



2023-2024 FSGP AND ASC SOLAR CAR COMPETITIONS

IMPOUND IN VEHICLE FOR MOV AND SOV CLASSES



Presented By Team Coordinator & MOV Inspector

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IMPOUND IN VEHICLE

Traditional Impound Overview

Path to Impound in Vehicle

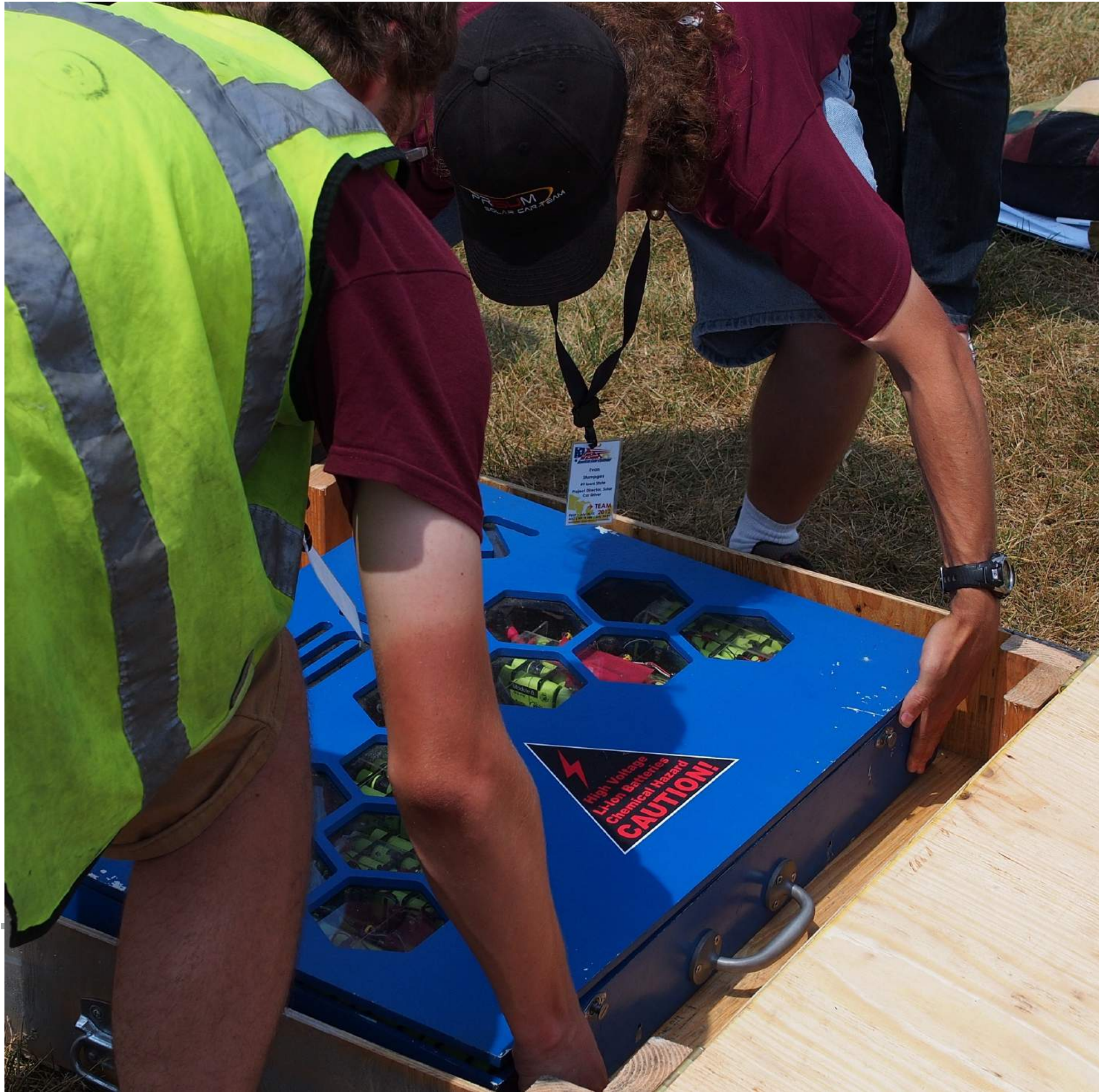
Certification Requirements

Case Study Examples

Open Discussion, Q&A

THIS CONTENT IS INTENDED TO SUPPLEMENT THE REGULATIONS BUT DOES NOT SUPERSEDE THEM

DISCLAIMER



TRADITIONAL IMPOUND OVERVIEW

IMPOUND PROCESS

- ▶ Purpose of impound: to ensure that no team can gain an unfair advantage by replacing battery modules or charging their vehicle batteries overnight while they are not under supervision by Officials or Observers
- ▶ Impound hours start at 8:00 pm each evening and end at 7:00 am the following morning for both FSGP and ASC
- ▶ During FSGP, Officials monitor the charging area to ensure that teams' batteries are impounded on time and that no impound seals are broken until after the start of solar charging time the next morning
 - ▶ For this track event, Officials provide a secure location for impound boxes to be stored overnight - outside of impound hours, solar cars must be within view of a race Official (garage/cold pit work must be supervised)
- ▶ During ASC, Observers monitor impound & impound release and record these times in their logs - outside of impound hours, Observers are to keep their assigned solar car in sight throughout the Tour
 - ▶ For this road event, teams must provide a secure location that is approved by their Observer to store the impound box overnight unless Officials designate a specific impound storage location at Stage Stops
- ▶ Teams should recognize that they will need additional power sources if they have to power or troubleshoot vehicle systems during impound hours since the vehicle batteries will be disconnected
- ▶ Headquarters should be appraised of any special issues for impound
- ▶ A 2 mile penalty is assessed for every minute that a team fails to Impound their batteries and teams that don't impound overnight at FSGP forfeit all official laps completed up to that point

