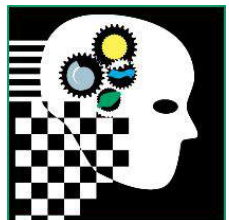


SOLAR CAR CONFERENCE

Virtual 2021



On-Road Operations

Jake Herbers (he/him)
February 20th, 2021

About Me

- ~5 years on UMNSVP
- Competed in ASC x2 & WSC x2
- Lead Navigator & Strategy Support
- Mechanical Engineer
- Sponsor Relations Manager
- Volunteer Observer at ASC
- MS in Energy Policy
- Program Analyst @ U.S. Department of Energy
- jacobherbers@gmail.com
- [linkedin.com/in/jacobherbers](https://www.linkedin.com/in/jacobherbers)
- Twitter @jakenergized



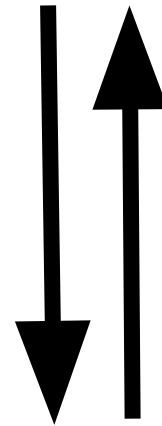
Overview

- Functional Roles
- Observers
- Radio Protocols
- Communication
- Preparation
- Caravan Driving
- Navigation
- Turning
- Traffic Dumping
- Lane Change
- Passing
- Pulling Over
- Conclusion



Minimum Functional Roles

Lead Vehicle (LV)	
Driver	Lead Navigator
	Cone Flagger



Chase Vehicle (CV)	
Driver	Crew Chief or Observer
Crew Chief or Observer	Cone Flagger
	Repair Crew

Lead/Chase Flexible
Mechanical Crew
Electrical Crew
SC Driver Support
Safety Officer

Solar Car (SC)	
Driver	Passengers?

Truck & Trailer (TNT)	
Driver	Navigator

Observers

- They write down everything
- They don't interpret regulations / route directions
- They stay in view of battery
- Driver changes / ballast
- Lights / horn / radio checks
- Safety compliance
- Penalty documentation
- Treat them well!!
- Food considerations
- Bathroom breaks
- Sleeping configuration
- Room for their luggage



Radio Protocols

- Know what channel / radio you're using, who's on it
- Plan your transmissions ahead of time, if possible
- Start talking after holding button for 1 second
- Enunciate clearly and slowly
- Describe the subject precisely and concisely
- Explicit state who you are, and who you're talking to
- "Copy" / "Roger that" / "Please repeat" / "Stand by" / "Affirmative" / "Negative"
- Avoid "stop" / "pulled over" unless intended
- Say "correct" instead of "right"
- No monosyllabic transmissions
- Hold button or 1 second after you finish talking
- Avoid immediately retransmitting



Communications

- Need clear/respected chain of command
- Avoid arguing over the radio
- Lead Navigator calls out hazards & route instructions to SC
- Crew Chief warns SC for passing vehicles
- Don't talk excessively w/ SC, unless they want jokes in the middle of nowhere
- Vehicle drivers don't touch radios - **keep your hands on the wheel**
- Keep the music low in support vehicles, and turn it off in urban areas
- Respond promptly to ASC On-Road Inspectors via CB



Prepare your Crew

- Good night's sleep for tomorrow's drivers
- Navs / Crew Chief can't fall asleep either
- Lead Driver frequently looking in rearview mirror
- Chase Driver protects SC
- SC Drivers can't have a 'tough guy' / hero mentality
- Swap out ALL drivers part way thru a full race day
- Register 3-4 SC drivers
- TNT Drivers need practice



Caravan Driving Safely

- LV <500 m ahead of SC, but >3 s ahead unless <25 mph
- CV & SC go thru intersections together, but avoid rear-ending
- Partly separate TNT route, >1 km away from all SCs unless passing
- Any other affiliated vehicles >1 km away from all SCs unless passing
- License/Regist./Insurance
- No teammates left behind



