

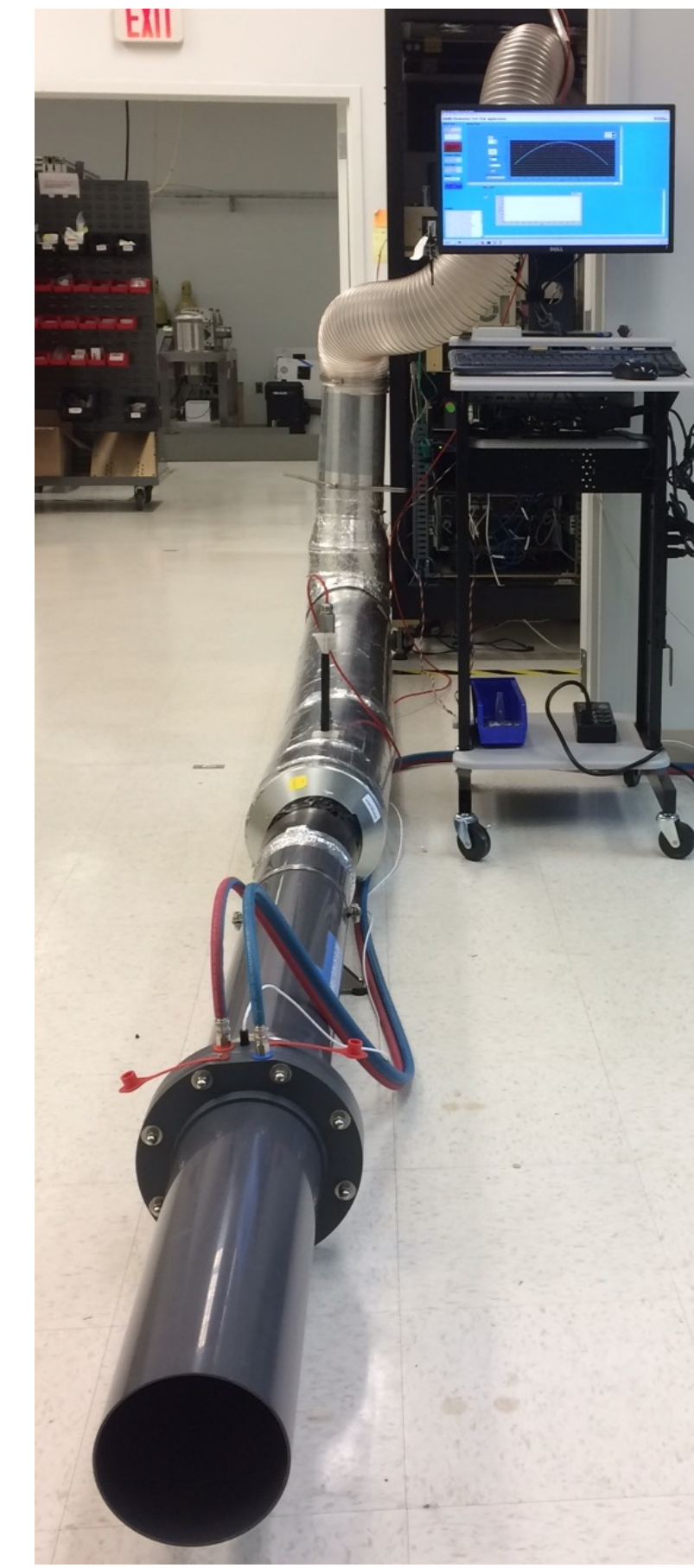


OVERVIEW

Recent CTBTO radionuclide station revalidation processes on International Monitoring Systems (IMS) stations led to General Dynamics Missions Systems (GDMS) developing an improved method of flow meter testing. The GDMS improved flow meter test rig allows for any number of system tests to be developed, performed, and analyzed in real-time. These results are then used to improve system performance and validate system process variables as needed. GDMS has also created an 'in lab' testing facility for component verification prior to field deployment, and a portable test rig to allow field verification. This improved method led to the quantification of secondary flow effects within the Radionuclide Aerosol Sampler/Analyzer (RASA) airflow path and the development of methods to minimize these effects in future station revalidation exercises.

