

Water Environment Association of Texas

Operations Challenge

Electrical Event – 2022

Goal

Safely connect an electric motor in an efficient manner.

Scenario

A new motor is to be installed. The motor is set, but new wire and conduit is to be installed and terminated.

Procedure

We have assembled a panel that consists of a 3-phase variable frequency drive, 3-phase motor circuit protector, control power transformer, HOA switch, start/stop pushbuttons, relays, etc. We have wired this using a very typical motor control circuit so that it can operate in “Auto” from a programmable logic controller (PLC) or in “Hand” from the start/stop pushbuttons.

Teams will be asked to finish installation of conduit to the motor, install the wiring and to place it in operation.

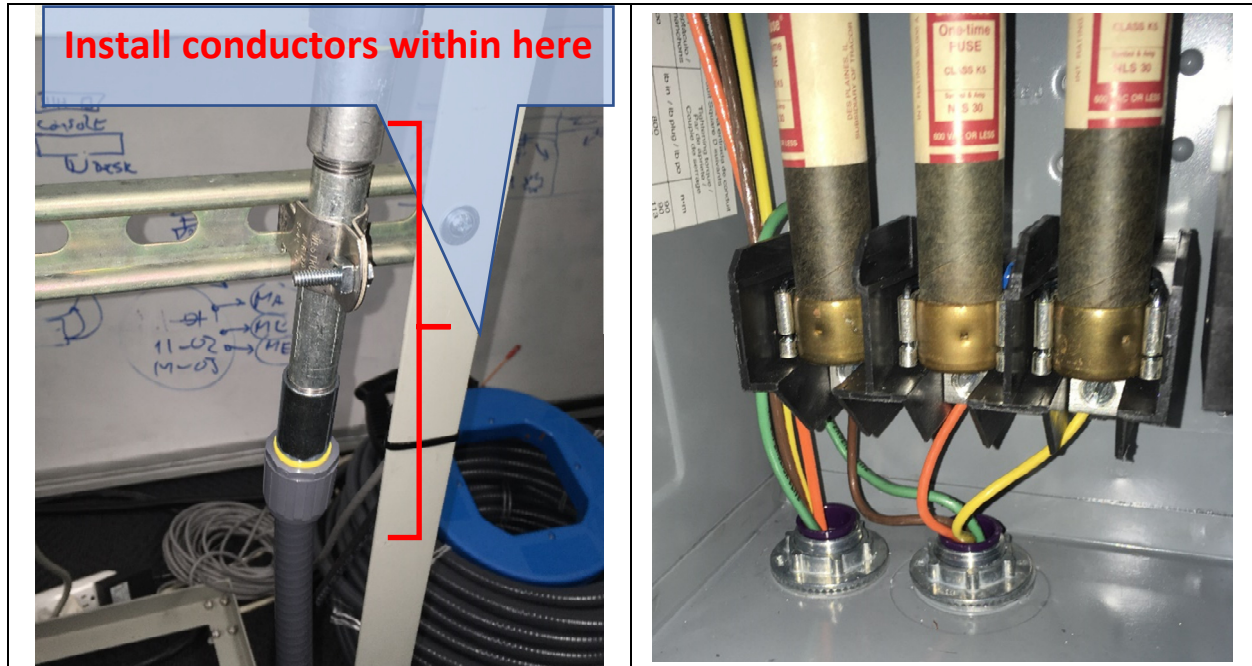
1. Each team will consist of four people.
2. Each team will be given the motor, wiring diagram, VOM, hand tools, wire, etc. to make all necessary terminations.
3. Each team will be timed.
4. Tools will have to be returned to their assigned location.
5. Penalties will be assessed for various infractions:
 - a. Lockout/tagout procedures must be followed.
 - b. Proper wiring color code convention must be followed to ensure proper “phase rotation” of the motor.
 - c. If a team member attempts to touch an energized circuit with bare hands, screwdrivers, etc., a penalty of five minutes per infraction will be added to the overall time.
 - d. If a team blows a control fuse or trips a circuit breaker, a penalty of five minutes per infraction will be added to the overall time.
 - e. If a team breaks the VOM by blowing the internal fuse, the team will be disqualified.
 - f. If a team does not finish within 15 minutes, they will be called to stop.

