

N F P A

Fluid Power

VEHICLE

Challenge



NFPA
Education and
Technology
Foundation

FINAL PRESENTATION & DESIGN
REVIEW
University of California – Irvine (UCI)
Bob Mosey, Edgar Torres, Perry
Johnson
4/23/26



Meet the Team



**Erick
Castellanos-
Ramirez**



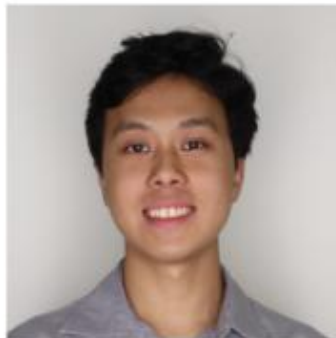
**Alyssa
Gomez**



**Henry
Nguyen**



**Alvin
Wang**



**Gabriel
Feliscuzo**



**Mart
Mojica**



**Kevin
Rivera**

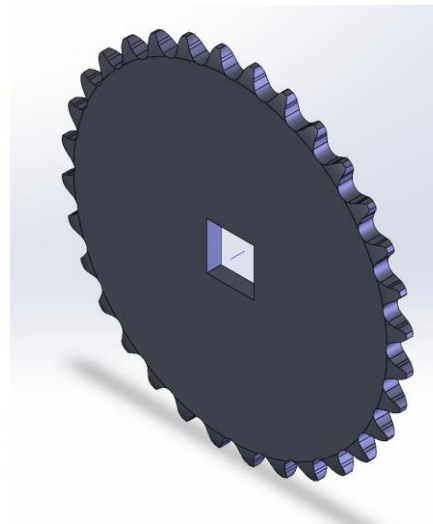
Design Objectives

Main Objective: Maximize efficiency of the vehicle

- Obstacles:
 - Limited gear ratios due to sprocket sizes that limit torque/RPM outputs
 - Large weight of vehicle (180 lbs)
 - Low efficiency of hydraulic components at low RPMs
- Solution:
 - Lower operating pressure to reduce leakage
 - Use pump/motor with greater CIRs and lower minimum RPMs
 - Use pressure intensifier to increase pressure/torque while maintaining max pump RPM/efficiency

Vehicle Components

- Mechanical
 - Frame: Schwinn Meridian Tricycle
 - Chain: Tritan ANSI 35
 - Sprockets: Tritan ANSI 35
 - Pump:Pedal -> 10:32
 - Wheel:Motor -> 19:10

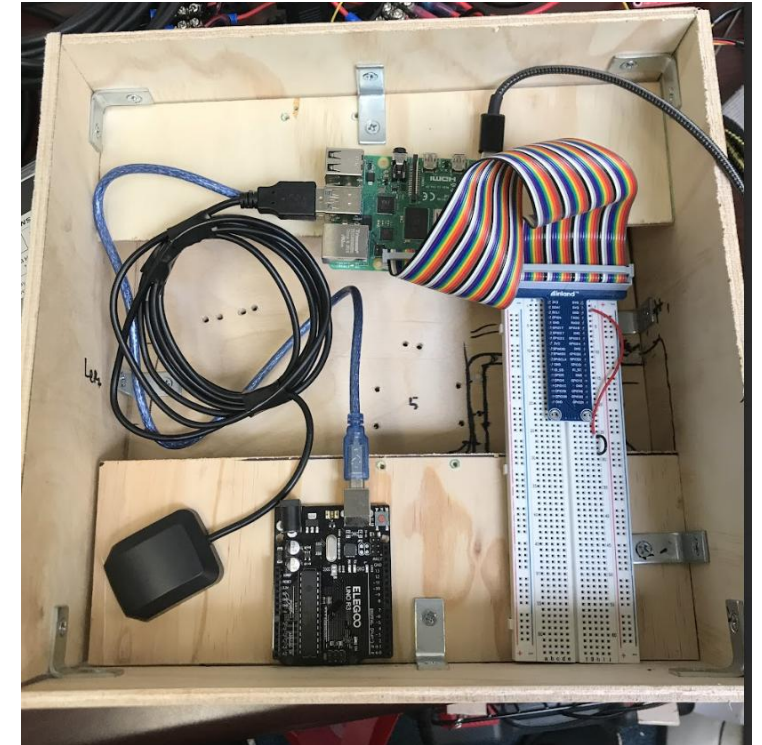
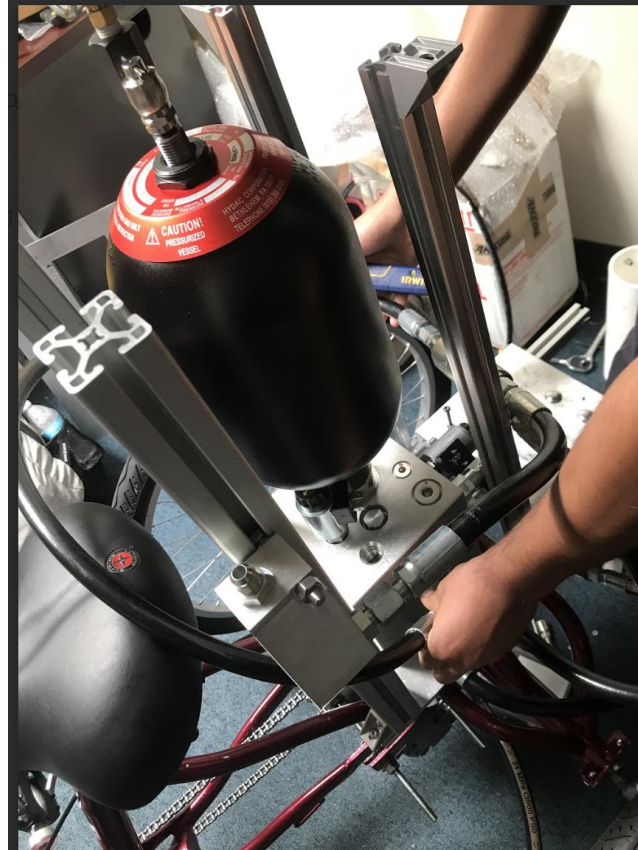