GDMS FLOW TEST RIG FEATURES

- Thorough conditional testing
- Validation of manufacturer claimed response
- Validation of CTBTO flow meter requirements
- Meter settings file for easy testing
- Test results parsed for easy read
- Expandability into other conditional tests as required
- Automation of many test features
- State machine architecture minimizes human error and maximizes repeatability
- Expandability to other flow measurement devices
- Statistical flow analysis
- High quality data acquisition
- Portability and durability

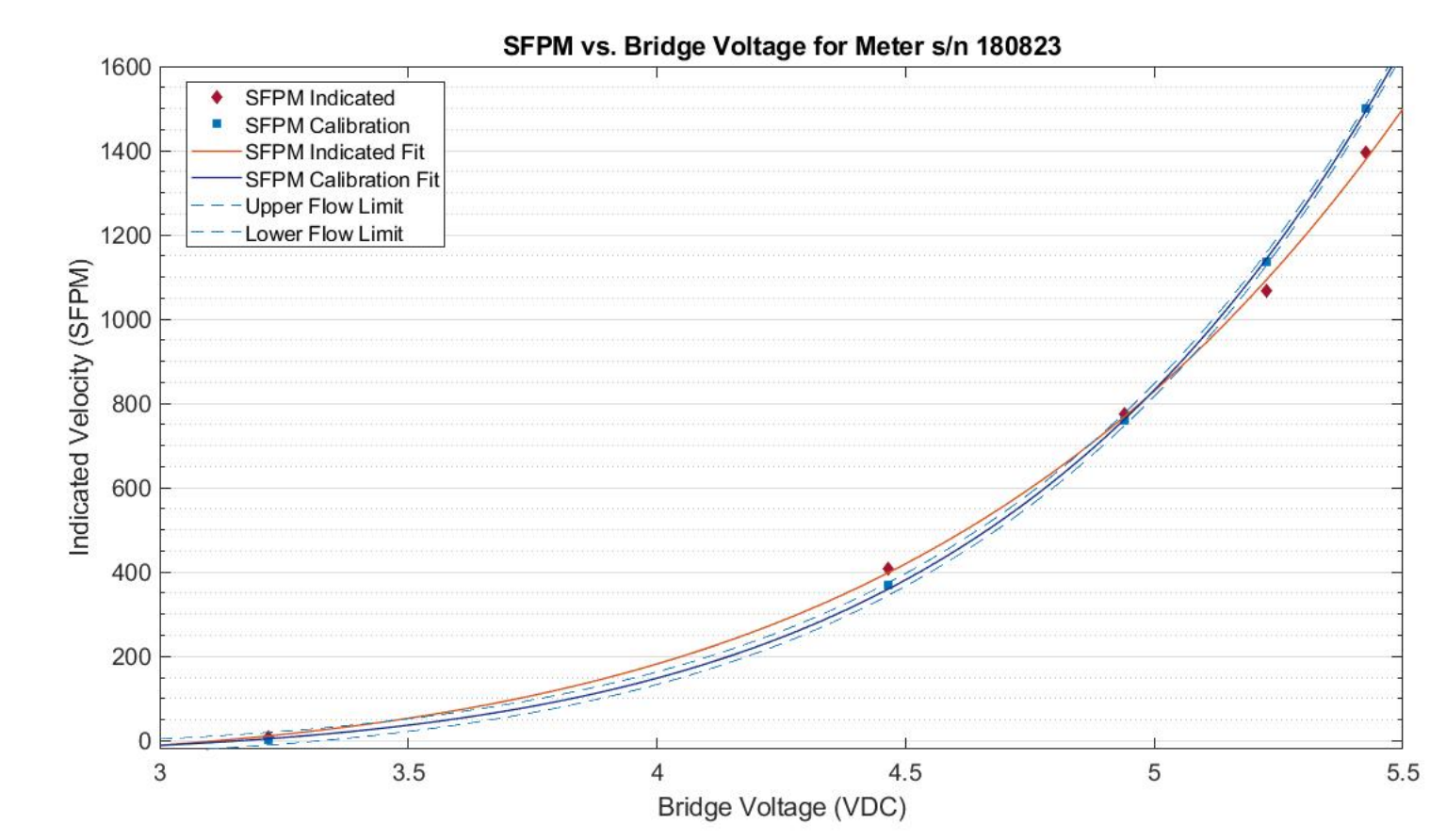
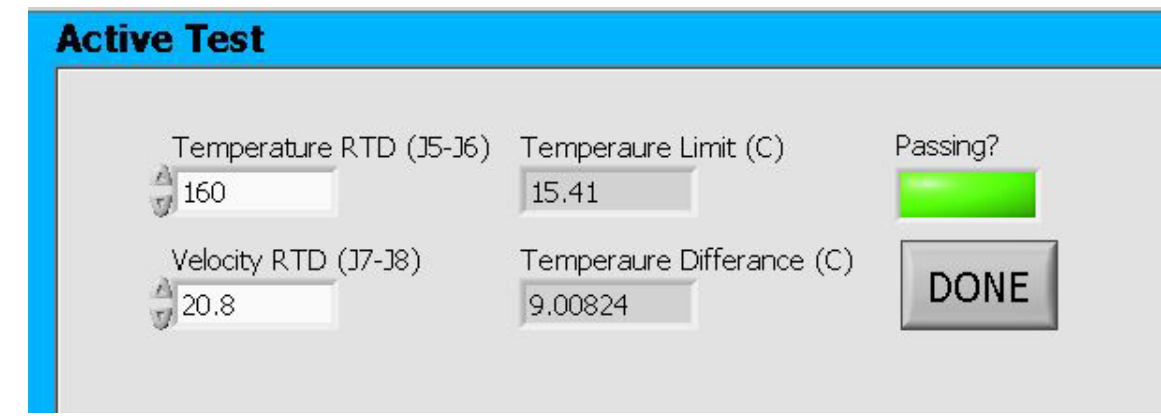


