LAFAYETTE COLLEGE

Electric Formula SAE 2019-20

Easton, Pennsylvania 18042-1775

FSAE Electric Formula Car Meeting Minutes – 3:10, AEC 429, September 10, 2019

Scribe: Simone Khalifa

Attendees: Leah, Simone, Connor, Clement, Alicia, Zhengxie, Tiger, Austin, Dwayne, Phil, Maureen, Tim, Jordyn, Jon, Zach, Dan, Carl, Noah, Gabe, Monserrat, Nick, Michael, Luc, Cat, Jack, Prof. Nadovich, Prof. Helm, Prof. Sajadian

Preliminary Design Review

- Ask Questions when they come up. Our meetings are the time to communicate.
- Need to discuss testing with system engineering team
- Add slide number and name of presenters
- Should know the rules

Our Goal

- With the proper schedules, we have the tools to succeed

Team Structure

- Decided on four system engineers to have someone to lean on when one is absent
- Update website with minutes later today

Subsystem Breakdown

- Subsystems to work efficiently and delegate specific tasks
- Everyone's strengths being used to max potential

Division of Labor

- Need assignments for system level testing, cooling system, forms for competition, dyno
- Torque RPM measurements of motor from SCADA and Drivetrain

GLV

Goals

- Big Goal: GLV/TSV Isolation--falls more under TSV
- Small changes to safety loop- missing BMS faulty loop
- Didn't make revision for breakout board. Left schematic but no KiCad file--contact Max

- New enclosure left--needs a few adjustments. Will work with Nick
- Purchase spare power supply and BOB as backup
- Replace short power cooling system--has been struggling to supply power
- If time allows, GPS and other features for bonus points

Diagram

- Need to redo GLV subsystem diagram. Use safety loop diagram as a model.

Mechanical Design

- New mechanical design with locking system so no unscrewing necessary
- Is there a place where this fits on the car? It's a weird shape.
- Two small boards within massive container--is there a way to shrink it down? Try to minimize volume and air space to make for easier mounting.
- Volunteer from MechE team to assist in redesign of container
- Value time most. Don't always have to build--could buy a case that is water resistant, but must pay attention that it meets all of the requirements and adheres to the rules
- Suspension needs to build mounts in the back
- Beware of using metal latches and fasteners on non-conductive materials when choosing box

WBS

- Nothing should be due March 10th-- choose earlier and consider interdependence
- Didn't have proper fuse for grounding connector
- What are the steps you need to take to complete the task

Budget

- Sent inquiry to company that makes battery for cost, can find it cheaper
- Missing connectors as budgetary item

TSV

Goals

- Many issues with rule compliance. New enclosure design and AMS
- No proof that system from last year is functional
- Ensure isolation within packs--remove metal bar that isolates GLV and TSV
- Standardize fasteners and parts (applies to rest of the car as well)
- Rapid cell replacement- if issue arises at competition, we are able to replace. Not as much of a major concern because we shouldn't *need* to replace the cells. More important to be able to replace the fuse or get to AMS to reprogram. General maintainability is important
- SOC is vital in balancing cells effectively so they do not die. After you charge the packs, SOC should display number around 100%, after they discharge a number around 0% should display, SOC shouldn't discontinuously jump erratically
- Not changing high level design
- Pretty much same AMS architecture with CellMen, SegMen, and PacMen.

- Will design for charging relay on each pack--increases budget by $1700-do we want this?
- Could use insulated metal conductor wires but need to investigate with judges in next week
- Insulated box within box of enclosure--design review Friday

  Budget
    - Will revisit $2500 for PCBs--misinterpreted website pricing
    - Cannot run two 1kW power supplies at one time in wall outlet
    - May want to consider building a prototype pack before constructing other two
    - Will try to make packs removable--need to be aware of rules for charging, insulation, AIRs, etc. (additional indicators)
    - Need aggressive date for prototype
    - Tim had discussions with chassis about space and we have plenty of room, but we do need to discuss mounting

Interconnect

Goals

- Structural Design has issues with water
- Cable tester to verify cable connections
- Work with mechanical for system integration, mounting, installing

Diagram

- Spent a lot of time looking at the actual system, but it is messy and hard to deal with
- In addition to electrical high level, we need physical objects noted in mechanical design
- Plans on updating diagram weekly--it is very important

Budget

- Low estimate for new cables which are incredibly expensive
- DT connectors are costly

TSI

Goals

- Enclosure-compact, accessible, waterproof, strain relieved
- Redesign new TSI board- resolve issues from last year with precharge, discharge, high voltage
- Firmware basically done--need to check logic
- Work with SCADA to make sure data communication is correct

Wiring Diagram

- Need to standardize convention for diagrams across all subsystems
- Make numbers and pins consistent with interconnect, top-level diagram

Mechanical Drawing

- Decreasing size of board and reducing spacing within enclosure

- To pass rain test, TSV and GLV need to stay isolated (motor power terminals)
- Likes that connectors are gathered on their own plate--use as a general rule to avoid redoing cases
- Look into rules and concerns regarding pumping water into TSI