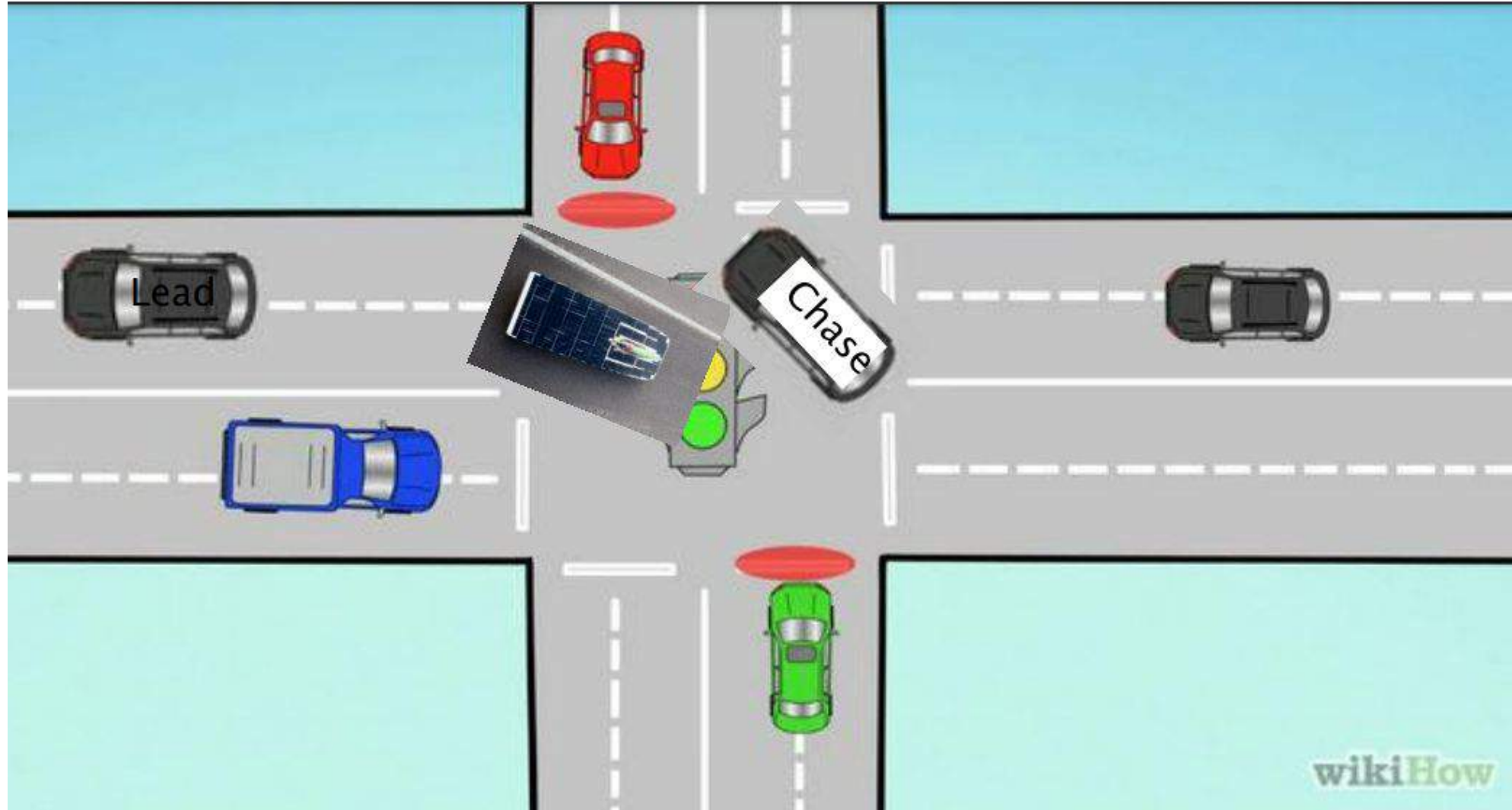
Navigation - Prepare and Focus!