Lights:

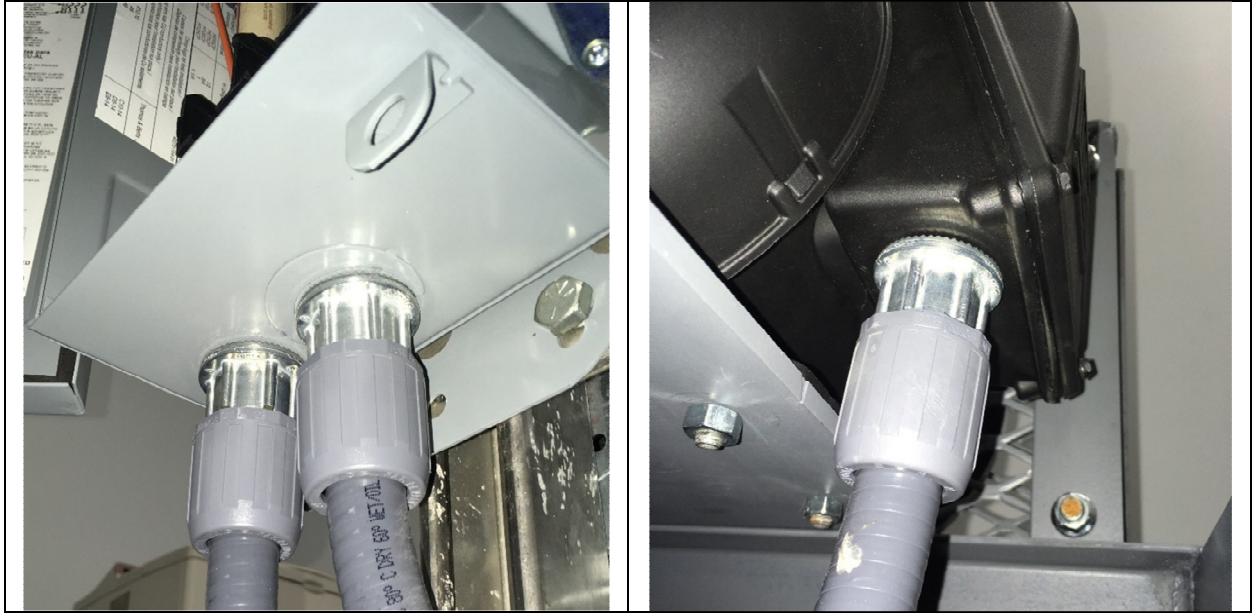
1. At the motor control panel is a three-color light stack
2. At the start of the challenge the green light will be on
3. At 12 minutes the yellow warning will light
4. At 13 minutes the red light will light
5. At 14 minutes the 1minute warning alarm will sound
6. Total time cannot exceed 15 minutes.
7. When the VFD is calling for the motor to run the red flashing light above the motor disconnect will shine

Directions:

- I. Apply lockout/Tagout to the main Feeder Disconnect
 - A. The lock must have the lockout tag and all 4 members must sign the tag
 - B. The key must always be in the Team Leader's possession
- II. A section of Liquid Tight Flexible Metal Conduit (LFMC) has been installed between the Variable Frequency Drive (VFD) and the local disconnect switch at the motor.
 - A. Conductors must be installed within this section of conduit and terminated.



