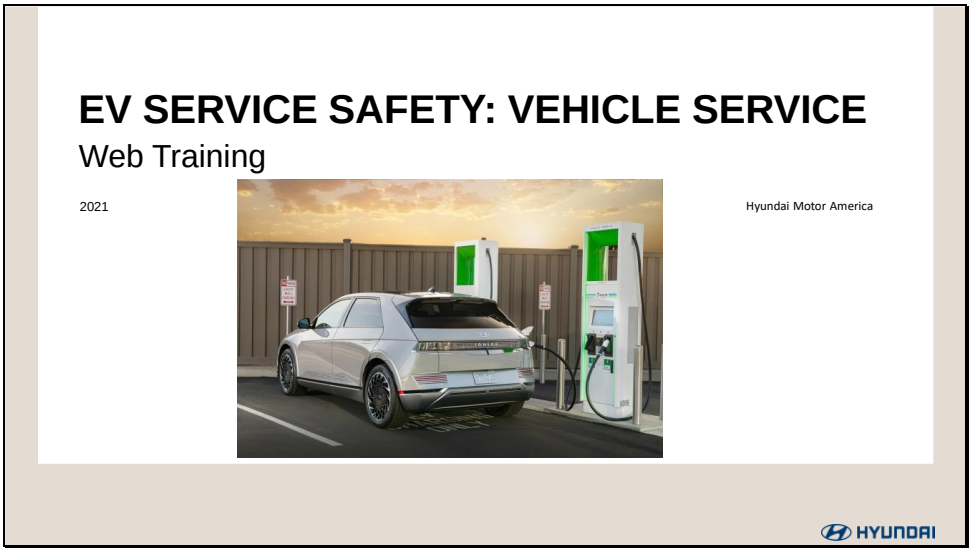
Slide 1

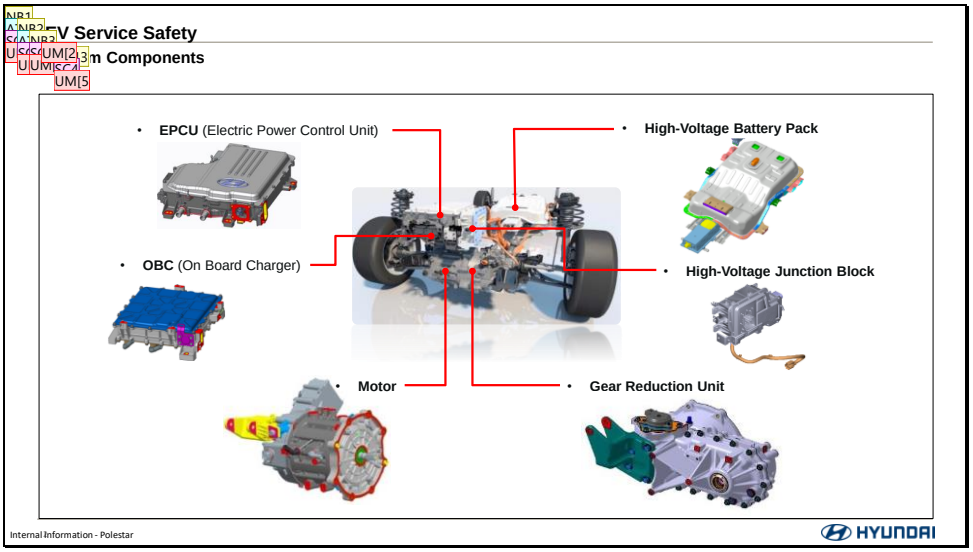


Production Notes: Title slide
Use image as background

VO:
Welcome to the EV Service Safety: Vehicle Service web-based training course.

Currently only Internet Explorer and Firefox browsers are certified for use with Hyundai Technical Online Training Courses. Other browsers may not record your progress or completion. Select OK to continue.

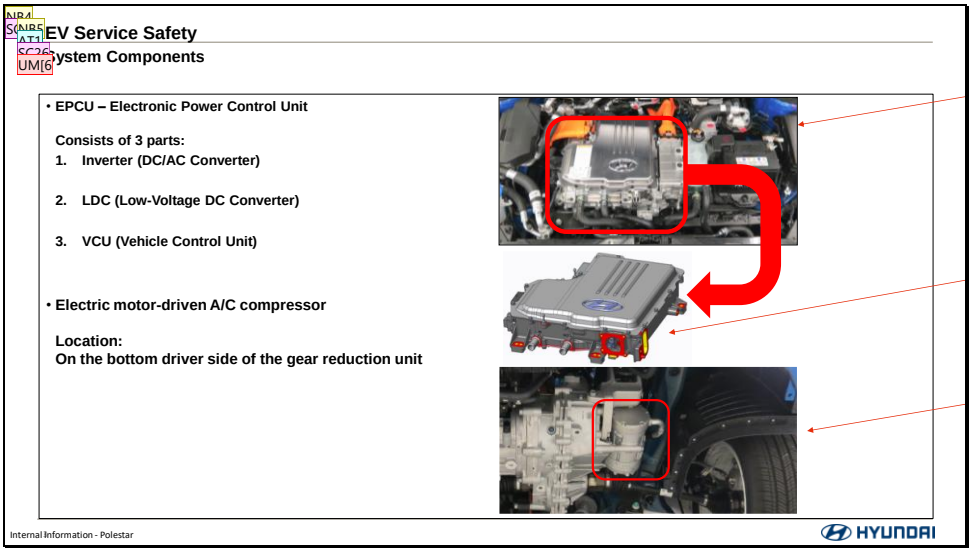
Slide 2



Production Notes:
Open with center image of chassis/front motor. Then fade in component parts with corresponding red lines as the VO mentions them.

VO:
A more detailed view of the chassis and front motor EV compartment components is shown here. They include: the EPCU (also known as the Electric Power Control Unit), ~~the EPCU is designed to receive data from sensor inputs and various other modules and calculate the correct outputs in order to control power within the system~~; the OBC (or On Board Charger) which converts 120/220-volt AC power supplied from a charging station to DC power for charging the battery; the motor which provides the vehicle's driving force using the electric energy stored in the high-voltage battery; and the gear reduction unit which provides a single-speed drive motor gear reduction to increase torque output of the motor and houses the differential assembly. There is also the high-voltage battery pack which stores electric energy while charging and supplies power while driving and the high-voltage junction block which distributes high-voltage power and houses the following fuses: OBC (40A), electric compressor (30A) and PTC heater (40A).

Slide 3



Production Notes:
Open with image A enlarged to full screen without the red outline and pop out. Read first line of VO.
Highlight EPCU with red outline and pop out image B while reading VO lines 2-4
Close all images and insert full screen image C with red marked area. Read last line of VO.