THE FOLLOWING MAJOR TESTS ARE CONDUCTED:



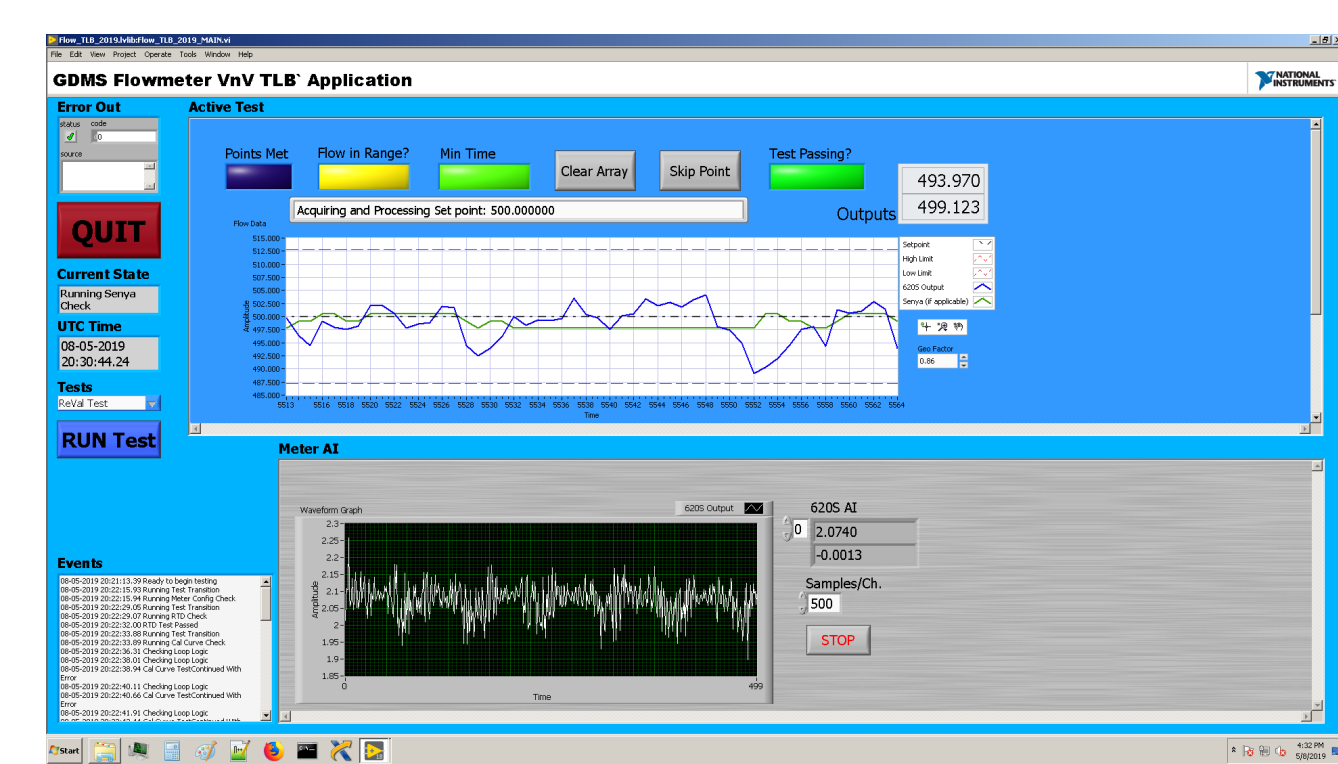
Sierra Instruments Meter Verification

- Meter Configurations → Sensor