Modified bore:
*Courtesy of Moseys
Production Machinists*

Manufacturing

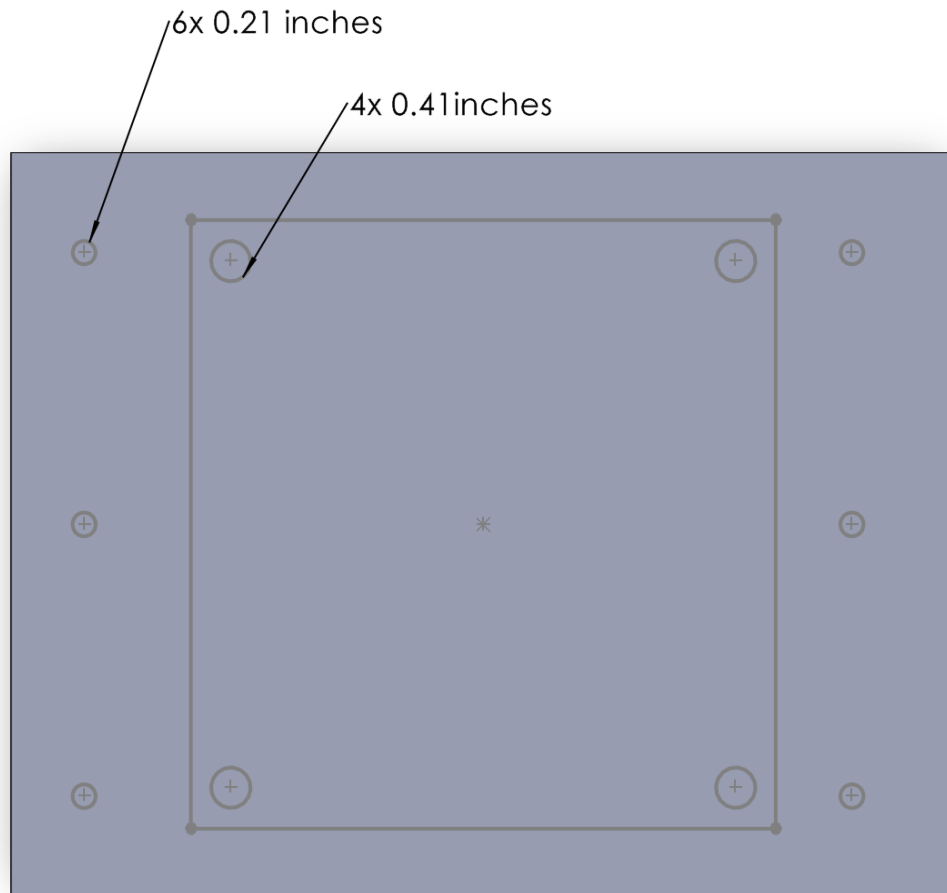
Hydraulic Mounting:
T-slot Aluminum Extrusions and Plates

