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GEV ARC: HPC ON-PREM AND CLOUD WITH IN-HOUSE APPLICATIONS

GE VERNOVA (GEV) - PUBLIC

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About me (Ravi) -

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- Ex-Amazonian → Before Joining GE, I worked as a TPM at AWS Security. Building anomaly detection and mitigation. E.g., S3
    - My team and I had filed 4 patents on novel detection.

- Ex-Oracle → I also worked at Oracle, as IT Manager. Led team to migrate from AWS Cloud to OCI.
    - Worked on getting 1st PCI attestation for a Oracle Utility Product (DSS) – PII, Financial data.

- Ex-NFL (IT) → worked on nfl.com, live streaming of game stats and videos.

- Little fun fact about me…

About GEV ARC -

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- GE Vernova (GEV) started as a new entity on 4/2/24.
- Advanced Research Center (ARC) – part of GEV and horizontally supports all business units.
- Based in Niskayuna, Albany, New York.
- Spread across 500 acres land with state-of-the-art facility. Planning to expand for supporting next gen tech.

HPC workload at GEV

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- Running on prem to support Computer Aided Engineering (CAE) workload.

- Run Computational Fluid Dynamic (CFD) and Finite Element Analysis (FEA) models using home grown tools and vendor provided.

- HPC used in GEV:
  - Gas Power – To find efficiencies in Gas Turbines.
    - To develop low-emission gas turbine products that meet or exceed regulatory requirements on emissions. This involves developing physics based predictive models.
  - On shore and off shore wind – To improve wind turbine efficiency.
  - Finite Element Analysis
  - Computational Fluid Dynamics

HPC workload at GEV – Continued...

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Key takeaway from HPC workloads:

- Ability to simulate designs significantly reduces both the time and cost before creating physical prototypes.
- Computational combustion tools also help us understand root causes of failures.
- Use experimental design methods to analyze and optimize our products.

Our goal –

- Reduce power consumption
- Improve the quality of energy generation
- Collaborate with National Labs and DoE on reducing carbon footprint, build energy efficient products.

HPC on Cloud

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- GEV works with several Cloud Service Providers to meet capacity needs.
- Cost and data classification plays a big part.
- Consider Total Cost of Ownership (TCO) over 3 yr/5yr period.
- Complexities of running in cloud.

GEV – National Lab Collaborations

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- 3 different active grant programs with Summit and Frontier using approximately 500,000 node-hours.

- Leveraging National Lab compute resources to develop and demonstrate advanced simulation tools and methods for multiple Vernova business units

Recap...

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1. Continue to partner with National Labs to run simulations, write proposals and build energy efficient solutions.

2. Cloud Smart approach.
   - Compare Total Cost of ownership with on-prem and Cloud – on a 3yr/5yr scale

   - Security, Compliance, data governance plays a big role in on-prem vs cloud.

Non-reactive flows

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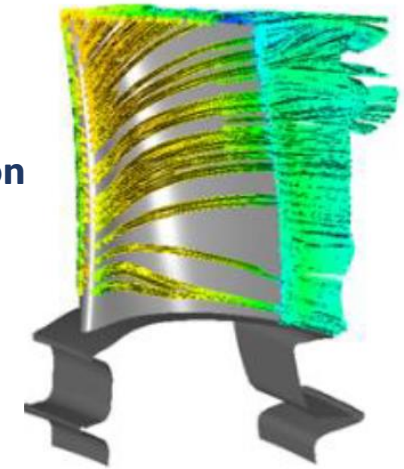
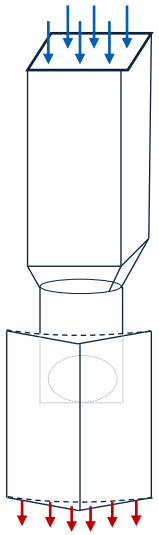
Aerodynamics

CFD areas of relevance:

- **Single phase**
- **Incompressible NS**
- **Compressible NS**
- **Fluid-solid Interaction**
- **Novel fluid**





