# NU Racing’s 2025 MCHA Team Scopes/Projects

This document contains the preferred amount of FYP Scopes and Directed Projects for NU Racing 2025’s team.

Assumptions:

* Number of FYPs: 5
* Number of Directed Reading/Extracurricular: 2

FYP Scope contain:

* Starter project
* Scope for the year

Directed Reading/Extracurricular Projects contain:

* Scope for a semester project

## FYP Scopes and Starter Projects

* Data Engineer– FYP
  + Starter Project
    - Read Jackson’s report
    - Read Nick Lyall’s report for amplifier circuit for wheel speed sensors
      * Read datasheet to see if this circuit is needed at higher revs, as Nick discovered this using a 3d printed mount to imitate a wheel
        + Failing datasheet retrieval, attempt to use Nick’s set up with a drill to see if higher revolutions can be achieved.
    - Mount wheel speed sensors (3d printed)
      * Design 3d printed mount to attach to potentially all 4 wheels of NU24
        + So that if project is finished, sensors can be easily tested
        + Do the front two first wheel speed sensors first
    - Creation of loom to plug into EXPANSION Board
      * Pinout of OEM connector researched
      * Pinout of new DT connector correct and able to interface with EXPANSION Board
    - Wheel speed sensor data is able to be read from MoTeC
      * Create 4 messages in NU25 DBC file for wheel speed sensors (one for each wheel), with correct scaling, offset, bit length and value range
      * Implement code for wheel speed sensors on the EXPANSION Board
        + With data from wheel speed sensor sent using the message from previous dot point
      * Configure MoTeC to read and display new message
    - Deliverable:
      * Front two wheel speed sensors mounted
      * Working with the EXPANSION Board on CAN King and (hopefully) MoTeC
  + DEN:
    - Resize to chassis (might not have to?)
    - All naming of AMS to BMS
    - Change from DT 8 pin to AT 8 pin keyed connector for CEN connection
  + EXPANSION Board
    - Size CAN lines correctly
    - Fix ground plane (not have big breaks)
    - Transfer SWEN functionality
      * Includes: dials for torque setting, switch for regen (implement a way so that the dial/switch are in the correct position after unplugging and plugging the board in)
    - Temperature sensors for radiator
      * Create loom to connect to them (already in radiator)
      * DBC file and MoTeC updates
    - Implement shock pots, wheel speed and steering angle
  + Strain gauge research/implementation
  + In charge of monitoring and managing MoTeC at track days
  + Mount shock pots and steering angle sensor
  + Work with HV Engineer for wheel speed sensors
* HV Systems-Powertrain – FYP
  + Starter Project Ideas
    - Read and understand both Hayward’s and Dawso’s reports?
    - Implement any recommendations from Hayward’s report
      * Implement pack current derating at cell/pack temperatures over 50 degrees.
        + PEN code

Use either maxsegtemp or mincellvol/maxcellvolt

Derate from the 3 degrees under the max temperature rating of the VTC6

Limit current down to ~30A under high temperatures. Shut down all current above 60 degrees

* + - Learn how to charge the car
    - Deliverable:
      * Current derate at high temperatures works as intended
        + Test to show it off could include having the max allowable temperature to be set to a low value (eg 30 degrees) and have a track day where the car is driven hard, if it works correctly, then current will be limited and cut out to the driver upon approaching and reaching the set limit
      * Know how to charge the car
  + Learn how motor controller and powertrain work – read Hayward’s report and MC preso
  + Dynamometer
    - Create Load Testing Node
    - Read Josh Dawson report on the dyno
    - Implement as much as possible for the dyno
    - If all goes to plan, will be able to test load test HV systems on the dyno without using the car
      * Mapping power curves
  + Know how to charge the car
  + Implement recommendations from Hayward’s report
  + Tune motor (big maybe)
  + Changes to powertrain due to LSD change
  + Launch control implementation/research (kind of traction control)
    - With wheel speed sensors, implement launch control on the PEN
    - Work with Data Engineer
  + Hub motor research and implementation on future NU Racing cars
* Accumulator – FYP
  + Starter Project
    - Read Daniel’s report
    - Design and commission new AIL, breakout board mounting, implement change from Ivo’s report
    - Learn how to charge the car
    - Deliverable:
      * AIL ordered (with LTspice or breadboard test)
      * Know how to charge the car
  + Service and refine the Energus Accumulator
    - Fix AMS Fault (maybe new version of CANaMons)
  + Change top plate fuse holders
  + New AIL/voltmeter
  + New LVD
    - Interpose from LVD to CEN
    - Use of IRLB3813 MOSFET for cooling circuit (gather information from CEN engineer) or use automotive relay
    - Investigate high current draw of accum fans
  + NU26 Accumulator
    - Design new voltage tap and temperature monitoring for pouch cell accumulator
    - Pouch cell testing and validation
* AV.One – FYP – Jayden Horvath
  + Starter Project
    - Read Lena’s and Sebastian Scott’s reports
      * ‘Past\_Reports’ folder within ‘Racing-AV1’ GitHub.
    - LVD rework to enable use of charger with AV.One
    - Troubleshoot DCDC
    - Deliverable:
      * New LVD ordered and found issue with DCDC
  + Implement and test 2x Raspberry HQ Cameras for stereo vision
  + Investigate use of either Marine’s LiDAR or use of spare LiDAR that is somewhere on campus – refer to Malcolm for details
  + Attempt to implement as many Autonomous Advancements as possible from Lena’s Report (section 8.2.)
    - Contact UQ’s autonomous race team on issues encountered and/or direction
      * [madeleine.warner@uqracing.com](mailto:madeleine.warner@uqracing.com)
      * [james.talkington@uqracing.com](mailto:james.talkington@uqracing.com)

