

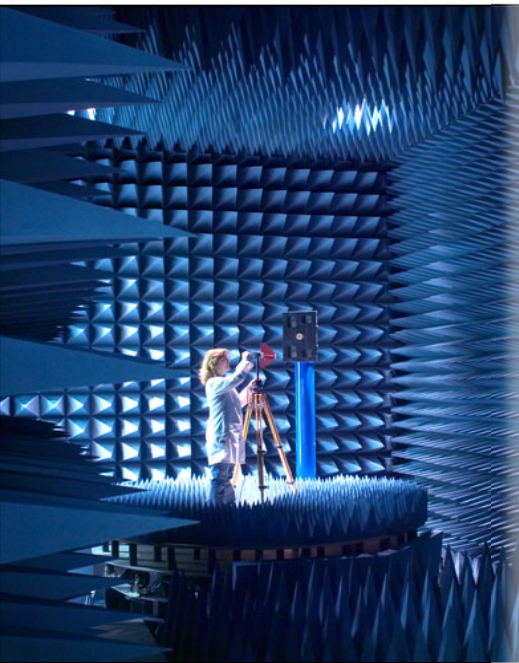
SOUTHWEST RESEARCH INSTITUTE®

*Benefiting government, industry
and the public through innovative
science and technology*

Divisions

Machinery
Department

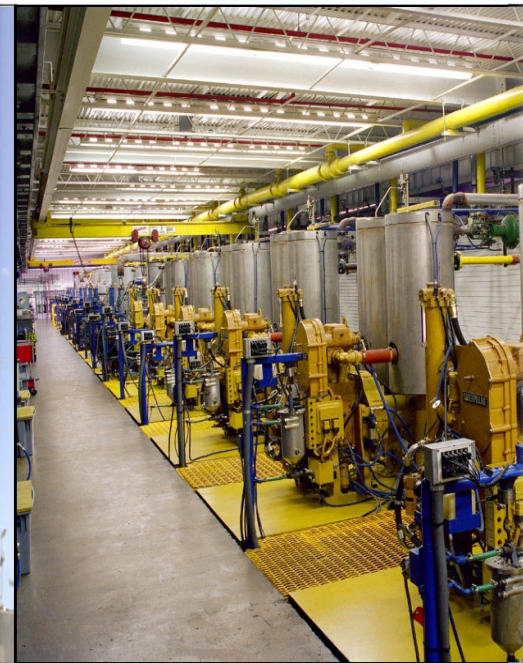




Applied Physics



Chemistry & Chemical Engineering



Fuels & Lubricants



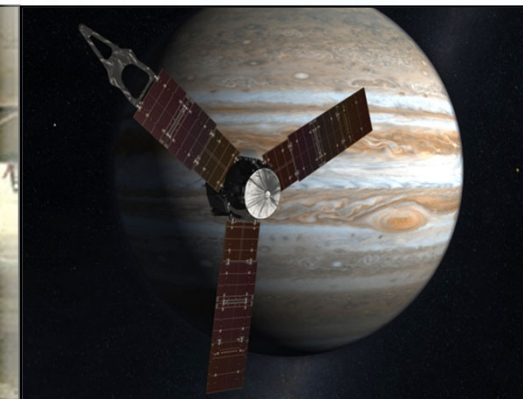
Intelligent Systems



Mechanical Engineering



