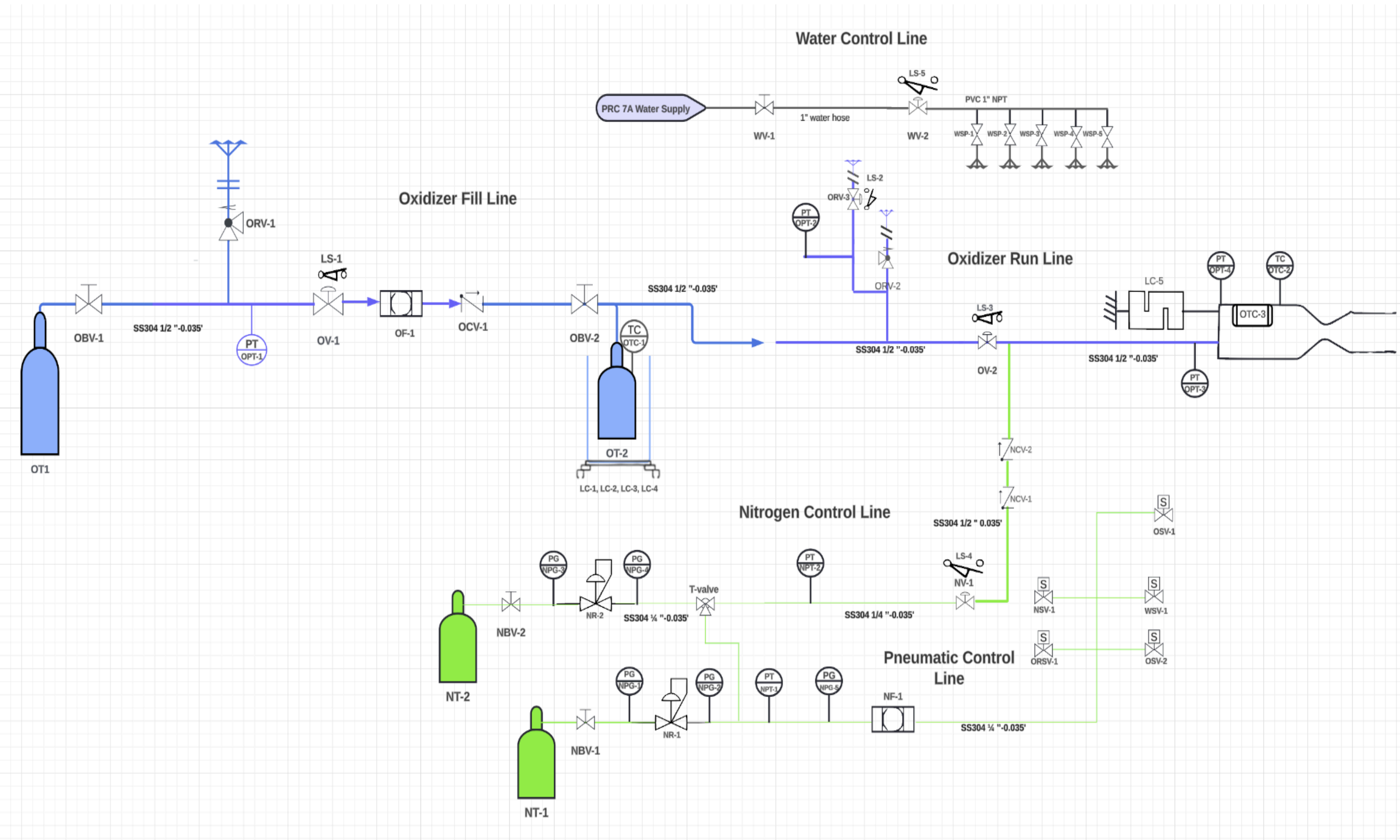
