The Mechanisms Engineering Test Loop (METL) facility at Argonne National Laboratory

Mr. Derek Kultgen

Argonne National Laboratory

14 December 2022

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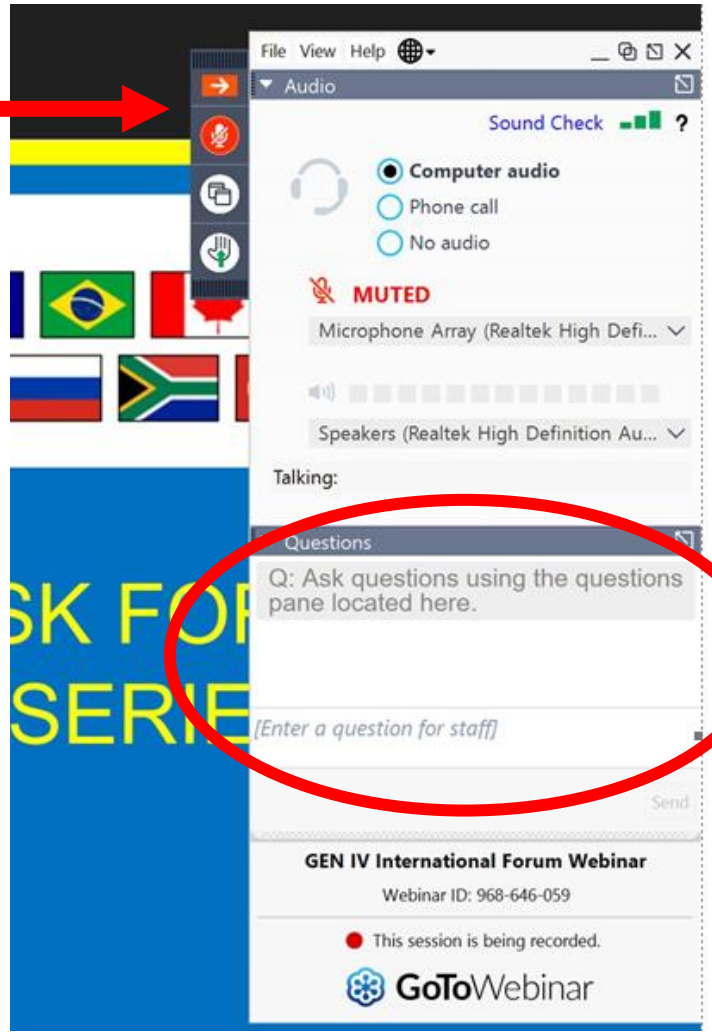

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Meet the Presenter

Mr. Derek Kultgen serves as the Group Leader for the Mechanisms Engineering Test Loop (METL) at Argonne National Laboratory.

METL is an experimental facility dedicated to developing small-to-intermediate scale components for Sodium Fast Reactors. The METL team conceptualizes, fabricates, and demonstrates equipment and instrumentation and assists scientists/engineers who conduct experiments in the METL.

Previously, Mr. Kultgen was the Lead Test Development Engineer for a leading lubricant and additive manufacturer. In this role, he created a mechanical testing laboratory for compressor lubricant evaluation, managed capital expenditure projects and served as a technical expert.

Mr. Kultgen received his B.S and M.S. degrees from Purdue University, is a licensed Professional Engineer and Certified LabVIEW Architect.