Electronic Mounting:
Wooden Box plus Nylon Screws

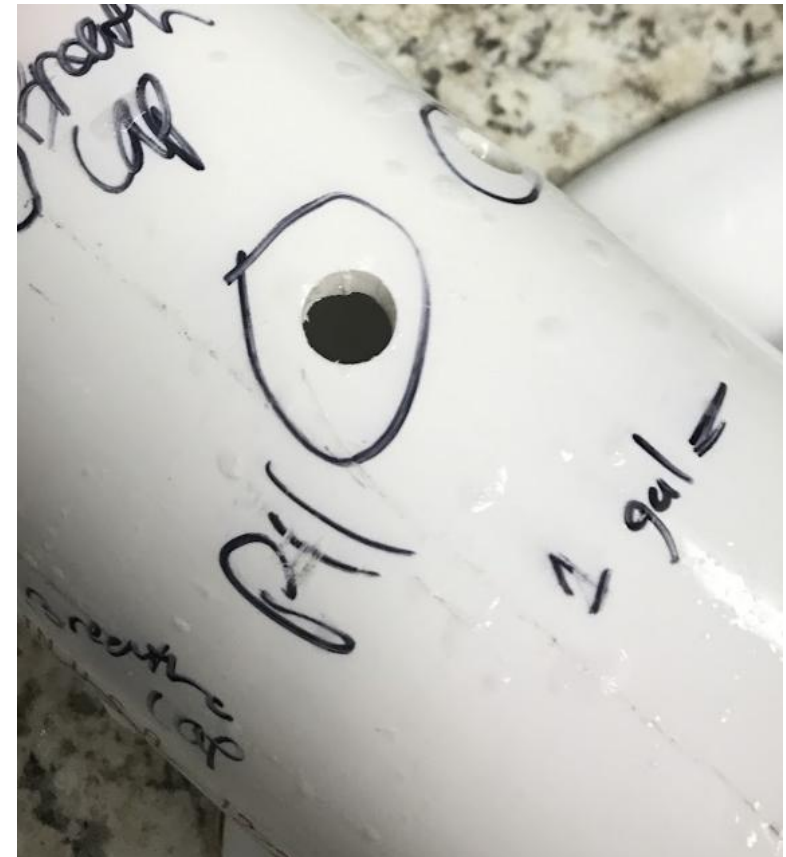


Manufacturing

- Base Plate CAD



- Reservoir

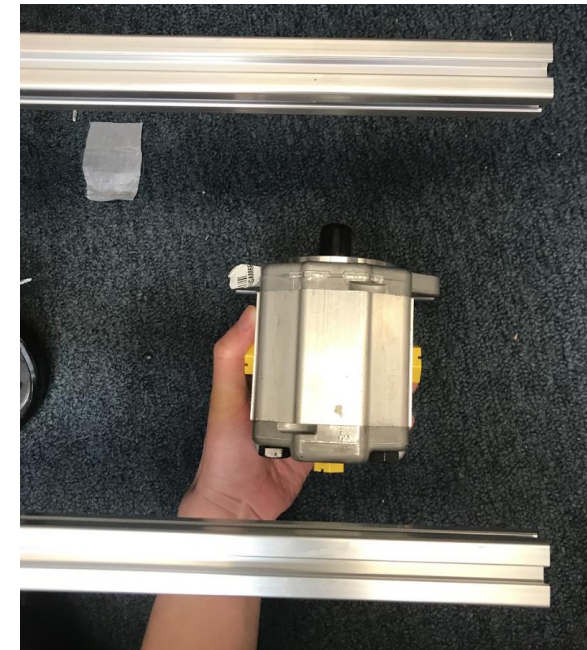


Vehicle Components

- Hydraulic



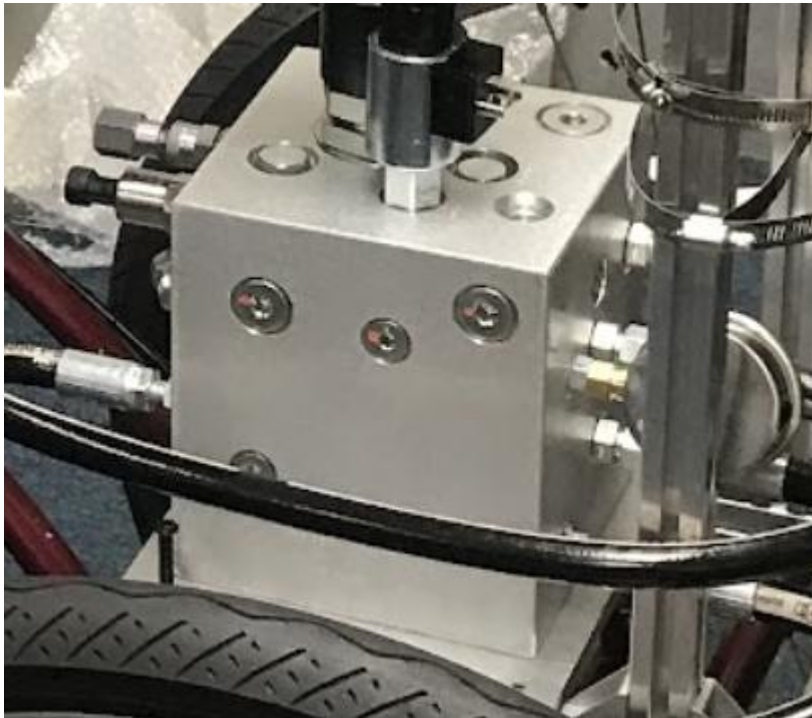
Danfoss Pump (0.66 CIR)



Danfoss Motor (1.025 CIR)

Vehicle Components

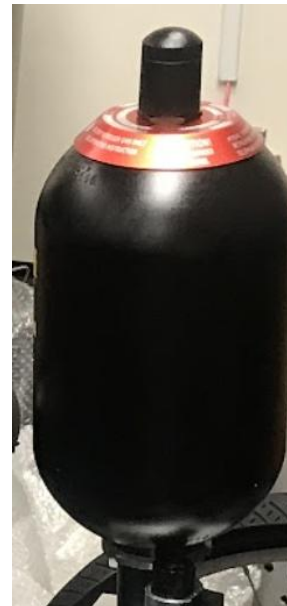
- Hydraulic



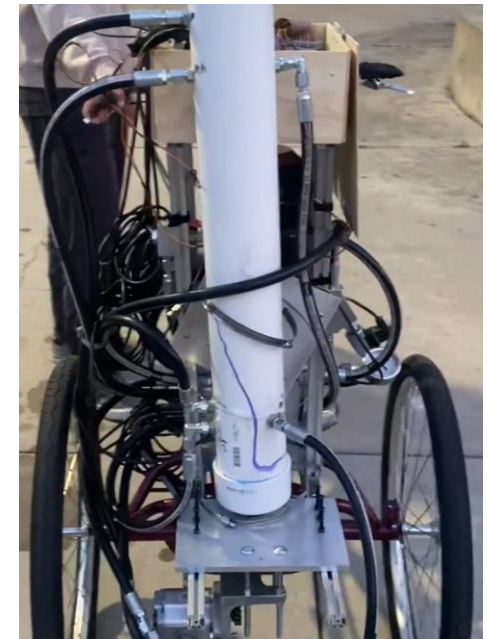
Sun Hydraulics Valves & Manifold (*manufactured by IFP*)



Parker Global Core Hoses (3/8" ID)