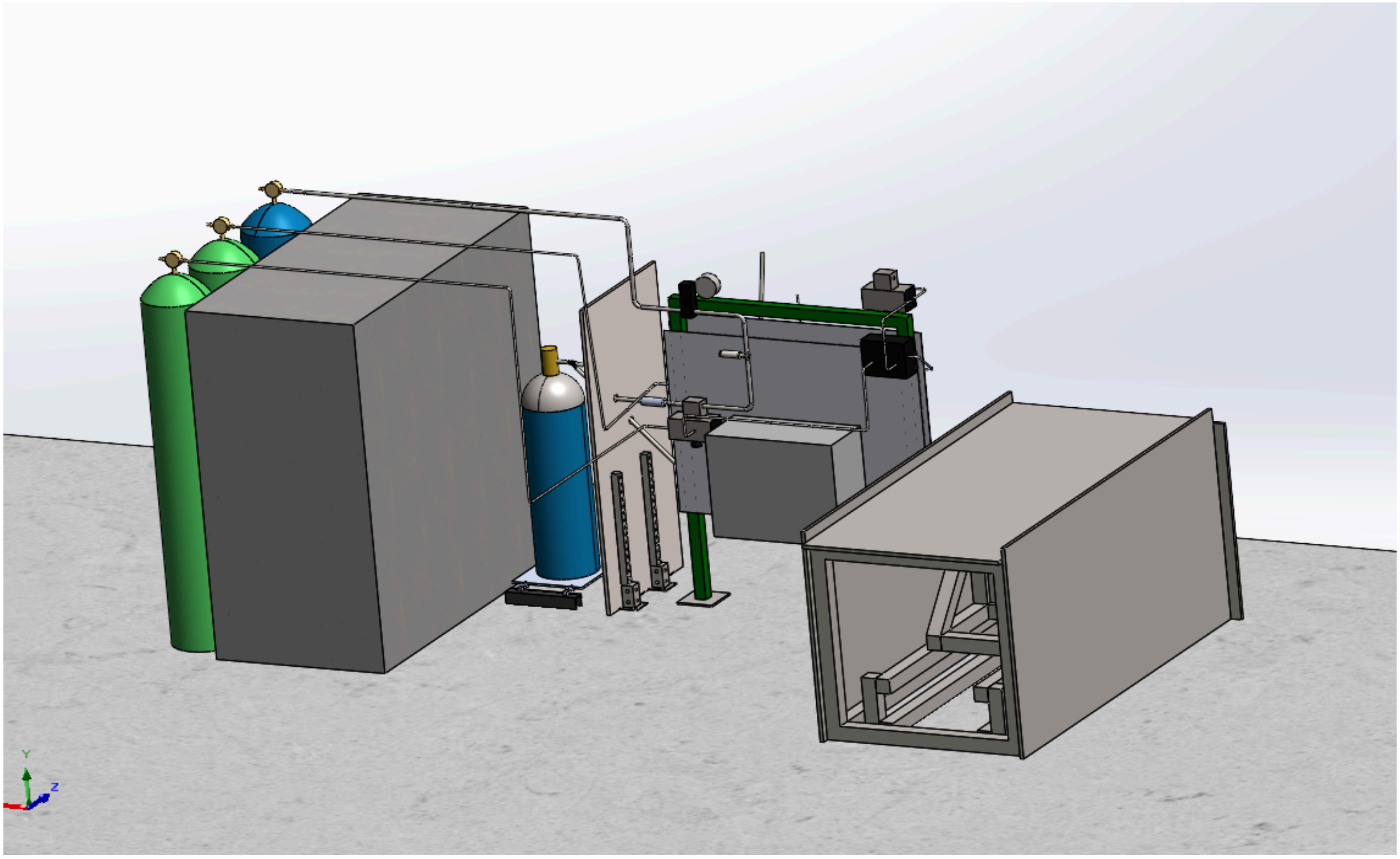
Andrew Cucinotta