Verification → Calibration Curve Verification



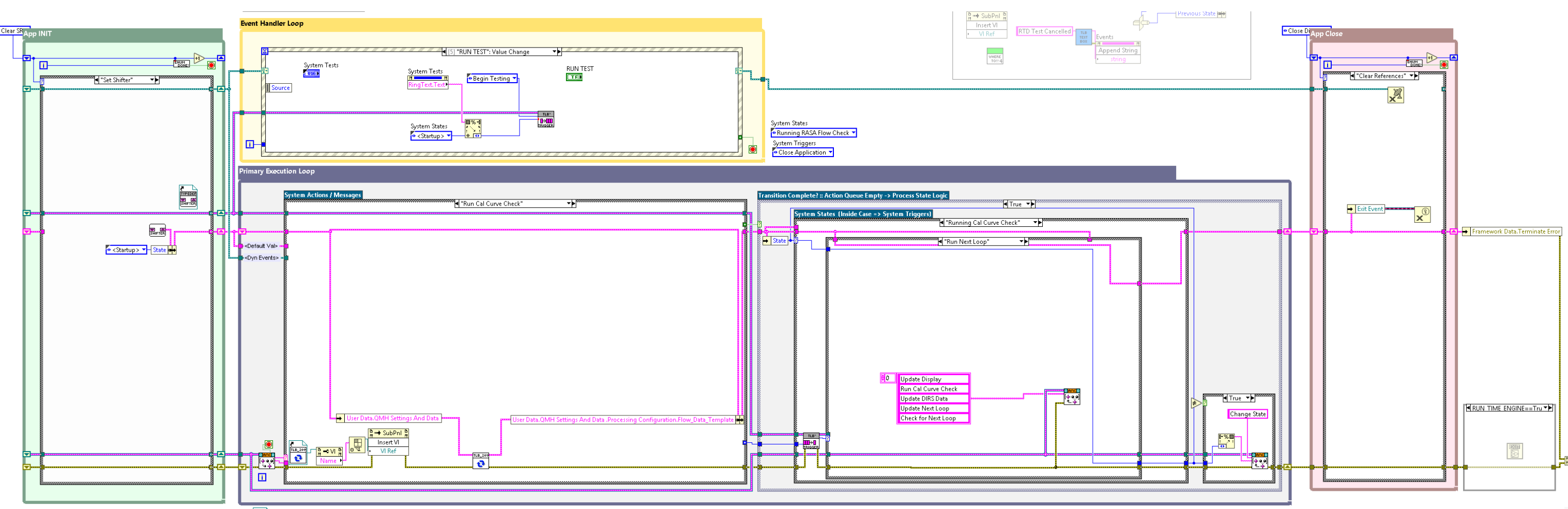
RASA Flow Verification

- RASA vs. National Instruments cDAQ Analog Inputs → RASA vs. Senya VM700



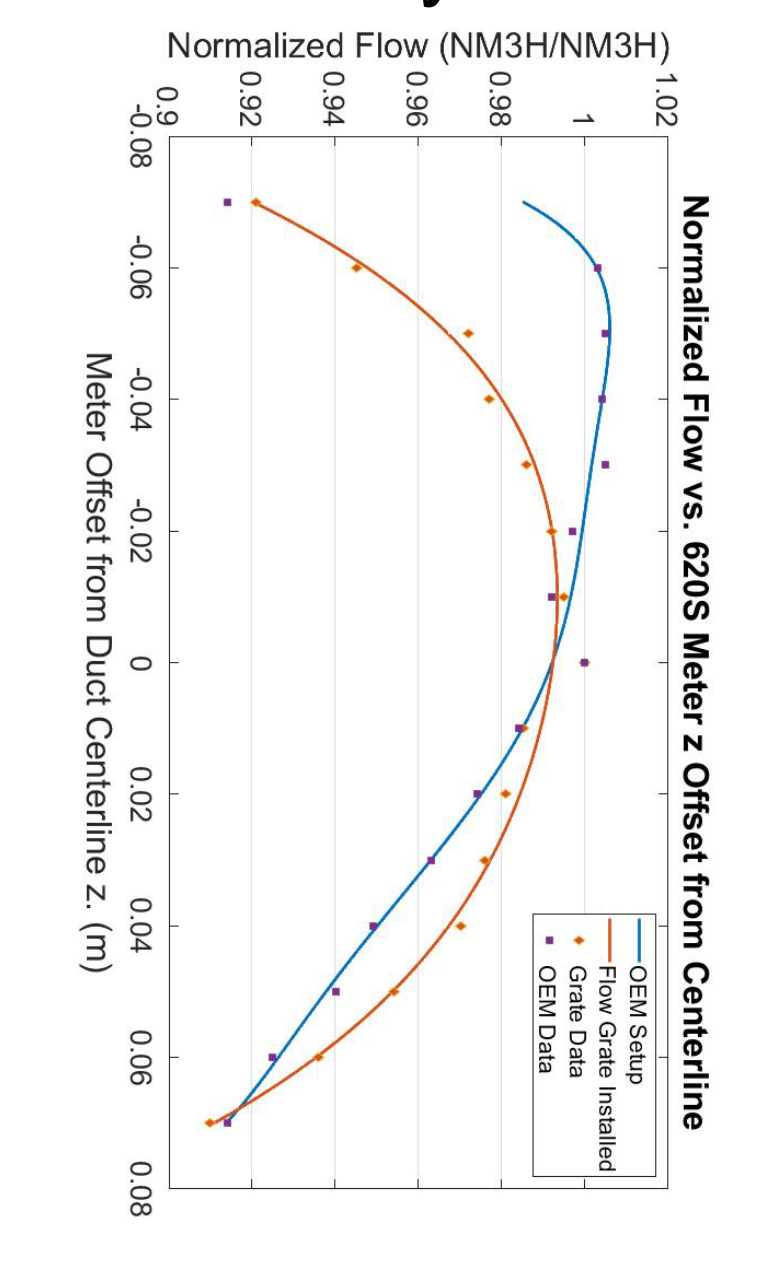
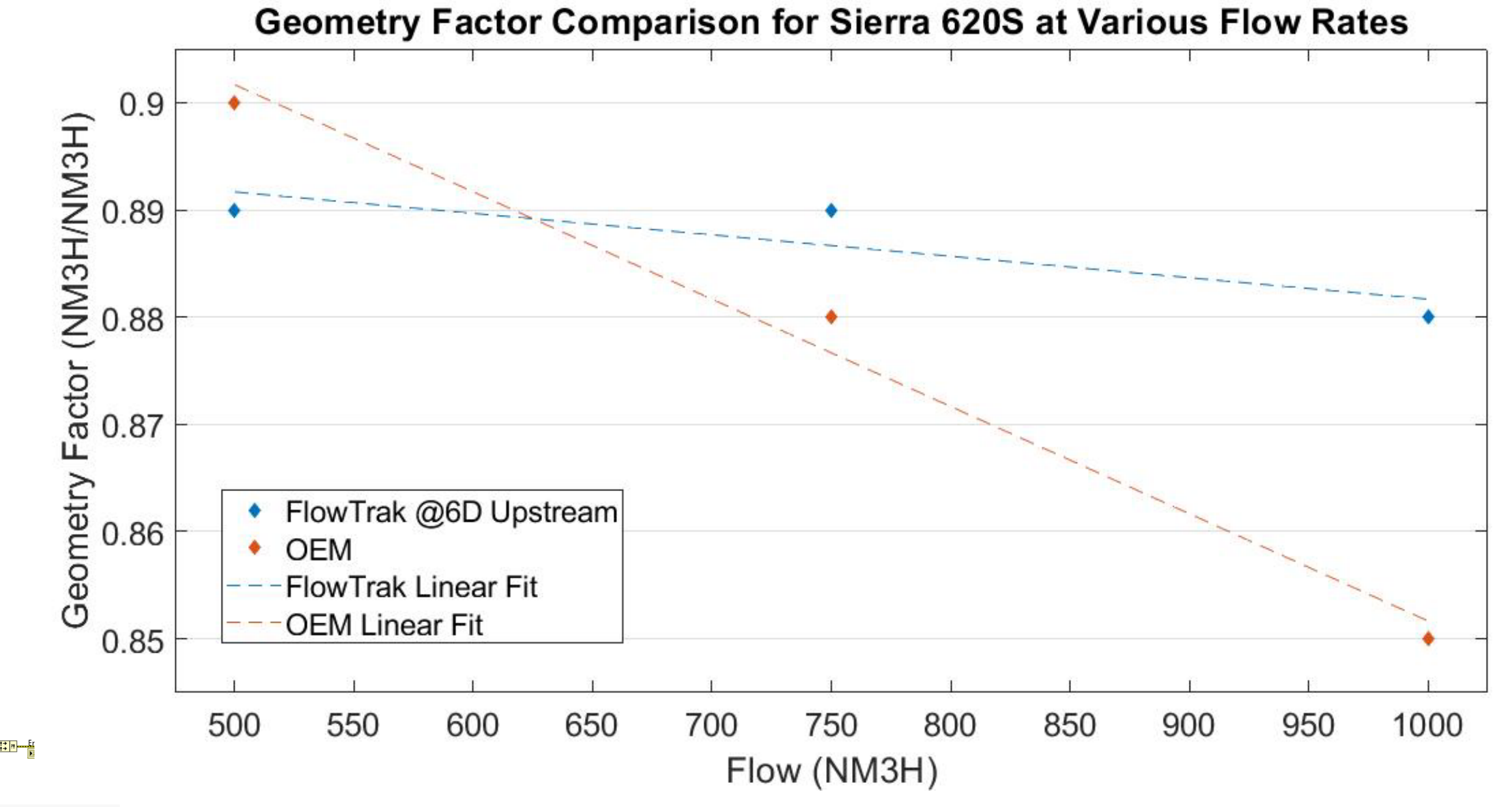
STATE(S) OF CONTROL: NI LabVIEW's TLB' ARCHITECTURE