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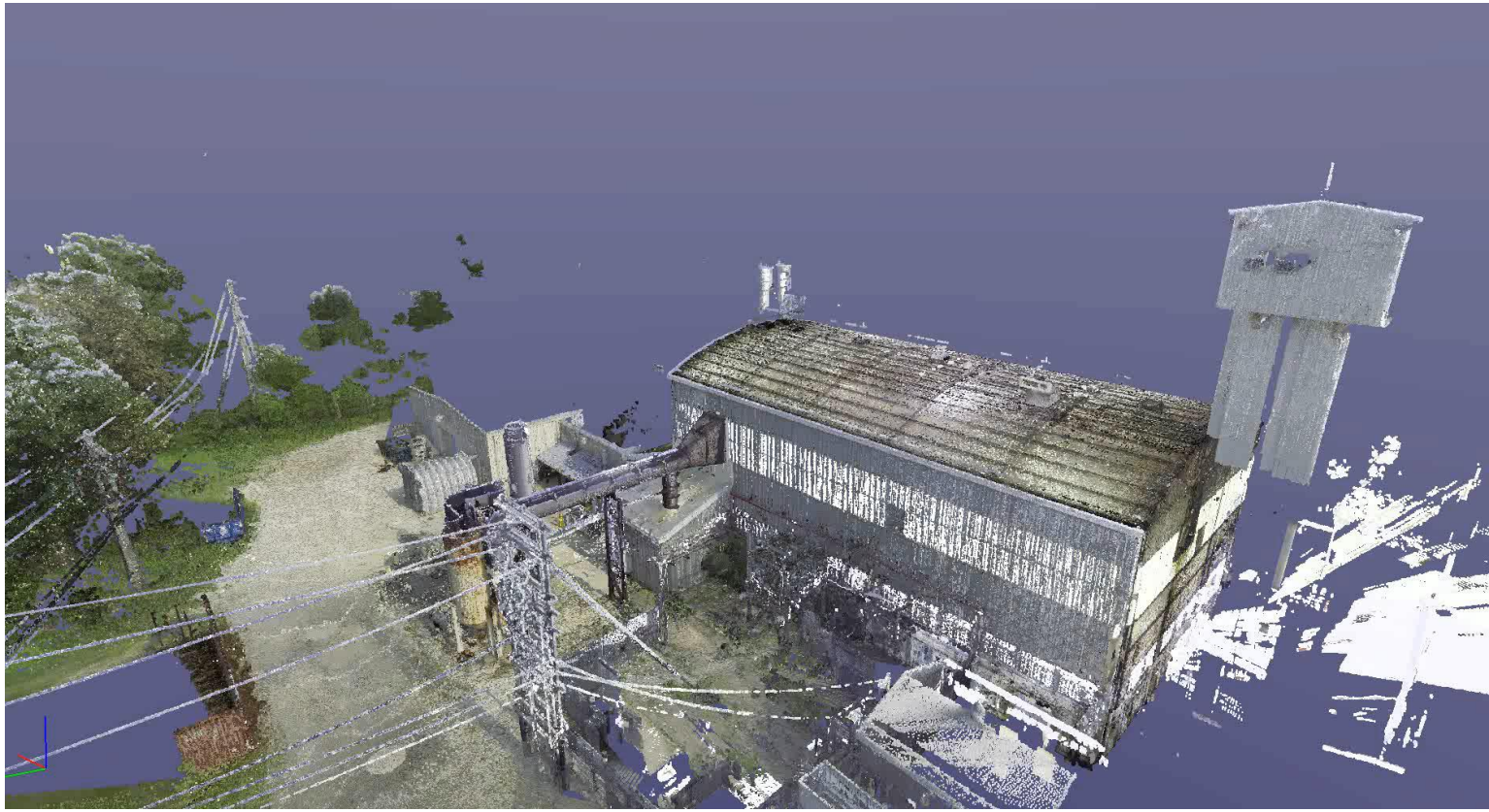
METL Program

- Argonne National Laboratory
  - Buildings 206, 208-F, 308, 309
- Advance Sodium Fast Reactors
  - Equipment
  - Instrumentation
  - Processes
  - Training
- Lifecycle Support
  - Design, Manufacture & Build
  - Test, Analyze & Reiterate
  - Decontaminate, Inspect & Dispose