IMPOUND BOX

- ▶ Until now the impound box has been the only Impound option for teams in the SOV class
- ▶ Battery enclosure(s) must be designed to be removed from the vehicle and placed in a sealed impound box during impound hours each day
- ▶ The impound box shall have provisions such that an Official can secure it with a maximum of two locks/seals
- ▶ The impound box must be constructed such that it does not contain external hardware that can be removed to gain access to the battery box without breaking the seal(s)
- ▶ Impound Box Construction Best Practices
 - ▶ Ensure the box is strong enough to support the mass of the battery enclosure(s) and to provide sufficient protection
 - ▶ Double check that the internal dimensions of the box will fit the battery enclosure(s) and provide enough clearance to safely install the enclosure(s) without pinching fingers
 - ▶ Lockable caster wheels on the bottom box can make it easier to move around
 - ▶ Many teams build their impound boxes out of wood but have also seen some nicer industrial travel cases
 - ▶ Ensure the box is designed that all fasteners are installed from the inside (externally removable fasteners that could be uninstalled to provide internal access to a sealed box are not allowed!)
 - ▶ Build your impound box and test fit your battery enclosure(s) before coming to Scrutineering

IMPOUND BOX CONSTRUCTION RECOMMENDATIONS

Do



Include casters



Use internally mounted concealed hinges



Use cabinet corner protectors to protect the outside of the box from damage



Use internally mounted lockable hasp latch



Use internally mounted corner braces in addition to wood glue to secure sides to the bottom of the box



Install heavy duty handles to safely carry the box

Don't



Use any externally mounted hinges, latches, etc



Don't use external fasteners as the sole means of securing the box panels together



PATH TO IMPOUND IN VEHICLE

IMPOUND IN VEHICLE PIONEERED WITH THE MOV CLASS

- ▶ When ASC officially introduced the MOV class in the FSGP 2019 regulations, in alignment with the WSC cruiser class, battery weight for these vehicles is unlimited
- ▶ It was not practical or feasible for some of these large/heavy packs to be removed from the vehicle for impound
 - ▶ Entire vehicle could be impounded at FSGP and sealed in trailer during ASC (undesirable since usually teams want to be able to work on their vehicles overnight)
 - ▶ The possibility of impounding the battery inside the vehicle was offered as a more desirable solution
- ▶ Scrutineering certification for impound in vehicle in MOVs has been challenging so far (many teams have not come prepared to meet the requirements)
 - ▶ Most teams have needed multiple modifications and re-inspections during Scrutineering which can take valuable time away from other more pressing issues
- ▶ Impound has not been required for MOV teams that declare they will be charging from unmetered external energy
- ▶ With the more recent introduction of metered external charging for MOVs they can charge from the metered charge inlet even in impound state so most MOV teams now choose to impound daily and metered charge
- ▶ Impound in vehicle requires additional staff or observation by a competing team during FSGP
- ▶ Some solutions implemented by MOV teams have required too many security seals

PROS AND CONS OF IMPOUND IN VEHICLE

- ▶ Pros
 - ▶ No need to construct and carry an impound box for the event
 - ▶ Can more securely attach the battery box to the vehicle chassis
 - ▶ Eliminating the need to remove the battery from the vehicle for impound reduces the risk of handling damage and saves team members' backs
- ▶ Cons
 - ▶ Battery box construction/security is held to a higher standard of inspection
 - ▶ Increases Scrutineering inspection/certification/documentation time
 - ▶ Requires training and close observation by observers/officials to ensure that impound is performed properly and the process is unique to each vehicle
 - ▶ May add some weight to the vehicle to ensure that impound requirements can be met
 - ▶ Usually requires more security seals than an impound box



CERTIFICATION REQUIREMENTS

IMPOUND IN VEHICLE REQUIREMENTS

- ▶ Teams utilizing the impound in vehicle option shall provide a robust impound solution that allows the event organizers to lock/seal any high voltage battery power connectors/conductors
- ▶ The solution shall seal any main battery high voltage power connectors/conductors such that the team cannot charge the battery from external energy sources - this includes the battery box lid(s), and any air inlets/outlets that could allow access to HV connections, as well as any power connections to the motor(s), solar array, etc
- ▶ The solution shall have provisions such that an Official can secure it with a maximum of four (4) locks/seals - additional locks/seals may be applied during Scrutineering so long as they do not need to be broken every time the vehicle is impounded
- ▶ The battery box shall be constructed such that it does not contain external hardware that can be removed to gain access to the battery box without breaking the seal(s)

