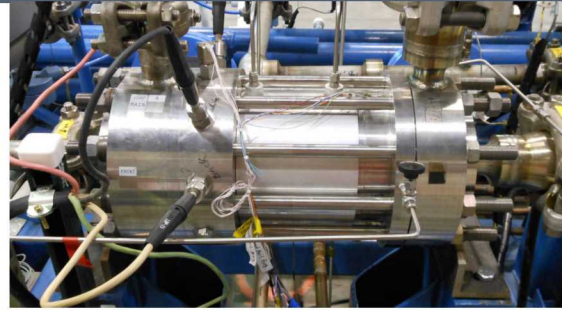


SAND2019-13316PE

Sandia National Laboratories Brayton Lab sCO₂ Testing Facilities



Logan Rapp

Sandia National Laboratories

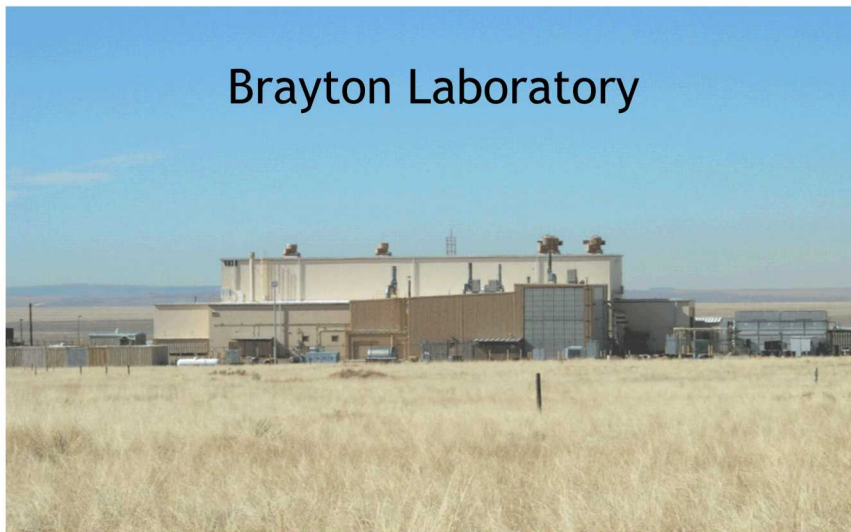
10/31/2019-11/1/2019



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Brayton Laboratory



Heat Exchanger Testing



Pressure Fatigue Testing



Turbomachinery Testing



Bearings Testing



Seals Testing

sCO₂ research at Sandia National Laboratories

The Brayton Lab at Sandia National Laboratories works closely with industry partners to reduce technical risk and commercialize sCO₂ Brayton power cycles.

Past/Current areas of research include:

- Turbomachinery
- Heat Exchangers
- Bearings
- Seals
- Component Fatigue
- Economic Modeling

SNL Bearings Test Rig

Bearings test capability in sCO₂ of 40,000 rpm, 1250 psi, and 250°F

Pressure transducers, RTDs, and thermocouples measure bearing conditions inside motor casing



SNL Seals Test Rig

- Capabilities
 - Rated Pressure: 4595 psi
 - Rated Temp.: 1292°F
 - Max. Speed: 40,000 rpm
- Instrumentation
 - Thermocouples: 37
 - Pressure transducers: 37
 - Accelerometers: 1
 - Displacements: 1
 - Current transducers: 1
 - Flowmeters: 4