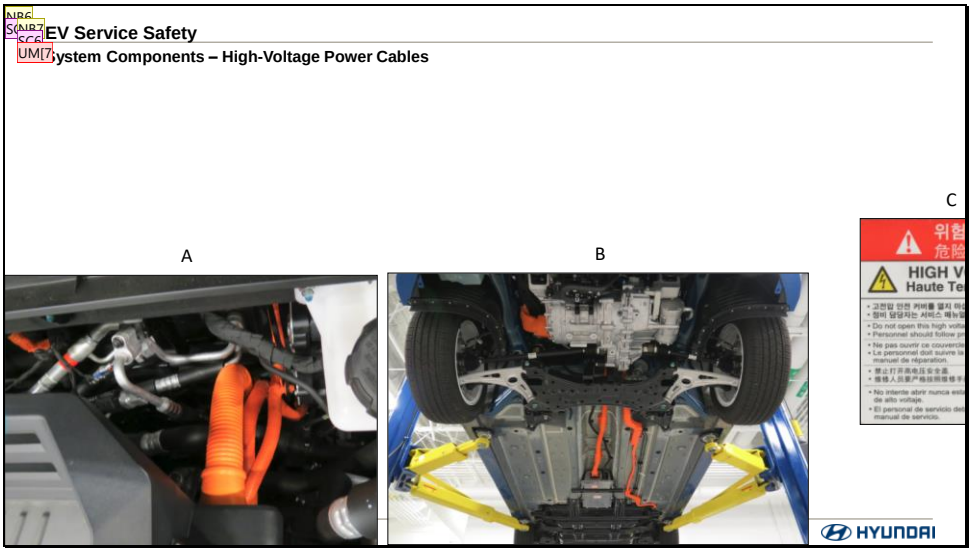
EPCU is the item circled in RED (top right)
AC compressor (bottom right)

VO:
Additional main EV components in the front motor compartment include the three parts that make up the EPCU.

The inverter converts DC to AC for motor control. The LDC (Low-Voltage DC Converter) converts high battery voltage to low voltage (12 volts) to supply power to electrical components. And the VCU (Vehicle Control Unit) is the main controller that controls all the EV-specific modules on the vehicle.

The high-voltage air conditioning compressor is located on the bottom driver side of the gear reduction unit.

Slide 4



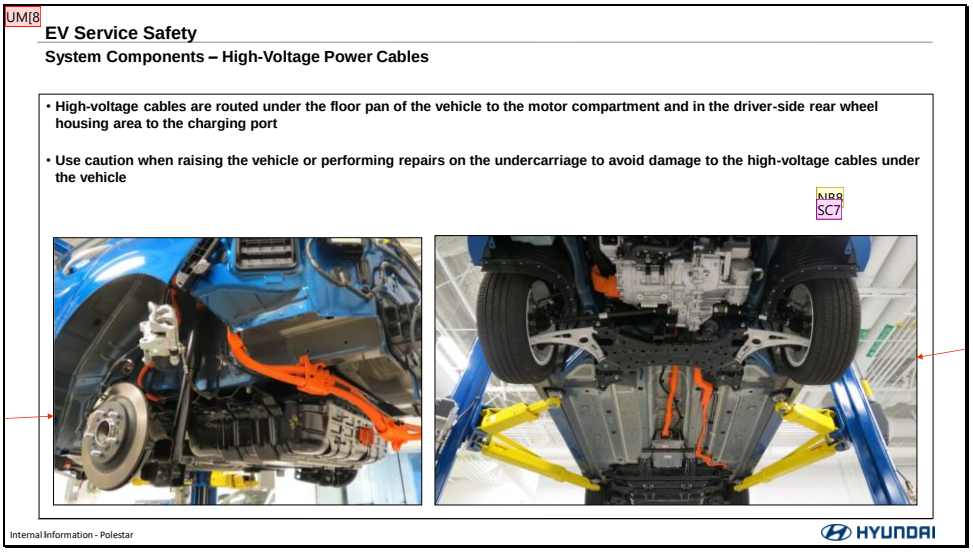
Production Notes:
Animated slide. View in presentation mode.
Open with image A full screen and text bubble A in the upper left corner and read first line of VO. Close all
Insert full screen image B and text bubble B in the upper left of the image and image C in the upper right corner. Read second line of VO.
Remove text bubble B and image C and insert chart D over image B. Read last paragraph of VO and highlight the appropriate lines in the chart.

VO:
High-voltage cables carry high-voltage DC electrical current from the EV battery to all the EV components. All high-voltage cables are identified by orange-colored housings as per SAE standard and some components have high-voltage warning labels.

There are many high-voltage system components. These include the high-voltage battery, quick charging relay assembly (or QRA), motor, power cable, BMS ECU, inverter, LDC, on board charger (or OBC), and power relay assembly (or PRA). There is also the main relay, pre-charge relay, and pre-charge resistor, the battery current sensor, the safety plug (or service disconnect), main fuse, battery temperature sensor, and high voltage junction box, as well as the charging port, electric AC compressor, and high-voltage PTC heater (located inside the HVAC box).

Internal Information - Polestar

Slide 5

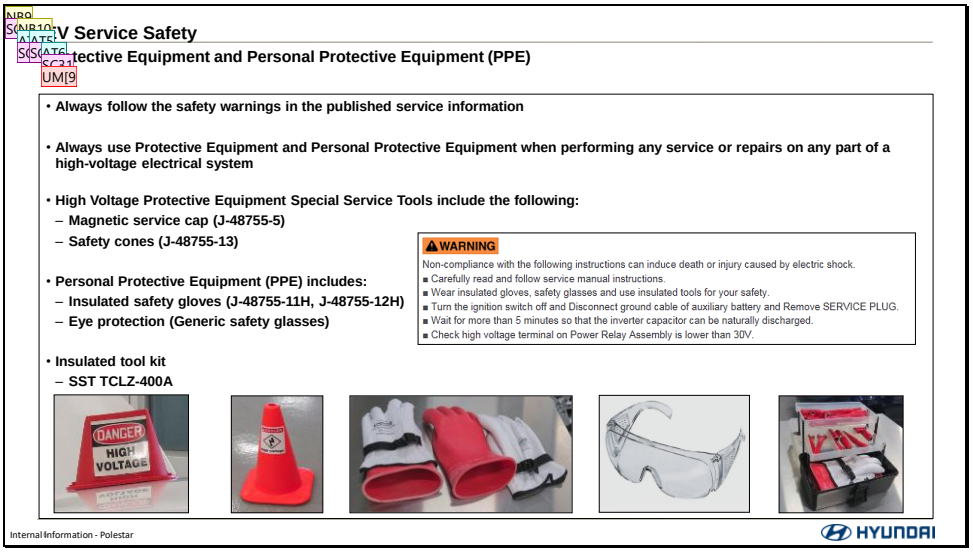


Production Notes:
Open full screen image A and read first sentence of VO.
Fade from image A to image B and read second sentence of VO.
Slide image B to the right and reinsert image A to the left while reading third sentence of VO.
Insert image C over the top of both images and read last line of VO.

VO:
In this example of the Ioniq EV, the high-voltage cables are routed under the center- and driver-side of the floor pan from the rear trunk area to the front motor compartment. The driver-side rear fender liner and rear bumper cover has been removed to show high-voltage cables routing from the battery to the charging port.