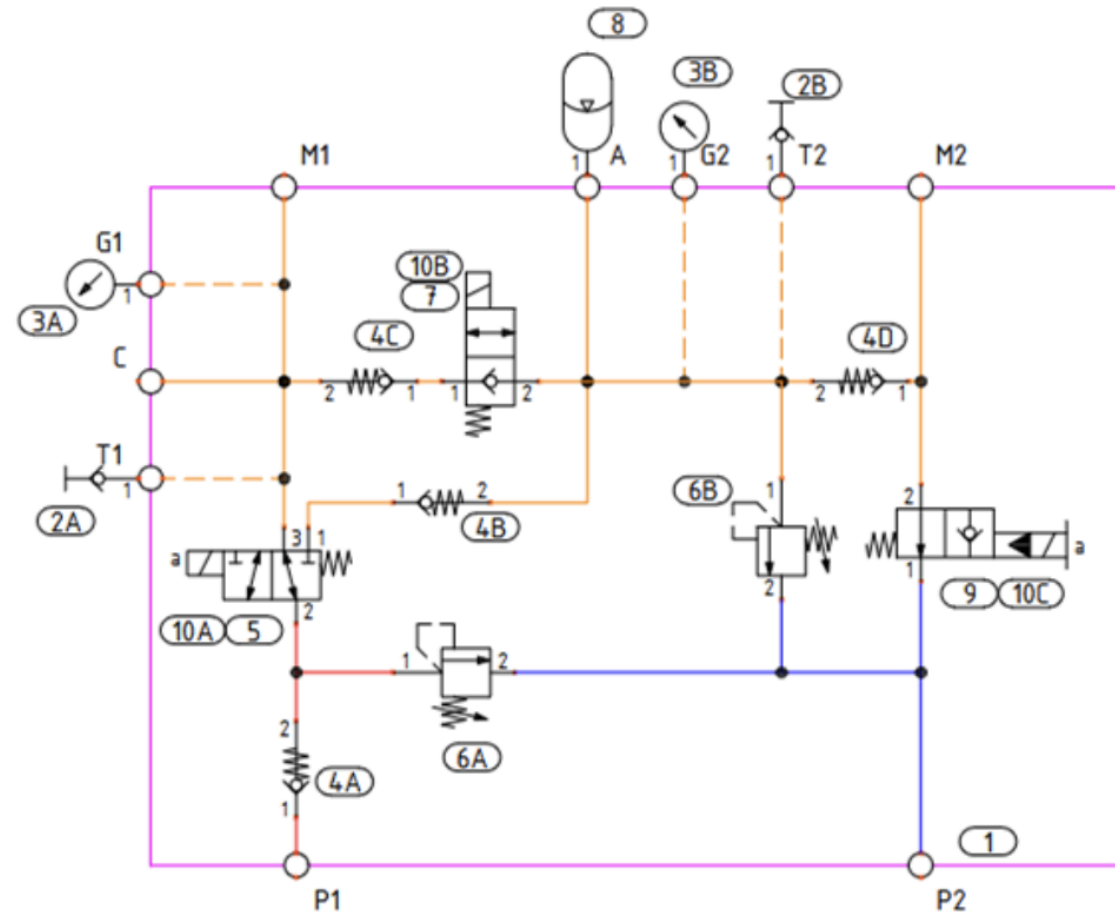
Hydac 3000 psi Bladder Accumulator



PVC Pipe Reservoir

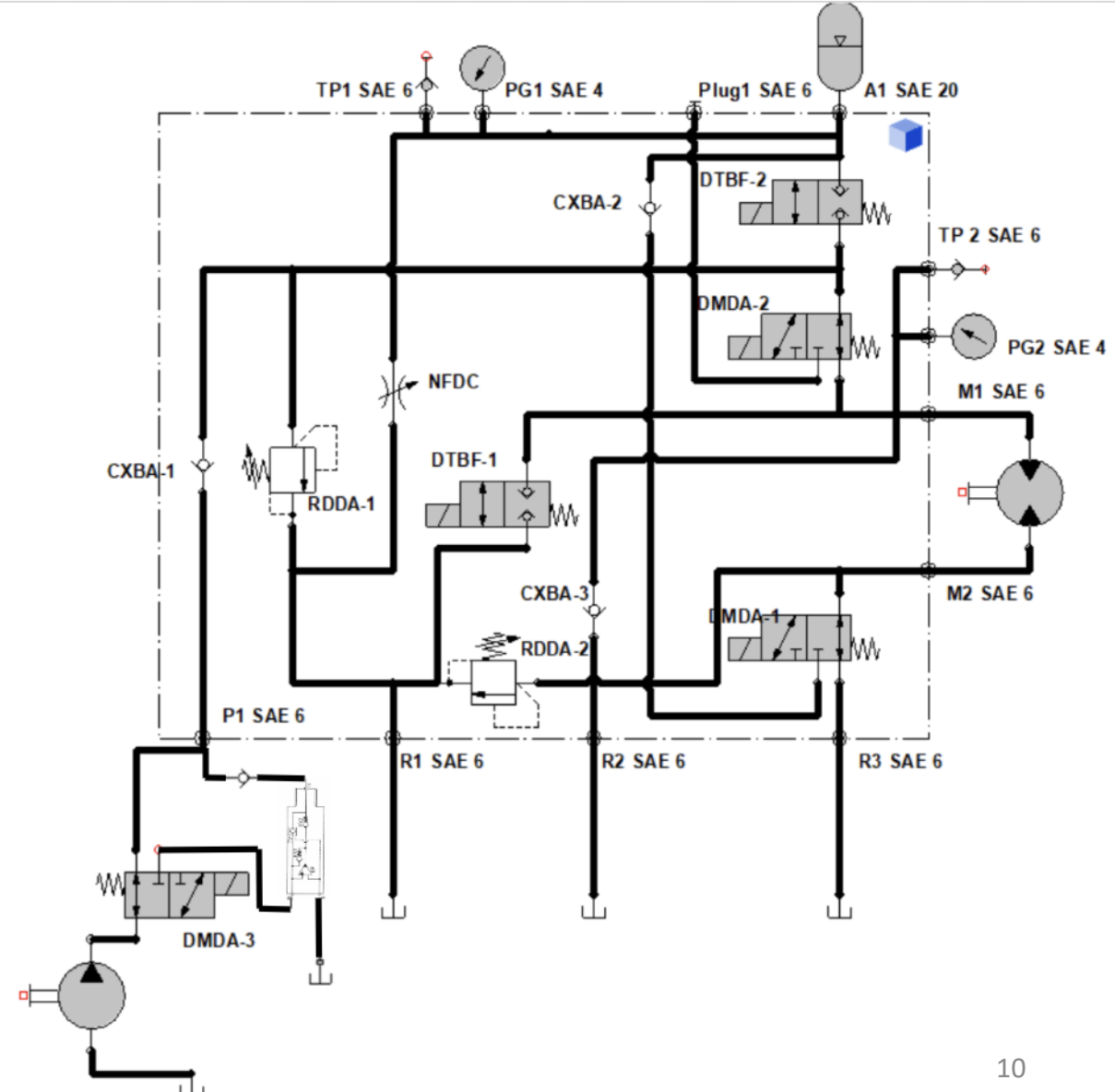
Last Year's Circuit

- 4 Drive States
 - Direct drive (Default)
 - Direct charging
 - Regenerative braking
 - Accumulator venting
- 3 Solenoid Cartridge Valves
- 2 Pressure Relief Valves
 - Main line pressure
 - Accumulator pressure