Recompression Closed Brayton Cycle (RCBC) configuration



Commissioned in 2012

Maximum Conditions:
2500 psi @ 1000F
17.2 MPa @ 538C

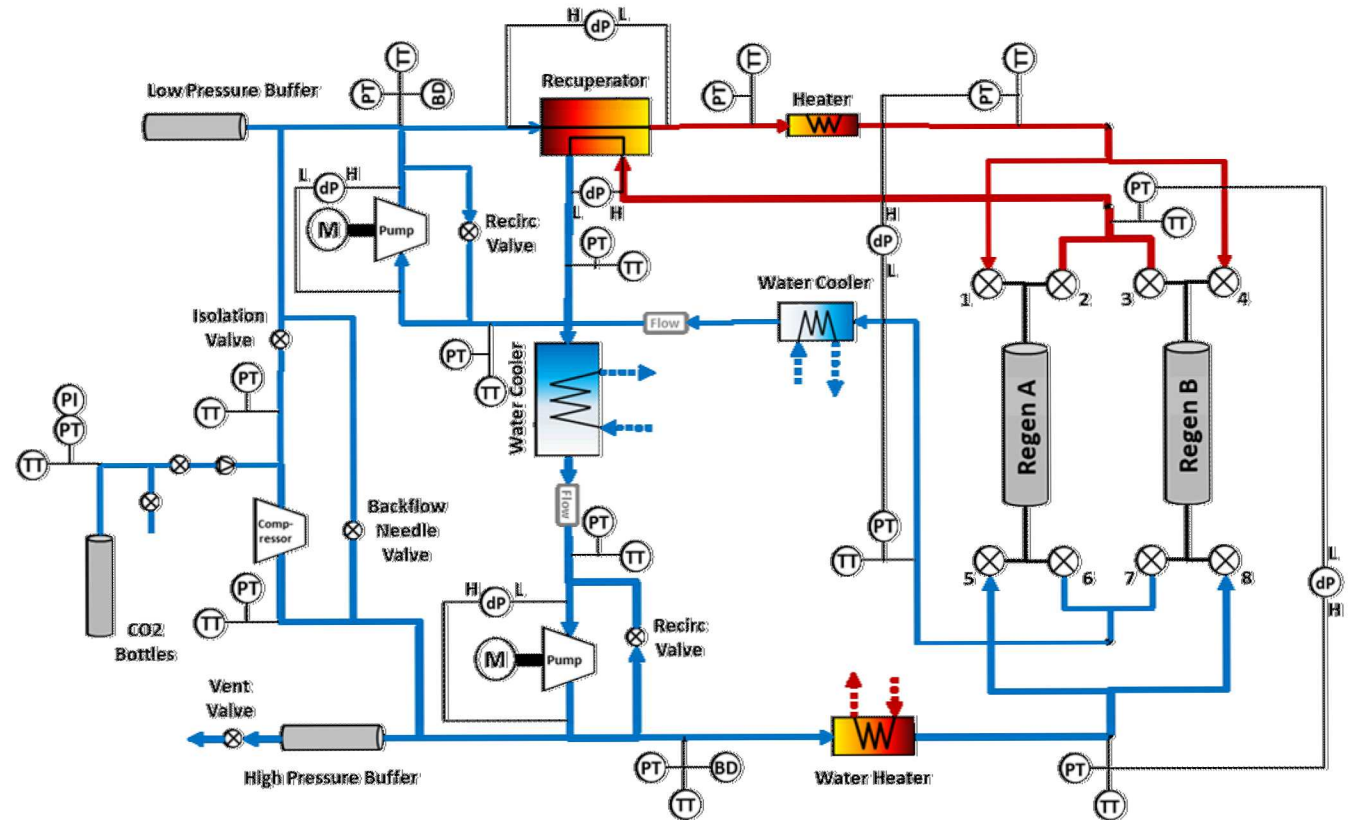
Only sCO₂ RCBC ever to have been operated

Many papers and conference proceedings have been published on the data from the RCBC experiments