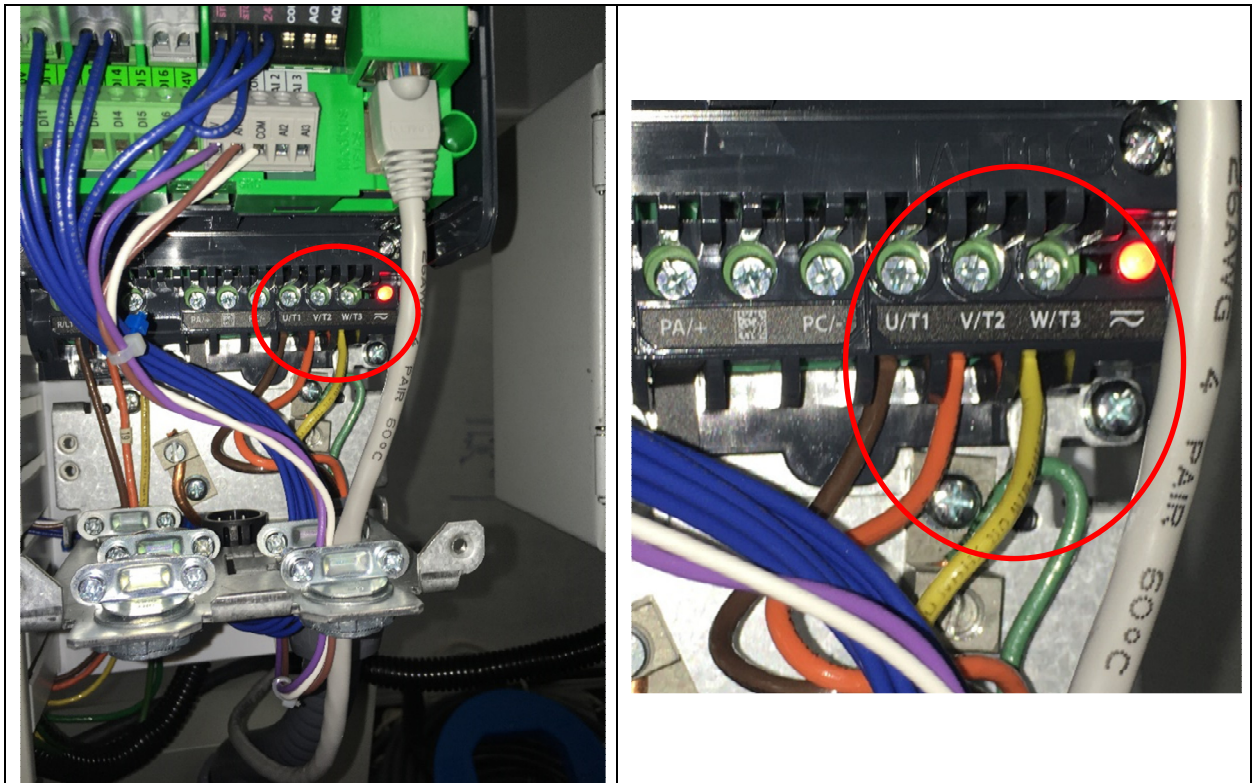
- III. Install a section of LFMC between the motor disconnect switch and the motor
 - A. Cut the LFMC to approximately 3' in length with clean and perpendicular cuts
 - B. Install correct fittings on both ends of the LFMC
 - C. Install correct hub fittings on the disconnect switch and the motor



IV. Pull and terminate conductors

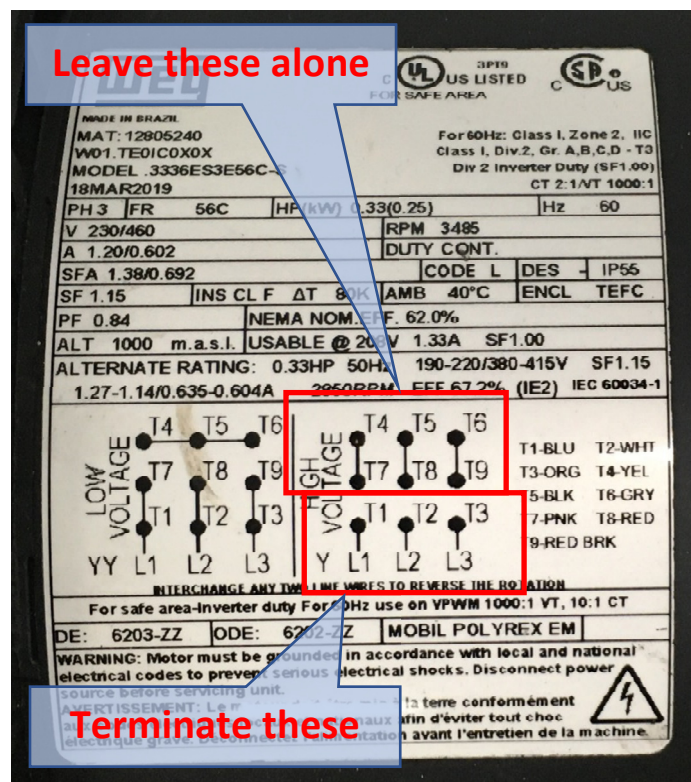
- A. Pull four wires (Brown, Orange, Yellow, and Green) from the VFD to the motor disconnect switch

