

# USTR Fellowship report out R. Porqueddu



University Turbine System Research fellowship

May 20<sup>th</sup> to Aug 9<sup>th</sup>, 2024, Greenville S.C.

Sponsored by DOE for R/D on converting turbines to Hydrogen fuel

\*Disclaimer – No Photos or electronic files / images were taken from GE without their approval\*

# GE Vernova: Greenville S.C. Gas Power and On Shore wind

- GE Vernova
- GE Healthcare
- GE Aerospace



## GE Vernova - Combustion Group:

- Mechanical
- Aerothermal



# About Me Education:



Norwich University class of 1991 BSME  
2003 MBA



Brooklyn Polytechnic Physics 21/35 credits

Georgia Institute of technology Masters 2025  
12 Credits remaining



# Richard Porqueddu: Employment



Brookhaven National Laboratory

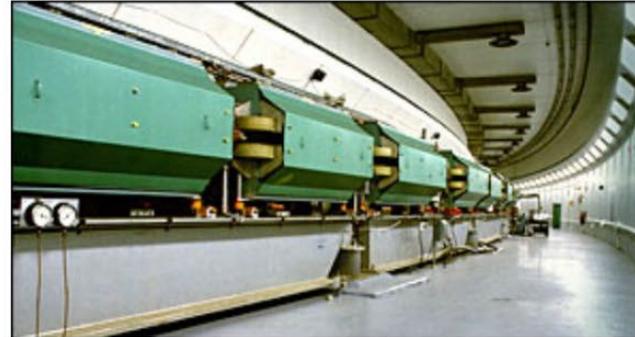
16 yrs 7 mos



Project Engineer

2008 - Present · 16 yrs 7 mos

I took a 12 week leave of absence to participate in the fellowship.



Alternating Gradient Synchrotron (AGS) and Generator



Senior Machine Design Engineer

Dayton T. Brown, Inc.

Sep 2007 - Jan 2008 · 5 mos



Senior Designer

Frequency Electronics

Jul 2005 - Aug 2007 · 2 yrs 2 mos



Design Engineer / Engineering Manager

Thomas C. Wilson, LLC.

