Purpose

The purpose of this document is to provide detailed instruction on the following for first responders:

• Safety Information
• High-Voltage Labels
• Personal Protection Equipment (PPE)
• Identify the Vehicle: Exterior
• Identify the Vehicle: Interior
• Identify the Vehicle: Under Hood
• Overview: Vehicle Systems and Components
• High-Voltage Battery
• Drive Motor
• High-Voltage Cables
• Immobilization
• Disable Direct Hazards
• Stored Energy / Liquids
• Hazardous Material Emergency Cleanup
• In Case of Fire
• In Case of Submersion
• Towing / Transportation / Storage
• Important Additional Information
Safety Information

NOTE: Certain warnings may be repeated throughout this manual.

⚠️ WARNING: To prevent personal injury and / or death, remove all jewelry such as watches, necklaces, and earrings. Remove all metal objects that are conductors of electricity.

⚠️ WARNING: To prevent personal injury and / or death, ALWAYS approach the vehicle from the sides whenever possible to stay out of potential travel path. It may be difficult to determine if the vehicle is running due to lack of engine noise.

⚠️ WARNING: To prevent personal injury and / or death, remove any charge cable from the vehicle, turn ignition OFF, set parking brake, and install wheel chocks to prevent vehicle from moving in either direction during further action.

⚠️ WARNING: To prevent personal injury and / or death, do not touch the high-voltage system or any ORANGE device without wearing appropriate high-voltage Personal Protection Equipment (PPE). The PPE should include:

a. Class 0 electrical insulating gloves, safety goggles, and Electrical Hazard (EH) rated safety shoes or boots, which must be at least appropriate up to 1000 volts.

b. A non-conductive object, about 5 ft (1.5 m) long, to safely push someone away from the vehicle if they accidentally come in contact.

⚠️ WARNING: To prevent personal injury and / or death, turn OFF the 12V disconnect switch and high-voltage disconnect switch before interacting with a damaged vehicle.

⚠️ WARNING: To prevent personal injury and / or death, ALWAYS REMEMBER the 12 Volt Battery Disconnect Switch only disables the vehicle 12 volt system, NOT the high-voltage battery system.

⚠️ WARNING: To prevent personal injury and / or death, ALWAYS REMEMBER that turning OFF the high-voltage disconnect switch will not dissipate voltage inside the high-voltage batteries or in level 2 or 3 high voltage cables. ALWAYS ASSUME the high-voltage batteries, high-voltage cables, and high-voltage components remain live and dangerous. Contact with the high-voltage battery pack or high-voltage component Internals may result in serious personal injury or death.

⚠️ WARNING: To prevent personal injury and / or death, handle a submerged vehicle with appropriate Personal Protection Equipment (PPE). Consider the entire vehicle as energized.

⚠️ WARNING: To prevent personal injury and / or death, always wear full Personal Protection Equipment (PPE), including Self-Contained Breathing Apparatus (SCBA) when fire is involved. Fires in crash-damaged electric vehicles could emit toxic or combustible gasses. Small amounts of eye, skin, or lung irritants may be present. If exposed, rinse with large amounts of water for 10-15 minutes. Consider the entire vehicle as energized.

⚠️ WARNING: To prevent personal injury and / or death, NEVER cut or attempt to breach high-voltage batteries, high-voltage components, or high-voltage wiring.

⚠️ WARNING: To prevent personal injury and / or death, pay attention to secondary fire events. Even days later secondary fire events cannot be excluded.
High-Voltage Labels

Figure 1. Extract of Available High-Voltage Labels Throughout the Entire Vehicle

Various high-voltage components are installed throughout the entire vehicle. A triangle with a lightning bolt is used to identify high-voltage components. The lightning triangle can be single or part of a combination. Also, any vehicle components that are ORANGE in color and / or ORANGE with stripes identify high-voltage components.

High-voltage components in the vehicle are divided into 3 levels / zones. Only components at level 1 / zone 1 are isolated after the high-voltage disconnect switch is turned OFF. Components in zone 2 and zone 3 remain live.
High-Voltage Labels (cont.)

Figure 2. Level 2 / Zone 2: High-voltage cables are orange with blue striping and have white and blue safety flags.

Figure 3. Level 3 / Zone 3: High-voltage cables are orange with white striping and have black and white safety flags.

**WARNING:** To prevent personal injury and/or death, **ALWAYS REMEMBER** that turning OFF the high-voltage disconnect switch will not dissipate voltage inside the high-voltage batteries or in level 2 or 3 high voltage cables. **ALWAYS ASSUME** the high-voltage batteries, high-voltage cables, and high-voltage components remain live and dangerous. Contact with the high-voltage battery pack or high-voltage component internals may result in serious personal injury or death.

