NASA Ames Arc Jet Complex
High Enthalpy Testing

SILICON VALLEY

AMES RESEARCH CENTER

Thermophysics Facilities Branch
Entry Systems and Technology Division

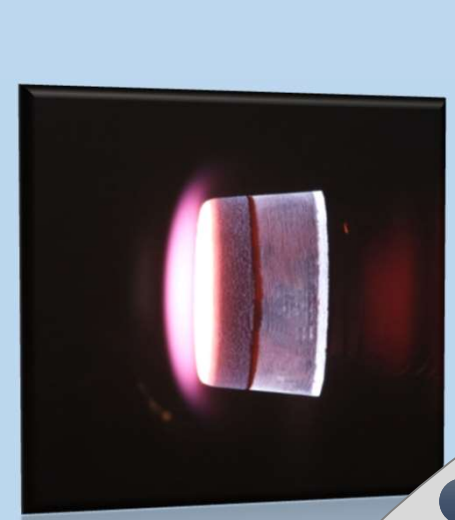
What we are about

- Arc Jet Complex provides the tools to study thermal protection materials and to test their responses to a scenario that closely matches hypersonic entry into an atmosphere of a planet or moon.

Objectives

- **Provide Aerodynamic heating**
  - Compression from shock wave (T> 13,500° F)
  - Radiation from shock layer
  - Surface friction
- **Provide representative pressures and gas composition**
- Provide close match to boundary layer edge temperatures and structure

The Division's Approach



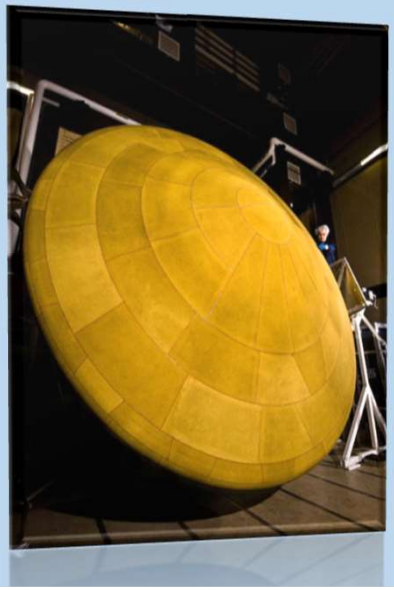
Concept

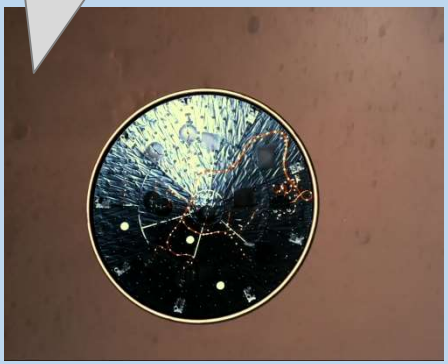
Design

Test

Analyze

Build





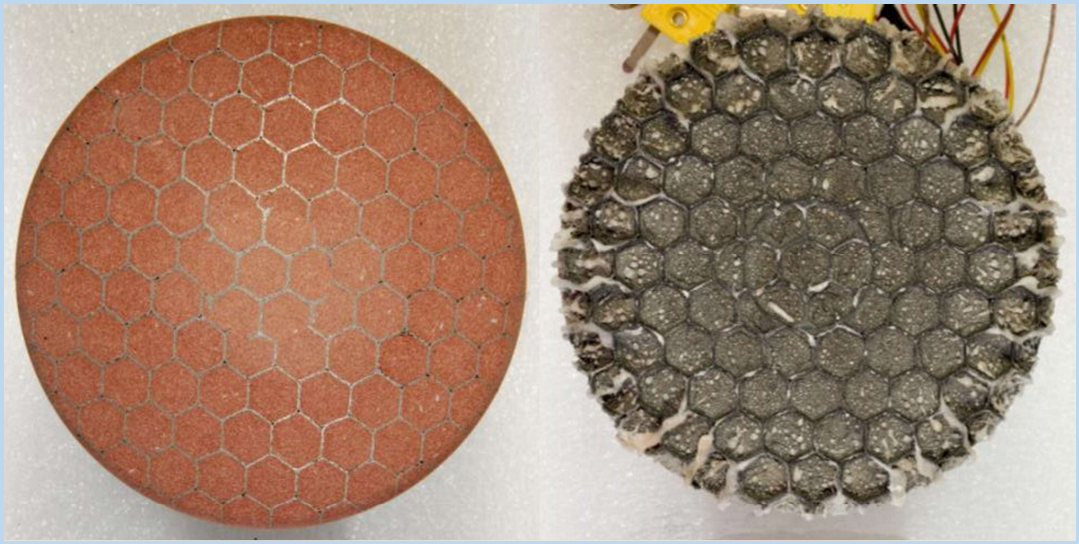
Division Staff:
~ 120 contract personnel
~ 70 CS personnel