Step	Trip	Int	Major Turns/Instructions	Landmarks/Notes	Ln	Spd	Shoulder	Services
A 69	63.00	1.30		Entering Greenwich	1	35	curb	fuel
A 70	63.30	0.30				25		
A 71	63.50	0.20		RR Tracks		35		
A 72	64.20	0.70				55	narrow gravel/grass	
A 73	64.70	0.50		RR Tracks				
A 74	71.80	7.10		Entering New Haven		45		
A 75	72.00	0.20	Turn left at SL onto OH-61 South	BP gas station on far right corner.	1	45		fuel
A 76	72.40	0.40				55		
A 77	73.90	1.50		Entering Plymouth		35	curb	Fuel, grocery
A 78	74.30	0.40		SL for Mary Fate Park				

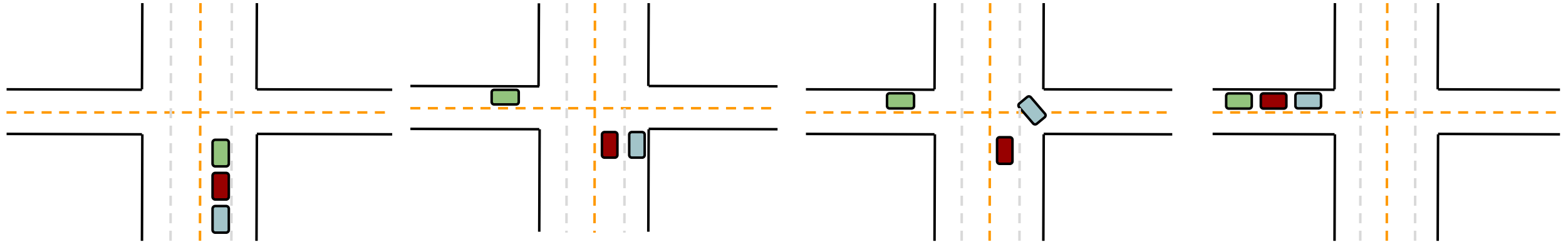


Turning

- CV blocks oncoming traffic
- CV & SC go thru together
- LV may need to block, or may need to wait, but don't block traffic



Turning



Nav: "We will be taking a left turn at the upcoming traffic signal. Currently red."

SC: "Solar car copies"

Chief: "Solar car, we will perform a chase block on your right. Please shift left"

Lead continues into intersection, and chase moves next to SC.

Lead may need to briefly block oncoming lane if necessary

When safe, Chase moves into intersection and blocks lane.

(flip chase block for right turn)

When in position...

Chase: "Solar Car, you are clear to proceed"

Solar car continues into intersection and performs the left turn

Caravan moves back into formation.

Make sure Lead doesn't get in the way!

Traffic Dumping

- Required if >5 vehicles lined up behind CV
- Not required if speed limited
- This # includes other SC caravans
- Doesn't include ASC Officials or non-caravan team vehicles
- Must find spot to pull over as soon as it's safe
- Look for passing lanes or pull-offs
- Shoulders can end abruptly
- NEVER let bogeys between CV-SC
- Ok to have bogeys between LV-SC
- Trailing team dumps first



Lane Change

- Default = right lane
- One decision-maker
- Turn signals on
- CV shifts over SLIGHTLY before SC
- CV & SC communicating without interruptions
- LV shifts after traffic clears



Passing Other Teams

- Have scout give advance notice via CB if possible
- Trailing team LV flashes headlights at leading team CV
- Trailing team Lead Nav contacts leading team Crew Chief via CB
- If multiple lanes, trailing team give notice of passing
- If single lane, trailing team requests to pass when it's safe & legal
- Leading team **must respond via CB** in a collaborative manner
- Leading team may ask for trailing team's target speed, **they must respond truthfully**
- Leading team Lead Nav radios when it's clear to pass - may need to play telephone
- Leading team **must slow down by 5 mph, or pull over** to facilitate pass
- LV passes first, then SC+CV together, ok to bogey between LV-SC