This Year's Circuit

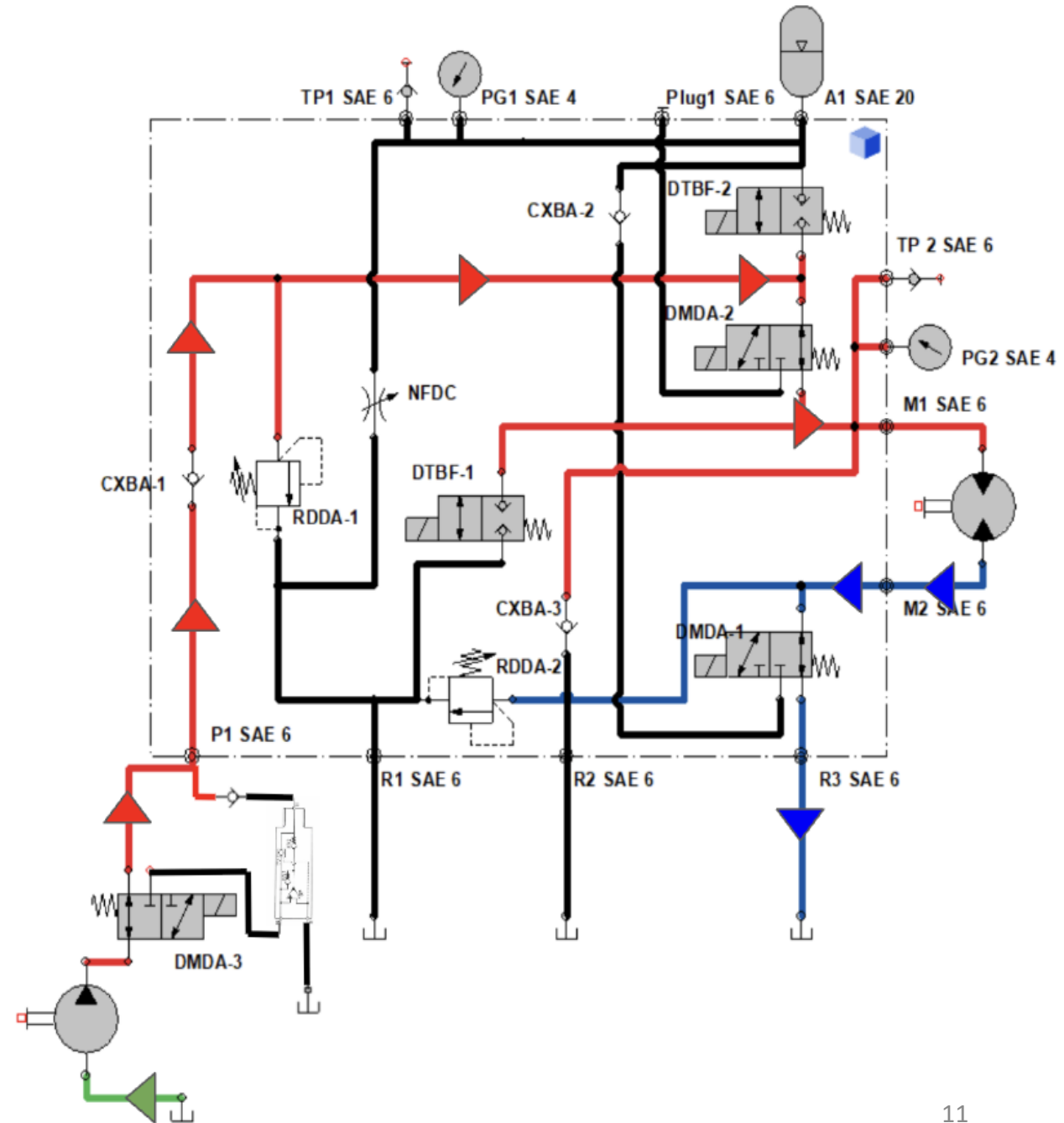
- New Additions:
 - Pressure Intensifier
 - Allows for higher pressures to be reached when charging the accumulator
 - Gets rid of need for changing gear ratios for the pedal/pump
 - 2 More Solenoid Valves
 - DMDA-3: Use or not use pressure intensifier
 - DTBF-1: “Free Wheel” Drive State



Direct Drive

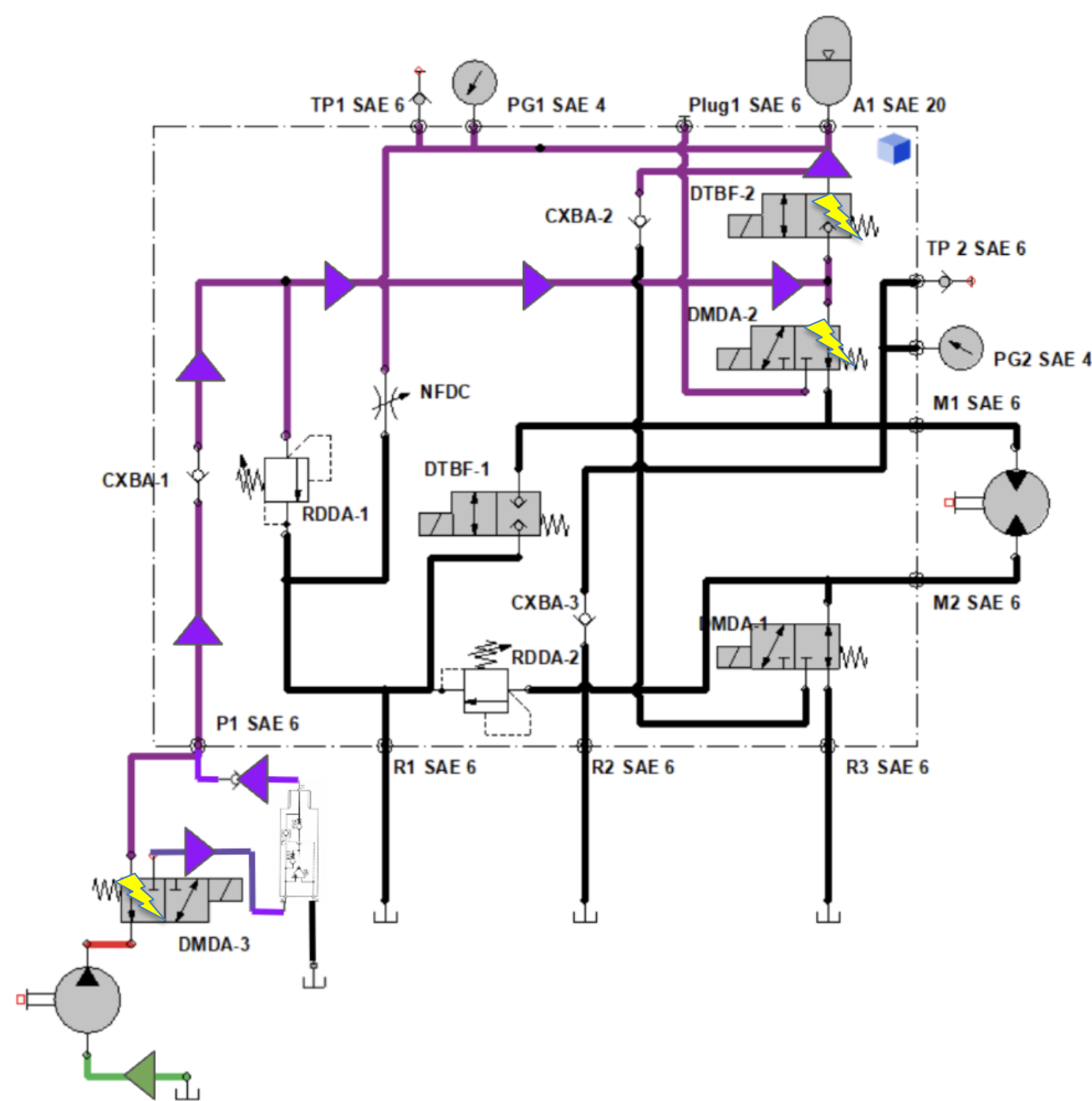
- Pathway
Pump -> DMDA-3 -> CXBA-1
-> DMDA-2 -> Motor ->
DMDA-1 -> Reservoir

No valves are energized to allow operation without electricity needed



Charging the Accumulator

- Pathway
Pump -> DMDA-3 -> Pressure Intensifier -> CV08 -> CXBA-1 -> DTBF-2 -> Accumulator
- DMDA-3 is energized, allowing oil to go through the pressure intensifier
- DMDA-2 is energized, blocking flow from going to the motor
- DTBF-2 is energized, allowing oil to flow into the accumulator