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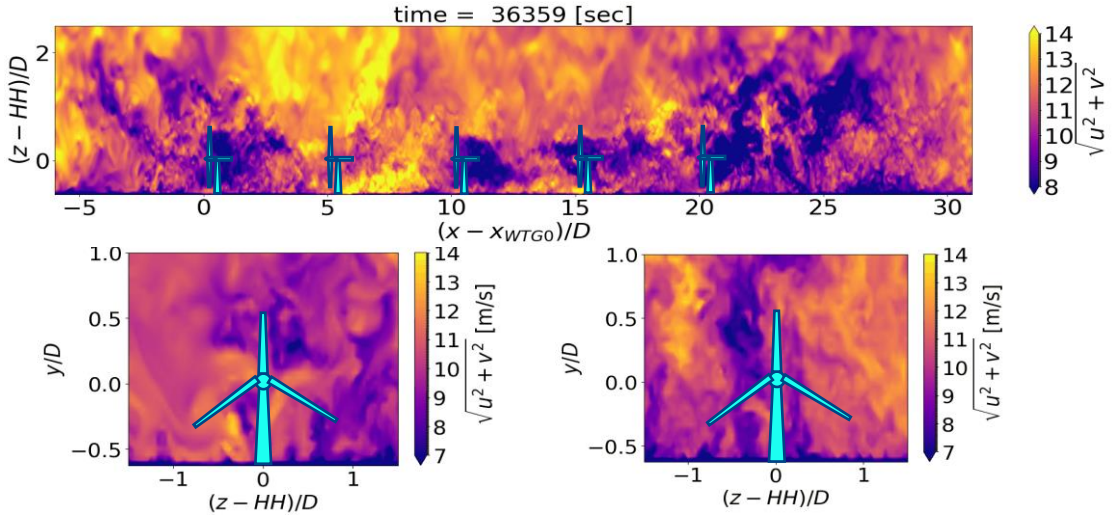
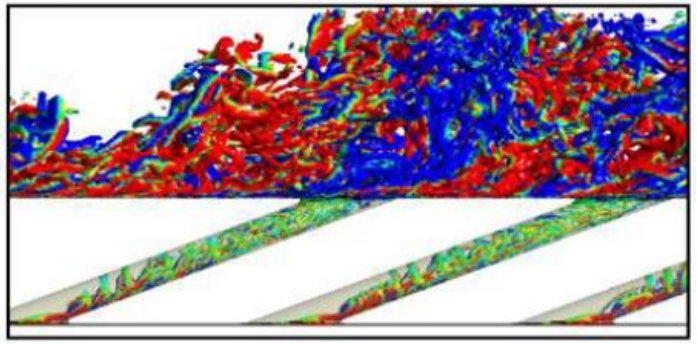


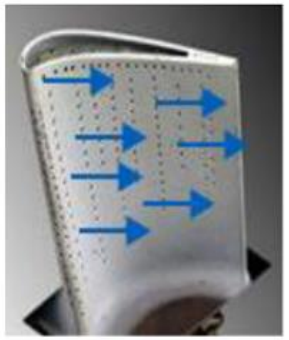
Chatterjee T, Jayaraman B, Yellapantula S, AIAA SciTech 2024, AIAA 2024-1700 https://doi.org/10.2514/6.2024-1700

Thermal systems

CFD areas of relevance:

- **Multiphase**
- **Mass/heat transfer phase closure model**
- **Incompressible NS + scalar transport**
- **Conjugate Fluid-solid Heat transfer**
- **Cryogenic fluids**





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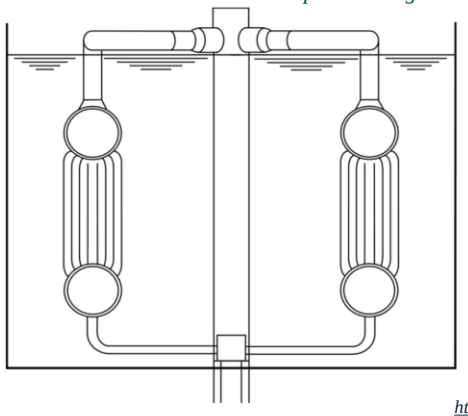

https://www.nrc.gov/docs/ML1410/ML14100A519.pdf

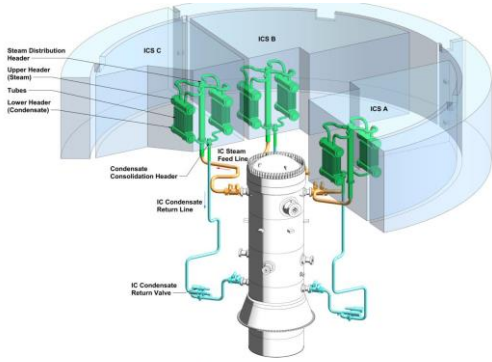

Figure 3-6: Isolation Condenser System

https://www.gevernova.com/content/dam/gepower-new/global/en_US/images/gas-new-site/en/bwrx-300/005N9751_Rev_BWRX-300_General_Description.pdf