- Allows for multiple layers and dynamically created state machines
- Expandability allows GDMS to continue to expand and improve testing
- LabVIEW interface allows for improved design and HW/SW interaction
- State decides actions in response to system triggers, thus driving code and improving stability



Flow Profile Verification

- Multi-axis measurement → Analysis/Integration → Desired Geometry Factor



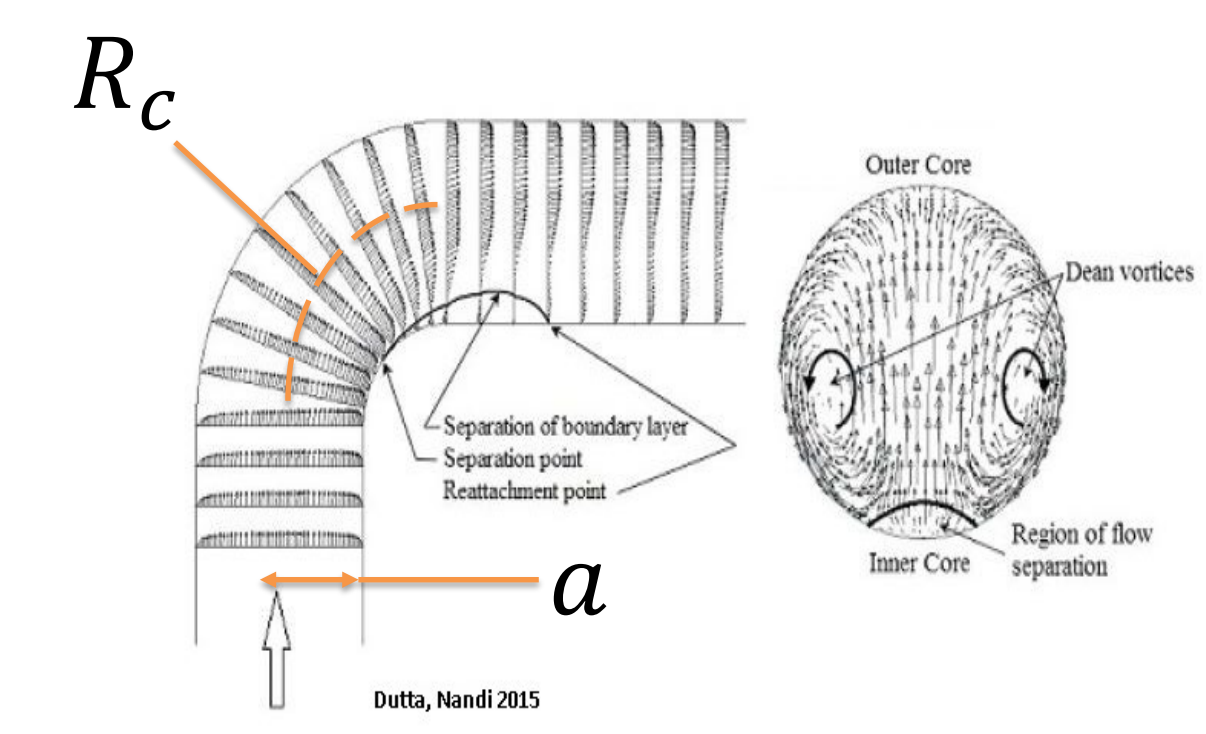
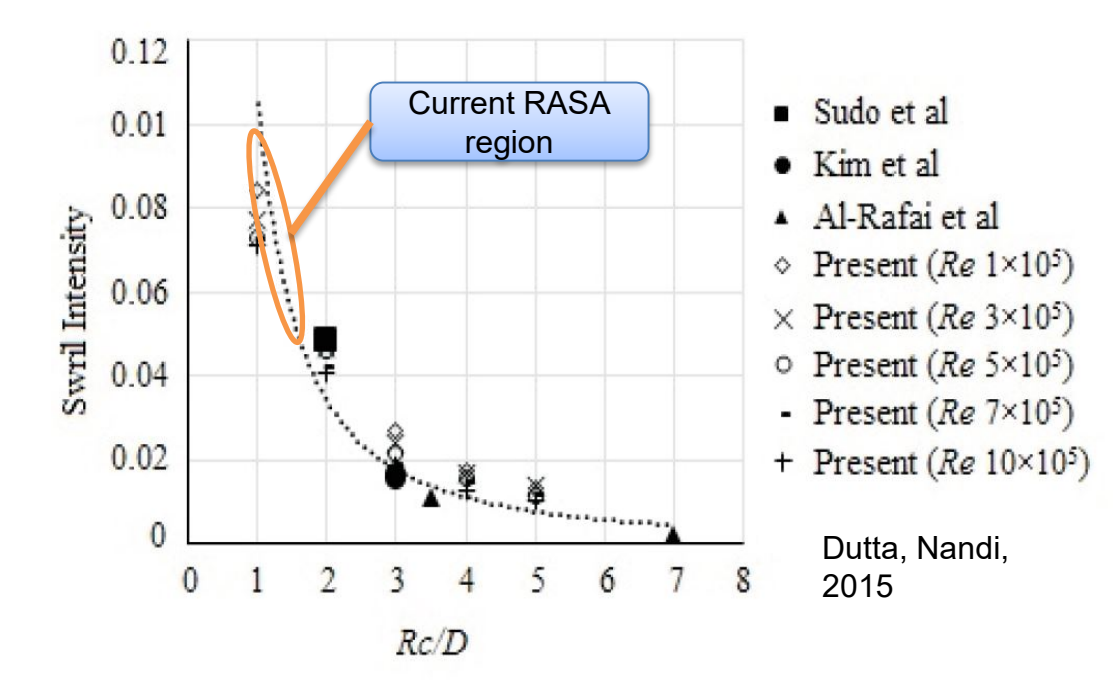
PROBLEM