Apr 2002 - Jul 2005 · 3 yrs 4 mos

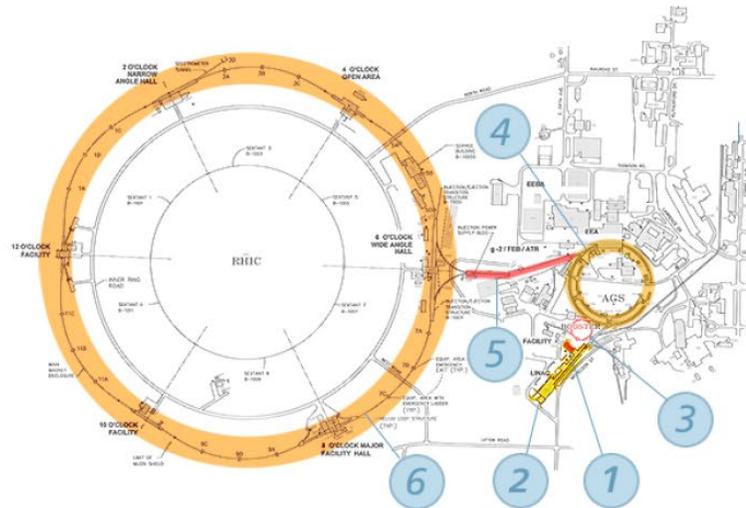
Long Island City, NY



Product Management Handling Systems

Festo

1998 - 2002 · 4 yrs



Relativistic Heavy Ion Collider

# About me, Fun stuff:

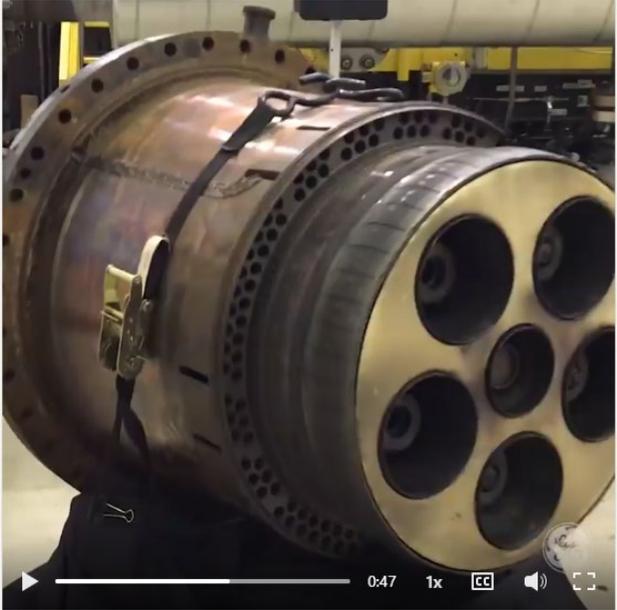


# Turbine Anatomy (101):

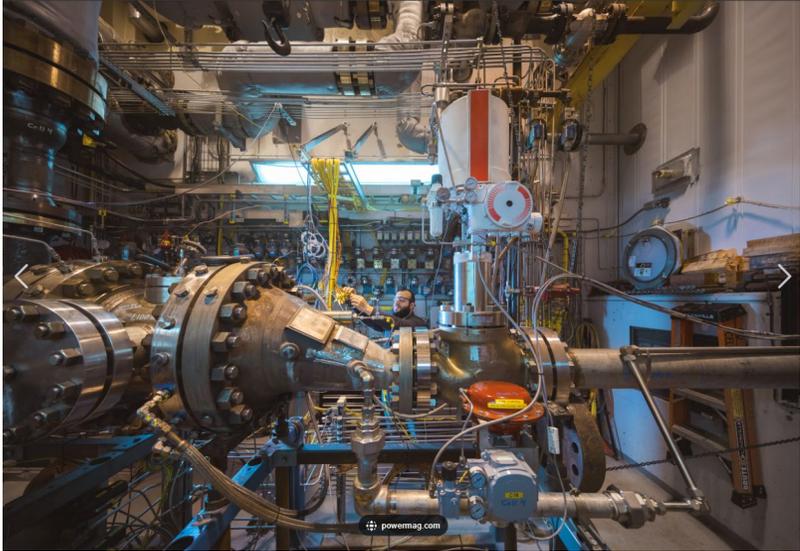
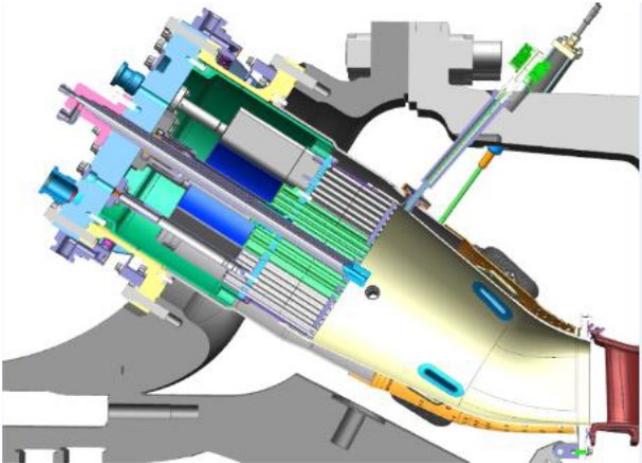


Test Stand 7

# Turbine Anatomy (101):



Combustor



Combustion test lab

Quick Disconnect  
(QD) fittings for  
Hydrogen  
connections to  
combustion can:



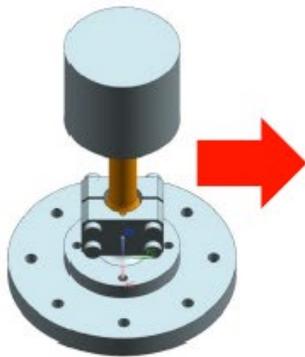
# The Project:

## Scope:

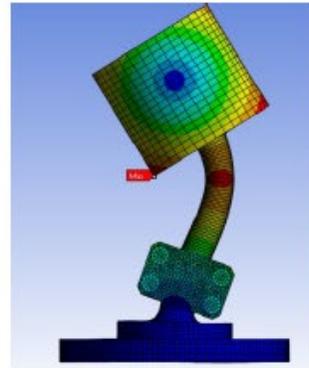
- Complete specifications for production Hydrogen fittings.
- Start with COTS fitting that had some success in testing.
- Duplicate Fitting design and scale it appropriately.
- Design Analysis and Test campaign.
- Implement as far as possible.

## Analysis:

- Harmonic & Modal.
- Force and moment analysis with initial clamping forces included.



Parts designed in  
CAD



Parts analyzed in FEA



Parts manufactured at  
local contractor



Finished Test Article

# Shaker Table / Vibration testing

## Modal Analysis:

- Harmonic modes identified up to 1000 Hz encompassing most combustion tones and rotor / line frequencies.

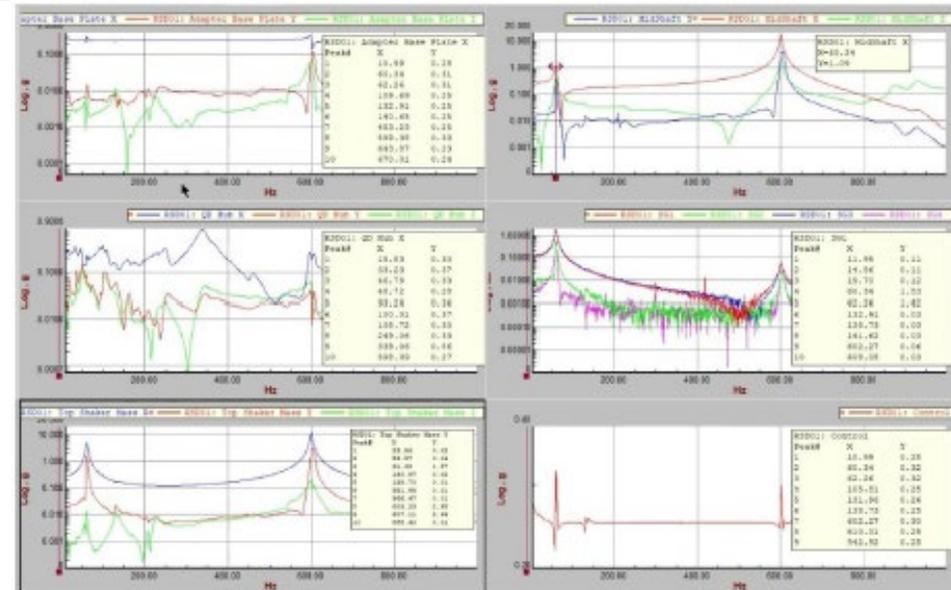
## Harmonic Analysis:

- Initial sweeps performed at .25G to verify modal findings and mode shapes.
- Simulations to 1G then a linear scale down to max elastic limit.
- Test at limit then test till failure.
- Evaluate test data and calculate actual system damping and rerun simulations.

## Testing:

- Accelerometers, Strain gauges, pressure transducers and Thermocouple. 19 Channels.

Ensure that simulation meets real life testing environment.