Use caution when raising the vehicle or performing repairs on the undercarriage to avoid damaging the high-voltage cables under the vehicle. Before performing any repairs on any EV high-voltage systems, proper service safety precautions should be performed.

Slide 6



Production Notes:
Open with row of pictures on the bottom of the screen and Image of (WARNING), begin reading VO. Insert bullet points as they are mentioned by the VO.

Instructor Script:
As mentioned in the previous, prerequisite HEV and EV related web-based training: always follow the safety warnings in the published service information when working on high-voltage vehicles. Additionally, always use protective equipment and personal protective equipment when performing any service or repairs on any part of a high-voltage electrical system.

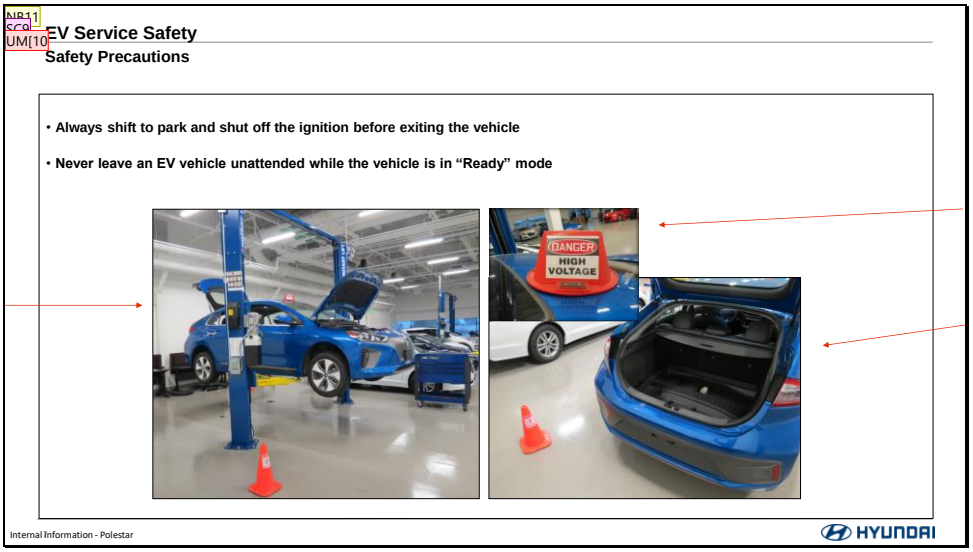
Shown here are high-voltage protective equipment special service tools which include the following: the magnetic service cap special service tool (or SST) which has part number J-48755-5, and safety cones which are SST number J-48755-13.

Personal Protective Equipment or PPE should also be used such as: Insulated safety gloves as well as leather safety gloves (SST number J-48755-11H or J-48755-12H), and generic safety glasses for eye protection.

Finally, use the insulated tool kit (SST number TCLZ-400A) as needed.

As an added precaution the insulated rubber gloves need to be inspected each use for any holes or cracks. The leather gloves are to be worn over the rubber gloves for another layer of protection.

Slide 7



Production Notes: Open with image A full screen and read first paragraph of VO.
Decrease the size of image A and move to the left half of the screen.
Insert image B to the right upper corner and image C to the lower right corner. Begin to read second paragraph of VO and as "magnetic service cap and safety cone" is read, highlight the areas with image D.
Slide images down slightly and read third paragraph of VO while inserting text bullet points.
Clear screen and return to only image A on screen. Read last sentence of VO.

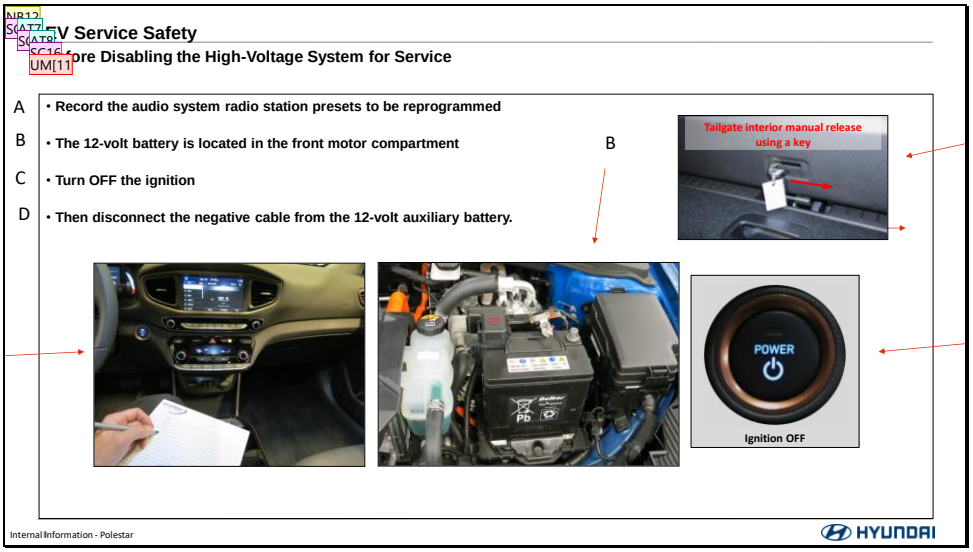
VO:
Because EV vehicles have unique safety concerns, it's important that correct safety precautions be performed while vehicles are being serviced. As mentioned earlier in this course, EVs use a high-voltage battery system to power the electric powertrain components.

All service personnel should be able to identify an EV vehicle by the use of a magnetic service cap, a safety cone, or a sign placed on the vehicle that identifies it as an EV.

Remember to always shift the transmission into park and shut off the vehicle before exiting. Never leave an EV vehicle unattended while the vehicle is in "Ready" mode.

Servicing all high-voltage components requires the correct procedure for disconnecting the high-voltage power to the EV systems.

Slide 8



Production Notes:
Open with image A in the upper left side of the screen and read first sentence of VO.
Insert image B to the right of image A and read second sentence of VO.
Insert Image C underneath and centered and read sentences 3 of VO.
Slide image C to the left and insert image D and read sentence 4 of the VO.