## Directed Reading Scopes

* PEN/BSPD and potentially TSAL\_Discharge – Directed – Jayson
  + Where to start:
    - Read Bushy’s reports the BSPD and the TSAL\_Discharge breakout boards
    - Lukes’ report on why the resistor voltage divider was a time-consuming idea. With too many variables to account for during the commissioning process.
    - Read the section of PEN from Joshua Hayward’s report, to gain a brief understanding of the PEN
    - Read Josh Dawson’s report
      * Mainly:
        + 4.4 Proposed Modifications
        + 4.5 CAD/Schematic/PCB/Code
        + 4.6.3 Charger V1 PCB
        + 4.7.1 ECU Verification
  + BSPD
    - Remove voltage divider for C\_REF. Replace with potentiometer, as this is easier for someone to understand how to tune it correctly
  + PEN
    - Fit to pedal box
    - Add capacitors to brake sensor inputs
    - Investigate need for Zener diodes, and if possibly removing them
  + TSAL\_Discharge
    - Change current naming of red to amber on Bushy’s V3 and order
    - Potentially implement green light turning off while red is flashing
  + Charger
    - Add new HV connectors
    - Fix oopsie wire on PCB
* HIP – Directed or Extra – Mia (is ENGG3200 in SEM 2)
  + Read Jackson’s report?
  + All naming of HVD to MSD
  + New Master Switches (footprint will change)
  + HV connector interlock (part of the mech enclosure role?)
  + Change from DT connector to one that is rated for higher voltage for DCDC to HIP connector
* Directed
  + HFR
    - Implement BMS-IMD Tractive System Status Indicator fault detection circuit on this board
      * Read 2025 rules and compare them to 2024’s rules to understand the change
      * Research circuit to implement this change
      * Design circuit
        + AND gate for BMS and IMD fault detection
        + 555 timer circuit for 2-5 Hz signal generation (research correct circuit (555 timer datasheet), but ultimately use the one that is on the TSAL\_Discharge board (use DMN6140L for all MOSFETs)
        + MOSFET to switch outputted gnd signal
        + Rough outline of circuit in obsidian notes
      * LTSpice the circuit
      * Breadboard the circuit
        + Red Flash of TSSI could be just a THT LED?
      * Correct PCB to accommodate for circuit
        + Increase input/output of header pins by 1 on each side
      * Order PCB
    - Implement green light turning off while red is flashing
      * Potentially make a second circuit to account for this possibility
        + Rough outline of circuit in obsidian notes
    - LTSpice/Breadboard test
  + Deliverable:
    - HFR with working and tested BMS-IMD fault detection circuit
  + CEN Iteration
    - TSAL DT
      * Change name to UEN
      * Make it an 8-pin connector (to route new red switch ground signal)
    - Route TSAL\_GREEN\_SWITCHED\_GND (rename) to HFR breakout
  + Ready To Move Light implementation (while PCBs are on order)
    - Order and commission a light that meets DOT FMVSS 108
    - Change loom
    - Design mounting for 2x amber DOT FMVSS 108 lights on the car (one facing forward and one facing backwards (aft))