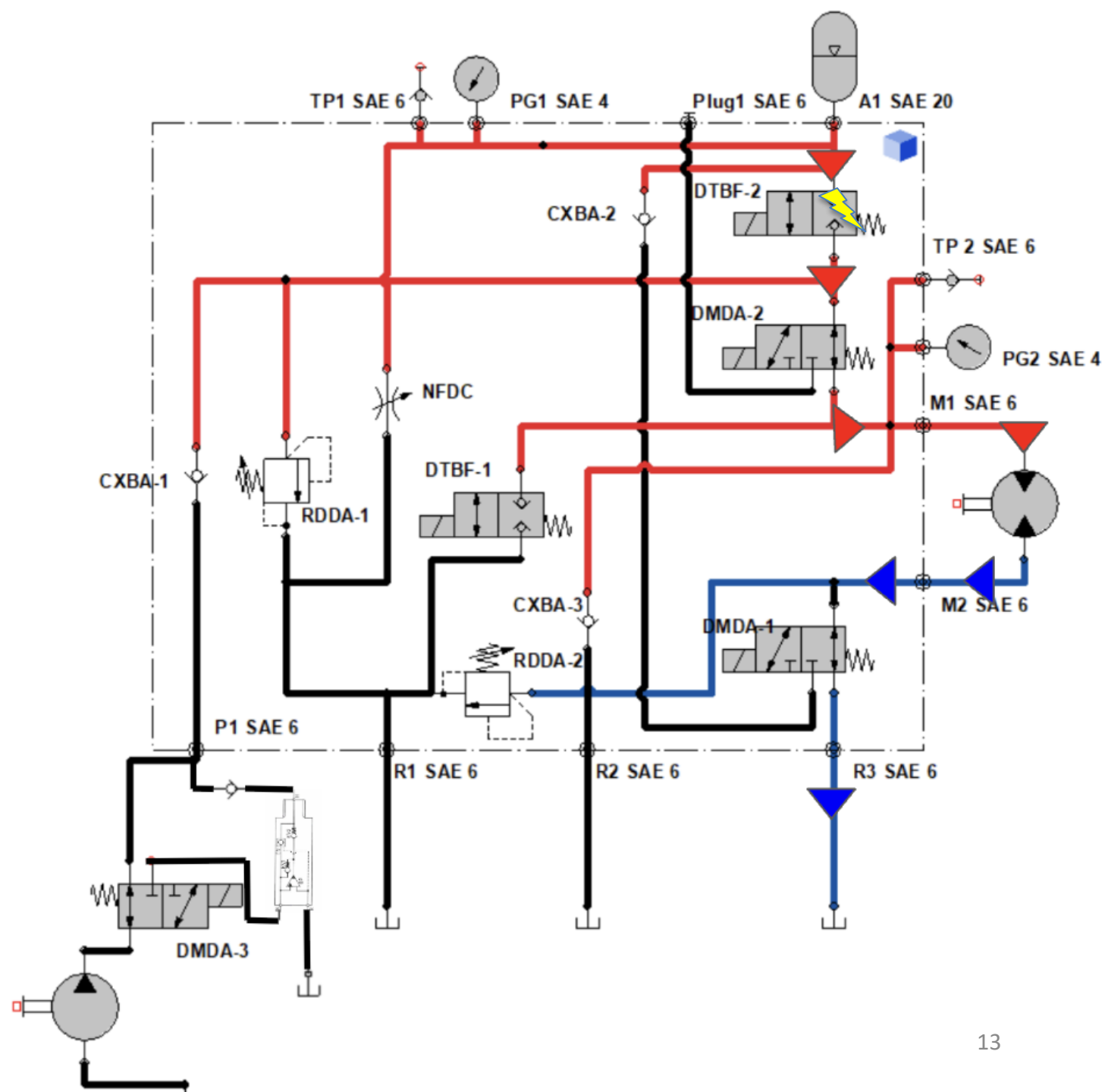


Discharging the Accumulator

- Pathway

Accumulator -> DTBF-2
-> DMDA-2 -> Motor ->
DMDA-1 -> Reservoir

DTBF-2 is energized so
oil can flow out of the
accumulator

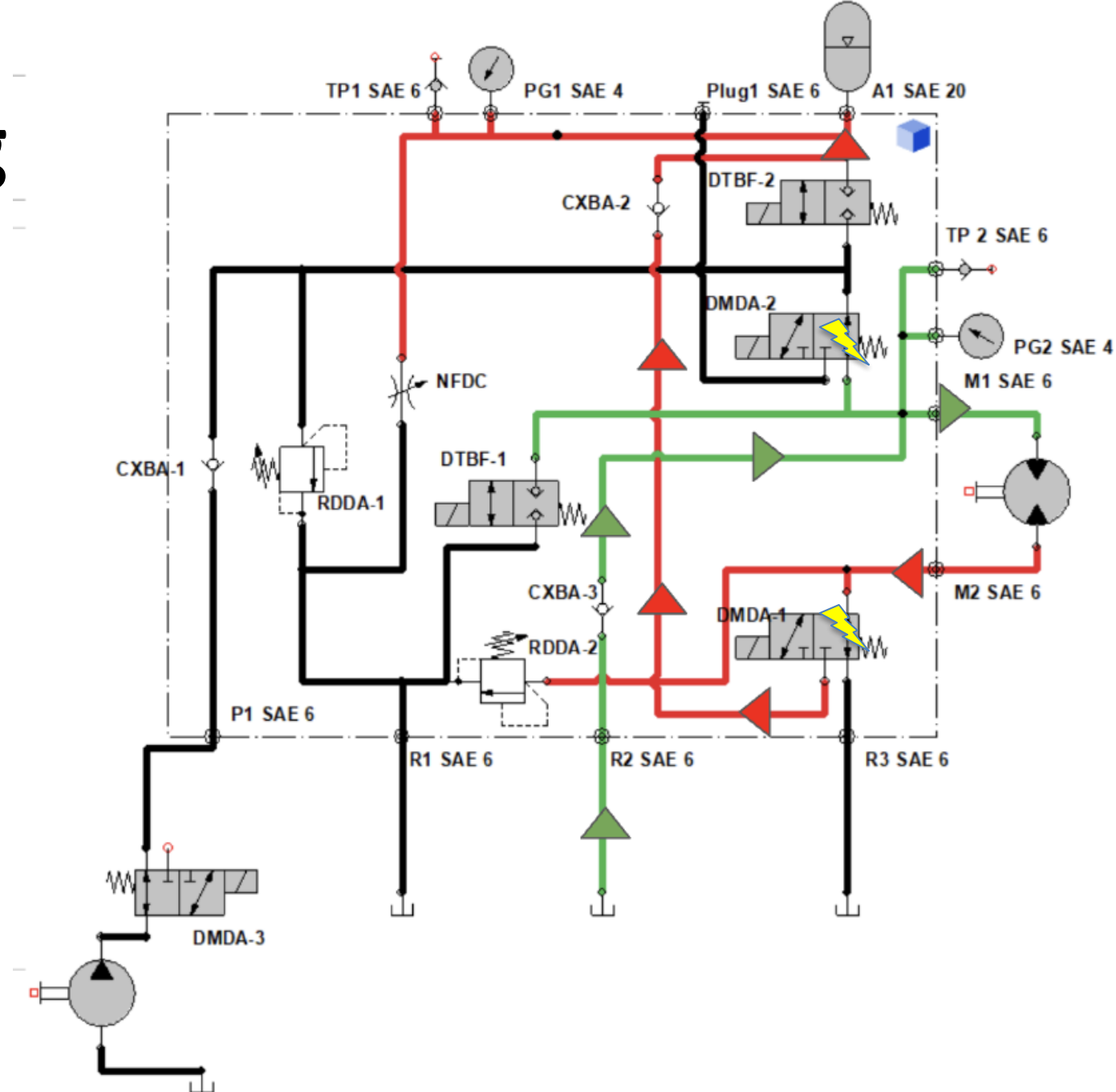