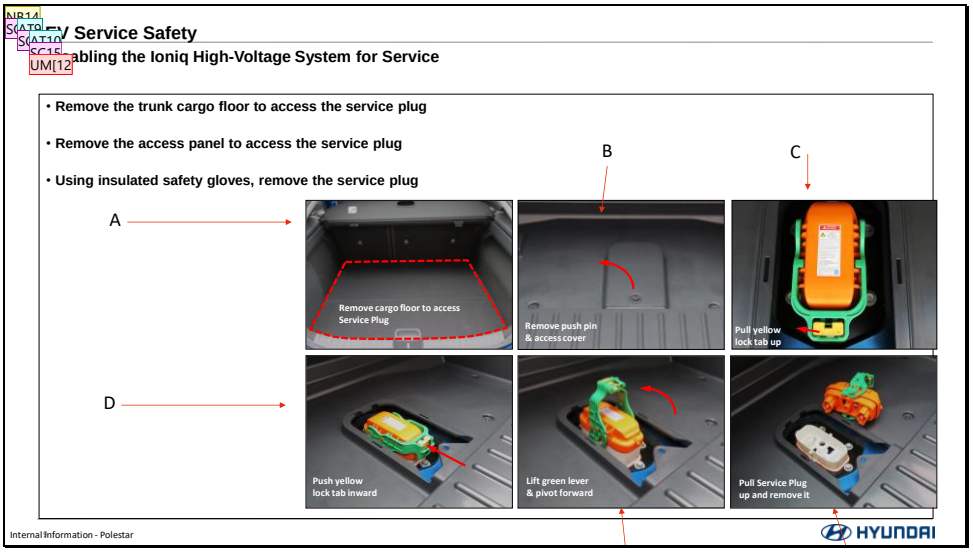
VO:
Prior to disable the high-voltage system for service, begin by recording the audio system radio station presets.

Then, locate the 12-volt auxiliary battery in the front motor compartment on the driver side.

Once you've located the battery, turn off the ignition and disconnect the auxiliary 12-volt battery by removing the negative battery terminal. This removes all the low-voltage power to the control units and relays.

Be aware that the outside rear hatch release is electrically actuated and will not operate if the 12-volt battery is disconnected. However, if necessary, the rear hatch can be opened from the interior using the mechanical emergency release on the mechanical door key from the smart key fob.

Slide 9



Production Notes:
Open with video https://www.hyundainews.com/gallery/videos/46205 (Play 3:00 – 3:06 and Freeze) Read first sentence of VO during sequence.
Insert images A through F as the corresponding directions are read by the VO.
When VO reads third paragraph, insert image G. Leave on screen for 5 seconds before allowing the user to move to the next slide.

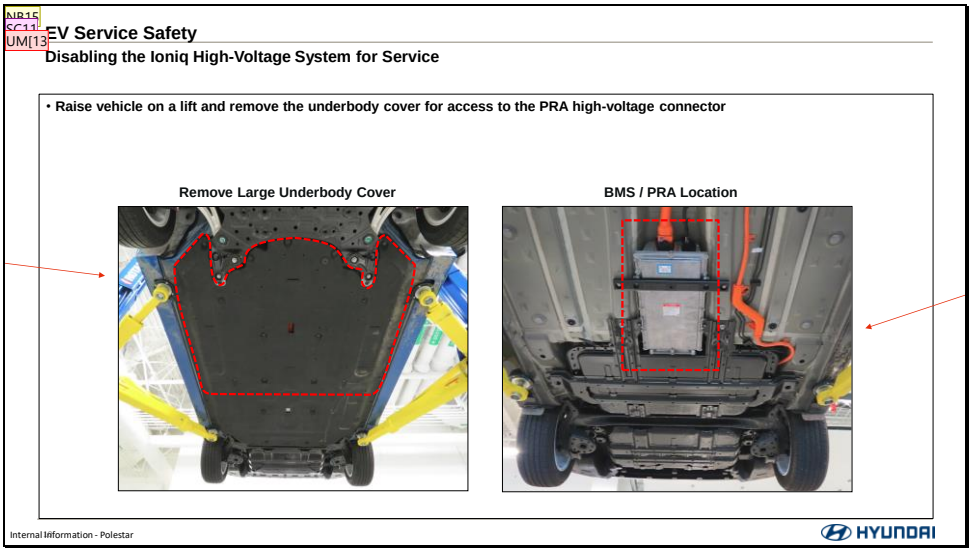
(This slide continues until PPT 14)

VO:
To disable the high-voltage system in the Ioniq EV, open the rear hatch to access the safety plug before disconnecting the 12-volt auxiliary battery. Next, remove the trunk cargo floor to access the service plug panel. With a small screwdriver, remove both the push pin and the plastic access panel.

Using insulated safety gloves, pull the yellow lock tab on the service plug upward to unlock the lever. Push the yellow lock tab inward or squeeze the lock tab and the green lever together and pull the green lever upward at the same time. Pivot the lever forward and pull the service plug up to remove it.

This image shows the process to unlock and release the service plug.

Slide 10

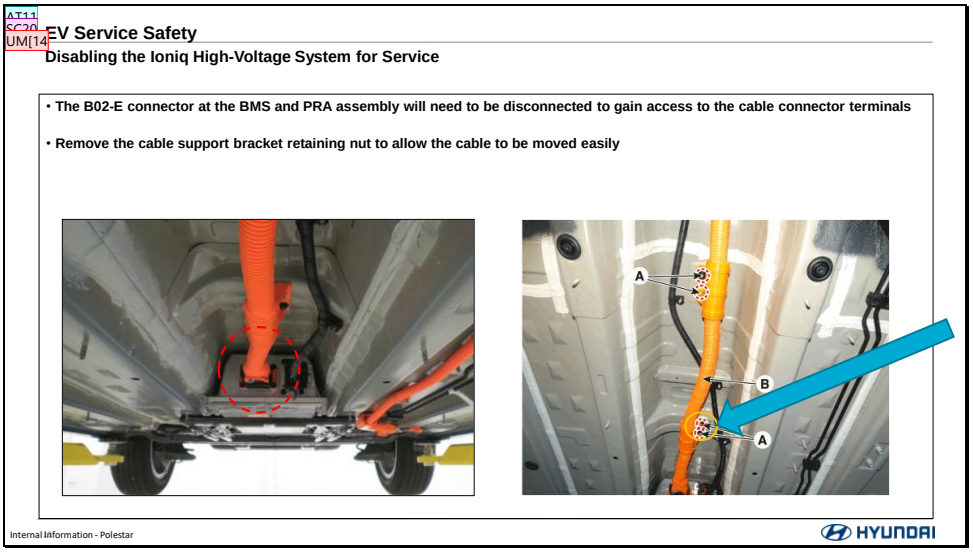


Production Notes: (continuation of previous slide)
Open with image A only and read first sentence of VO.
Close image A and Fade in image B. Read second sentence of VO.
Insert Image C over the top of image B and read the last paragraph of VO.

VO:
Next, raise vehicle on a lift and remove the large front underbody cover, as shown, to provide access to the battery management system (or BMS), power relay assembly (or PRA), and the B02-E high-voltage connector. In this example, both underbody covers have been removed to show the location of the BMS and PRA more clearly.

The same safety precautions used when servicing HEVs apply when servicing EVs and disabling the high-voltage system. It is very important that you allow 5 minutes or more for the capacitor voltage charge to dissipate before disconnecting any high-voltage cables.

