Purpose of the project

- Create a functional and educational model of a grid system
- Demonstrate critical portions of power delivery networks
  - What different pieces do
  - What happens to the system when pieces fail
  - Role each piece plays in mitigating damage due to faults or failure of other pieces

Technical scope

- Power quality calculations and corrections
- Load flow analysis
- Maintenance of deflection angles in 3Φ power
- Transmission/Distribution protection schemes and topologies
- Harmonic disruption mitigation
- Proper protection response to transients
- Dynamic response to changing load conditions
- Inertia maintenance of the grid
- SCADA display

Assumptions made and how they were validated (formatted as Assumption → Validation)

- LTSpice as modeling platform → Too difficult and intensive to analyze phase rotation and power factor calculations as events such as faults or transformer tap changes occurred. Swapped to Simscape, which has optimizations for power flow analysis.
- Using a signal generator as "generation" → A physical mass would be more realistic, but we couldn't maintain frequency at 60 Hz without some sort of input energy. A signal generator is controllable enough that we could change inputs at one end and witness how the system responds with some idea of what to expect before hand.
- AC vs DC analysis → Idk on this one. I think AC is potentially simpler, especially at the transformation phase since we just slap down a bank and let it do it's thing. If we did DC, I feel like the overall analysis might be simpler. Real grid analysis uses both because they give you different pieces information that are all important. Here's what chatgpt had to say:

Feature	AC Power Flow	DC Power Flow
Driving variable	Angle difference (\delta)	Voltage difference (V_1 - V_2)
Impedance type	Mainly reactance (X)	Pure resistance (R)
Power–flow relation	(P \propto \sin(\delta))	(P \propto (V_1 - V_2))
Reactive power	Yes ((Q))	None
Angle analysis	Yes (phase stability)	Not applicable
Losses	I^2R + reactive effects	I^2R only
Power quality	Harmonics, PF, flicker	Ripple (from converters)

- Add considerations if there are any

key design choices made

- Simscape for modeling
- Two substation system serving two loads

- Eating turkey on Thursdays
- Operating on the range of 2-10V (Subject to change, I based it on the relays)
- P34-125 transformers used as step banks

time-based development plan

- Basic model on a breadboard before Thanksgiving
- Specific and detailed list of components we need/don't need to include before Thanksgiving
- Everyone up to speed on Simscape and improving the model by TBD
- Substation module TBD
- Protection and contingency topology & methodology TBD
- Physical components used for loads TBD
- Other shit TBD per meeting on Friday 11/7

Showcase expected outcome

- Upgrade the initial schematic Travis made with more depth