Regenerative Braking

- Pathway

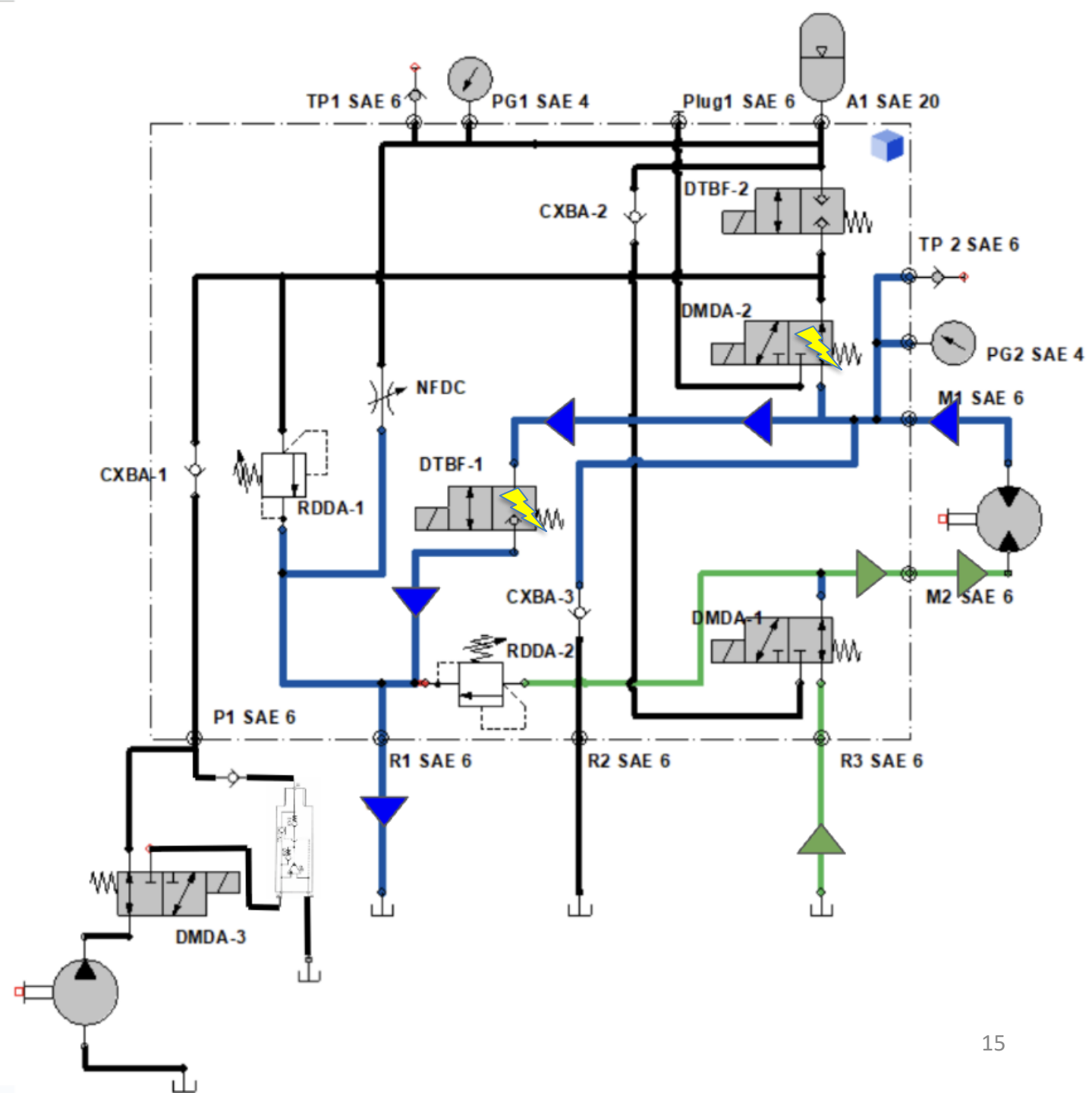
CXBA-3 -> Motor ->
DMDA-1 -> CXBA-2 ->
Accumulator

DMDA-2 is energized to prevent backflow and DMDA-1 is energized so that fluid goes into the accumulator from the motor