Slide 11

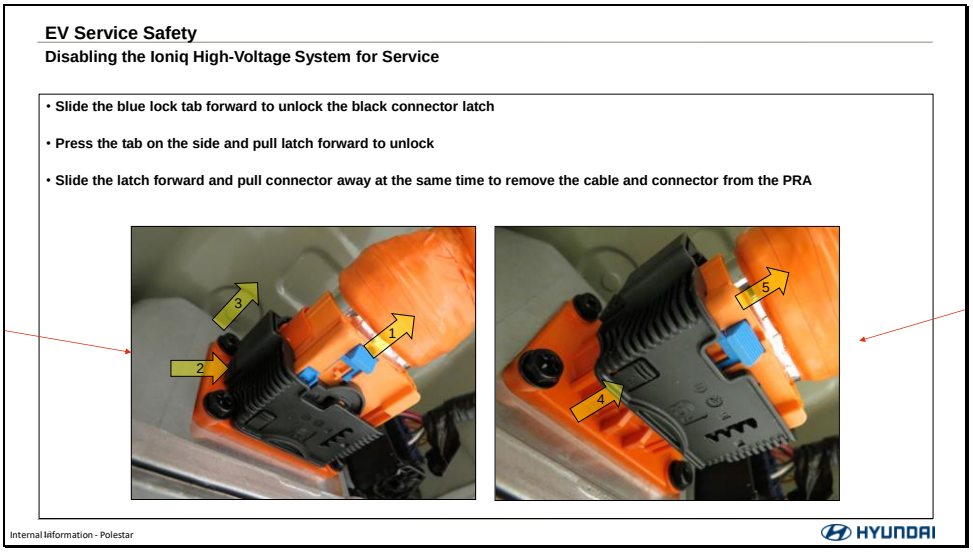


Production Notes: (continuation of previous slide)

Open with both images on screen. Read first sentence of VO and circle identified area in the left image with a red circle when “B02-E” is said in VO.
Read second sentence of VO and circle nut area in right image where indicated by the blue arrow when “nut” is stated in VO. (remove all markings on right image with exception to the indicated area with the blue arrow)

VO:
After allowing five minutes for the capacitor voltage charge to dissipate, the B02-E connector at the BMS and PRA assembly will need to be disconnected to gain access to the cable connector terminals. Remove the cable support bracket retaining nut to allow the cable to be moved easily.

Slide 12

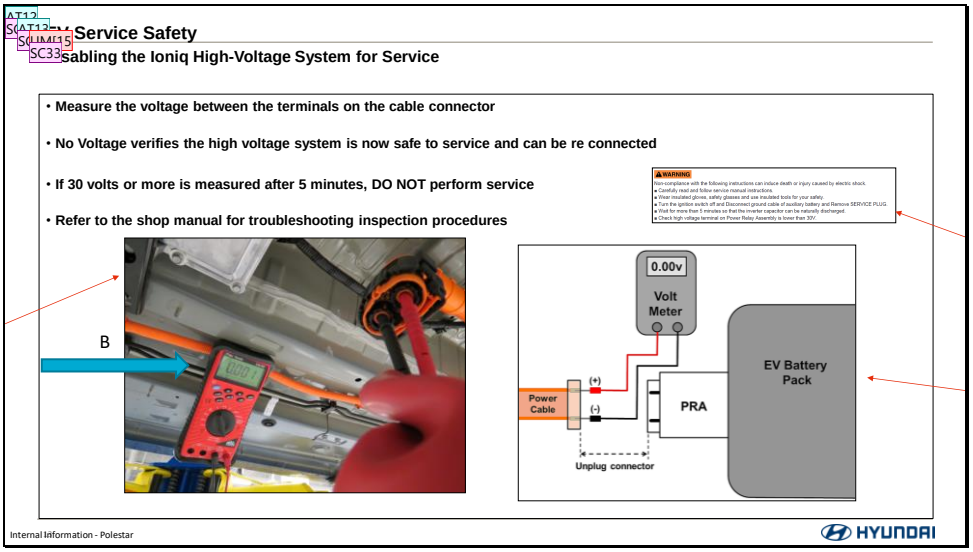


Production Notes: (Continuation of last slide)
Open with image A full screen (W/O) yellow arrow markers and read first paragraph of VO.
As the VO is read insert Yellow markers 1,2,3 as indicated in the first paragraph of VO. Slide Image 1 to left side of screen and insert image 2 to the right and read the last paragraph of VO. As the VO is read, insert Yellow markers 4 and 5 as indicated in the VO.

VO (numbers are for prog. ref. only; do not include in VO script):
After allowing five minutes for the capacitor voltage charge to dissipate, carefully unplug the B02-E connector at the BMS and PRA assembly to gain access to the terminals. (1)Slide the blue lock tab forward to unlock the black connector latch, (2) press the tab on the side, and (3) pull the latch forward to unlock.

Slide the latch forward (4) and pull connector away at the same time (5) to remove the cable and connector form the PRA.

Slide 13



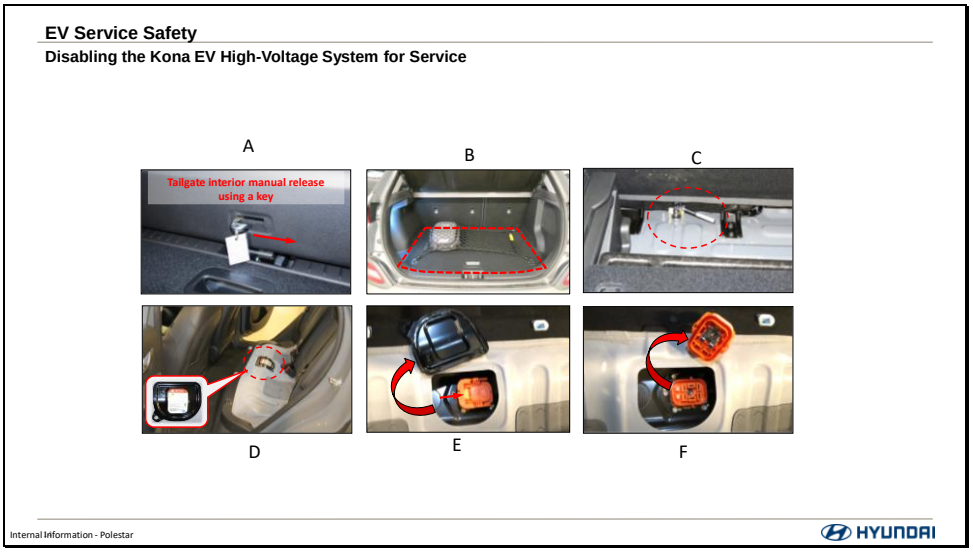
Production Notes: (continuation of previous slide)

Open with image(s) A in full screen. Read first paragraph of VO. Insert image B to indicate location on the Multimeter when the VO says “In this image, no Voltage…” Reduce the size of image A and insert image C above A. Read second paragraph of VO and insert bullet point text lines as they are read in the VO just to the right of image A

VO:
Using a high-voltage compatible multi-meter with CAT III or CAT IV, measure the voltage between the terminals on the cable connector. The measured voltage with the safety plug removed should be 30 volts or less. In this image, no voltage verifies that the high-voltage system has been safely disabled. The vehicle is now safe to service and the B02-E connector can be reconnected.