7 Heat Exchanger Testing



Switched bed regenerator testing





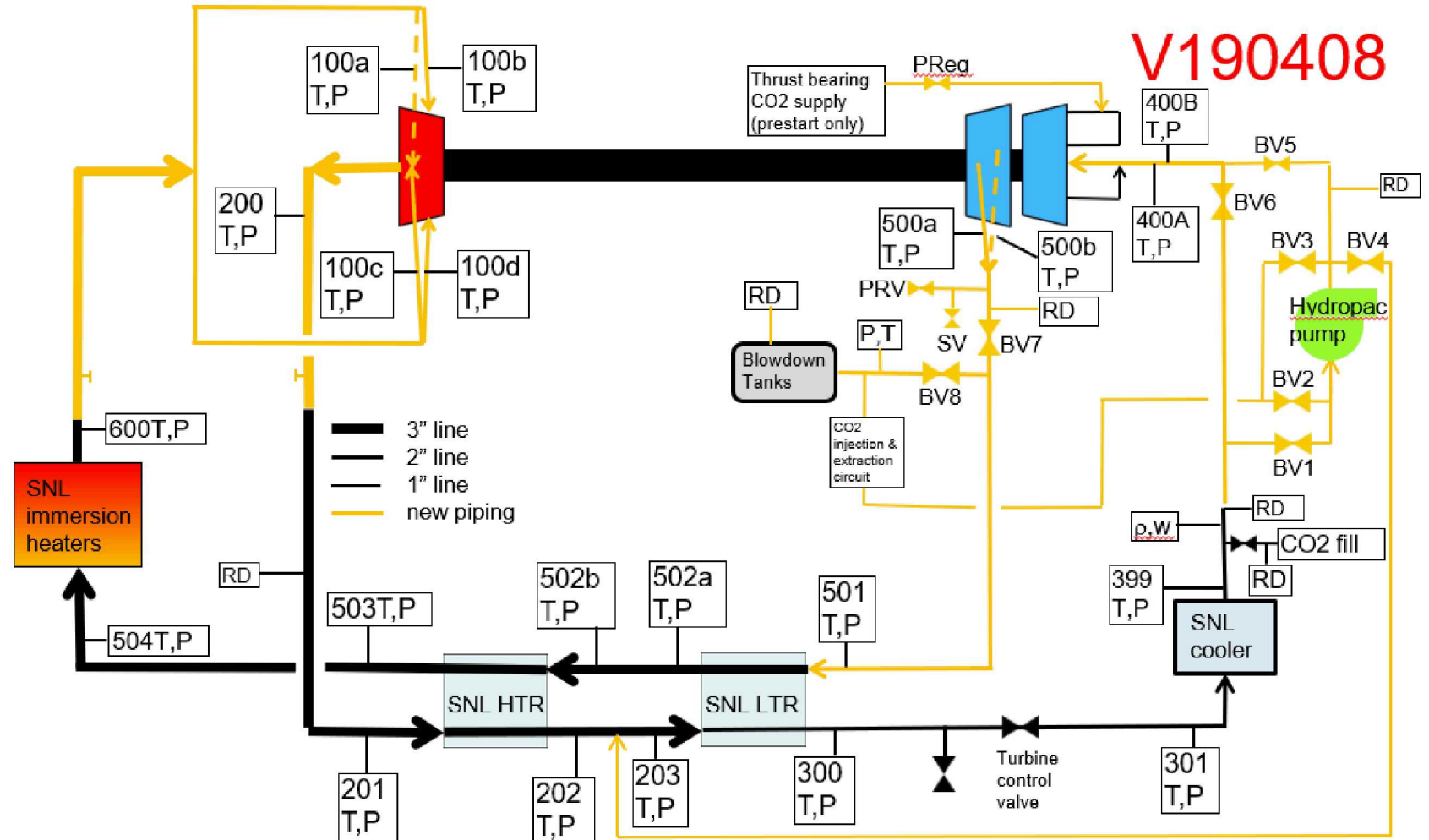
780 kW electric immersion heat

2.3 MW duty High Temp
Recuperator

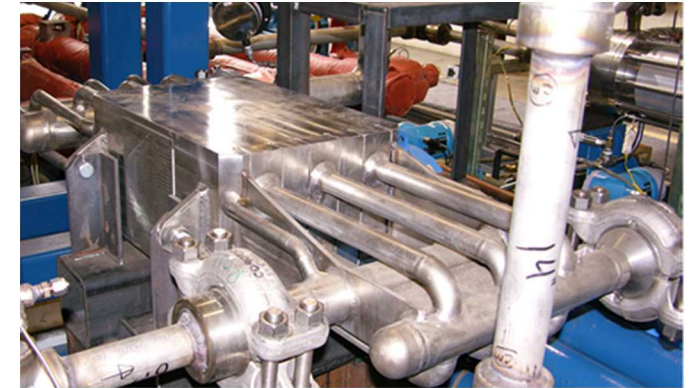
1.6 MW duty Low Temp
Recuperator

540 kW water/sCO₂ cooler

Hydro-Pac Piston compressor
pump



9 TurboMachinery Development Platform at SNL



Peregrine Turbine Technologies Turbocompressor

Design Conditions:

- 118,000 RPM
- 750 C Turbine Inlet
- 42.9 MPa compressor discharge

Loop Maximum Conditions:

- 538 C Turbine Inlet (1000 F)
- 17.2 MPa compressor discharge (2500 psi)



General Lab Equipment

Auxiliary heating



Miller ProHeat Induction Heater



Heat tape with variac



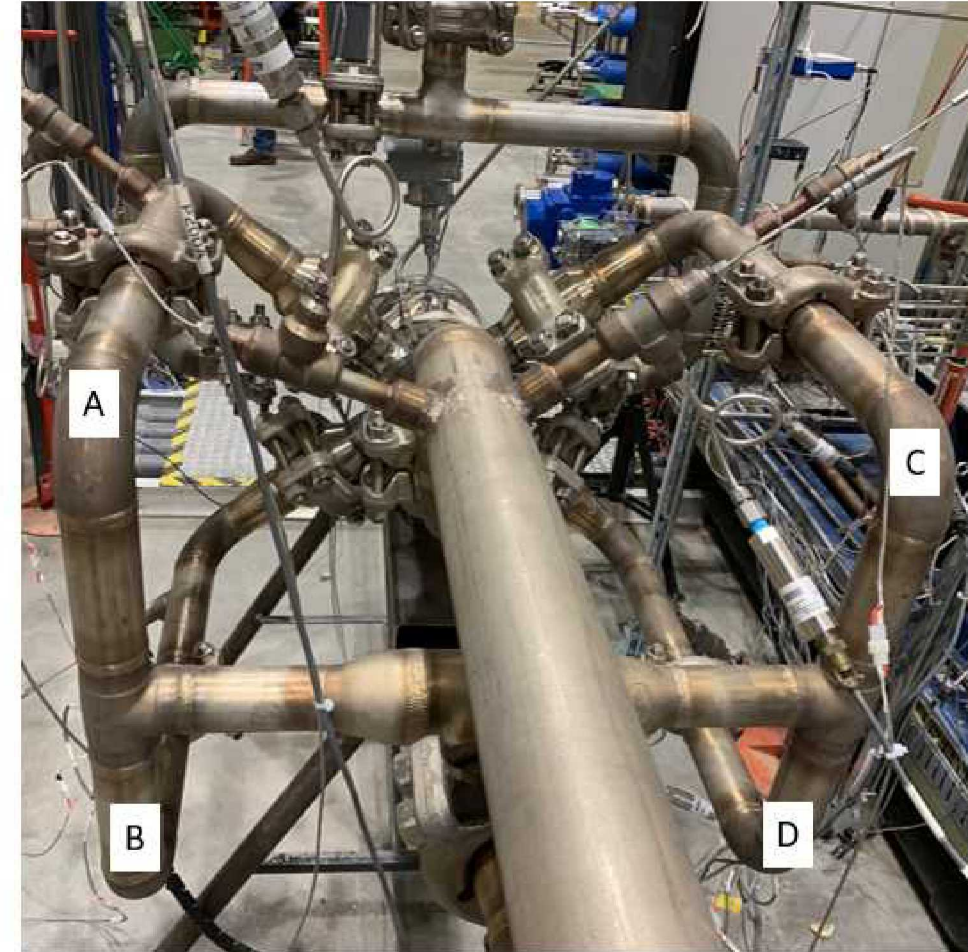
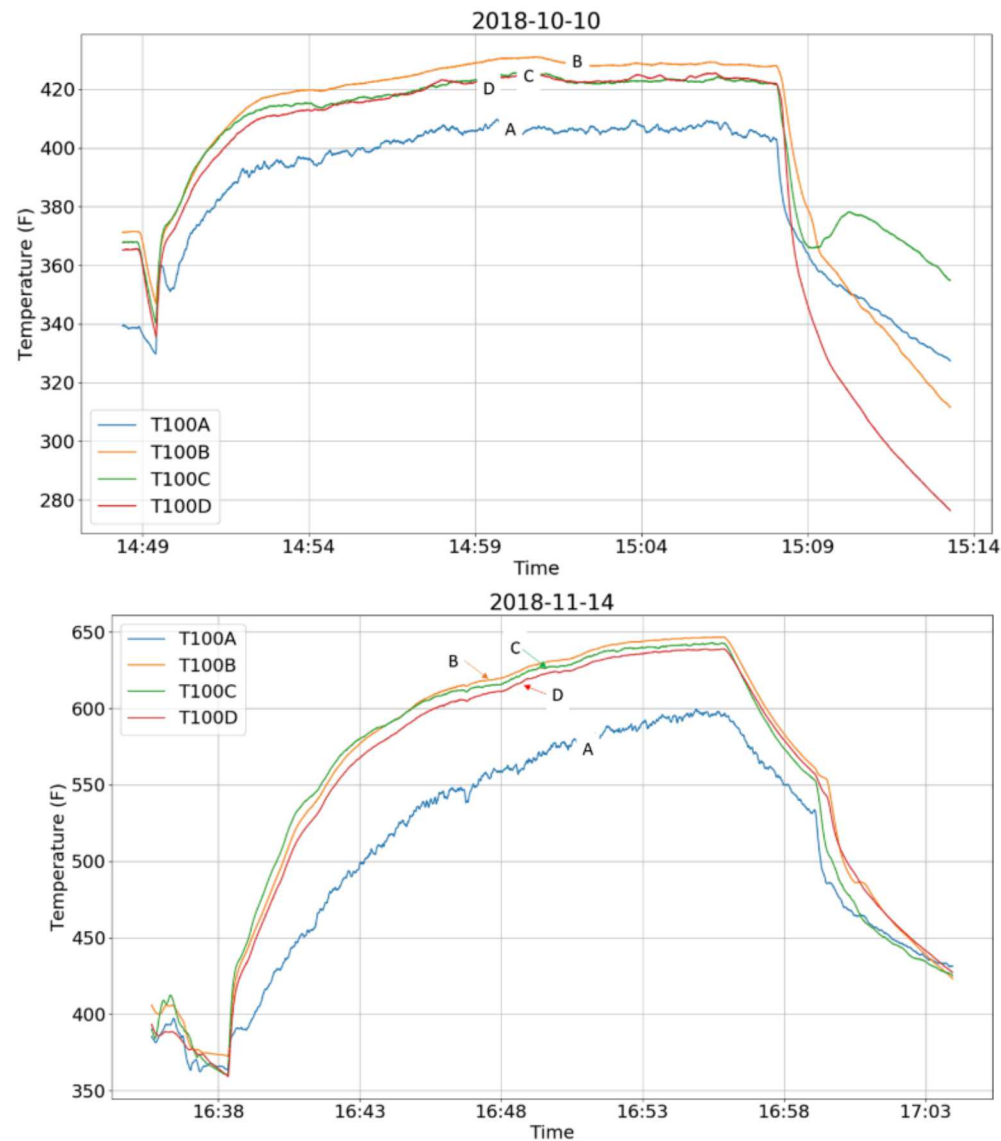
Hydropac piston compressor