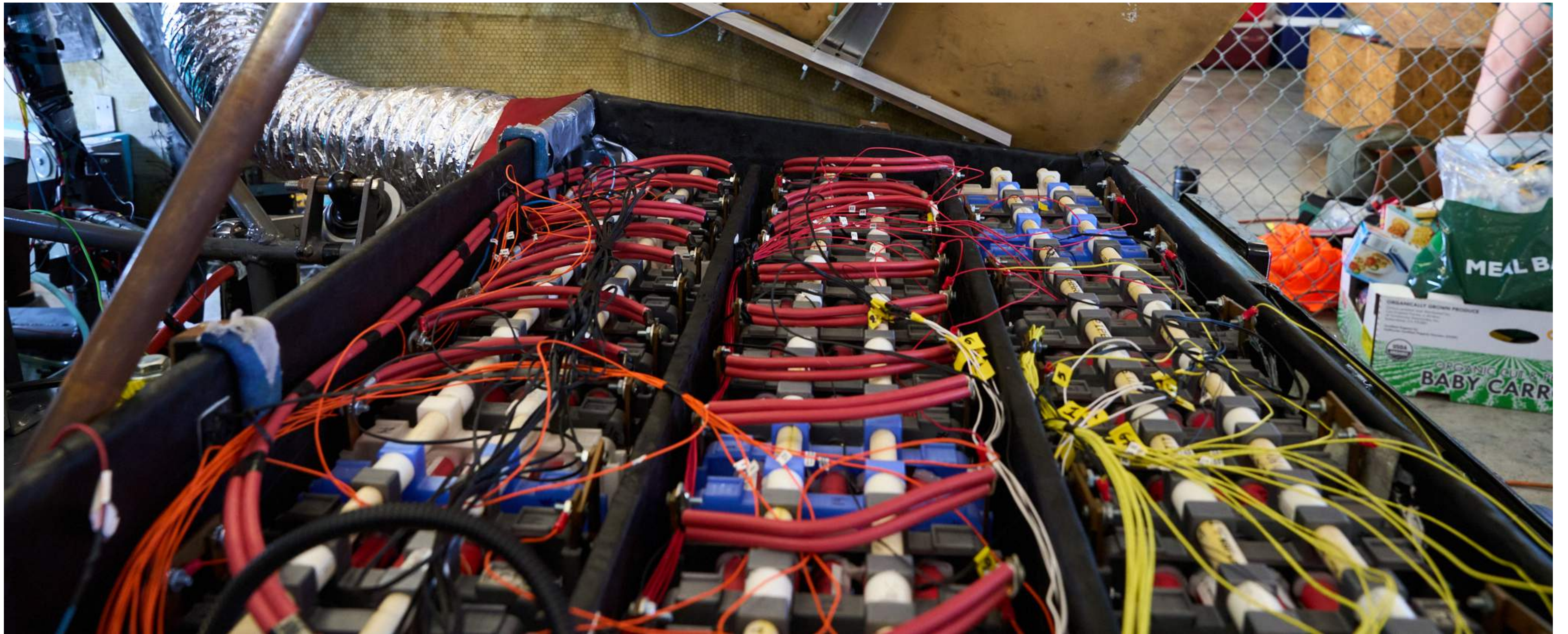
RECOMMENDATIONS FOR TEAMS PLANNING TO IMPOUND IN VEHICLE

- ▶ As of now and impound box remains the preferred method for SOV teams but we are now allowing impound in vehicle as an option in alignment with WSC
- ▶ For any teams that want to attempt to get certified for impound in chassis:
 - ▶ Recommend two piece composite battery box construction consisting of a flat lid on top and the bottom of the box built with integral side walls
 - ▶ Remember carbon fiber can conduct electricity but fiberglass and Kevlar do not
 - ▶ Lid hinges should be concealed and internally mounted
 - ▶ Lid must be lockable with security seals and rigid enough when secured to prevent internal access to the box
 - ▶ Ensure that that externally accessible hardware is not used as the sole means of box construction
 - ▶ Recommend electrical connectors that install from the inside with internal hardware
 - ▶ Ensure that any internal conductive hardware is not at risk of creating a short with any HV circuitry
 - ▶ Think carefully about the size and location of any holes in the box
 - ▶ Any openings in the battery box for connectors, air inlets/outlets, service, etc will be closely scrutinized to ensure that they would not allow you to gain internal access for charging the battery during impound hours
 - ▶ Internally secured screen/mesh may be approved as a way to block access to the box without completely restricting airflow - securely sealing manifolds to the battery box during Scrutineering could also work
 - ▶ Please design your battery box sealing strategy to be robust and ensure it is in place before Scrutineering!
 - ▶ Recommend minimizing the number of power connectors exiting your battery box and locate them in close proximity to each other so that a single cover/seal can be used to lock them out for impound
 - ▶ Options for locking out power connectors could include lockable dummy plugs or a plate/3D printed cover that can be locked over the HV connectors
- ▶ We recommend that SOV teams maintain the option of using an impound box in case they fail to get certified

SECURITY TAG SEALS

- ▶ Here is an example of what a security tag seal looks like
- ▶ Design your battery box sealing solutions with this in mind
- ▶ Security seals are not structural and should not be relied on as a means of mechanically securing anything
- ▶ We want to minimize the number of seals that need to be purchased for the event so do your best to minimize how many seals will be required for your vehicle
 - ▶ Seals for vent ducts and battery box lids that get installed during Scrutineering and left in place throughout the event are less of a concern for minimization than the seals that need to be broken on a regular basis (HV connector impound for example)
 - ▶ If you'll need to open your battery box lid to replace/charge your Aux battery make sure your Aux battery is sized to last at least a full day and minimize the number of seals required to secure the lid



