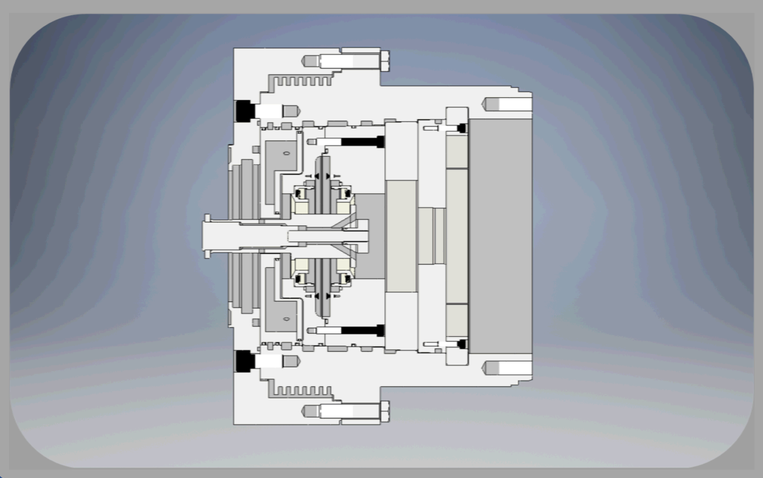
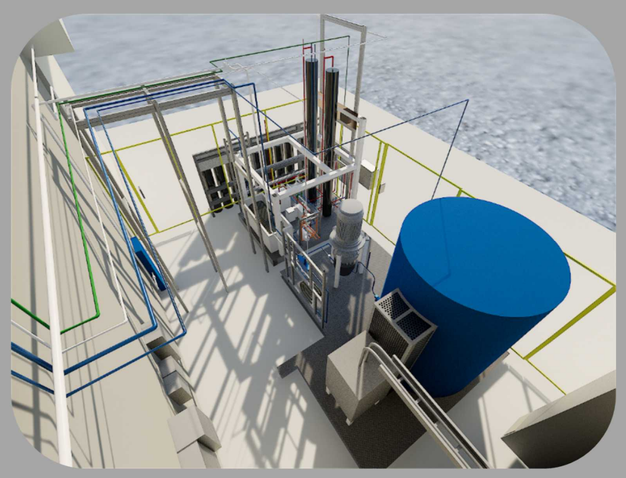
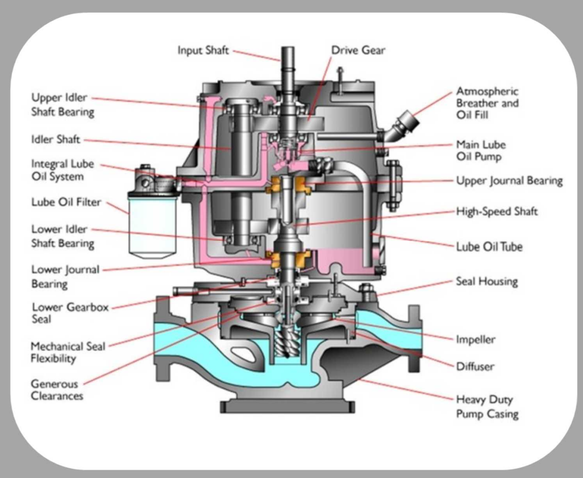
SAND2017-12251C

Exceptional service in the national interest

SEAL DEVELOPMENT PLATFORM







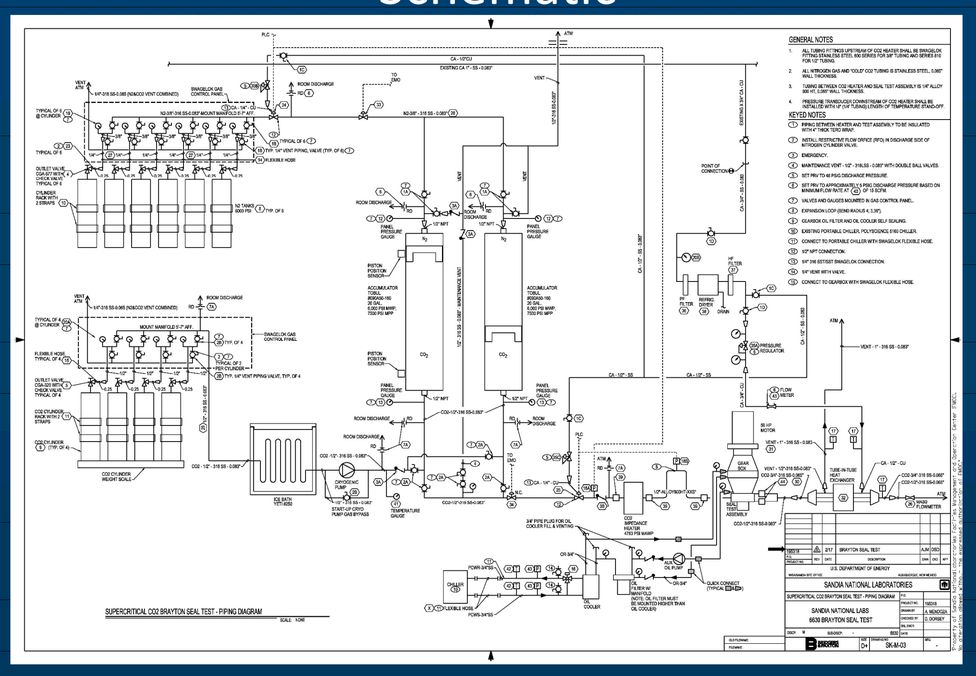
sCO_2 Brayton Capability at NESL

Sandia's sCO_2 Brayton power cycle test capability has matured to include turbomachinery seal evaluation at 700°C, 4,400 psi and 40,000 rpm