MaxPro piston compressor

Some Lessons Learned

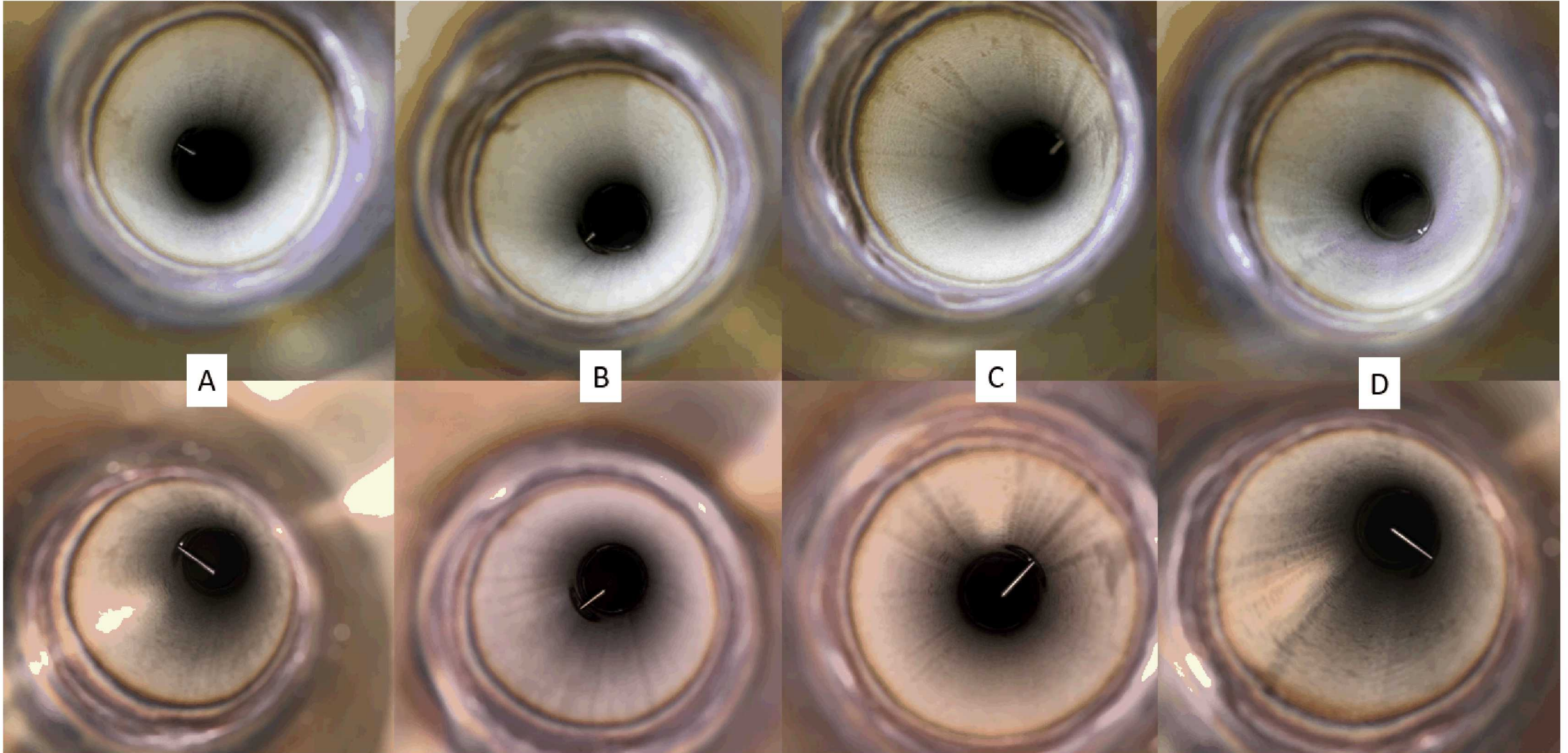
Turbine Inlets



Leg “A” was consistently lower temperature than the other 3