Fig/Vid 1. Building 308 Point Could Fly-Through



METL Flagship Facility Overview

- Location: Building 308
- Sodium Inventory: 750 Gallons
- Footprint: (2) Levels, 60’x24’ & Growing
- Test Vessels: (2) 50 Gallon, (2) 150 Gallon
- Max Operating Temperature: 1000/1200 °F
- Pressure: Argon ≈ 5 psig
- Materials: Stainless 316 & 304 + Some Exotics
- Energy Source: Electric Resistance Heaters
- Insulation: Cerablanket, Pyrogel & Vermiculite

Fig 1. Dump Tank

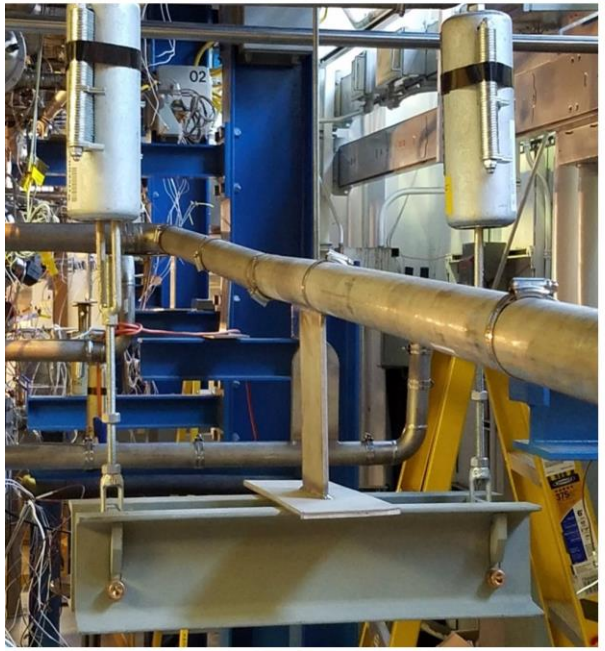


Fig 2. Piping Trapeze

METL Flagship Component Highlights

Fig 1. Current Vessel Family

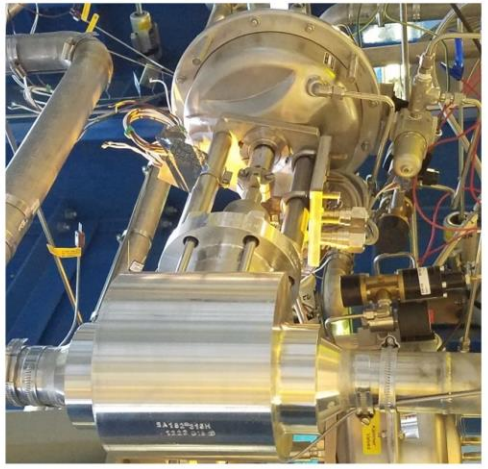