Caution: a reading of 30 volts or more indicates there is a high-voltage circuit failure. If 30 volts or more is measured after five minutes, there is a malfunction or damage to the vehicle causing an electrical short. To avoid any possibility of electrical shock or injury, DO NOT perform any service to the high-voltage system. You should refer to the shop manual for appropriate precautions when handling a vehicle after an accident or for troubleshooting inspection procedures.

Slide 14



Production Notes:
Open with the screen as shown.
Pop out image A to fill screen and read first sentence of VO, then return to opening image.
Pop out images B and C to fill screen and read second sentence of VO, then return to opening image.
Pop out image D and E to fill screen and read second paragraph of VO, then return to opening image.
Pop out image F to fill screen and read last paragraph of VO, then return to opening image.

(This slide continues until PPT 17)

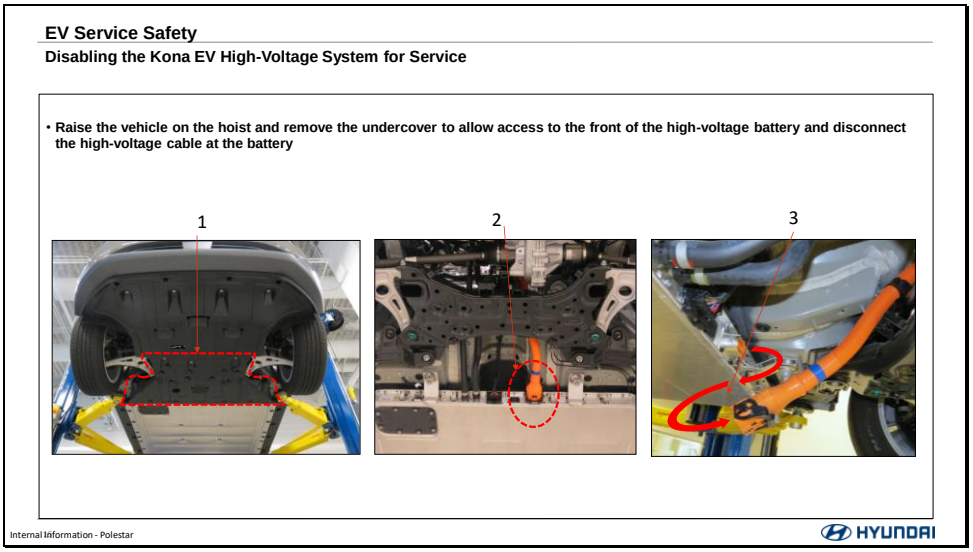
VO:
To disable the high-voltage system on the Kona EV, open the rear hatch to access the safety plug before disconnecting the 12-volt auxiliary battery. Remove or slide the back cargo floor toward the rear to allow access to the two bolts that secure the rear seat lower cushion to the floor and remove the rear seat cushion.

Locate the sheet metal access cover in the center which is identified with a high-voltage warning label. Pry it upward with a trim removal tool to remove it.

Following the proper safety procedures outlined in the shop manual, unlock the safety

plug latch by sliding the yellow lock tab and pivot the lever upward while pulling up on the safety plug to remove it. After removing the safety plug, wait five minutes for the inverter capacitor to discharge.

Slide 15

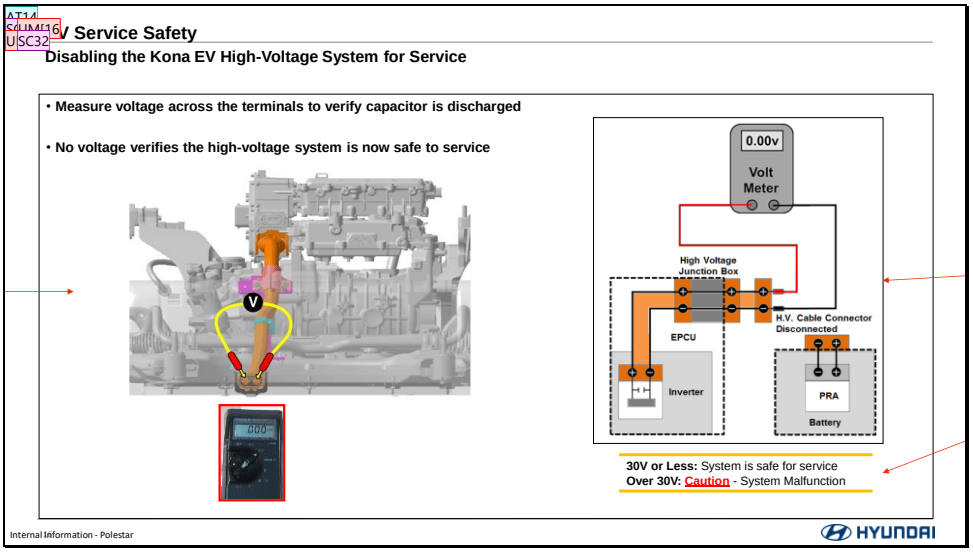


Production Notes: (continuation of previous slide)
Open with Slide as shown above. Start reading VO and highlight all red marked areas as they are marked in the VO. (I.E. Under Cover 1, High Voltage Battery Cable 2, Measure Voltage 3)

VO:

Raise the vehicle on the hoist and remove the undercover at the front of the battery to allow access to the front of the high-voltage battery. Disconnect the high-voltage battery cable at the PRA and measure voltage across the high-voltage terminals to verify the capacitor is discharged.

Slide 16

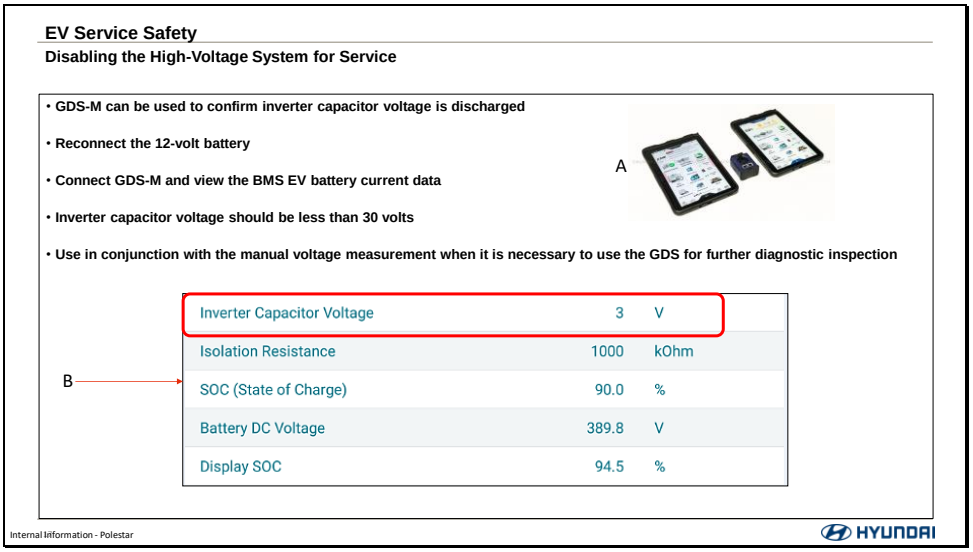


Production Notes: (continuation of previous slide)
Open with image(s) A full screen and read first paragraph of VO.
Slide image A to the left and insert image B to the right. Read last paragraph of VO.