We're Talking Heatshields

Mercury

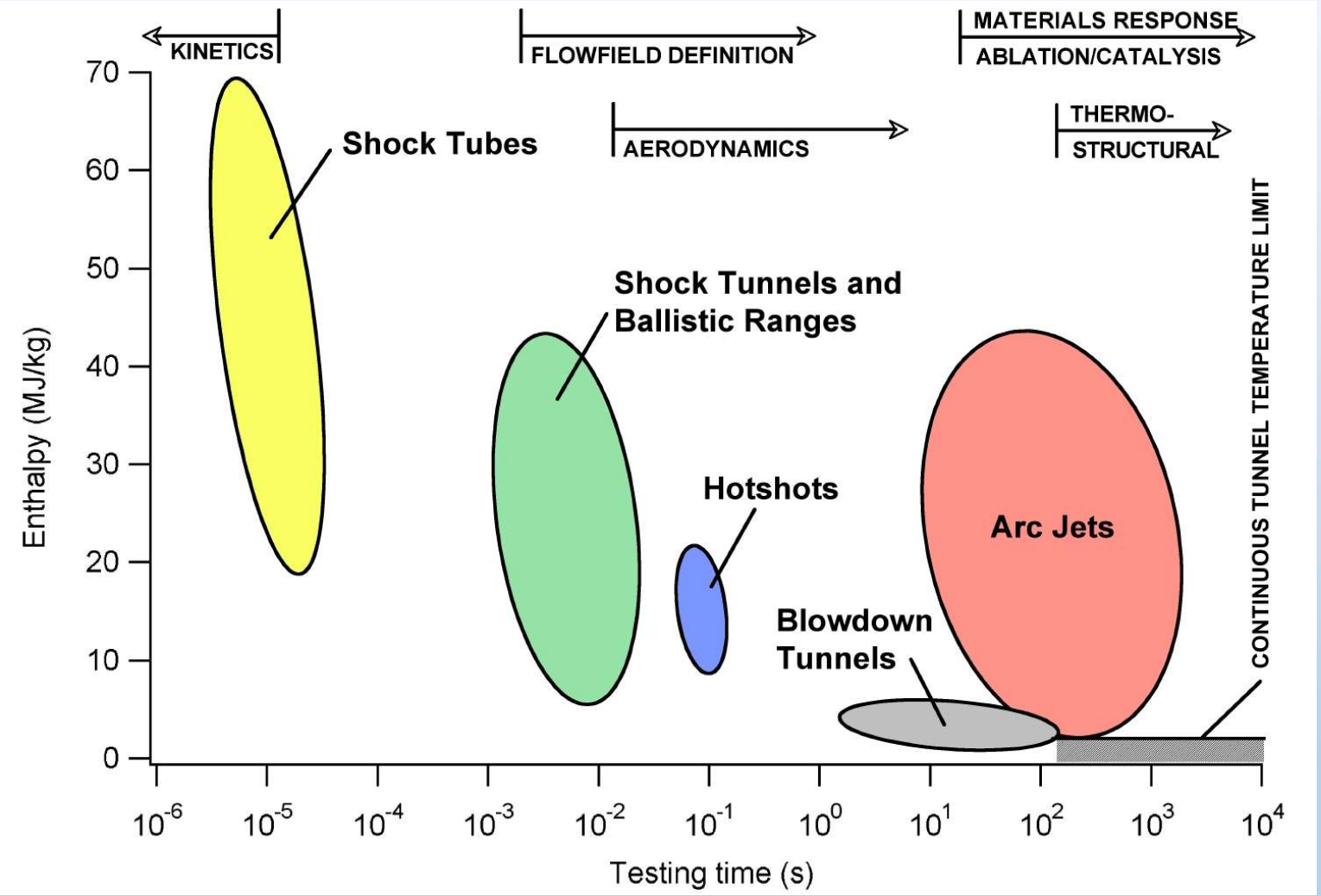
Gemini

Apollo



Orion

Ground testing for TPS design element validation



- No single facility can replicate ALL flight conditions
- Arc jets provide <u>sustained</u> aerothermal conditions for TPS validation

Our Mission

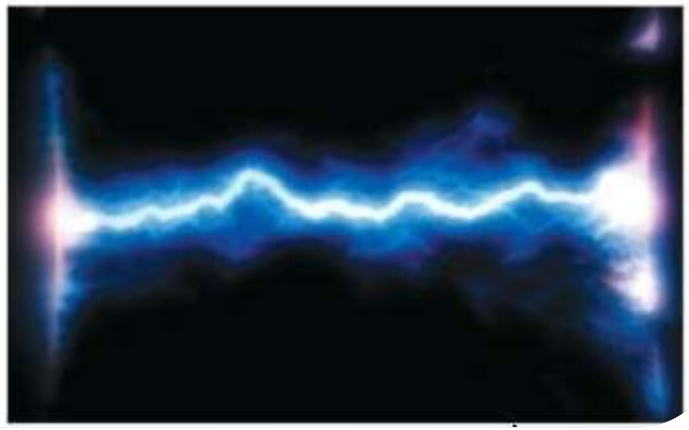
Thermophysics Facilities Branch
Entry Systems & Technology Division

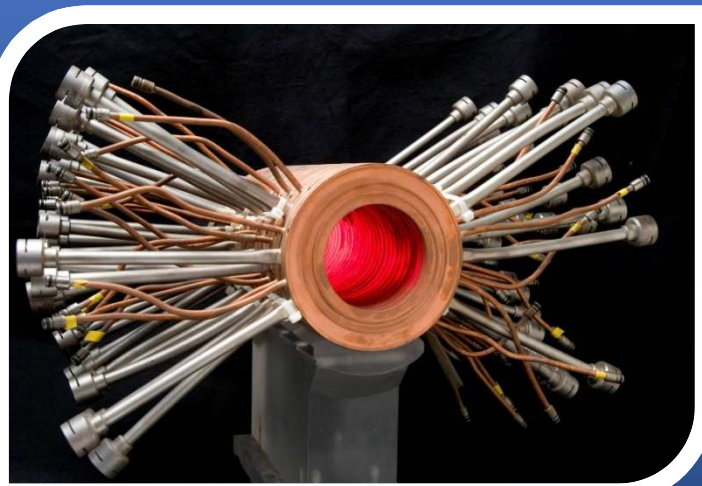
- Arc jets support the Division for TPS design, materials development, thermal modeling, and TPS verification
- TSF operates, maintains, and improves
  - the Arc Jets (N234, N238)
  - Ballistic Ranges (N237 and N204A)
  - and Electric Arc Shock Tube (N229)
  - TSF supports the Planetary Aeolian Laboratory as required.

Proving the System – Arc Jet Testing

An arc jet produces an electrically heated, high speed gas flow projected onto a test article – matching key parameters of high-speed entry from space into an atmosphere