Hybrid Engine Test Stand Portfolio

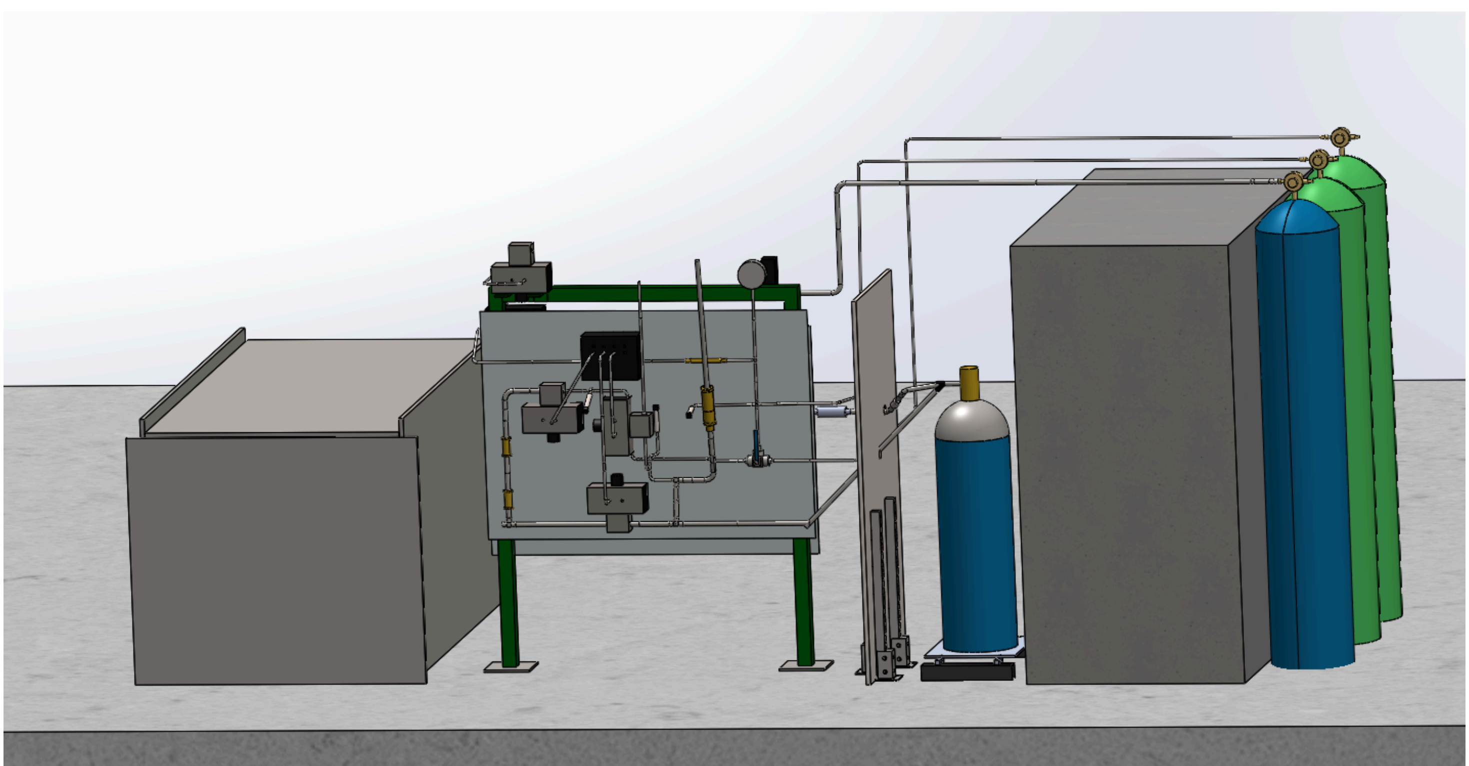
A major culmination of my engineering work at UT Austin so far has been my contribution to the engine test stand for the “Taurus I” engine, the Longhorn Rocketry Association’s first hybrid engine model. Over the past two years I have gone from a team member, to Fluids Lead, to Director of Test & Launch Operations, and I now remain in TLO as a mentor figure for new members. This work has primarily consisted of team collaboration for design of the P&ID (piping and instrumentation diagram), material procurement, fluid panel assembly, procedural oversight, and writing standard operating procedures (SOPs) for tests.



The current P&ID (key not included) consists of 3 main lines: 1) An oxidizer fill line, intended to carry nitrous oxide safely through the fluid panel into the accumulator where the flow/pressure can be regulated, and then into the engine. 2) The nitrogen control line, which serves the purpose of both pneumatically actuating solenoid valves and purging nitrous gas after tests throughout the panel. 3) A small water control line with sprinklers designated to different parts of the testing pad in the event of a fire. The full diagram was then modelled in Solidworks in the images below, with each team member working on a few models and then creating the assembly as a group (individually, I had done the tubing and the various valves on the panel itself).



Pictured above is the “fill” side of the tank, solely responsible for filling the accumulator (smaller frontal tank) with nitrous with an electronically activated valve (electronics contained in gray box on fluid panel) so that the whole operation can be conducted autonomously with personnel out of harm's way. Pictured here are the green tanks, containing nitrogen, the blue tanks which signify nitrous oxide, an accumulator shield to prevent tank damage in case a line becomes over pressurized, the fluid panel itself, and the horizontal engine stand.



Above is the “run” side of the tank, responsible for fluids that will be delivered directly to the engine via a cut in the steel engine box on the left of this image. Pictured on the panel are the various solenoid valves to be actuated remotely, as well as check & relief valves to ensure safety. This image also offers a better view of the concrete block protecting our two nitrogen tanks and singular nitrous oxide tank from any damage in the event of debris. You may have also noticed a rectangle under the nitrous oxide accumulator tank, which represents 4 load cells that measure the total mass of the accumulator. This is used during live testing to measure the mass flow rate of nitrous oxide leaving the accumulator and running into the engine.

Fill Side pictured above, Run Side pictured below

The two pictures on the previous page show the assembled fluid panel including pressure regulators, valves, pressure transducers, and the electrical box which runs wires to a National Instruments Data Acquisition (DAQ) module to collect data. From the angle these pictures are taken from the thermocouples are not pictured, but they are present on the accumulator tank to measure the temperature of the nitrous oxide, as well as on the external surface of the engine and inside the combustion chamber. Cumulatively, the goal is to measure the pressure, temperature, and thrust from the engine.

So far the team has successfully tested the water-based extinguishing system (pictured on the right), the actuation of our valves via nitrogen, and the ignition sequence (pictured on the left). Currently, the team is now working with faculty from the J.J Pickle Research Campus to coordinate a nitrous oxide cold flow and a hot fire test of the engine. The data gathered from these engine tests will be implemented in the development of Taurus II, the next iteration of the rocket engine which will be used in the annual International Rocket Engineering Competition.