Variability in station design and revalidation testing process



SECONDARY FLOW EFFECTS

- High Reynold's numbers and tight bends produce significant secondary flow
- Secondary flow can be quantified by the Dean number
- Flow conditioning prior to the flowmeter greatly reduces this effect
- Flow profile mapping, via GDMS system, allows these effects to be measured and addressed

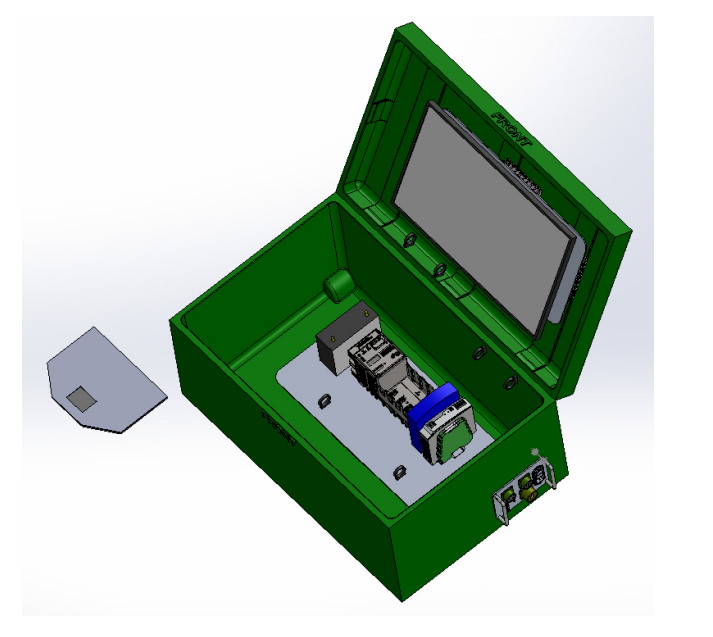


$$Re = \frac{\rho \bar{u} L}{\mu} \left[\frac{\text{Inertial Forces}}{\text{Viscous Forces}} \right] \quad S = \frac{V_w}{W_b} \left[\frac{\text{Rotational Speed at Wall}}{\text{Bulk Velocity}} \right]$$

$$De = Re \sqrt{\frac{a}{R_c}} \left[\text{Centrifugal and Pressure Gradient Forces} \right] \quad (\text{Vester, 2014})$$

RESULTS AND RECOMMENDATION:

- GDMS recommends automation of the revalidation process using the GDMS test rig to minimize errors and develop accurate flow profiles across the network
- GDMS recommends implementing the FlowTrak flow conditioner and verifying effectiveness using the test rig
- Use of the GDMS test rig in other network wide systems



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