Defense & Intelligence Solutions



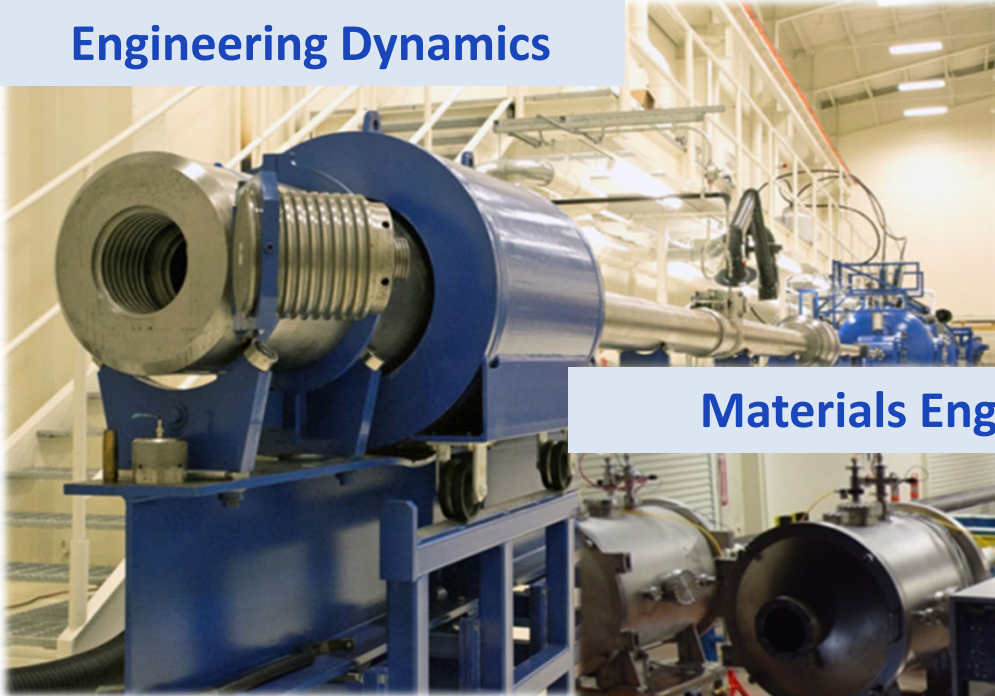
Space Science & Engineering



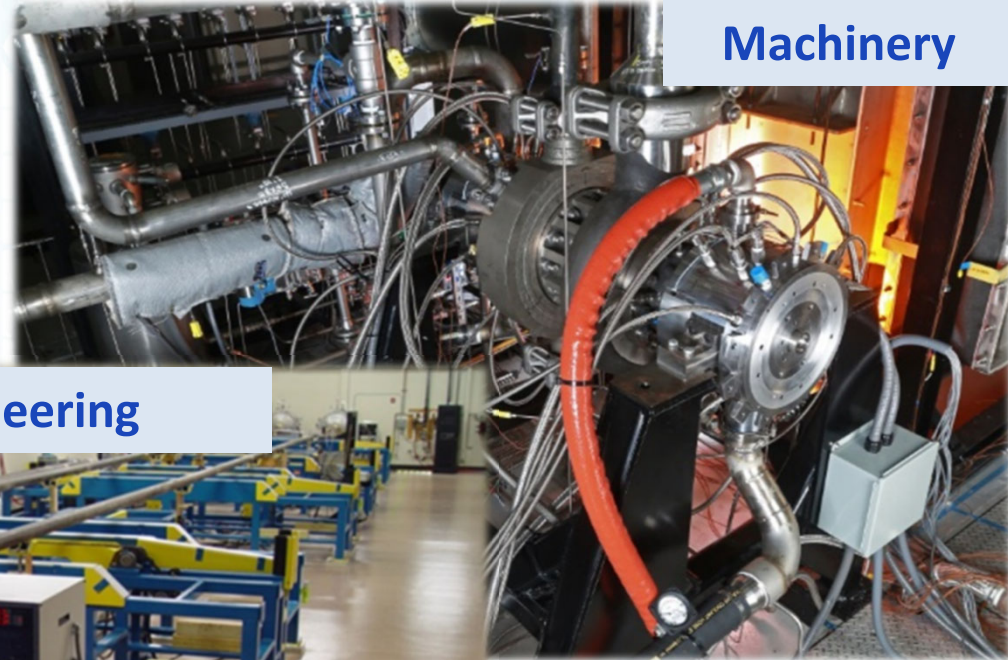
Powertrain Engineering

Mechanical Engineering Division

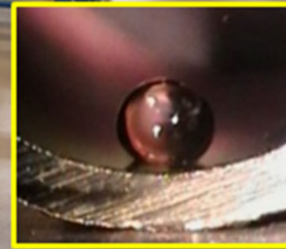
Engineering Dynamics



Machinery



Materials Engineering



Fluids Engineering

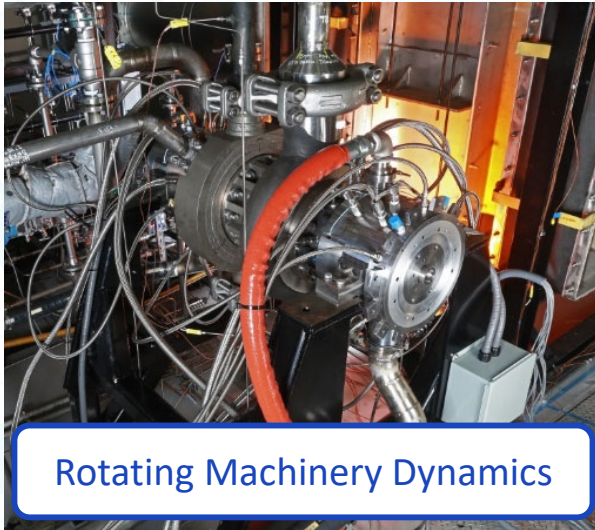
Structural Engineering



Machinery Department

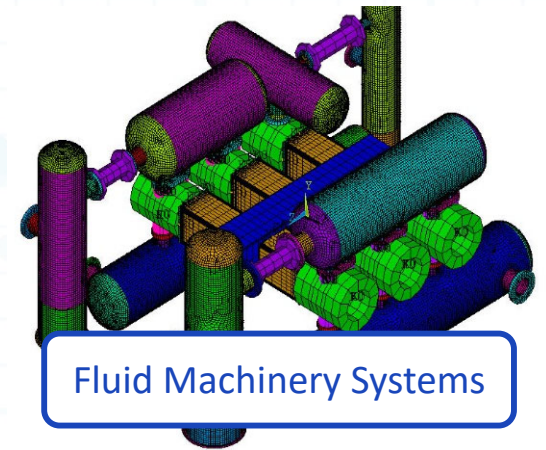


Propulsion &
Energy Machinery



Rotating Machinery Dynamics

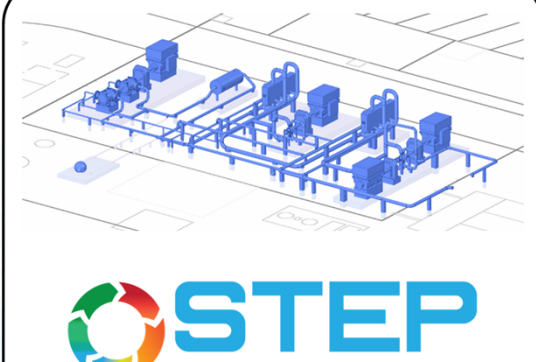
- 70 engineers/technicians
- Design, analysis and testing
- Turbomachinery
- Thermodynamic cycle
- Performance testing
- Life cycle analysis/design
- Mechanical systems (bearings, seals, etc.)
- Prototype development
- Computer aided engineering
 - CFD, FEA, CAD
- Rotordynamics
- Fluid/thermal systems