Reacting flows

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Combustion flame

CFD areas of relevance:

- **Incompressible NS**
- **FGM/PDF flame table generation/read-in**
- **Conjugate Fluid-solid Heat transfer**
- **Atomization (Lagrangian, droplet coalescence/break-up)**

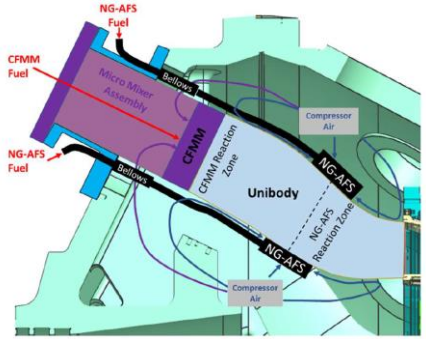


FIGURE 6: HA-STYLE AFS FUELING APPLIED TO F-CLASS UNIBODY

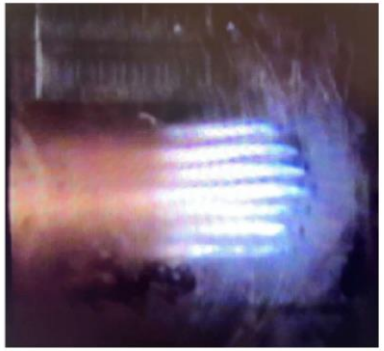
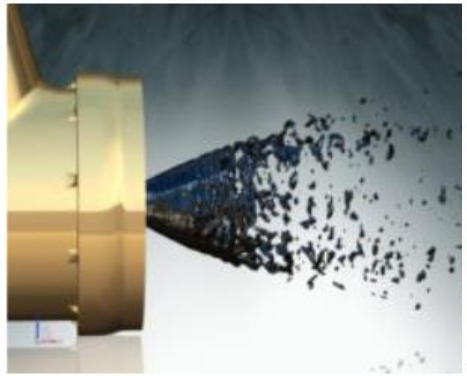


FIGURE 12: MM FUELED WITH 100% H_2

Hughes et al. Proceedings of ASME Turbo Expo 2023 - GT2023. June 26-30, 2023, Boston



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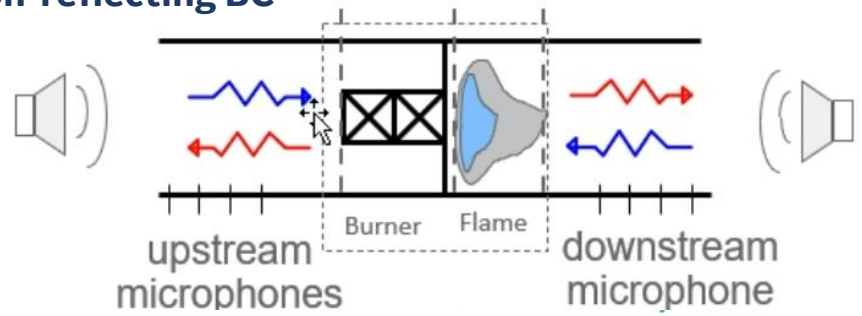
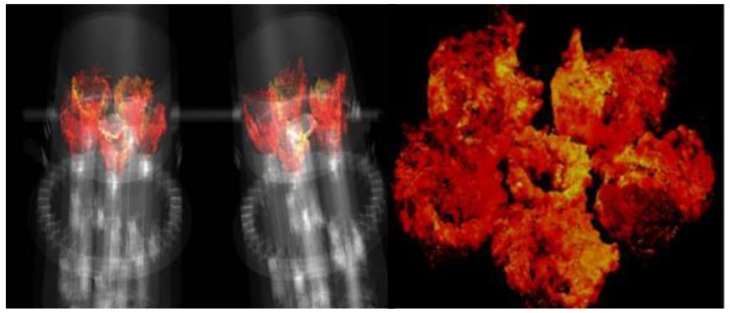
Combustion dynamics

CFD areas of relevance:

- **Incompressible/Compressible NS**
- **Mesher compatibility**
- **Partially/perfectly premixed**
- **Acoustics**
- **FGM/PDF flame table generation/read-in**
- **Hydrogen/sustainable fuel**
- **Time dependent profile as forced inlet BC**
- **Non-reflecting BC**





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