Fig 2. Welded Bellows Valve

Fig 3. Expansion Tank

Fig 4. Air-Cooled Cold Trap

Fig 6. Air-Cooled Plugging Meter

Fig 5. Annular Linear Induction Pump

METL Ecosystem I&C

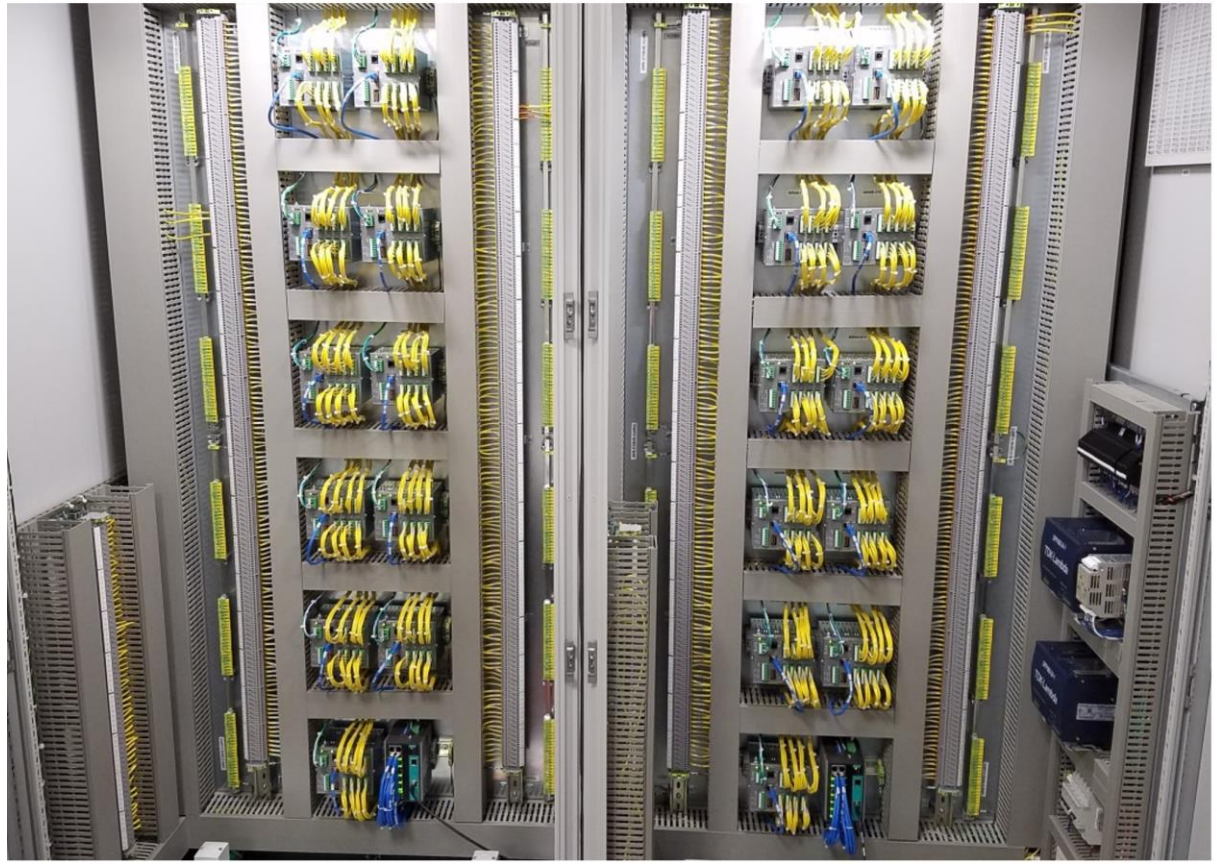


Fig 1. Control Enclosure 1

Fig 2. Main Industrial Control Enclosure

- (2) RT Linux Controllers
  - (10) Expansion Chassis
- (22) Process Loop Controllers
- (10) Electric Meters
- (2) Power Quality Meters
- (7) Automation Controllers
- (8) UPS
- (3) VFD
- (4) Gateways
- (4) Enclosure A/C
- (1) UT Flowmeter
- More on the way
  - Servers, RT Controllers, VMs, HMIs, Hands-Free, etc