Fluid Machinery Systems



Machinery Services



Power Cycle Machinery

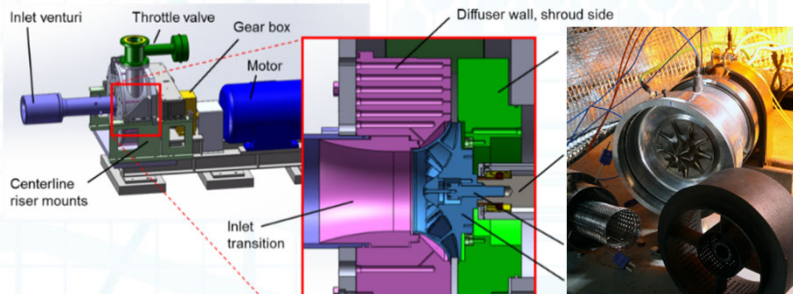
Machinery Department Test Facilities



Multiphase Machinery
Laboratory (B287)

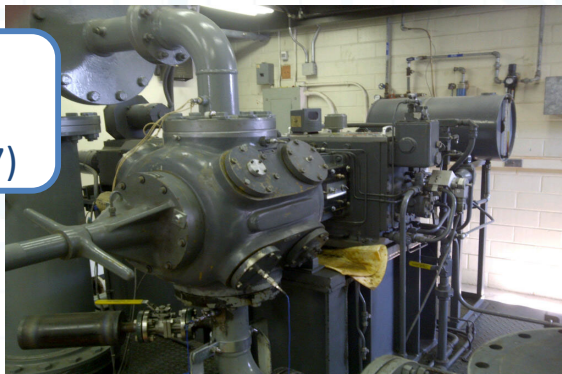


Turbomachinery Laboratory (B278)



Gas Turbine Laboratory (B129)

Recip
Compression
Laboratory (B77)



- Operating Fluids: Air, CO₂, N₂
- Multiphase with Air/H₂O
- Drive power up to 4 MW
- Shaft speeds up to 140,000 rpm
- Machinery: centrifugal pumps & compressors, reciprocating compressors, and small gas turbine engines

SwRI has a test facility for atmospheric testing of gas turbine combustors and elevated pressure testing of single-injectors

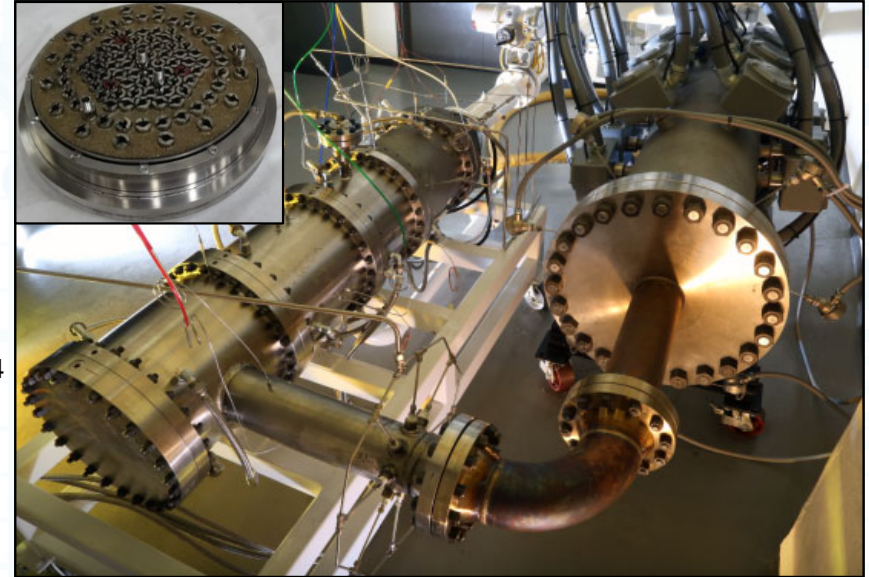


Air Supply

- 4-7 lb_m/sec
- 1,050°F
- 16.8 psia

Fuel Supply

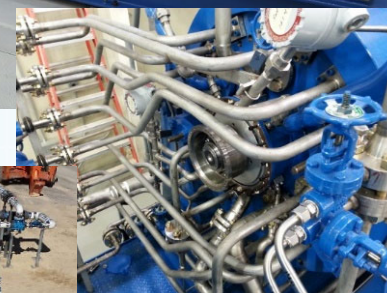
- H₂, N₂, CO₂, CH₄
- 500 psig supply
- 100:1 turndown