Original and New Turbine Inlet RTD insertions

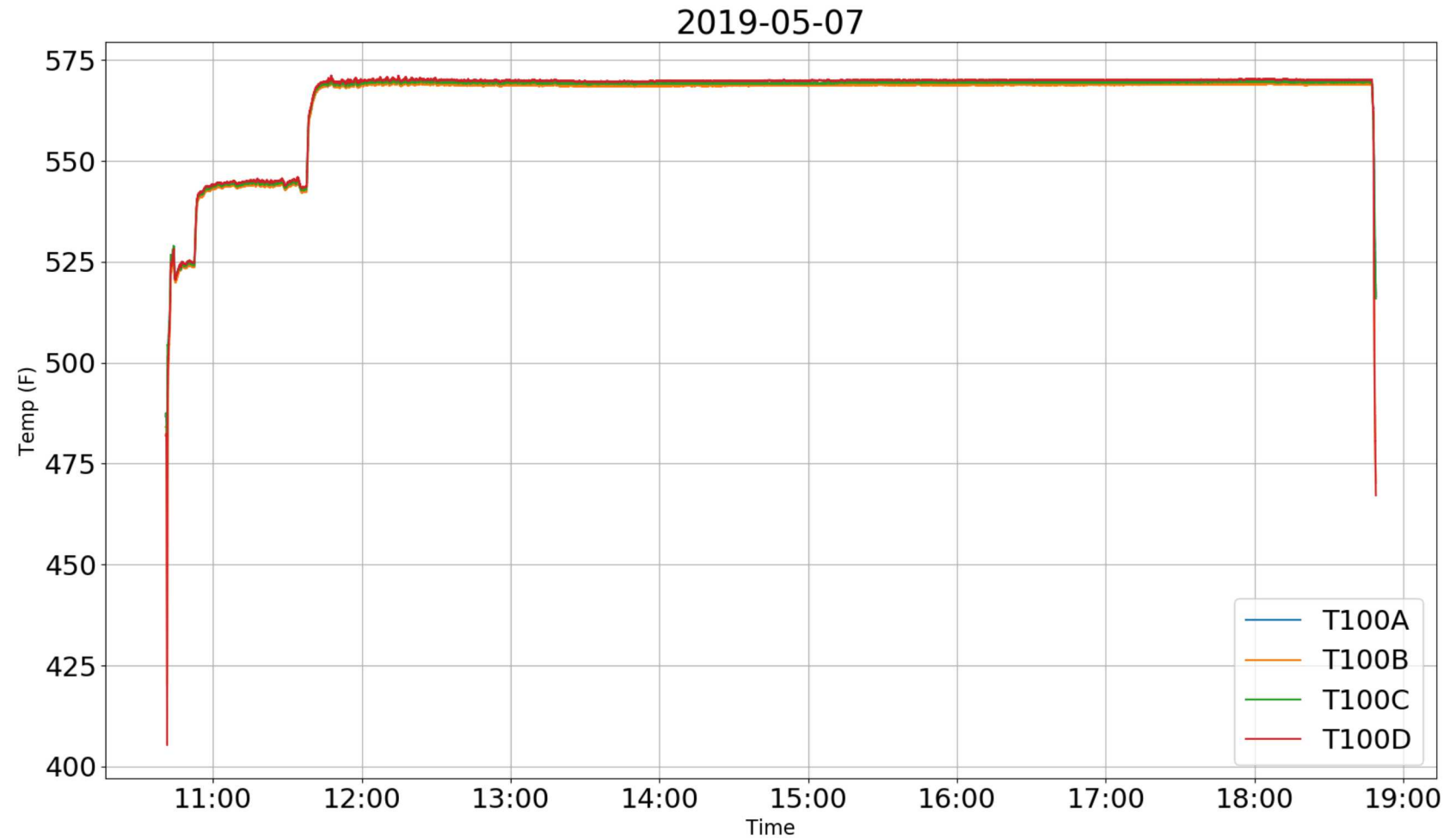
Original

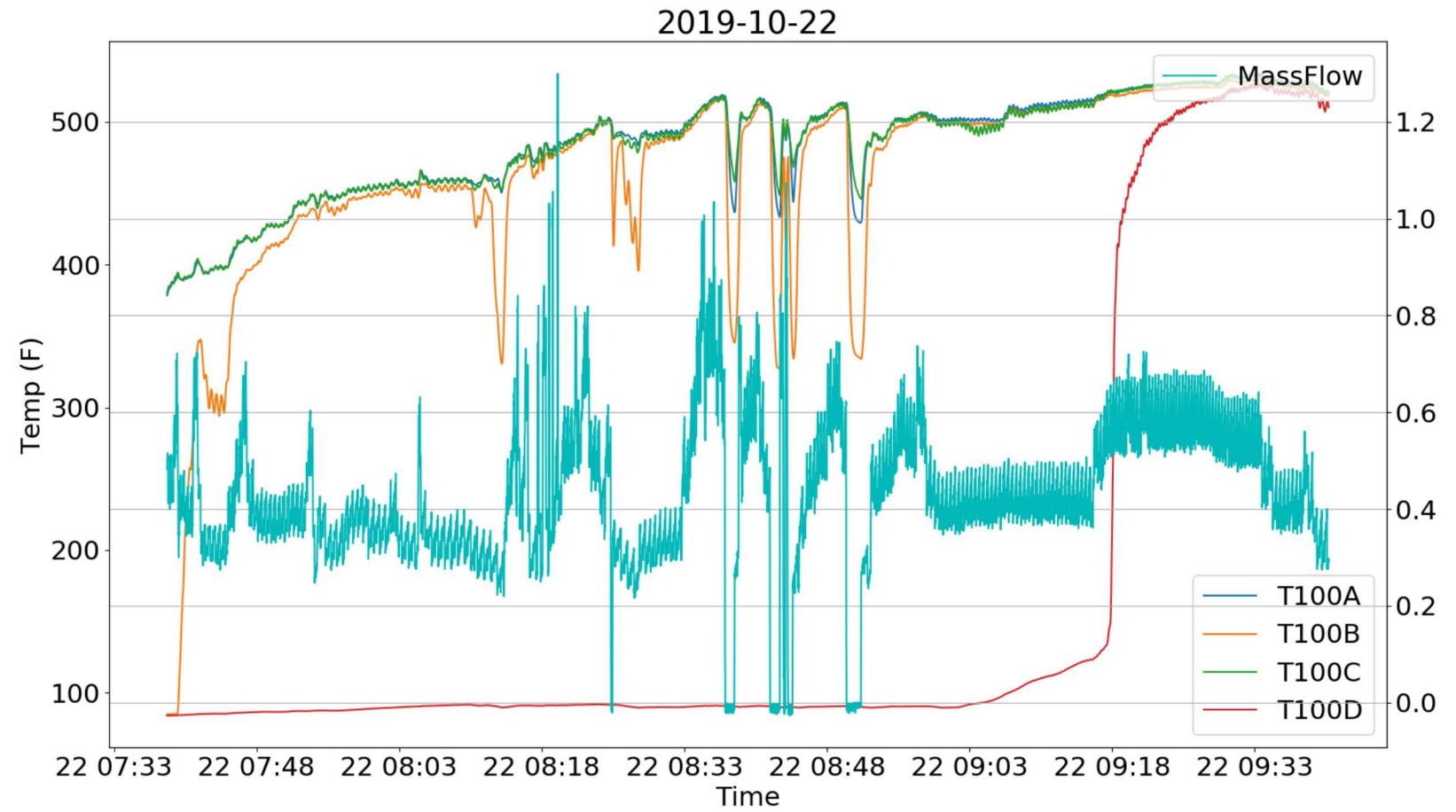
