DEPARTMENT OF MECHANICAL ENGINEERING

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Design Calculations & Decisions

MATLAB Simulink for gas simulation

- Dynamic **pressure monitoring** during configuration changes
- Helped develop operation procedures based on instability
- Includes **pressure losses** from the filter and pipe fittings

Monte Carlo Simulation analyzing uncertainty

- Variables: specific gas constant, ground temperature, upstream pressure
- Found the pressure is stable (mean: 92.33psi, std: 0.004psi)

SolidWorks FEA analysis for custom components

- Parts validated to withstand 150 lb ft of torque (SF = 1.5)
- Resized dog clutch components through testing

Electronic Valve Actuation Decisions

• Design allows for **electronics and manual** operation



Simulink Gas Simulation

ENME - D1 - Downstream Dream Team **BGE Regulator Station Revitalization**

• BGE's current layout is 340ft^2

- Single point failure (SPF) improvement would require a 4th regulator
- Design team created **isolated regulators** while **maintaining SPF**
- Overall footprint shrinkage 24%
- Electronic system designed to reduce pipeline switching complexity













- Prototype
- allows pressurization of 10-18 psi Testing
- was **31.46% faster**
- but higher than expected



TIme Trial

Stabilized Regulator Response



A. JAMES CLARK SCHOOL OF ENGINEERING

Final Design



Prototype & Test Results

• Utilizes solenoids to physically **control airflow** • **Relays** and **Arduino** switch on and off **solenoids** • Regulators step down pressure and joint sealant

• Time trial test: test speed of electronic design. • Electronic C1 was **28.42% faster**, Electronic C2

• Decision: continue using electronics in the design • Pressure test was conducted while doing C1 and C2 • Resulting pressure spike was similar to simulation,



Pressure Testing