WBS

- Need a high level WBS that is readable in a powerpoint (for each week)
- High-Level gantt chart

Budget

- Single TSI board costs roughly $320
- Make a spare board in addition to two final boards and two test fixtures
- Try to leave most of old TSI and GLV intact for as long as possible. Build a new one without taking apart old one-requires new IMD and CAN isolator

SCADA

Goals

- System overall works pretty well, Need to work on automation, calibration and accuracy
- Want to design test fixture. Run code before pushing it to the car
- Data stored in database, want a processor to make info more readable
- WIll be improving on system that already exists

Diagram

- Working individually on things that need complete reworking

WBS

- Expect to have certain features completed by certain dates (monthly feature)
- What features will be available when so team knows when to expect them

Budget

- Separate system outside of car for SCADA to run tests
- Raspberry Pis get hot

Mechanical Systems Overview

- Need a better layout of where everything will go. Need to decide on mounts and layout to avoid interferences. System Engineers
- Go over weekly high level goals
- Chassis is responsible for mounting things to the car--should they cover cooling?
- TSI said they would cover it--have drivetrain and chassis cover it (*specify assignment*)
- Suspension connect wheels to cra
- Drivetrain powers back two wheels
- Impact attenuator falls under chassis
- Driver’s feet kick wiring near pedals, dashboard wiring easy to rip out and break

- Think about what isn't shown--many buttons and switches. Where will they go? Define placement of EVERYTHING early on
- Can only bend cables by a certain amount--may need longer cables to bend. Figure out their connections to adhere to the rules
- Firewall has to hover over the system due to cables--maybe find a neater alternative

Chassis

Goals

- Firewalls to protect driver will be complicated due to bent pieces
- Cockpit needs to be widened--will cut out and bend four pieces (an inch out in each direction), support beams required, create new members and weld back together--will be designed and sent out in next week

Diagram

- Mount seat with comfort and ease of access
- Redesign floor for chassis

WBS

- Mounting will be an ongoing process. Dependent on other systems (*other groups should coordinate with chassis)
- Seat mounting is an early priority
- Slight problem with steering to work on

Budget

- Unsure about manufacturing costs
- Will be manufacturing a lot in house

Suspension

Goals

- Building off of many previous designs--look at what is structurally sound
- Will work with chassis on mounting system for push-rod/bell crank. Need new design that gets push crank around upright bar
- Spherical bearings were a major issue last year
- Many mounts are unsturdy-moving back and forth
- New A-Arm plate design

Diagram

- A lot is manufactured for new car including front uprights
- Tubing diameter for a-arms and push-rods was changed so plates don't fit as they should
- Many cups with many different screws can be consolidated into one
- Holes going to damper are different sizes than holes for rockers--may want to consider eliminating push rod and going instead with a shock bearer

WBS

- Lots of overlap with chassis
- This week's plan is to take apart the car and find parts to reuse
- Waiting on drivetrain to decide on half shafts
- Rolling chassis includes brakes, suspension, steering, but not motor (by end of semester)
- Testing: suspension travel and other parameters can be measured once on car
- Dynamic testing-could we use SCADA to assist in this? Most can be done in the shop
- Measure the roll and accelerations of the car actively, multiple times to create useful info
- Put numbers on data to make decisions on what can be added and what can go (anti-roll system)

Budget

- Welding cups to avoid welding spherical bearings themselves
- Reusing brakes from last year, but getting new brake pads, etc.
- Will reline the whole car
- Steering just needs some stuff with control rods and other adjustments

Drivetrain

Goals

- Left with solid base to work off of. New motor mount with differential.
- Fasteners holding in mount were not compliant at all- no lock nuts or safety wire. Clearance issues will be resolved with helicoils
- Cooling System- motor has two ports for cooling fluid. Will get radiator cooling fan
- Housing to relieve stress and seal from water
- Guarding for spinning parts
- Test parts built last year so they do not fail
- Install half shafts and hubs to fit in

Diagram

- Sprocket is attached to differential adaptor with nuts that barely clear
- Will determine if gear ratio is correct after getting info from SCADA (can approximate-motor controller is very efficient so analysis can be done now)
- Sprocket sits on shelf nicely and is centered, need to guard the chain
- What is the mass of the car? Need that info before determining gear ratio
- Last year's differential adapter got hammered into place--need help from Rob to remove
- Some sort of guard around the motor to protect people working on the car
- Avoid a pinch point but this runs the risk of getting a rock stuck in between
- Nick did analysis of gear ratio last year-- should be rechecked but it was done nonetheless

WBS

- Some dates may be pushed back a bit--greater undertaking

- Lots of stuff that hasn't been taken into account for the system as a whole-we depend on one another

Budget

- Misc: tubing and radiators
- Need to determine highest temperatures before we make calls on radiators
- Half shafts seem to be overpriced--overestimated to be cautious

Overall Budget

- Every budget has been overestimated so number is subject to go down