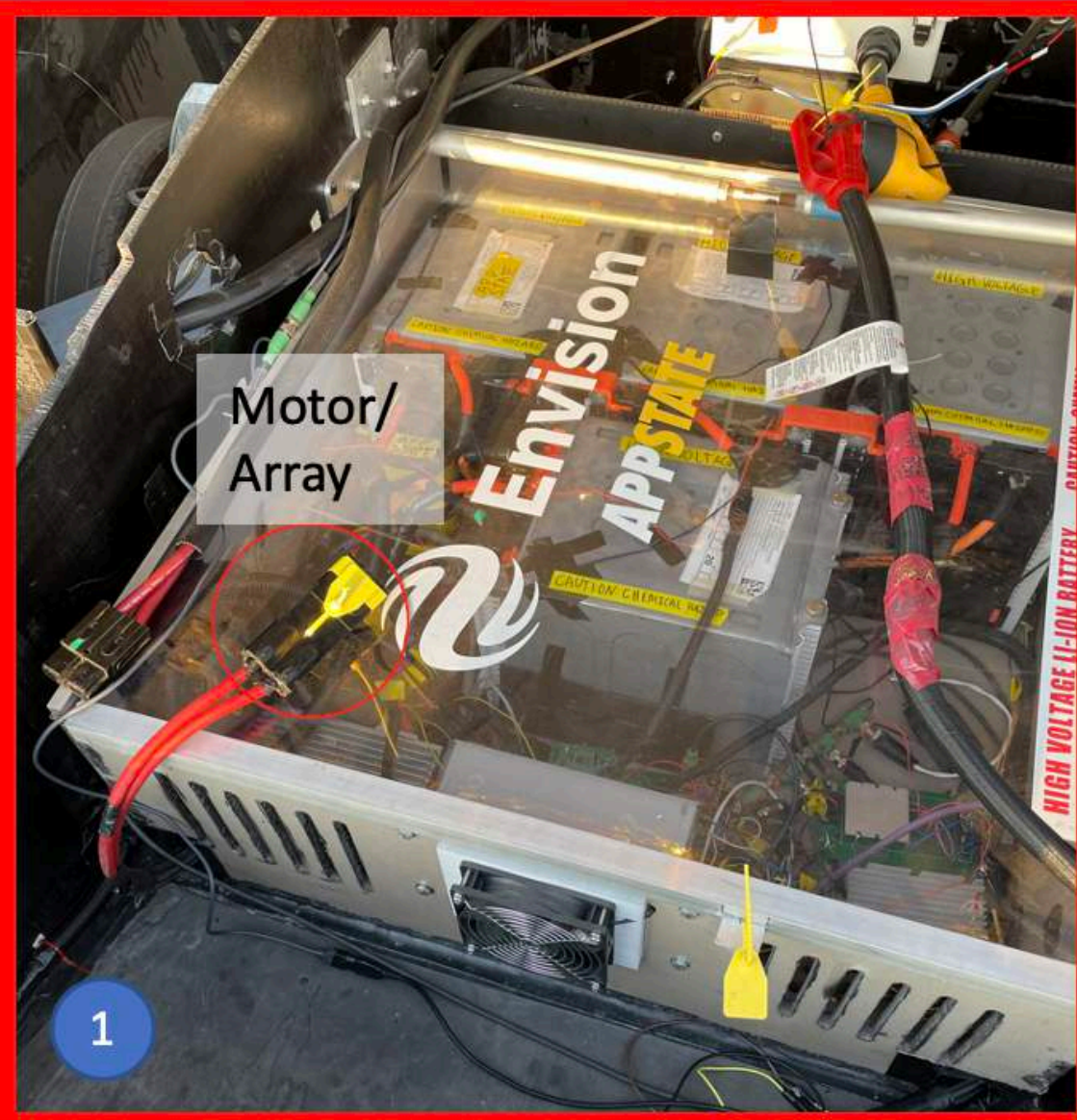


CASE STUDY EXAMPLES

EXAMPLE 1

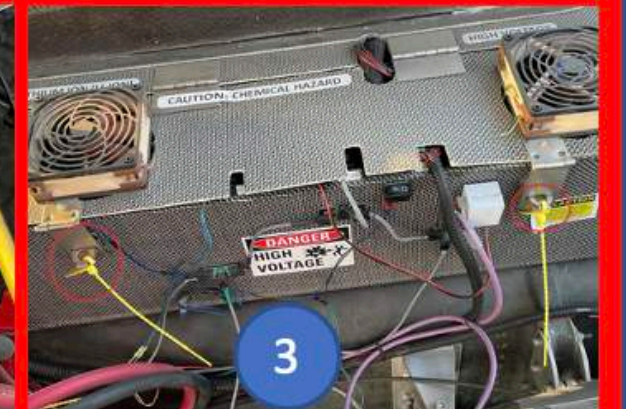
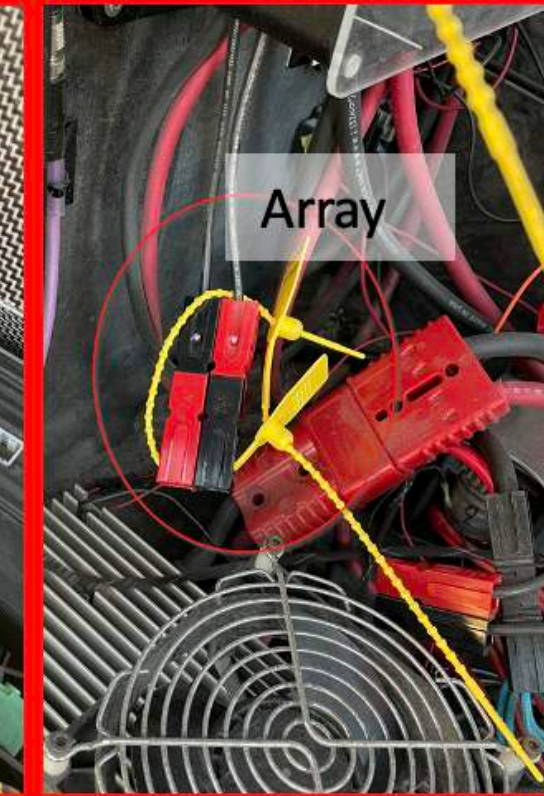
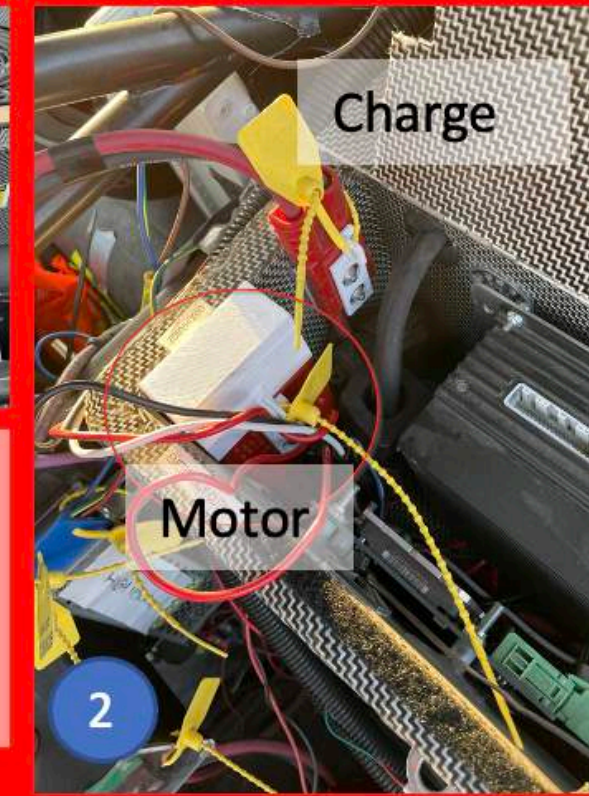
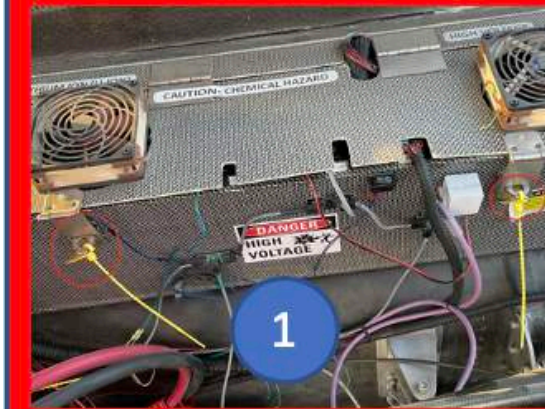
TO IMPOUND