METL Flagship Virtual Tour

METL Example Experiments

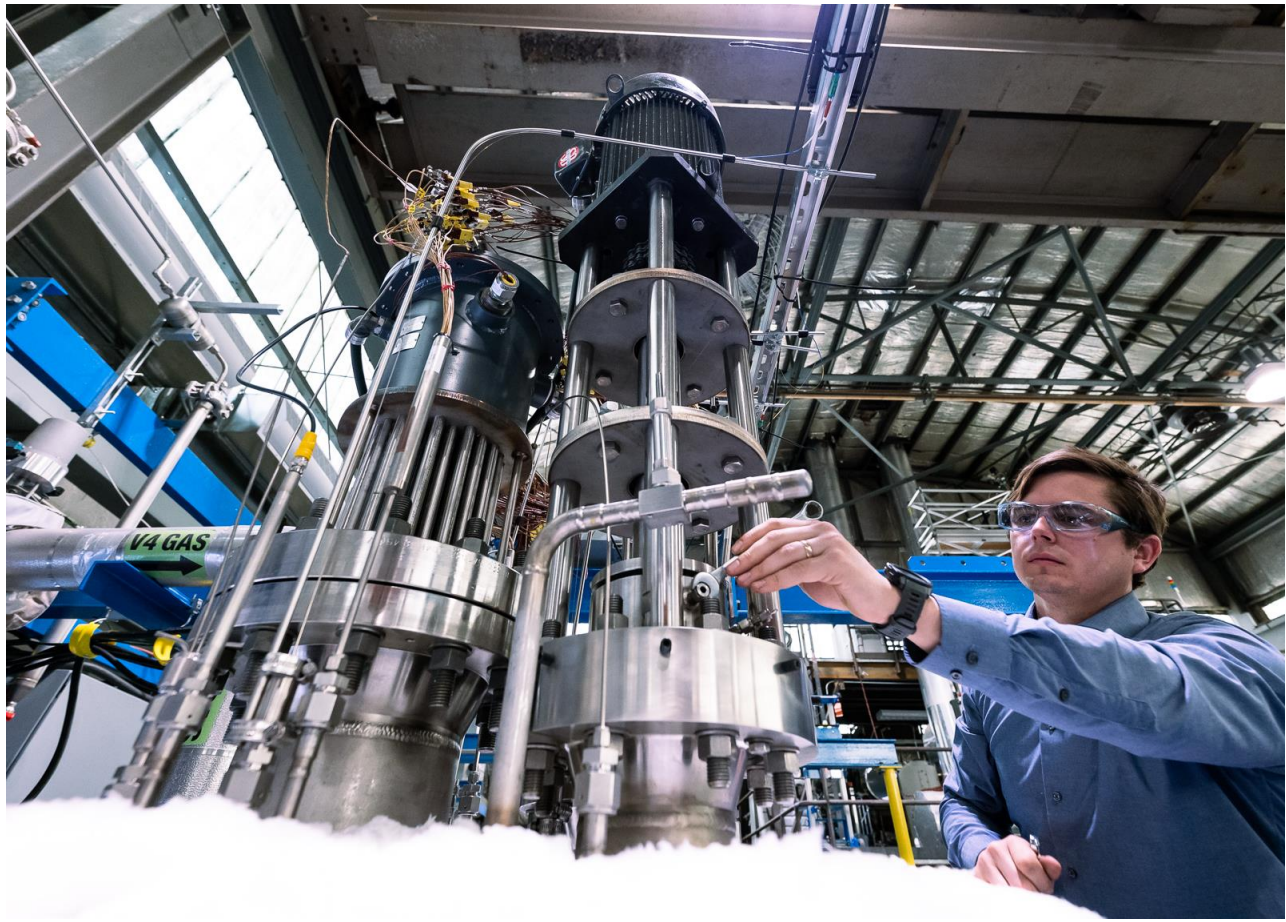
- **Gear Test Assembly (GTA)**
  - Liquid Sodium Lubricated Gears
    - Bearings
    - Seals
  - Simulated Load
  - (6) Test Runs Completed
  - Status: 6th Test Run

Fig 1. GTA

METL Example Experiments

- **Thermal Hydraulic Experimental Test Apparatus (THETA)**
  - Pool-type, Electrically Heated SFR
    - 28”Test Vessel
    - Hot & Cold Plenum
    - Mechanical Pump
    - Submerged EM Flow Meter
  - Thermal Hydraulic Phenomena
  - Hardware & Instrumentation
  - Status: Installing Balance of Plant
    - Air Cooled Heater Exchanger

Fig 1. M.Weathered (PI) Next to THETA



METL Example Experiments

- **F-STAr**
  - In-Core Instrumentation
  - 28” Test Vessel
  - Status: Assembling
- **Gripper Test Assembly (GrTA)**
  - In-Vessel Transfer Machine
  - 28” Test Vessel
  - Status: Manufacturing

Fig 1. F-STAr Under Construction

METL Support

- **Alkali Metal Scrubber**
  - 30,000 CFM blower
  - Ducted to building 308 & burn stall
    - METL breach
    - Controlled disposal
- **Flexible Cask**
  - Inert containment for test article removal/installation
- **Argon Glovebox**
  - Dedicated for alkali metals: NaK
- **Qualifying Station**
  - Identical test vessels