VO:
The measured voltage with the safety plug removed should be 30 volts or less. In this image, the multimeter shows no voltage, which verifies that the high-voltage system is safely disabled and safe to service.

Caution: If 30 volts or more is measured after five minutes, there is a malfunction or damage to the vehicle causing a high-voltage circuit failure. To avoid any possibility of electrical shock or injury, DO NOT perform any service to the high-voltage system. You should refer to the shop manual for appropriate precautions when handling a vehicle after an accident or for troubleshooting and inspection procedures.

Slide 17



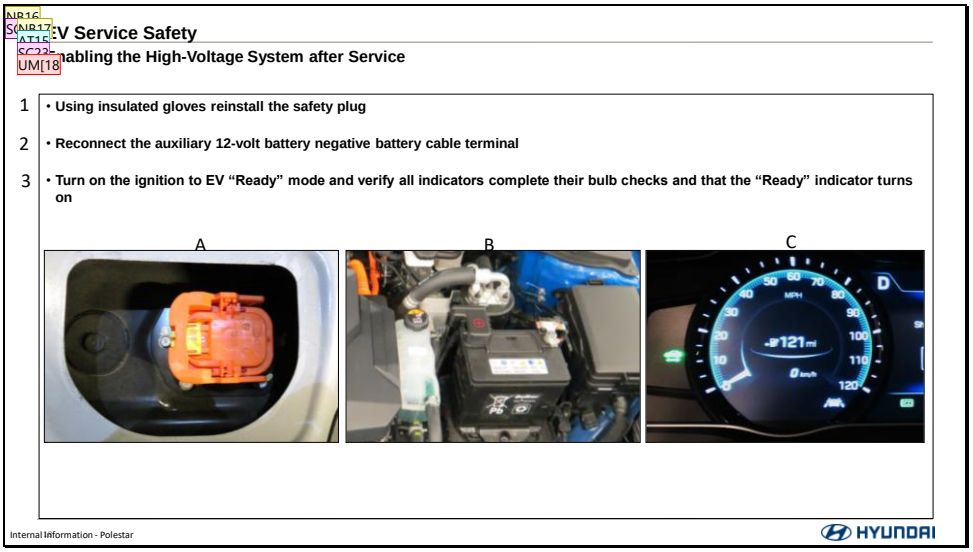
Production Notes:
Open with image A full screen and read first paragraph of VO.
Close image A and fade in image B and read second paragraph of VO.

VO:
The GDS-M can be used to confirm inverter capacitor voltage is discharged. However, this can only be performed after reconnecting the 12-volt battery.

Connect the GDS-M and view the BMS EV battery current data. Then, check the value measured for the inverter capacitor voltage. A reading of 30 volts or less indicates that there is no high voltage reaching the electronic power control unit from the PRA and the high-voltage system is safely disabled. This method of inspection can be used in conjunction with the manual voltage measurement when it is necessary to use the GDS for further diagnostic inspection.

Internal Information - Polestar

Slide 18

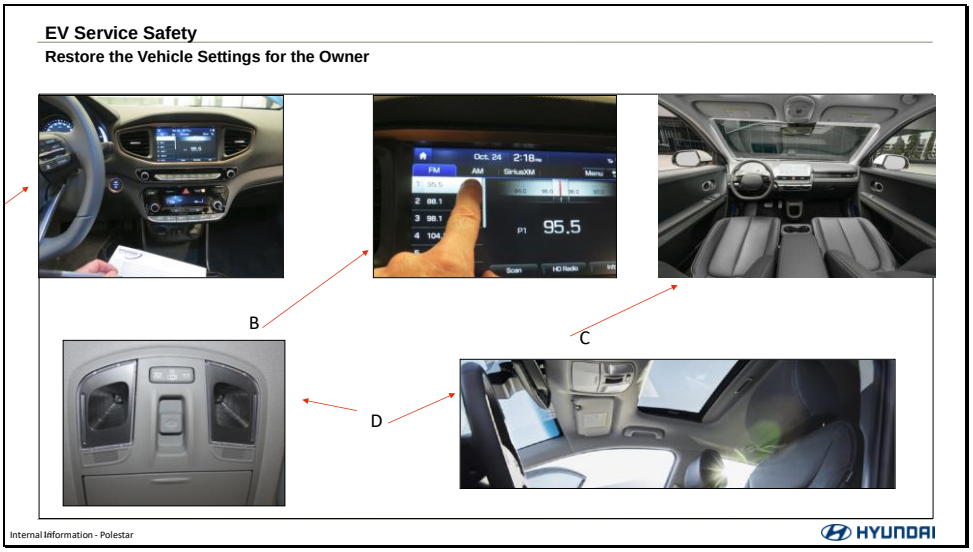


Production Notes:
Open with the screen as shown above.
Read first sentence of VO and highlight bullet point 1. Pop out image A. Then return image A to normal size.
Read second sentence of VO and highlight bullet point 2. Pop out image B. Then return image B to normal size.
Read fourth sentence of VO and highlight bullet point 3. Pop out image C. Then return image C to normal size.
Read last paragraph of VO.

VO:
After completing service on an EV, you'll need to enable the EV powertrain. To do so, using insulated gloves, reinstall the safety plug on the high-voltage EV battery. Next, reconnect the auxiliary 12-volt battery negative battery cable. Then, turn the ignition to EV "Ready" mode and verify that all the malfunction and service indicator lamps complete their bulb checks and then turn off. Finally, ensure that the Ready Indicator turns on.

After confirming that the vehicle goes into "Ready" mode, turn off the ignition and reassemble the battery safety plug access panel as needed.

Slide 19

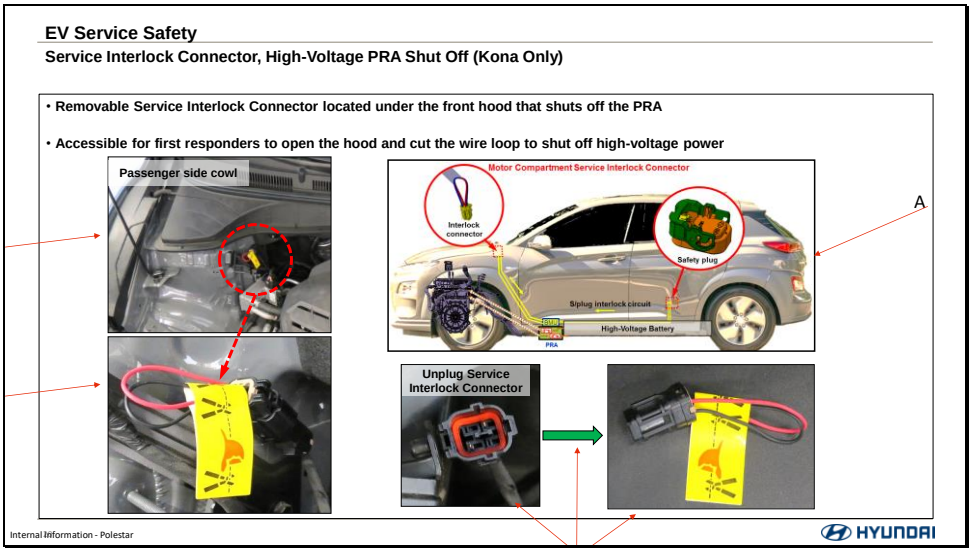


Production Notes:
Open wit image A in full screen. Read first sentence of VO.
Reduce the size of image A and move it to the upper left corner of the screen. Insert image B to the lower right corner of the screen and begin second sentence of VO.
Slide image B to the upper right corner and insert image C below image A and B and read fourth sentence of VO.
Slide images A,B,C to the upper row and Insert images D beneath. Read final paragraph of VO.