Ensure Motor/Array HV connector is unplugged and capped. Apply security seal through the connector cap. Ensure the end of the cap is filled as shown below.



EXAMPLE 2

TO IMPOUND



Verify battery door seals are intact then cut these seals.

Reapply battery door seals.

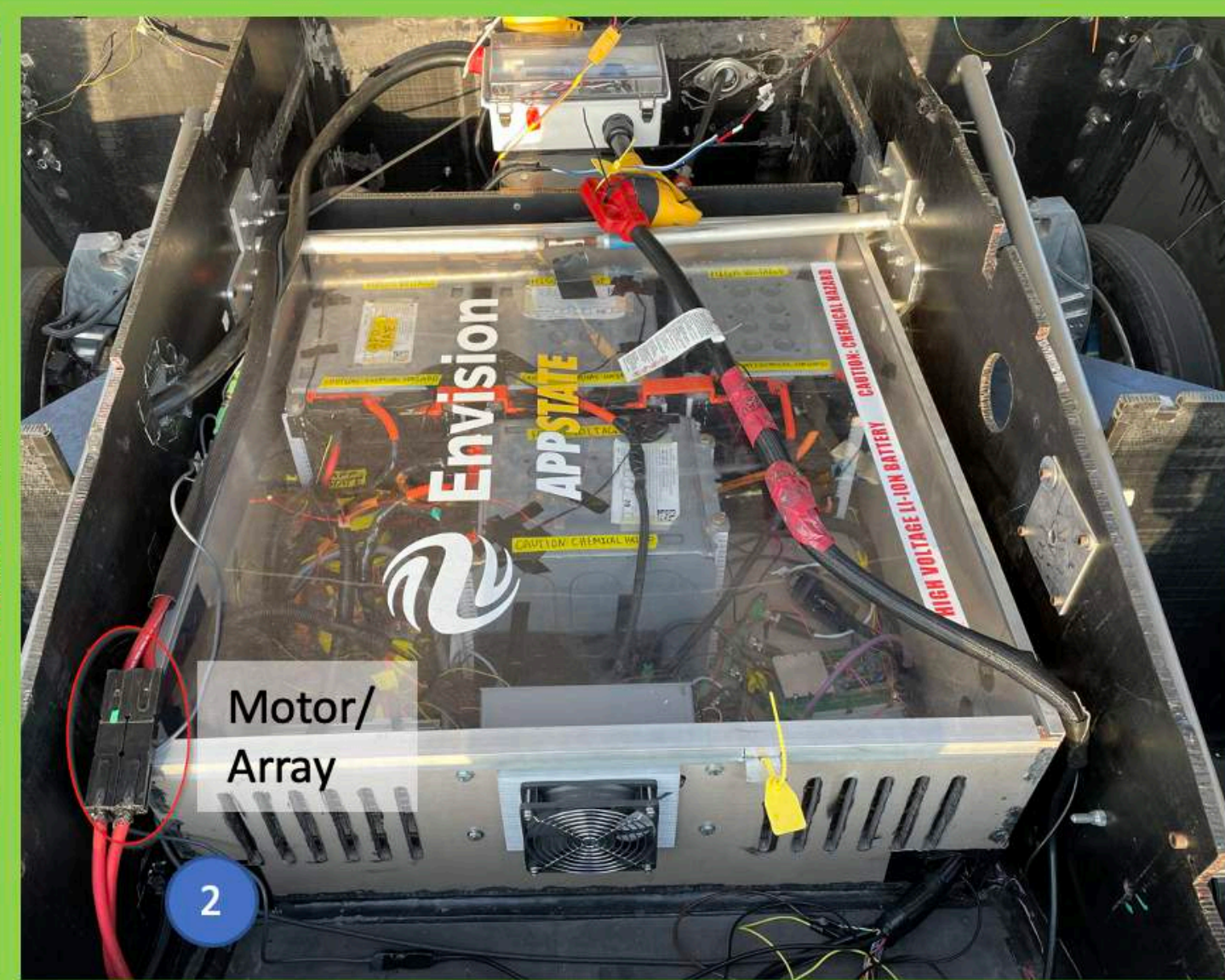
Ensure Motor/Array HV connectors are unplugged, capped, and sealed. The Charge connector should remain sealed/plugged in.

TO RELEASE IMPOUND

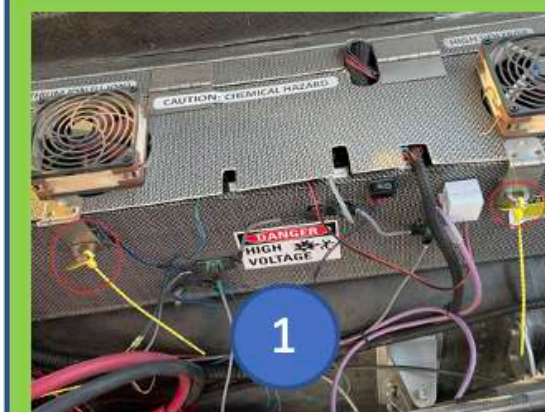
Verify Motor/Array HV connector seal is still intact. Then cut this seal.