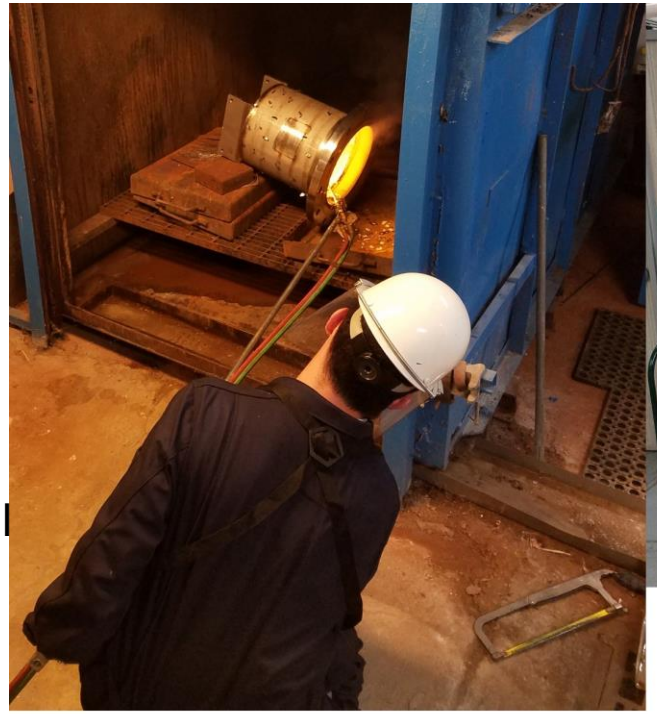


Fig 1. T.Kent Burning Sodium

Fig 2. 4-Port Alkali Metal Glovebox

Fig 3. Flexi-Cask Sequence of Operations

METL Outreach

- **METL External Website**
  - Progress Reports & Papers
  - Virtual Tour + Promo Video
  - Sodium Resources
- **Collaboration**
  - Quantum Key
  - Machine Learning
- **Webinars**
- **Internships**