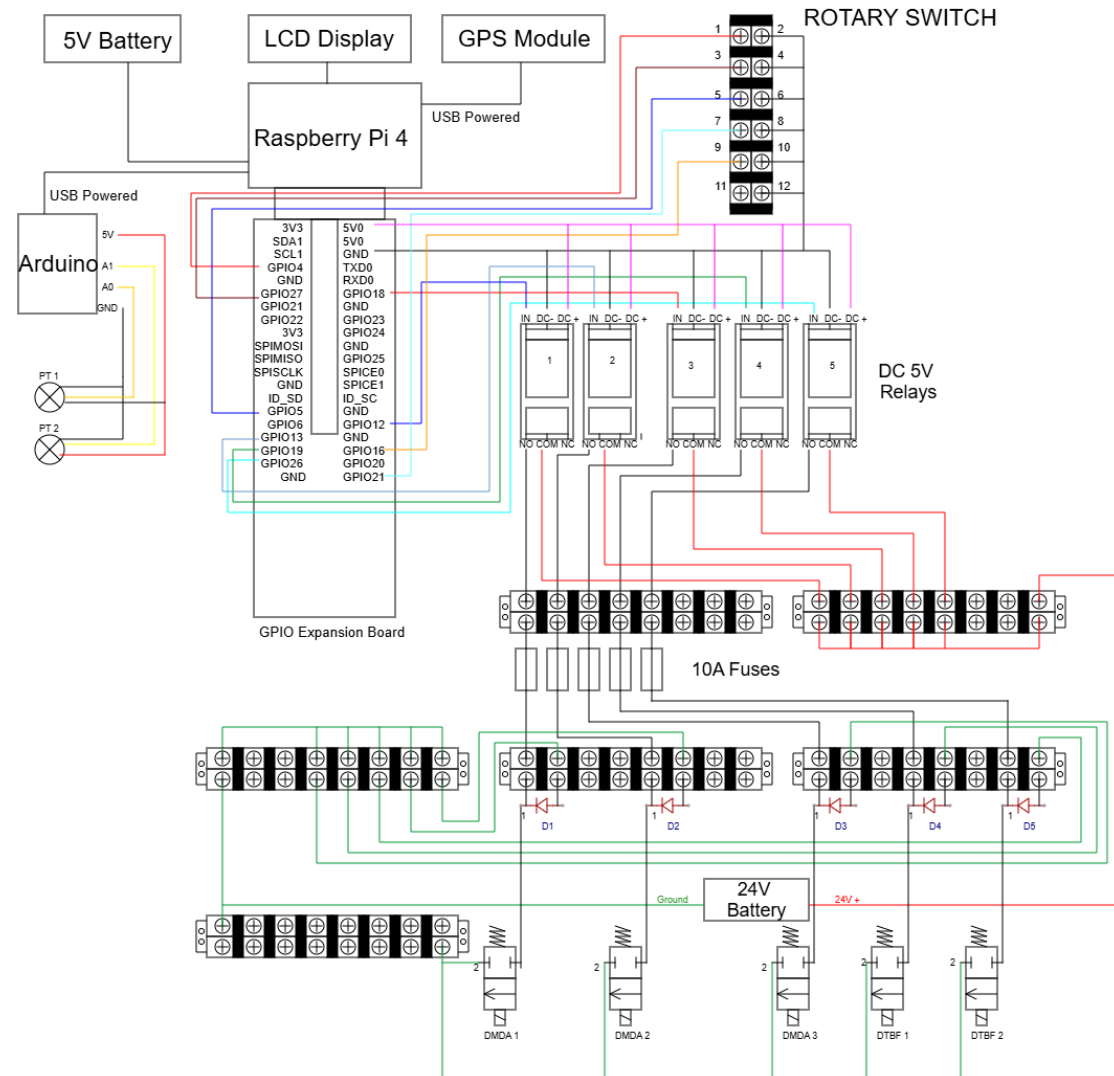
Free Wheel

- In case the cyclist would like to walk backwards with their bike, they can do so with minimal resistance by energizing DTBF-1 and DMDA-2



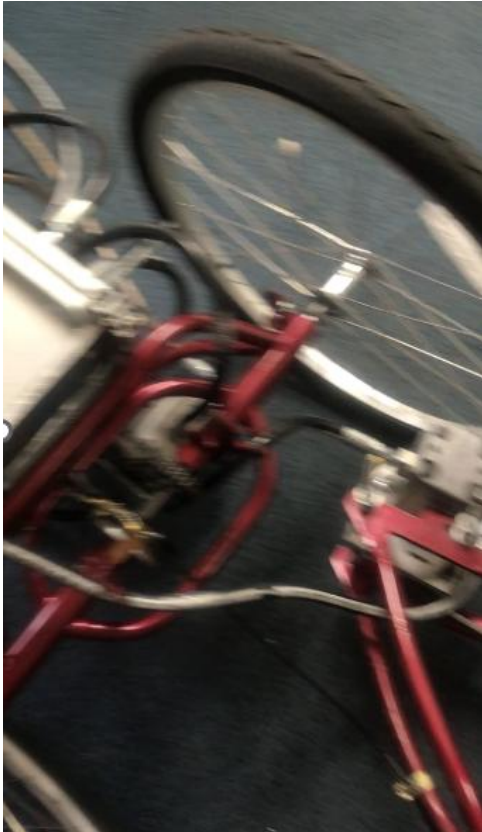
Vehicle Components

- Electrical Diagram



Vehicle Testing

- Day 1 of Testing:
 - Bike Frame Splits in Two



Cause: Slippage of bolts holding 2 parts of the frame together

Effect: Spillage of 2 gallons of oil on a carpeted floor
(+ 2 hours of cleaning at 2 am)

Improvement: Drilling hole into a sturdy part of the two frames
to put a connecting bolt that cannot slip

Vehicle Testing



- Further Results
 - Pressure Transducers were unable to work. Replaced with Pressure Gauges
 - Coils get hot after prolonged use, causing valves to sometimes malfunction. Use Direct Drive state (no coils activated) as default
- Direct Drive
 - Roughly Estimated Speed = 6 mph
 - Pressure = 500 psi
 - *Must test faster gear ratio*
- Accumulator Discharge
 - Roughly Estimated Speed = 10 mph
 - Charged Pressure = 1000 psi
 - Pre-charge = 500 psi
 - *Must test charging without pressure intensifier for the first 2.5 min, and with intensifier for the last 2.5 min to build up to 2000 psi*
 - *Must test faster gear ratio*



Lessons Learned

- Anticipate lead times when ordering parts
- Perform testing as soon as possible to validate calculations
- Meet milestones to prevent cramming of work and allow more time for testing
- Stay busy. Even with delayed parts, there is always something to do. Help other members to prevent delays if the work of one member is dependent on another.

Thank You!

- Much thanks to:
 - Mary Pluta, Stephanie Scaccianoce, and the NFPA and company sponsors
 - For running this awesome program
 - Ernie Parker
 - For the very informative educational webinars and 1-on-1 help
 - Bob Mosey, Edgar Torres, and Perry Johnson
 - For the machining, plus the love and support throughout the competition
 - Motion and Flow Control Products Inc + Newport Pack and Crate
 - For making our hoses and making our crate



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