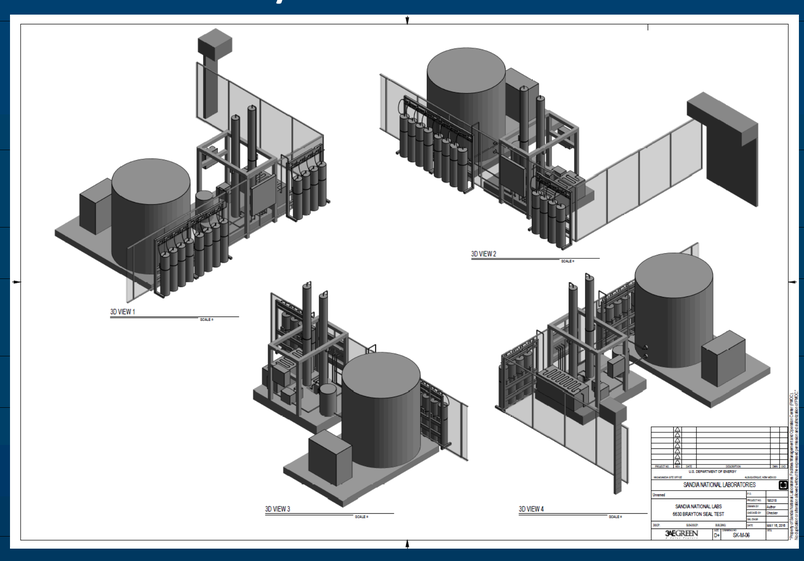
Currently collaborating with Flowserve, Inc. on dry gas lift-off seals for sCO_2 Brayton power cycles

Sandia positioned to advance technology readiness level (TRL) of critical turbomachinery seals to realize commercial sCO_2 Brayton power cycle systems

Schematic



System view



Specifications/Features

CO_2 fill system
- Siphon CO2 cylinders
- Heat exchanger for liquid fill
- 18-stage piston pump

CO_2 inventory system
- Trobul piston accumulators
- N2 backfill system

Heater
- 20 kW impendence heater with Inconel 800HT tubular element
- 20 g/s flow
- 1292°F and 4,400 psi

Seal test concept
- VFD motor, runs 4,000 rpm
- Gearbox with 10:1 ratio
- Seal test module, 2" sealing diameter for 10 MW_e size demo

Current status

- Preliminary design review of Sandia seal development platform is underway and being finalized for high temperature and pressure stress requirements
- Flowserve has designed a seal to test sCO_2 at 700°C and 4,400 psi
- On schedule for prototype testing in FY18

Technical challenges

High temperature materials are needed to get to the 700°C inlet temperature of Turbine

High leakage rates using sCO_2

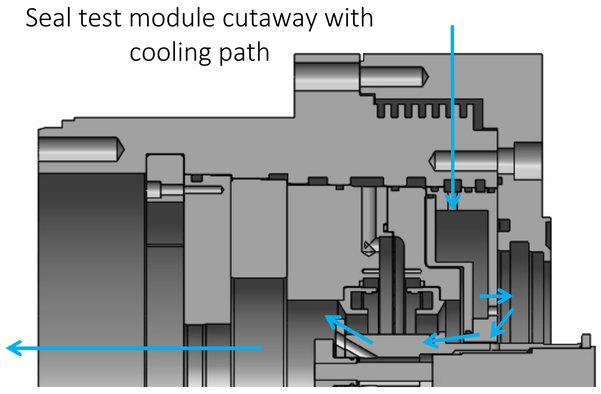
Qualified seals to operate in a sCO_2 environment


Seal failure

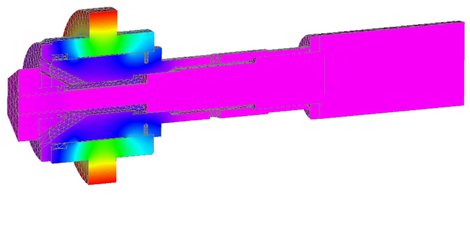
Seal test rig thermal analysis

Test module can maintain rotating seal test conditions (700°C, 4,400 psi sCO_2) while managing heat load with integrated cooling

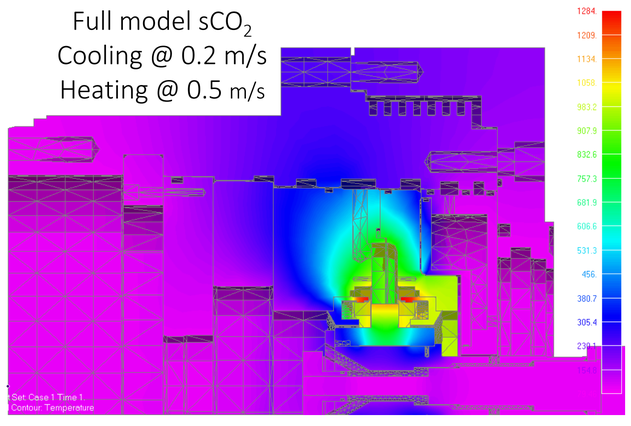
Seal test module cutaway with cooling path



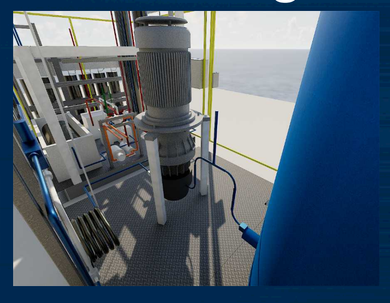
Shaft sCO_2 cooling = 0.5 m/s (max 0.34 CFM)



Full model sCO_2 Cooling @ 0.2 m/s Heating @ 0.5 m/s



Additional system renderings



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