Components in high-voltage zone 2 and high-voltage zone 3 remain live after the high-voltage disconnect switch is turned OFF. These zones are mostly located between the frame rails on the underside of the vehicle and are labeled as indicated in Figure 2 and Figure 3. However, the exact location of zones 2 and 3 varies by location and number of batteries packs installed.
High-Voltage Labels (cont.)

Figure 4. High-Voltage Isolation Levels / Zones for 2-String Vehicles (Viewed from Bottom)

If there are no high-voltage battery stacks between the rear wheels of the vehicle and the rear bumper, the level 2 and 3 zones are located as shown in Figure 4. This is called a “2-String” configuration.

Figure 5. High-Voltage Isolation Levels / Zones for 3-String Vehicles (Viewed from Bottom)

If there is a battery stack between the rear wheels of the vehicle and the rear bumper, the level 2 and 3 zones are located as shown in Figure 5. This is called a “3-String” configuration.
Personal Protection Equipment (PPE)

⚠️ WARNING: To prevent personal injury and/or death, remove all jewelry such as watches, necklaces, and earrings. Remove all metal objects that are conductors of electricity.

⚠️ WARNING: To prevent personal injury and/or death, do not touch the high-voltage system or any ORANGE device without wearing appropriate high-voltage Personal Protection Equipment (PPE). The PPE should include:

a. Class 0 electrical insulating gloves, safety goggles, and Electrical Hazard (EH) rated safety shoes or boots, which must be at least appropriate up to 1000 volts.

b. A non-conductive object, about 5 ft (1.5 m) long, to safely push someone away from the vehicle if they accidentally come in contact.

On an IC Bus® Electric CE Series WITHOUT any damage, the ignition, 12V disconnect switch, and high-voltage disconnect switch can be operated without any special high-voltage Personal Protection Equipment (PPE). Do not touch any high-voltage component or ORANGE colored device for no reason.

A vehicle with DAMAGED high-voltage components or with UNKNOWN safety status should only be handled by special trained and equipped personnel. The Personal Protection Equipment must be at least appropriate up to 1000 volts. Consider the entire vehicle as energized.

Always wear full appropriate Personal Protection Equipment (PPE), including Self-Contained Breathing Apparatus (SCBA) when fire is involved or the vehicle was submerged due to the high risk of reignition.
Identify the Vehicle: Exterior

Figure 6. Exterior Badges

The IC Bus® Electric CE Series can be distinguished on the exterior from common bus models by badges over the entrance door and over the driver-side window with BLUE stripes, the YELLOW IC logo and BLUE ELECTRIC lettering. Additionally, there is an IC Bus Electric CE Series badge on the left side of the entrance door and an ELECTRIC POWERED sticker on both the front bumper and the rear bumper.
Identify the Vehicle: Under Hood

Figure 7. Under Hood

Under hood, the IC Bus® Electric CE Series has several high-voltage modules, which can be distinguished by the ORANGE cables and high-voltage labels.
Identify the Vehicle: Interior

Figure 8. Cluster

1. Charging station icon

The IC Bus® Electric CE Series can be distinguished from common school bus models by the charging station icon (Figure 8, Item 1) on the top left of the instrument cluster.
Vehicle Systems and Components

Figure 9. Vehicle Overview

1. High-voltage battery pack (up to five total, dependent on vehicle options)
2. Traction Power Inverter Module (TPIM)
3. Auxiliary Heater
4. DCDC converters and 12V batteries (DCDC)
5. 5kW 2-in-1 inverter
6. 11kW Onboard Charger (OBC) (2)
7. High-voltage power steering pump
8. High-Voltage Distribution Unit (HVDU)
9. Charge port front (AC & DC) and Onboard Charging Interface (OCI) module
10. Air brake pressure tanks
11. Battery Thermal Management System (BTMS)
12. High-Voltage Distribution Module (HVDM)
13. S-box
14. Drive motor
15. Charge port rear (AC & DC) and Onboard Charging Interface (OCI) Module
Vehicle Systems and Components (cont.)