CAUTION
STUDY VEHICLE AHEAD

VHF
20

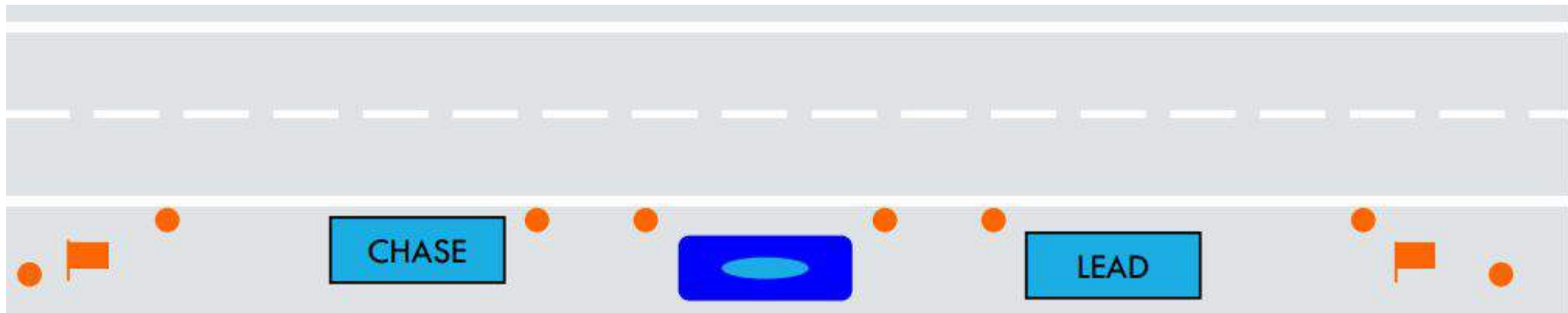
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SAT + 88164141 0306

Pulling Over

- Crew Chief should have situational awareness at all times
- Most important position: CV cone flagger
- LV cone flagger not needed if on a divided highway or 1-way street
- **Stay out of the traffic lanes** if at all possible
- Nobody else exits the vehicles until cone flaggers in position
- Cone flaggers don't break formation until everyone else is back in vehicles
- Drill your team's procedures for both simple repairs, and emergencies - & in different conditions: wide shoulder, no shoulder, hills, urban area, etc.



Pulling Over

CV cone
flagger
looking
backwards



Pulling Over

Wide pull
off
location
and good
vehicle
placement



Pulling Over

Not
Blocking
side
road
good
cones



Pulling Over

ASC
On-Road
Inspector
helping out



Pulling Over

CV protects SC, and LV nearby to help but tires should be pointed towards ditch



Pulling Over

Good
position
but raise
that flag



Pulling Over

Good vehicle placement but flagger should be in front of LV and don't use road side doors