VO:
Upon completion of a repair, you should restore the vehicle settings for the owner. Reset the radio stations presets to the original stations recorded before the service began. Check and reset the digital clock if the vehicle does not have a navigation system. Reinitialize the auto window function by closing the driver's and front passenger's windows and continue pulling up on the power window switch for at least one second after the window is completely closed.

Reinitialize the sunroof (if equipped) by first closing the sunroof completely. Then release the control lever. Within three seconds, pull and hold the control lever downward until the sunroof tilts and slightly moves up and down, and then release the lever. Pull and hold the control lever downward until the sunroof operates through the tilt down, slides to the fully open position, and then finally slides closed. Finally, release the control level.

Slide 20



Production Notes:
Open with image A at the top of the screen with image B beneath. Read first sentence of VO.
Remove image A. Enlarge and slide image B to the left. Pop out image C from B as shown above and read second paragraph of VO.
Clear screen. Insert images D (3) Read third paragraph of VO.
Clear screen and insert Image a full screen. Read VO 4

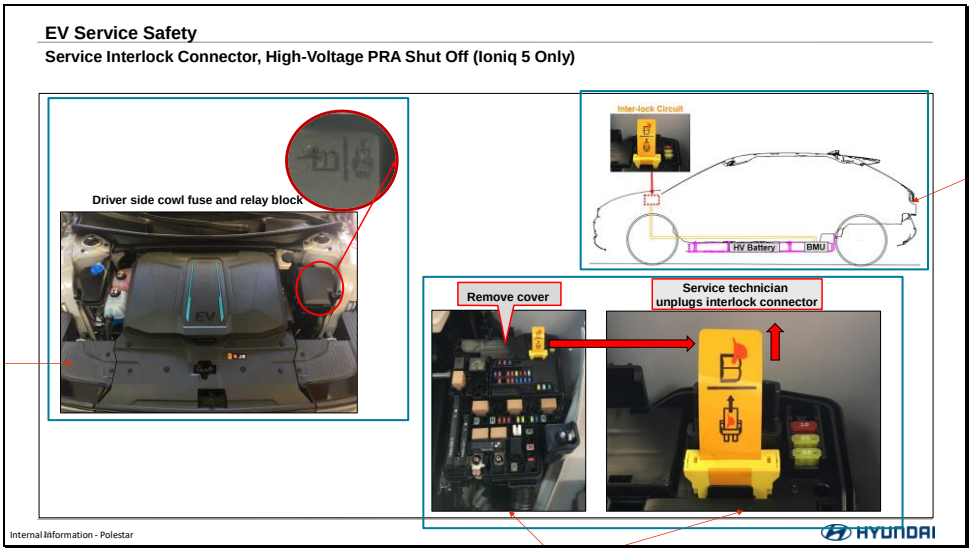
VO:
The Kona EV is equipped with a service interlock connector wire loop located under the front hood, passenger side cowl area that shuts off the PRA when it is removed.

This service interlock connector is an additional safety device accessible for an emergency first responder to open the hood and identify the wire loop with a yellow tag showing a fireman's helmet. The tag shows to cut the wire loop as indicated by a dotted line to shut off the high-voltage system.

The service interlock connector can be removed by a service technician to shut off the high-voltage to the inverter/EPCU. However, it does not open the serial connection within the high-voltage battery. Therefore, the battery still has high-voltage potential.

Reinstall the service interlock connector to restore the high-voltage system operation to normal.

Slide 21

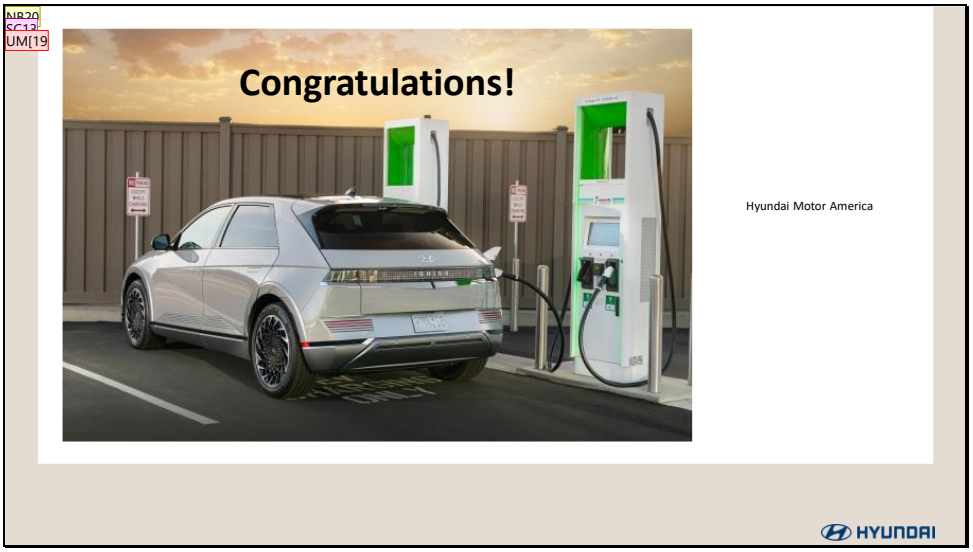


Production Notes:
Open with image A on the top center of the screen and Image B below image A. Read first sentence of VO. As the VO states, **"It is located…",** pop out the indicated area on image B.
Clear screen and insert images(2) C. Read last paragraph of VO.

VO:
The Ioniq 5 EV is also equipped with a service interlock connector. It is located inside the underhood fuse and relay block on the driver side area. It is a non-removable type and is designed to be easily accessible for an emergency first responder to open the hood and see the marking on the fuse and relay block cover.

Remove the cover and identify the yellow tag showing a fireman's helmet with an arrow to pull up on connector and shut off the high-voltage system. Push down on the service interlock connector to restore the high-voltage system operation to normal.

Slide 22



Production Notes: Final slide
Use image as background

VO:
Congratulations! You have completed the EV Service Safety: Service Safety web-based training course. Please continue to the final exam when you're ready.