, oil, water, and sunlight, intermateable wiring devices, and unique overcurrent protection methods (Article 400.5). Hard wiring from supply to battery or induction from supply to battery may be done on site or, as the technology develops, while in motion. The required amperage draw of electric vehicles dictates limitations in the installation of branch circuits and may involve Energy Management Systems (Article 750.30), adjustable settings, and readily available disconnecting means. Substantial battery power involves novel requirements for ventilation, fire prevention and overcurrent protection. Wireless Power Transfer Equipment (WPTE) presents new challenges in charging equipment, control, and grounding.

COURSE OUTLINE

The course outline will cover the sections in Article 625 and specify as much as possible the time spent on each section.

Part I. General (50 Minutes)

625.1 Scope

 The article applies to the conductors and equipment between the premises wiring and the electrical vehicle for the purpose of charging the battery, power export and/or bidirectional flow. The electric vehicle must have an inverter for AC from Level 1 or 2 supplies but must be able to accept substantial DC power from “superchargers” at some Level 3 or 4 locations (Note the category of “Level 4” is not consistent.)

625.4 Voltages

Voltages can vary considerably from 120 to 1,000 AC or DC to supply equipment covered by this article. Output voltages to the electric vehicle are not specified.

625.6 U.L. Listings

This Article requires that EV equipment be listed, and this involves several U.L. listings because of the complex charging equipment, voltage conversions, volatile chemicals, confined spaces and high voltages and currents in portable cords and cables. The following U.L. listings are specific to EV charging: 2022, 2231, 2251, 2580, 2594 and 9741. U.L. listing 489 for circuit breakers is also referenced. A review of the differences among the terms: listing, labelling, field approval and the role of the authority having jurisdiction is necessary.

625 Site Requirements

 The interaction between the public and EV charging locations whether in the home, retail locations or highway will require special precautions not unlike the precautions taken historically with fuel distribution (See TIA for 625.43). The pedestal height, sidewalk requirements, concrete pads, wall mountings, cable types and lengths, single and dual-port chargers will be part of any installation.

625 Intermateability

 NEMA established the requirement for manufacturer Intermateability (NEMA Configurations) as a safety precaution to protect the public from electrocution. If people “field adapt” devices because of different manufacturers’ configurations for the same voltages and currents, the danger of exposed and energized surfaces would increase. EV manufacturers have tried to protect their market share with proprietary connectors rather than standard and/or intermateable ones. A review of those proprietary connectors and the transition to intermateable ones is worthwhile.

Part II (70 Minutes)

625.17 Cords and Cables

(A) Power Supply Cords for Electric Vehicle Supply Equipment (EVSE) must comply with all the following:

 (1) Listed for EV’s in table 400.4 & 5)

Hard service type listed for exposure to oil and damp and wet locations.

(2) Have an ampacity as specified in Table 400.5 (A)(1) or for 8 AWG and larger in the 60 degree C Table 400.5 (A)(2).

(3) Limited length from 12” to 6’ depending on whether the cord is attached to portable or fastened-in-place equipment or a maximum of 15’ if the GFCI is located at the attachment plug.

(B) Output Cable to EV’s shall be one of the following:

 (1) Listed for EV’s in Table 400.4

 (2) Integral to the listed EVSE.

(C) Length limited to 25’ unless equipped with a cable management system that is part of the listed EVSE.

 (1) Portable Equipment specifically measured from point to point.

(2) Fastened-in-Place specifically measured from point to point except for Wireless Power Transfer Equipment (WPTE).

(D) Interconnecting Cabling Systems that are integral to listed EVSE using approved installation methods.

625.22 Personal Protection System

A listed protection method against electric shock shall be provided unless the EVSE supplies less than 60 volts dc.

Part III Installation (75 Minutes)

625.40 Electric Vehicle Branch Circuit

Individual Branch Circuit greater than 16 amps and 120 volts except when part of an EMS.

625.41 Overcurrent Protection

Continuous and Noncontinuous Loads protection for feeders and branch circuits.

625.42 Rating

The EVSE shall have a sufficient rating to supply the load served unless there is an (A) Energy Management System (750.30 (A) or (B)) or (B) Adjustable Settings (750.30 (C)).

625.43 Disconnecting Means

For EVSE and WPTE rated more than 60 amps or 150 volts to ground, disconnecting means must be readily accessible and lockable in the open condition (110.25).

(Note: There is a TIA to this section included in the Power Point.)

625.44 Equipment Connection (A)-(C)

(A) & (B) EVSE and WPTE Portable Equipment and Fastened-in-Place Equipment shall connect to premises wiring systems with NEMA configurations.

(C) Fixed-in-Place Equipment shall be permanently wired to the supporting surface.

625.46 Loss of Primary Source

Energy cannot be backfed from the EV to the premises unless through 625.48. Connections must follow the requirements in Article 705 especially 705.12.

625.47 Multiple Feeder or Branch Circuits

 Restrictions on identified equipment.

625.48 Interactive Equipment

 Requirements in 702 and 705 shall apply especially 705.12.

625.49 Island Mode

Both EVPE and EVSE incorporate a power export function and can operate in Island Mode.

625.50 Locations

Restrictions on indoor and outdoor cable heights above indoor and outdoor locations.

625.52 Ventilation

When (A) not required and (B) required following Table Values in 625.52 (B)(1)(1) and 625.52 (B)(1)(2) or Engineered Systems (3). Supply Circuits for Ventilation (4) shall be interlocked.

625.54 GFCI Protection

 Required for all receptacles.

625.56 Receptacle Enclosure

 Requirements for wet locations

625.60 AC Receptacle Outlets used for EVPE.

Outlets shall be (A) listed (B) rated for 250 volt/50 amps (C) have an AIC rating equal to fault current and (D) have GFCI protection.

Part IV Wireless Power Transfer Equipment (30 Minutes)

625.101 Grounding

 Connections to the EGC or double-insulated system

625.102 Installation (A) – (E)

 (A) General Requirements

 (B) Control Box and Mounting

 (C) Primary Pad Installation and Protection

 (D) Protection of Cords and Cables

 (E) Other Wiring Systems for WPTE

There will be a 15-minute break approximately half way through the course.

COURSE OBJECTIVES

The course objective is to give journeymen, limited maintenance electricians and apprentices an awareness of the complexities of charging electric vehicle batteries with different voltages and amperages and the returning bi-directional energy flow if the batteries are required to operate in island mode. Attendees will hear about the requirements of cables and cords, mounting restrictions, ground fault protection, ventilation, and other variables.

INSTRUCTOR

The course instructor is Ralph Bliquez who has taught at the NECA/IBEW Training Centers in Oregon and California and has been authorized to teach continuing education classes for credit by the states of Oregon, Washington, California, Idaho, Nevada, Montana, and Utah.

COURSE PREREQUISITES

The prerequisite for the course is a current journeymen electrical license or a limited maintenance electrician’s license and apprentice or trainee license.

PROGRAM MATERIALS

The program materials for the course are the attached outline and a power point presentation that contains examples from the NEC Article 625 and Sections noted above, definitions of terms, and examples from manufacturers of the vehicles and supporting equipment.