![Diagram of a vehicle with service access covers highlighted]

Figure 10. Service Access Covers

1. High-voltage service disconnect cover
2. 12V battery disconnect cover

The High-Voltage and 12V Battery Service access covers (Figure 10, Items 1 & 2) are located on the driver side of the vehicle. Each cover is equipped with a lock. In an emergency situation, if keys are not available, access covers must be opened by force.
High-Voltage Batteries

The IC Bus® Electric CE Series may be equipped with up to five high-voltage battery pack locations. Each battery pack can contain two vertically stacked high-voltage batteries. This arrangement depends on the vehicle configuration. However, the rearmost location is always a single battery. The high-voltage batteries are located under the bus cabin between the frame rails. Four battery locations are between the axles and one is located behind the drive unit. The rearmost pack of the front locations and the pack located behind the rear axle are optional.

Drive Motor

The drive motor is located behind the rear axle and is powered by 6-phase Alternating Current (AC). The drive motor and the differential are connected by a drive shaft.
High-Voltage Cables

Figure 13. High-Voltage Cables

High-voltage cables are colored in ORANGE and / or ORANGE with stripes. Never cut, breach, or stress ORANGE high-voltage components or cabling.
Disable Direct Hazards

Turn OFF Ignition

Figure 14. Dashboard

1. Parking brake (park position)
2. Neutral selector button
3. Vehicle key (OFF position)

1. Push Neutral (N) button (Figure 14, Item 2).
2. Pull the parking brake (Figure 14, Item 1).
3. Turn the key (Figure 14, Item 3) to the left to turn OFF ignition.
4. Remove the key.
Disable Direct Hazards (cont.)

Turn Off the 12 Volt Battery Disconnect

Figure 15. 12 Volt Battery Disconnect Location
1. 12 volt battery disconnect cover
2. 12 volt battery disconnect switch (OFF position)

⚠️ WARNING: To prevent personal injury and/or death, turn OFF the 12 Volt Battery Disconnect and the High-Voltage Service Disconnect before interacting with a damaged vehicle.

⚠️ WARNING: To prevent personal injury and/or death, ALWAYS REMEMBER the 12 Volt Battery Disconnect Switch only disables the vehicle 12 volt system, NOT the high-voltage battery system.

1. Open the 12 Volt Battery Disconnect cover (Figure 15, Item 1). The cover has a lock. In emergency and if keys not available open by force.
2. Turn the RED 12 Volt Battery Disconnect switch to OFF position (Figure 15, Item 2).
3. Lock the switch with a padlock to avoid anyone from turning it back ON.
Disable Direct Hazards (cont.)

Turn Off the High-Voltage Disconnect Switch

Figure 16. High-Voltage Disconnect Location

1. High-Voltage Disconnect cover
2. High-Voltage Disconnect Switch (OFF position)

**WARNING:** To prevent personal injury and / or death, ALWAYS REMEMBER the High-Voltage Disconnect Switch only disables the vehicle’s high-voltage system. The High-Voltage Disconnect Switch does NOT turn OFF the voltage in the S-box, the high-voltage batteries, and the cables between these items. The vehicle 12 volt system could still be energized. ALWAYS turn OFF both the High-Voltage Disconnect switch and the 12 Volt Battery Disconnect Switch whenever interacting with a damaged vehicle. NEVER touch ORANGE cables without wearing appropriate Personal Protection Equipment (PPE).

1. Open the high-voltage service disconnect switch cover (Figure 16, Item 1). The cover has a lock. In emergency and if keys not available open by force.
2. Turn the BLACK high-voltage service disconnect switch to OFF position (Figure 16 Item 2).
3. Lock the switch with a padlock to avoid anyone from turning it back ON.

Components in high-voltage zone 2 and high-voltage zone 3 remain live after the high-voltage disconnect switch is turned OFF. These zones are located entirely between the frame rails on the underside of the vehicle and are labeled as indicated in Figure 2 and Figure 3.
Disable Direct Hazards (cont.)

Disconnecting Manual Service Disconnects (MSD)

Figure 17. S-Box Location

1. S-box

The vehicle S-box (Figure 17, Item 1) is located between the vehicle frame rails, forward of the rear axle. The Manual Service Disconnects (MSD), located on the S-box are, accessible from the driver-side of the vehicle.
Disable Direct Hazards (cont.)

Figure 18. Master Service Disconnects (MSD)

1. S-box
2. MSD (2 total)

The Manual Service Disconnects (Figure 18, Item 2), located on the S-box (Figure 16, Item 1) are accessible from the driver-side of the vehicle.

The MSD can be removed by pressing down the locking tab while pulling the release handle downward approximately 45 degrees.