- 1. At the VFD, terminate the wires without crimped lugs in the following order:



- a. Brown to U/T1

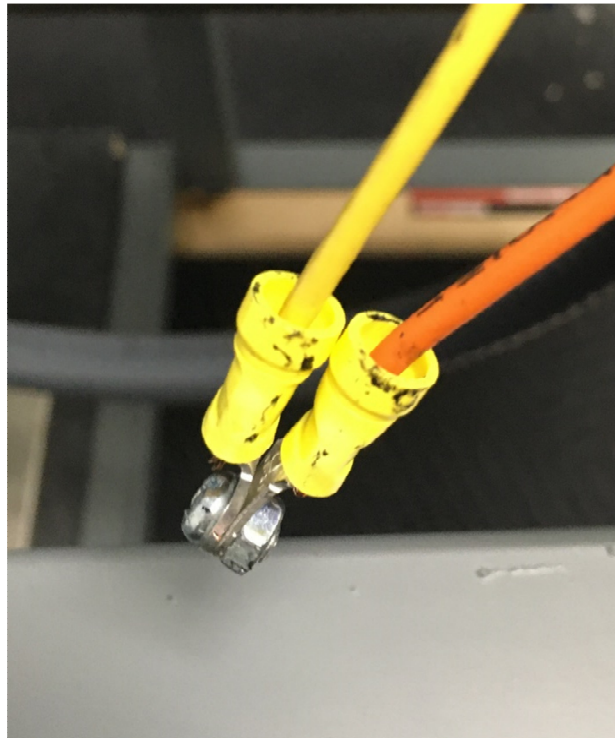
- b. Orange to V/T2
 - c. Yellow to W/T3
 - d. Green to Ground Lug
2. At the motor disconnect switch, terminate the wires without crimped lugs to the top of the disconnect switch in the following order:
 - a. Brown on the far-left hand side
 - b. Orange on the middle
 - c. Yellow on the far-right hand side
 - d. Green to Ground Lug
- B. Pull four wires (Brown, Orange, Yellow, and Green) from the motor disconnect switch to the motor
 1. At the motor disconnect switch, terminate the wires without crimped lugs to the bottom of the disconnect switch in the following order:
 - a. Brown on the far-left hand side
 - b. Orange on the middle
 - c. Yellow on the far-right hand side
 - d. Green to Ground Lug
 2. At the motor, terminate the wires with crimped lugs inside the junction box in the following order (refer to the Motor Nameplate for wiring diagram):



- a. Three sets of wires are pre-joined, marked with yellow tape, and are not to be disturbed



- b. Apply a crimped ring lug on the wires installed from the disconnect switch
- c. Connect the wires installed from the disconnect switch to the motor leads using screw and nut



- i. Brown to T1/U1 (Blue)
 - ii. Orange to T2/V1 (White)
 - iii. Yellow to T3/W1 (Orange)
 - iv. Green to Ground Lug
 3. At the motor, tape each termination:
 - a. Starting at the base of the crimped lugs, apply insulating tape to totally cover the crimped lugs, overlapping approximately $\frac{1}{2}$ tape width



- b. Extend the tape beyond the screwed terminals, without cutting the tape, reverse rotation and apply tape in the opposite direction to the bottom of the crimped lugs
 4. Install motor junction box cover
 - V. Prepare to run the motor
 - A. Ensure all enclosures are properly closed and everyone is clear
 - B. Remove lockout
 - VI. Run the motor utilizing the manual start stop station and check rotation (if wrong rotation, correct the wiring and restart)
 - VII. When motor is running in the correct rotation, and verified by judges, stop motor.
 - VIII. Place Hand off Auto selector switch in the Auto position and remote start utilizing the HMI.