CASE STUDY: Improving Gaseous Fuel Supply System Response

35 % Faster Valve Actuation, Lower Downtime, and Enhanced Shutdown Safety

Project Snapshot

Industry: Aerospace / Combustion Test Facilities
Challenge: Existing gaseous-fuel supply system exhibited slow valve response, extended recalibration cycles, and hardware safety risks during emergency shutdowns.
Result: Upgraded to electronically actuated control valves with advanced trim materials, relocated isolation valves for instant trip protection, and reduced recurring calibration downtime—enhancing system reliability and responsiveness.

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1. Opening Hook – The Challenge

A major test facility sought to **improve the responsiveness and reliability** of its gaseous-fuel delivery system feeding a high-pressure combustion rig.
Operators were experiencing slow valve response during fueling transitions and significant downtime as technicians repeatedly recalibrated pneumatic valve trims.

Between trim replacements, re-lapping cycles, and manual calibration, valuable test-cell hours were lost. During emergency trips, long fuel headers also caused **delayed isolation**, introducing unnecessary flame-temperature spikes and potential hardware damage.

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2. Problem Definition

Our initial investigation revealed three core issues:

1. **Slow pneumatic actuation** limited response time during fuel adjustments.
2. **Manual calibration dependency** and stainless-steel trim wear caused excessive maintenance labor.
3. **Distant isolation solenoids** increased risk during emergency shutdowns by allowing additional gas throughput before fuel cut-off.

The goal was not simply to speed up valve movement—it was to **engineer a more agile, self-maintaining, and safer system**.

Our Approach

1. Electronic Actuation for Faster Response

We replaced pneumatic control valves with **electronically positioned valves**, where both actuator and feedback were integrated in a digital control loop.

- **Response improvement:** ≈ 35 % faster versus pneumatic valves.
- **Cost impact:** ≈ 80 % higher than the original valves, but offset by reduced downtime and calibration labor.

The upgrade enabled **automatic calibration** whenever a trim was swapped, greatly improving convenience and consistency. In a high-utilization environment, these time savings quickly translated into cost recovery.

2. Advanced-Material Trim Kits

We specified **stellite trim kits** in place of stainless steel. Although the material cost increased, service life and wear resistance improved dramatically.

- **Effect:** Fewer trim changes, reduced manual lapping, and significantly less calibration.
- **Result:** Consistent fuel control stability and substantially higher valve uptime.

By focusing on *total lifecycle economics* rather than equipment price, this choice yielded both operational reliability and true return on investment.

3. Relocation of Isolation Valves

The safety review uncovered that the **main isolation solenoids were positioned too far from the test article**. In the event of an emergency trip, the entire downstream header volume had to vent through the combustor, risking transient temperature spikes and flame overshoot.

We **relocated the isolation valves directly adjacent to the rig inlet**, minimizing trapped gas volume and ensuring immediate fuel cutoff.
Post-implementation testing demonstrated **instantaneous isolation** during emergency shutdowns, protecting downstream hardware and eliminating flame-temperature surges.

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4. Results and Benefits

Metric	Before	After	Improvement
Valve response time	Baseline pneumatic	35 % faster (electronic)	Faster transitions, improved controllability
Calibration frequency	Manual after each trim	Automatic on trim swap	Near-elimination of manual effort
Trim durability	Stainless steel	Stellite advanced alloy	Longer life, fewer replacements
Emergency isolation	Remote header volume purge	Local isolation at test article	Instant shutoff, no flame spike
Overall downtime	High, recurring	Substantially reduced	Continuous testing, fewer interruptions

The upgraded architecture achieved **responsive, precise, and safer fuel control** while reducing long-term maintenance costs.

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5. Takeaway & Forward Value

This project highlights how **ProReadyEngineer** approaches system improvement:

- We don’t stop at component efficiency—we analyze **system interactions** and **safety integration**.
- We apply **advanced specifications** and **material science** to enhance reliability.
- We think beyond steady-state performance to ensure **safety, maintainability, and operator convenience**.

By engineering the fuel system holistically—from valve dynamics to emergency behavior—we delivered a solution that’s **smarter, faster, and safer** for continuous-duty combustion testing.