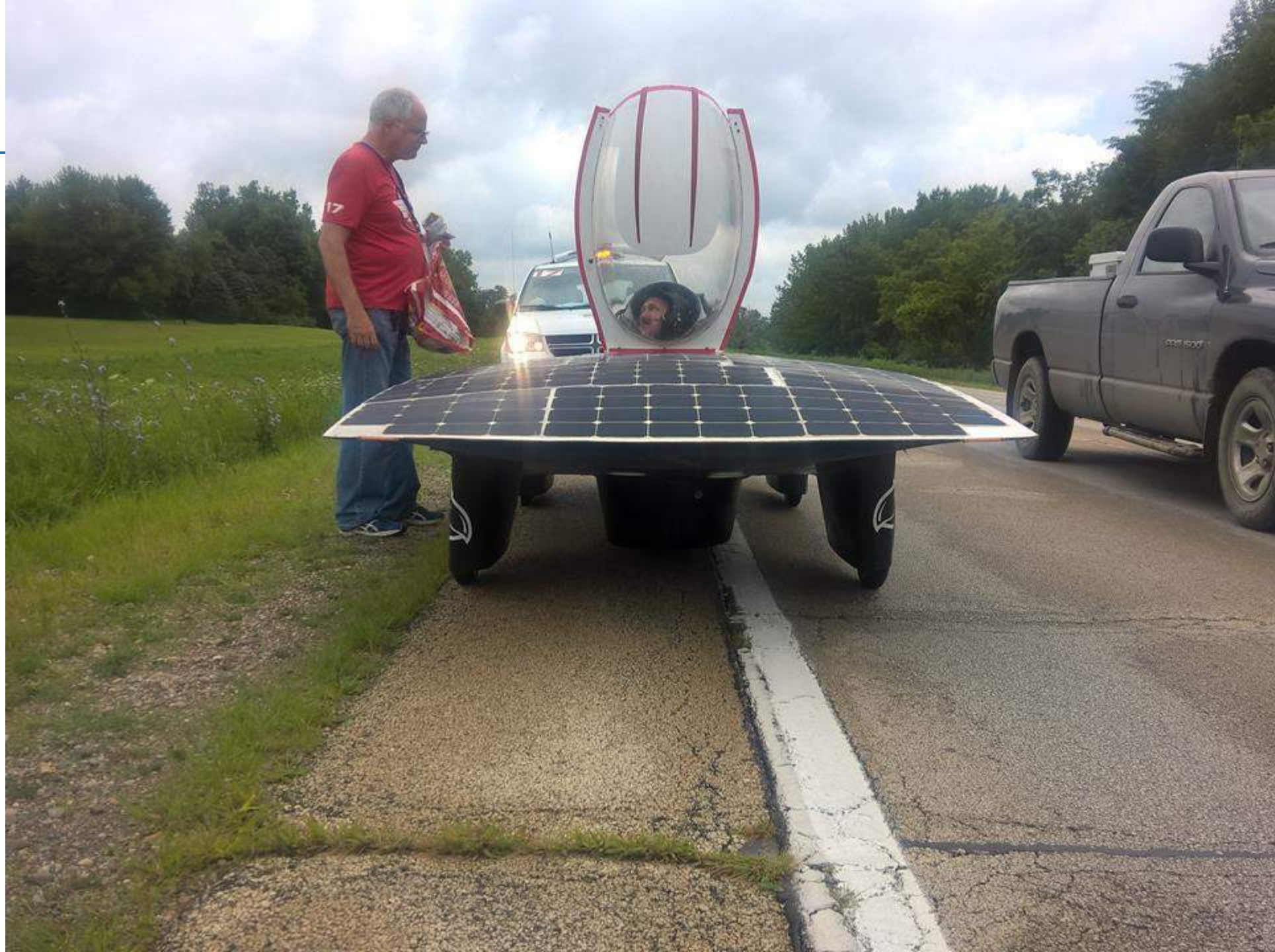
Pulling Over

Situational
Awareness



Pulling Over

Situational
Awareness



Pulling Over

Wide pull
off
location



Pulling Over

Bring in
TNT if
needed



Pulling Over

LV cone
flagger
keep your
head on a
swivel



Pulling Over

LV too far
into road



Pulling Over

Don't
block
side
roads
also
where
is the
flagger



Pulling Over

Blocking
side road
without
protection



Pulling Over

Blocking
side
road



Pulling Over

Move it
to the
grass if
you're
going
to be a
while



Pulling Over

Bathroom
break but
where are
the flaggers



Pulling Over

Situational
Awareness



Conclusion

- Safety First
- Read The Regs
- Read The Route Book
- Plan & Coordinate Communications
- Situational Awareness
- Good Sportsmanship
- Practice makes perfect