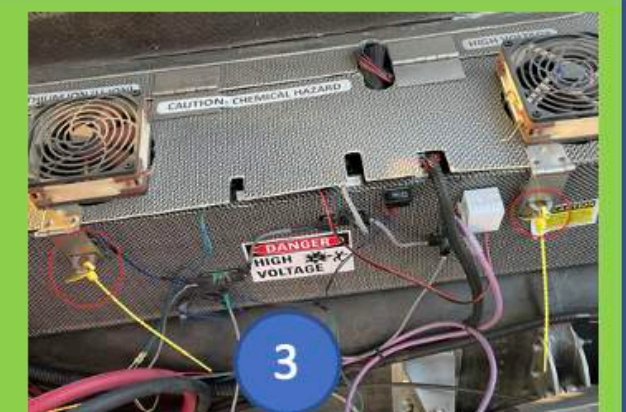
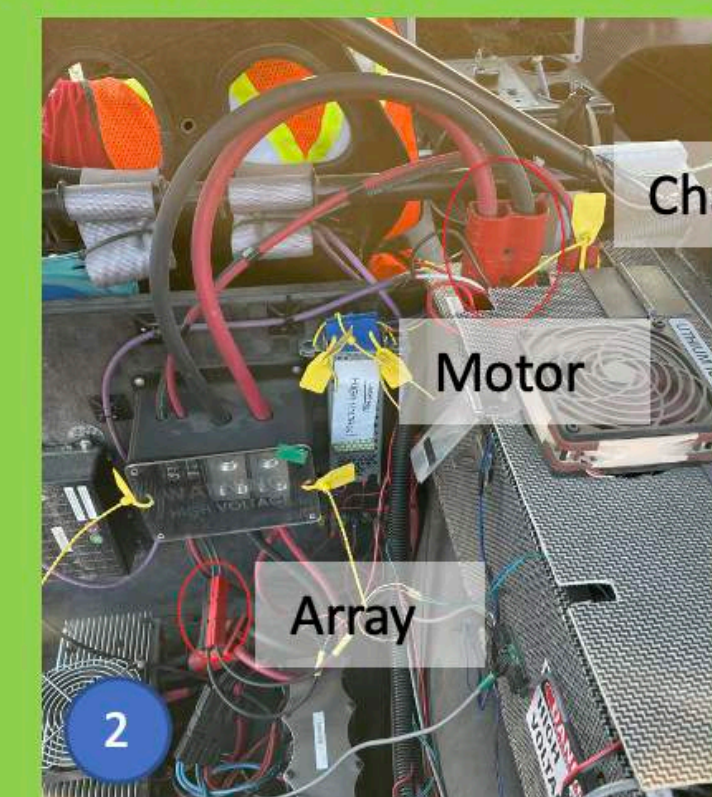
Ensure Motor/Array HV connector is plugged back in.



TO RELEASE IMPOUND



Verify battery door seals are intact then cut these seals.



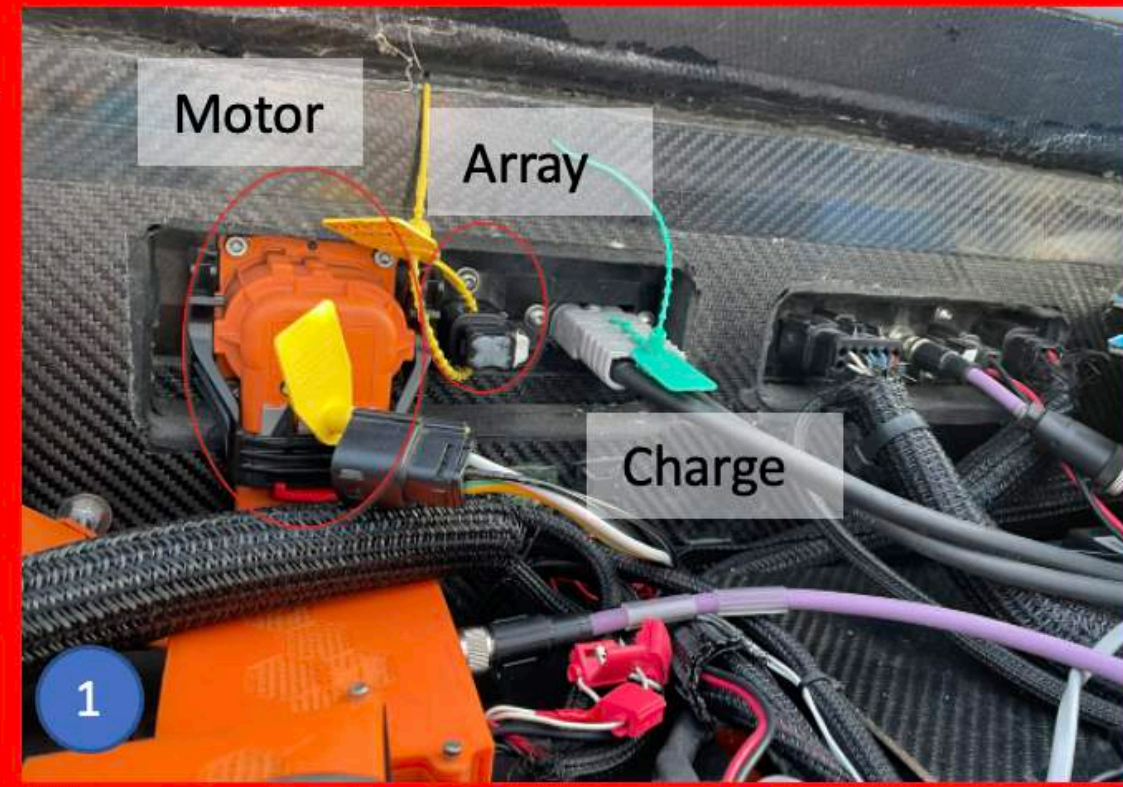
Reapply battery door seals.

Ensure Motor/Array HV connector seals are intact then cut these seals. Then plug in both Motor and Array HV connectors. The Charge connector should remain sealed/plugged in.