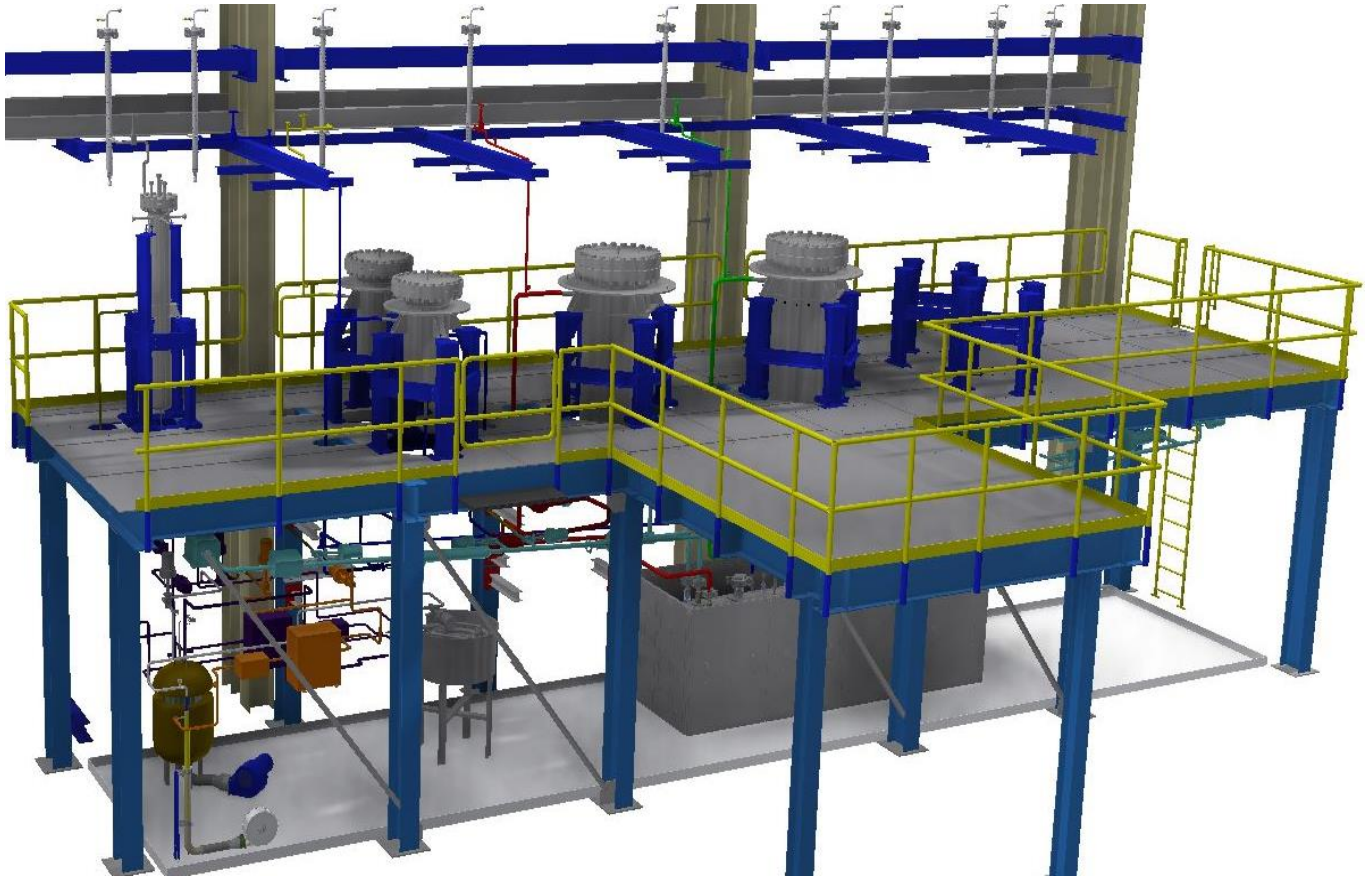


Fig 1. METL Flagship CAD

Summary

- **METL Ecosystem**
  - Cradle to grave
  - Client driven
- **METL Flagship**
  - SFR proving grounds
  - Open to industry & academia
  - Emphasis on flexibility
- **METL is a Hybrid**
  - An experiment to host experiments
  - Workforce development

Fig 1. D. Andujar Using Hand-Free Device (assisted Reality)

Acknowledgements

- Current DoE-ART program manager Tom O’connor, former art program manager Alice Caponiti, federal program managers Janelle Eddins and Kaatrin Abbott
- ANL NSE: Bo Feng (art fast reactor ntd), Christopher Grandy
- National Reactor Innovation Center (NRIC) director Ashley Finan
- METL CREW: Matthew weathered, Edward Kent, Daniel Andujar, Jordan Rein, Alex Grannan
- ANL EOF: Henry belch, Roger Kellogg, Lu Krajtl
- ANL CS: Bill Toter, Bob Sommers, Dan Berkland
- ANL EGS IT: Christian Kourkemelis, Jay Johnson
- ANL BIS: Corey Hall, Brent Kolasinski, Brandon Siegel, Nick Stoops
- ANL FMS: Gedeon Teame, Jeff Slawinski

Fig 1. Core METL Crew

Upcoming Webinars

Date	Title	Presenter
25 January 2022	Molten Salt Reactor Fuel Cycle and Thermo-Dynamics simulation	Dr. Jiri Krepel, Paul Scherrer Institute, Switzerland
22 February 2022	Safe Final Disposal of Spent Nuclear Fuel in Finland	Mr. Mika Pohjonen and Mari Lahti, Posiva, Finland
5 April 2023	Overview of Nuclear Graphite R&D in support of advanced reactors	Dr. Will Windes ORNL, USA