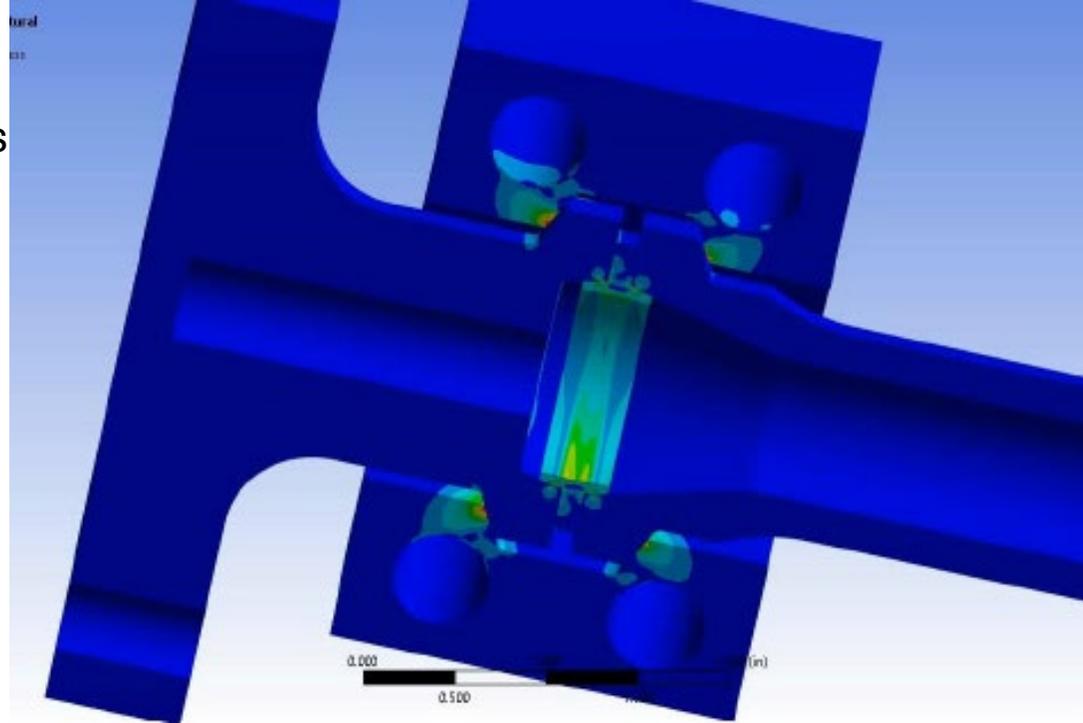
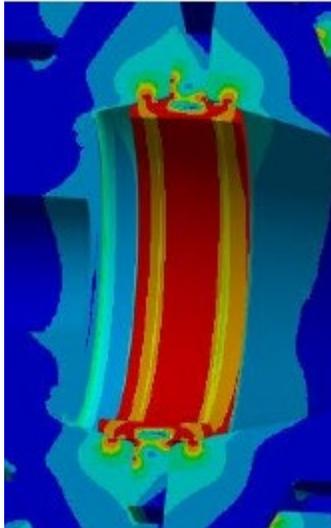
**Done**

\*Used with permission\*

# QD Force and Moment testing

## Analysis:

- 3.2M elements / 6.5M Nodes
- 21 load steps / 320 total steps with auto time stepping
- Solution over 100Gb W/O intermediate steps saved
- 23.6 hours to solve using 96 cores.



\*Used with permission\*



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# Takeaways and results:

- Takeaways:
  - Amazing to work alongside such experience and talented team members.
    - How to calculate system damping from testing results.
    - Low and High cycle fatigue analysis.
  - Experience in NX and ANSYS.
  - Taking real world test results and refining analysis based on that.
  - Great opportunity to step outside of my current position, experience something from a fresh perspective and sharpen my skillset.
- Results:
  - Production Hydrogen fitting specification project scope defined.
    - Three major phases.
    - Product sizing defined.
  - First phase of fitting design, analysis and testing completed.
    - Failure criterion for fitting line defined.
    - Vibration limit of fittings defined.
    - Allowable force and moment limits defined.
    - Analysis architecture defined and verified / refined with testing results for Modal - Harmonic and Force - Moment simulations.