EXAMPLE 3

TO IMPOUND

Disconnect HV Motor and Array Connectors. Ensure that the dummy plugs are filled as shown below. Install dummy plugs on the motor and array ports. Install security seals on the motor and array dummy plugs. The Charge connector should remain sealed/plugged in.



TO RELEASE IMPOUND



Verify that the HV Motor and Array dummy plug seals are still intact then cut these seals.



Reconnect the HV Motor and Array Connectors. The Charge connector should remain sealed/plugged in.

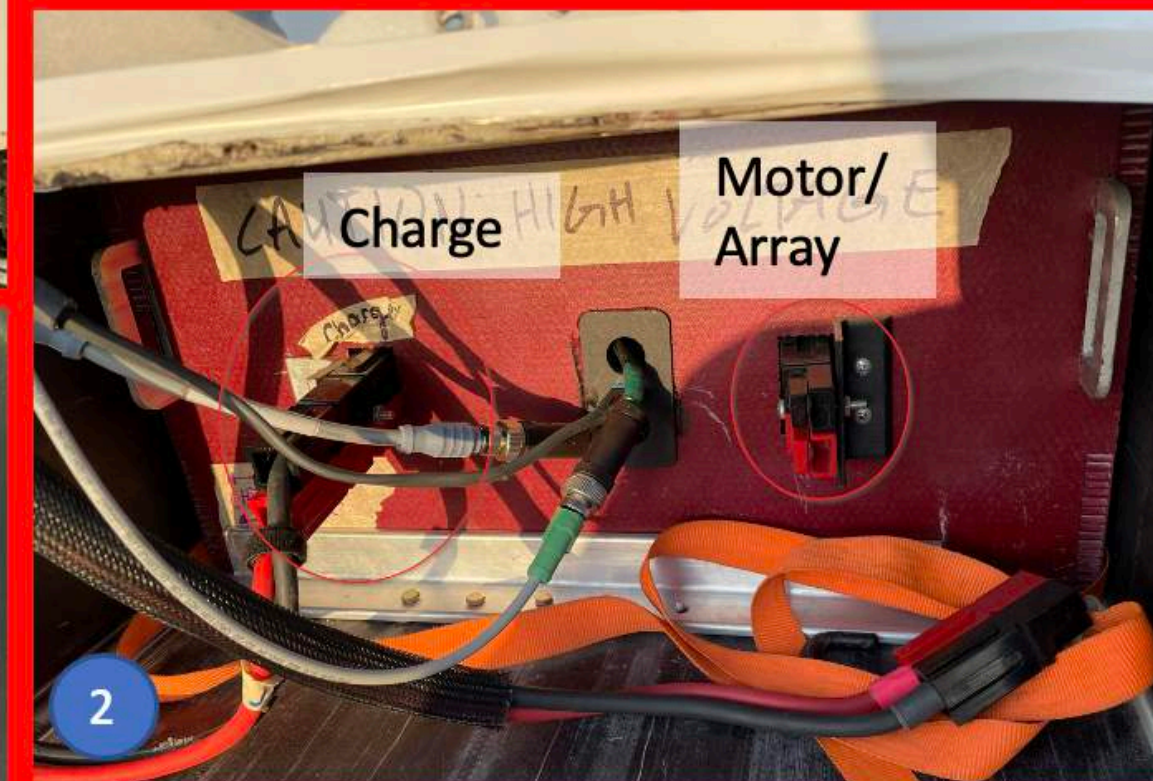
EXAMPLE 4

TO IMPOUND



1

Verify battery door seal is intact then cut this seal.



2

Ensure Motor/Array HV connector is unplugged and the Charge connector stays plugged in.



3

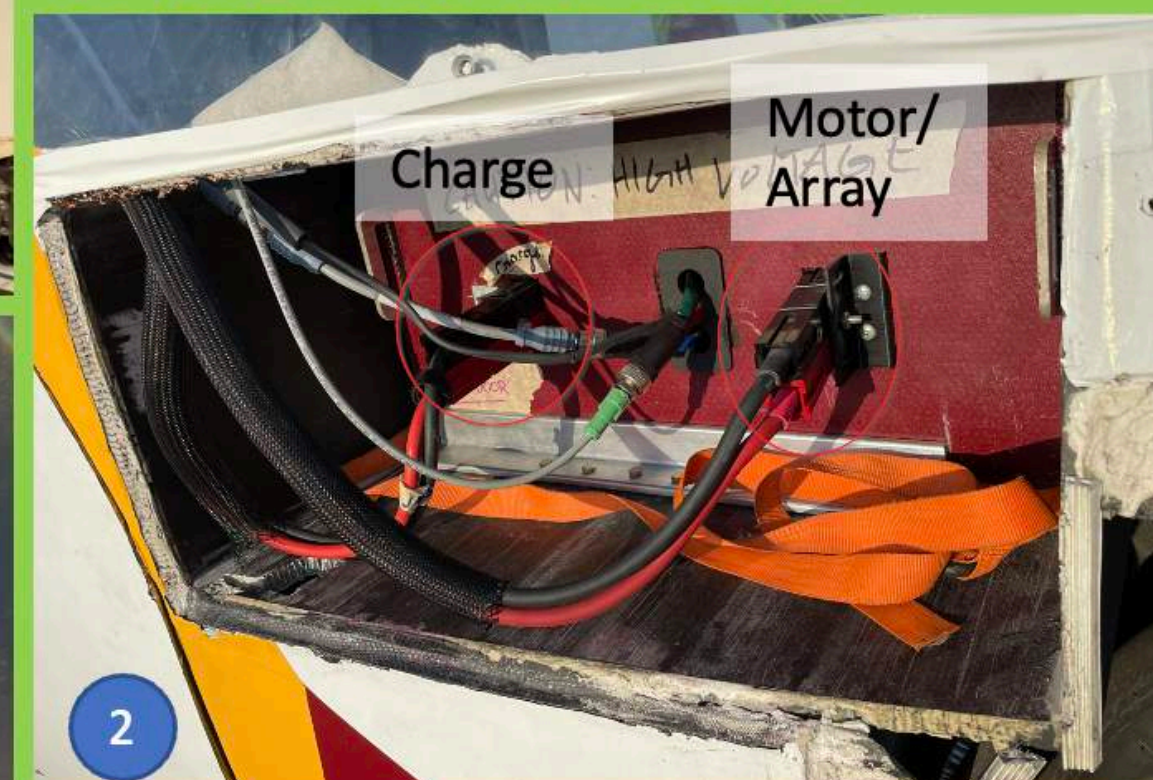
Reapply door seal and verify it is properly secured.