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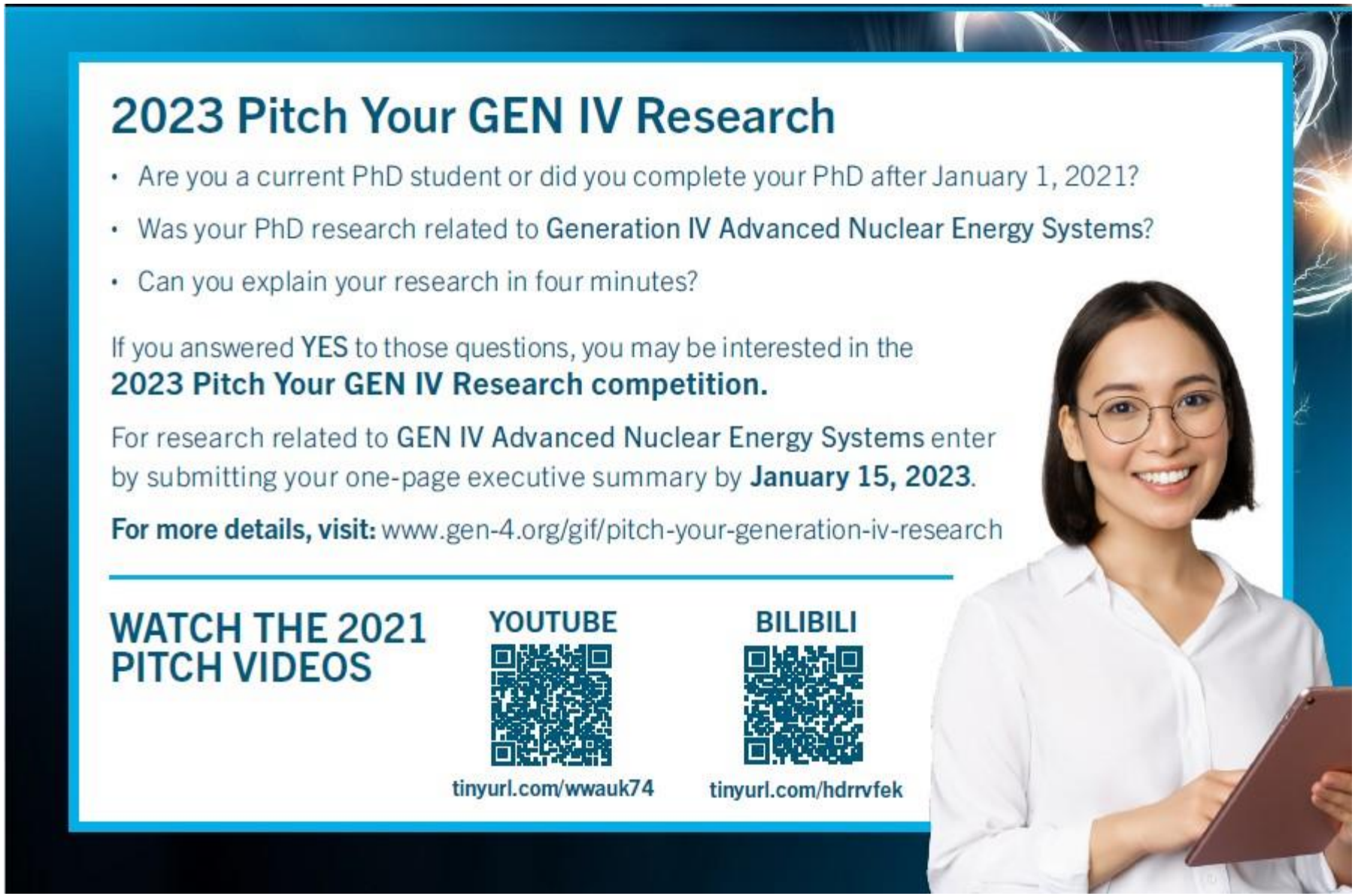

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