DOE CO2 Compression Project

Development of Isothermal Compression for CCS

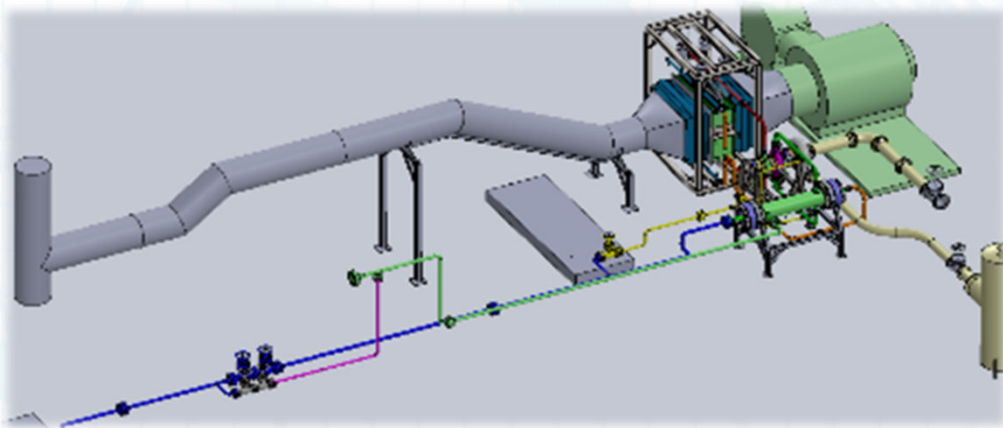
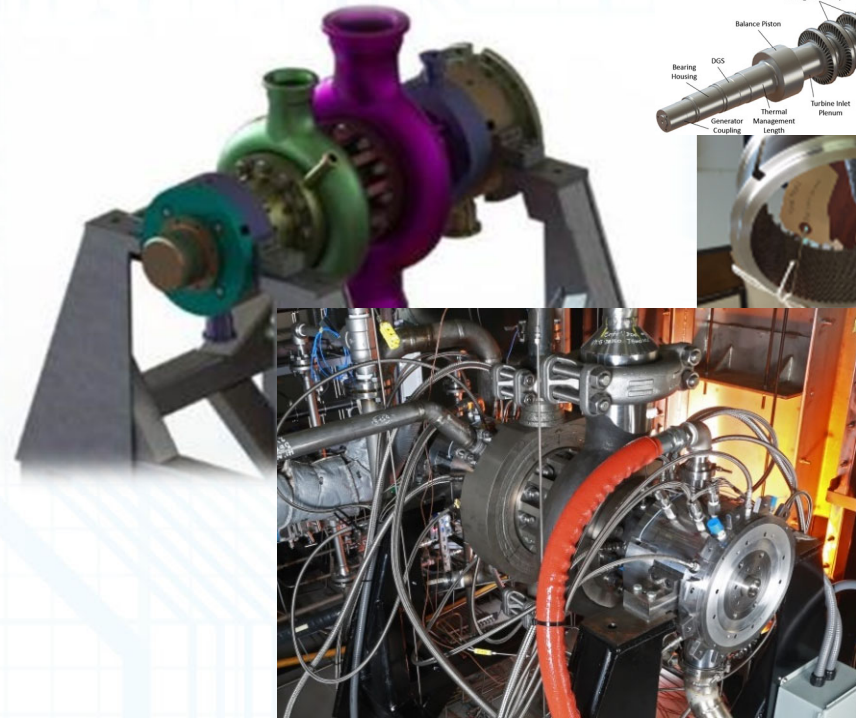
- Phase 3 is a pilot-scale demonstration of an internally cooled compressor design
- Compressor specs:
 - 6-Stage, Back-to-back
 - 4000 hp (3 MW)
 - 10,000 ACFM Flow Capacity
 - 1200 psi Case rating
 - 3200 psi Loop rating
 - Loop size: 16", 10", 6"