Removing the two Manual Service Disconnects (MSD) physically disconnects high-voltage after the S-box, isolating high-voltage away from High-voltage Isolation zone 1. High-voltage will still exist in high-voltage isolation zones 2 and 3.
Stored Energy / Liquids

Lithium-ion batteries are used in the High-Voltage (HV) system. These cells are dry cells. Most of the electrolyte stored in these batteries is absorbed by active materials. There is only a small amount of fluid, which may leak if damaged. Leaking electrolyte will occur in drops, not puddles. The fluid is clear in color with a sweet ether-type odor. The smell may indicate a battery leak. Call the fire department immediately.

The high-voltage batteries, Onboard Chargers, DC-DC converters, Traction Power Inverter Module (TPIM), and drive motor are liquid cooled with a glycol-based automotive coolant. This liquid is RED in color and may leak in case of a damaged cooling system.

Hazardous Material Emergency Cleanup

Following an electric vehicle accident / incident, hazardous materials need to be cleaned up appropriately. Please contact your local and state authorities for more information regarding proper response and cleanup of hazardous materials.

In Case of Fire

⚠️ WARNING: To prevent personal injury and / or death, always wear full Personal Protection Equipment (PPE), including Self-Contained Breathing Apparatus (SCBA) when fire is involved. Fires in crash-damaged electric vehicles could emit toxic or combustible gasses. Small amounts of eye, skin, or lung irritants may be present. If exposed, rinse with large amounts of water for 10-15 minutes. Consider the entire vehicle as energized.

⚠️ WARNING: To prevent personal injury and / or death, pay attention to secondary fire events. There is a high risk of reignition after fire is extinguished.

Flames, smoke, arcing or hot spots like melted plastic may indicate fire or the presence of high voltage. A thermal camera or IR temperature probe may be useful to identify hot spots. If signs of fire are noted, call the local fire department immediately. Clear the area around the vehicle if possible and open the vehicle doors to avoid build-up of gases in the passenger compartment. If a battery has started burning, it will try to burn to completion. Cool down the batteries with direct and large amounts of water. If possible, remove combustible materials from around the vehicle to prevent fire growth.

Batteries must be completely cooled down before releasing the vehicle to second responder. Advise second responder that there is always a risk of reignition.
In Case of Submersion

In case of submersion, secondary impact damage can never be excluded. Damaged high-voltage components pose an increased electrical shock hazard. Stay away from damaged high-voltage components. Handle any fully or partially submerged vehicle while wearing the appropriate Personal Protection Equipment (PPE).

A submerged vehicle without impact damage has a low electrical shock hazard risk. Small bubbles may be noticed exiting the vehicle. This is due to electrolysis of the water and does not create a higher risk of shock hazard.

⚠️ WARNING: To prevent personal injury and / or death, consider the entire vehicle as energized. Always wear full Personal Protection Equipment (PPE).

⚠️ WARNING: To prevent personal injury and / or death, pay attention to secondary fire events. There is a high risk of reignition due to damage and corrosion. Saltwater increases this risk for electrical shorts post incident. Keep full Personal Protection Equipment (PPE), including Self-Contained Breathing Apparatus (SCBA) ready.

⚠️ WARNING: To prevent personal injury and / or death, avoid any contact with a submerged high-voltage system. Do not attempt to disable the Main Battery Disconnect while the vehicle is submerged. The ignition may be turned OFF.

1. Turn the ignition OFF (if possible).
2. Recover the vehicle
3. Drain the water out of the vehicle
4. Initiate the deactivation of the Main Battery Disconnect

Towing / Transportation / Storage

Towing

The preferred method is to tow the vehicle with the front wheels suspended. If towed with the rear wheels on the ground, the drive shaft / propeller shaft must be removed between the drive motor and rear axle.

To improve traffic safety the IC Bus® Electric CE Series may be slowly [max 5 mph (8 km/h)] moved anytime over very short distances. The electric drive motor is connected to the wheels and generates electric voltage as the wheels are rotated. Higher speed could cause damage to the drive motor, the high-voltage system and represents a potential hazard.

Transportation

Inform the tow truck driver that reignition is possible at any time with a damaged high-voltage system. If possible, use a thermal or infrared camera to check whether the battery stacks are cold before towing the truck. To ensure that electric motor is not rotating, remove the drive shaft / propeller shaft before towing the vehicle to the next location.

Storage

Damaged vehicles should be isolated outdoors until inspected. Open windows and doors during isolation to avoid build-up of gases in the compartment. Separate the vehicle from all combustibles and structures by a distance of at least 50 feet (15 m).
WARNING: To prevent personal injury and/or death, pay attention to secondary fire events. Even days later secondary fire events cannot be excluded.

Important Additional Information

Additional information about accident assistance and recovery of vehicle with high-voltage systems can be found at:

- SAE J2990 Hybrid and EV First and Second Responder Recommended Practice