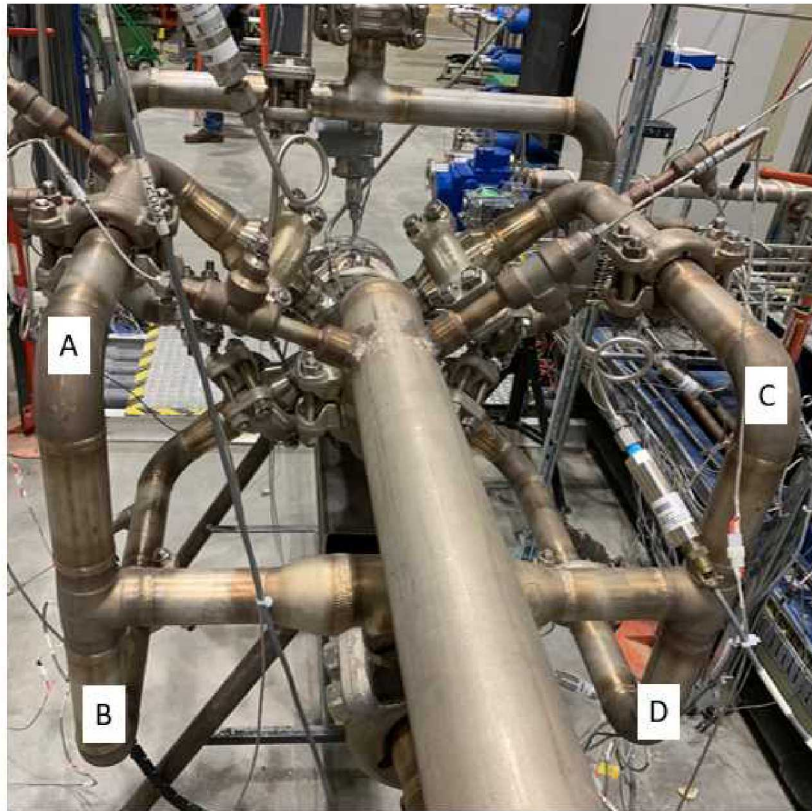


New

Turbine Inlet Temp with new Insertion depth

No difference in centerline temperature of turbine inlets





Thank you