Sunshot: Development of a High Efficiency Hot Gas Turbo-Expander and Low Cost Heat Exchangers for Optimized CSP Supercritical CO₂ Operation (*SwRI, GE, Thar for DOE EERE*)

Innovation: This MW-scale sCO₂ turbo-expander and heat exchanger are a critical step in increasing energy conversion efficiency to >50%, while reducing power block costs. SwRI and GE built a MW-scale sCO₂ turbo-expander optimized for concentrating solar power plant duty cycle profile.

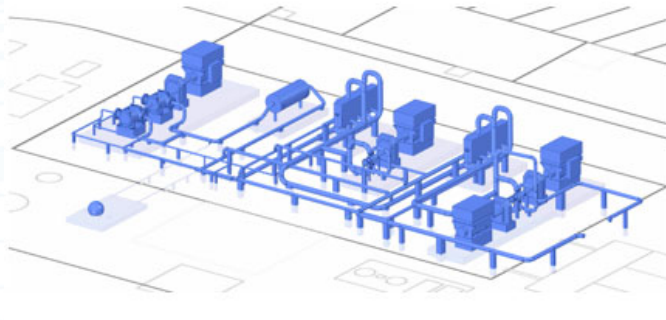
Rotor: 20,000 hp
160 lbs



MECHANICAL ENGINEERING

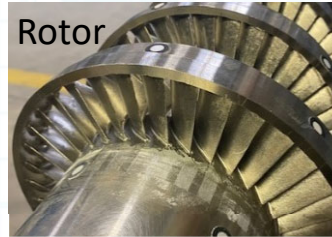
Supercritical Carbon Dioxide (sCO₂) Power Cycle Test Facility

- Develop an indirect-fired, 10 MWe sCO₂ power plant using recompression Brayton cycle
- Construction underway completing in 2023