TO RELEASE IMPOUND



1

Verify battery door seal is intact then cut this seal.



2

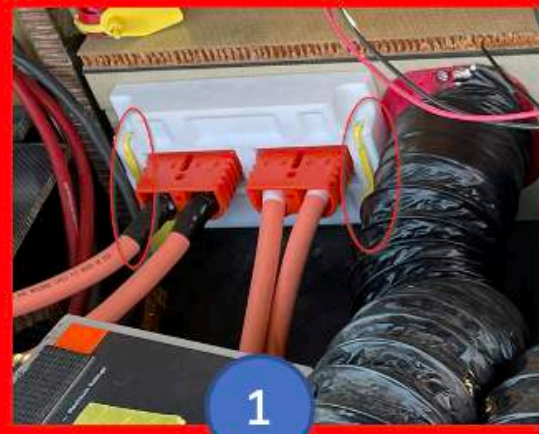
Ensure both Charge and Motor/Array HV connectors are plugged in.



3

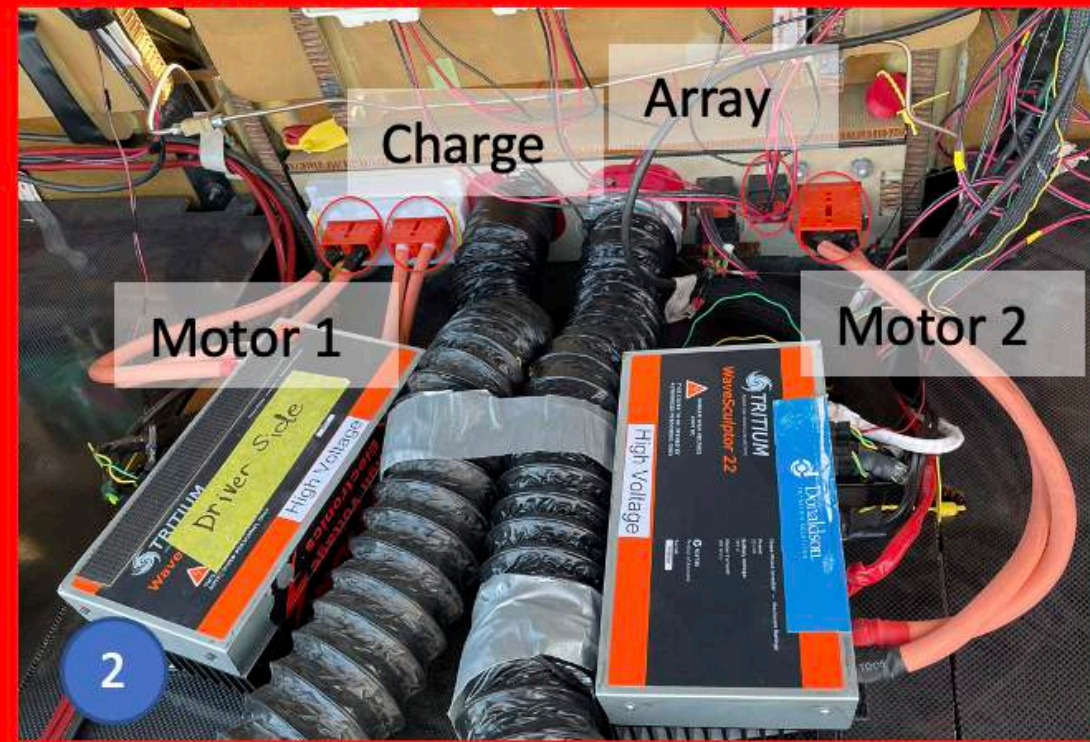
Reapply door seal and verify it is properly secured.

EXAMPLE 5



Verify that the seals for the white cover are intact and that the cover can't be pulled off then cut the seals.

TO IMPOUND



Ensure Motor/Array HV connectors are unplugged, capped, and sealed. The Charge connector should remain sealed/plugged in.



Install white and red covers to cover the Motor/Array HV ports. Reapply seals for these covers and verify that the covers can't be pulled off.

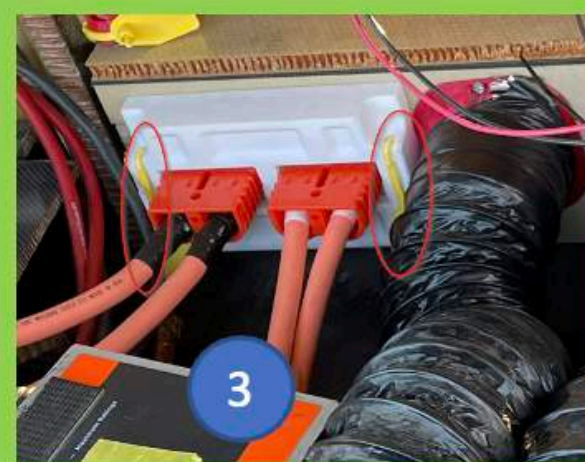


Verify that the seals for the red and white covers are intact and that the covers can't be pulled off then cut these seals.

TO RELEASE IMPOUND



Ensure both Motor and Array HV connectors are plugged in. The Charge connector should remain sealed/plugged in.



Reapply cover seals and verify the white cover can't be pulled off.



OPEN DISCUSSION, Q&A