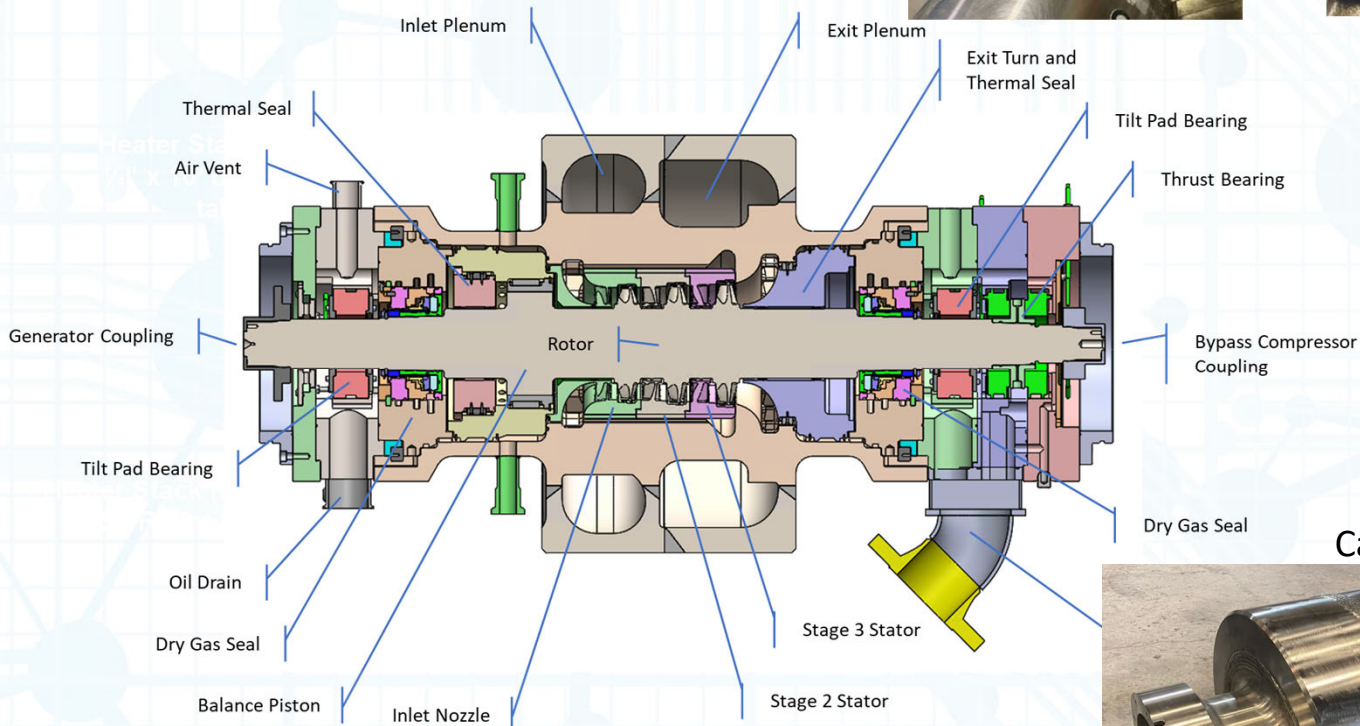


STEP 10 MWe Turbine

Monolithic Rotor and Stators



Stator Nozzle

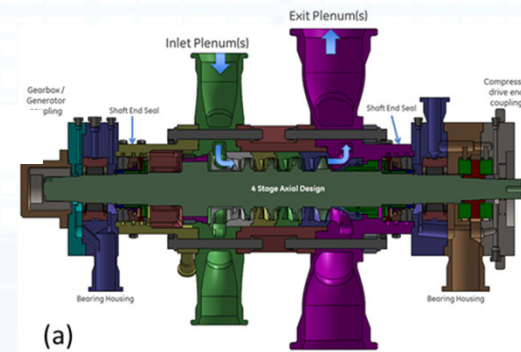


1-Piece
Fabricated
Inconel Casing



Casing

Sunshot Turbine



(a)

- Sunshot was Design Basis
- Monolithic Fabricated Case
- Same One-Piece Rotor
- Similar bearing and dry gas seal design
- 3 vs. 4 stages

Root Cause Failure Analysis

Rotordynamic Audits



Pipeline/Plant Simulation



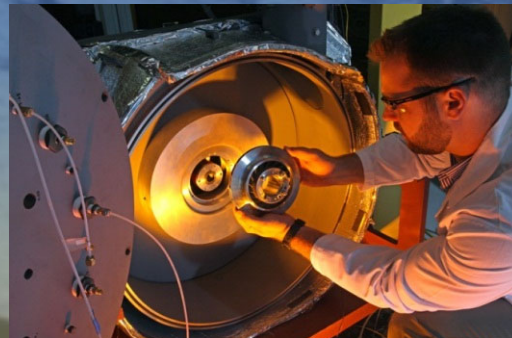
Machinery Section

Southwest Research Institute

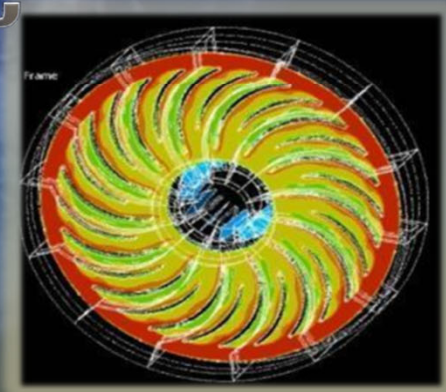
machinery.swri.org



Test Rig Design



Performance Testing



CFD/FE Analysis