How it works





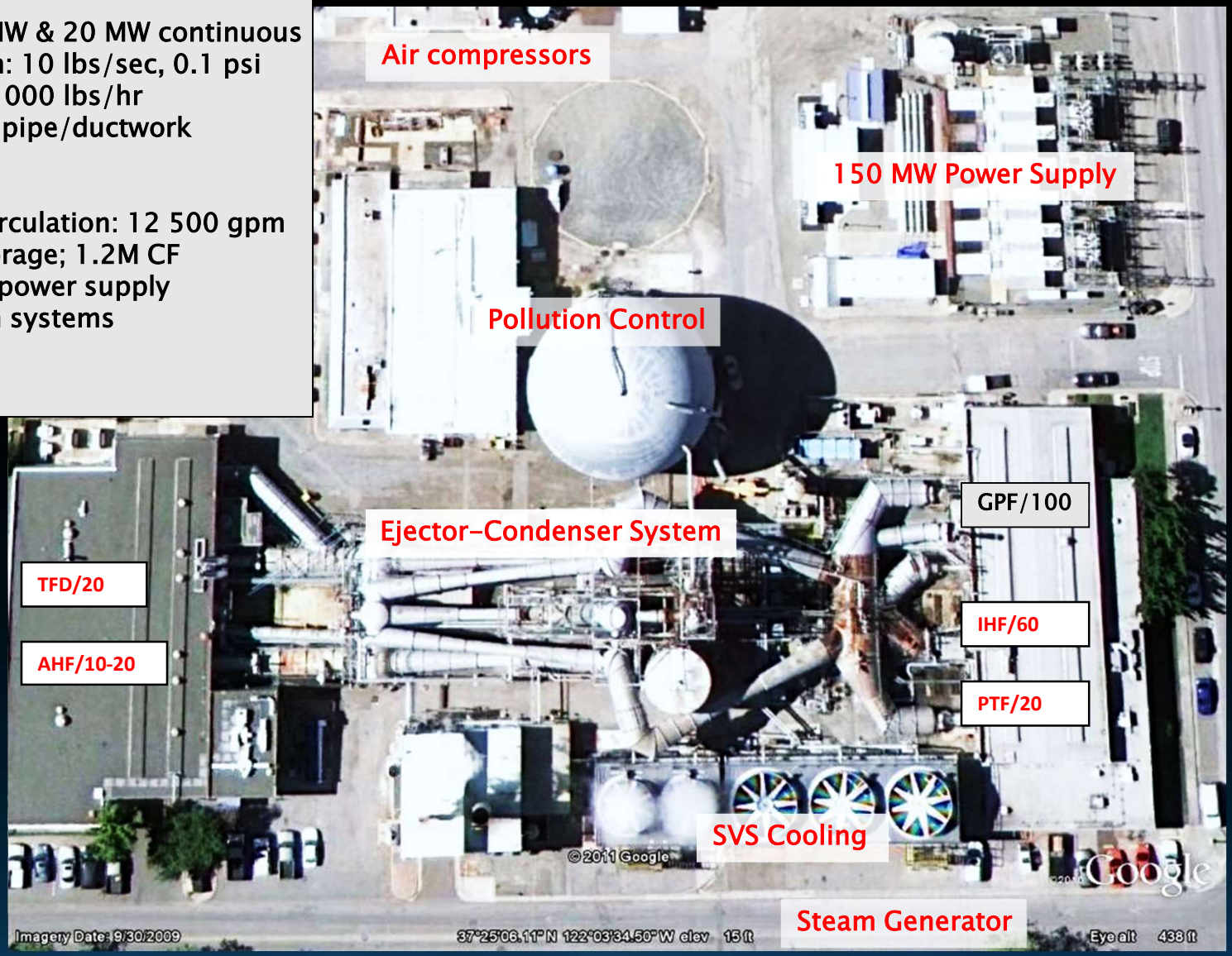
- Under vacuum, add argon gas; connect a hi-voltage car battery across electrodes to breakdown argon; and we have a flow of electrons inside the arc jet tube.
- Air flow collides with electrons in this "lightening bolt"→ dissociated air at high temperatures (> 9000º F)
- Expand dissociated air out a nozzle to hypersonic conditions and into a chamber at altitude conditions matching peak heating
- When conditions are correct, insert test sample and see what happens!

NASA Ames ArcJet Complex Overview

Power supplies: 150 MW & 20 MW continuous
Steam Vacuum System: 10 lbs/sec, 0.1 psi
Steam Generator: 250 000 lbs/hr
Approximately 1.5 mi pipe/ductwork

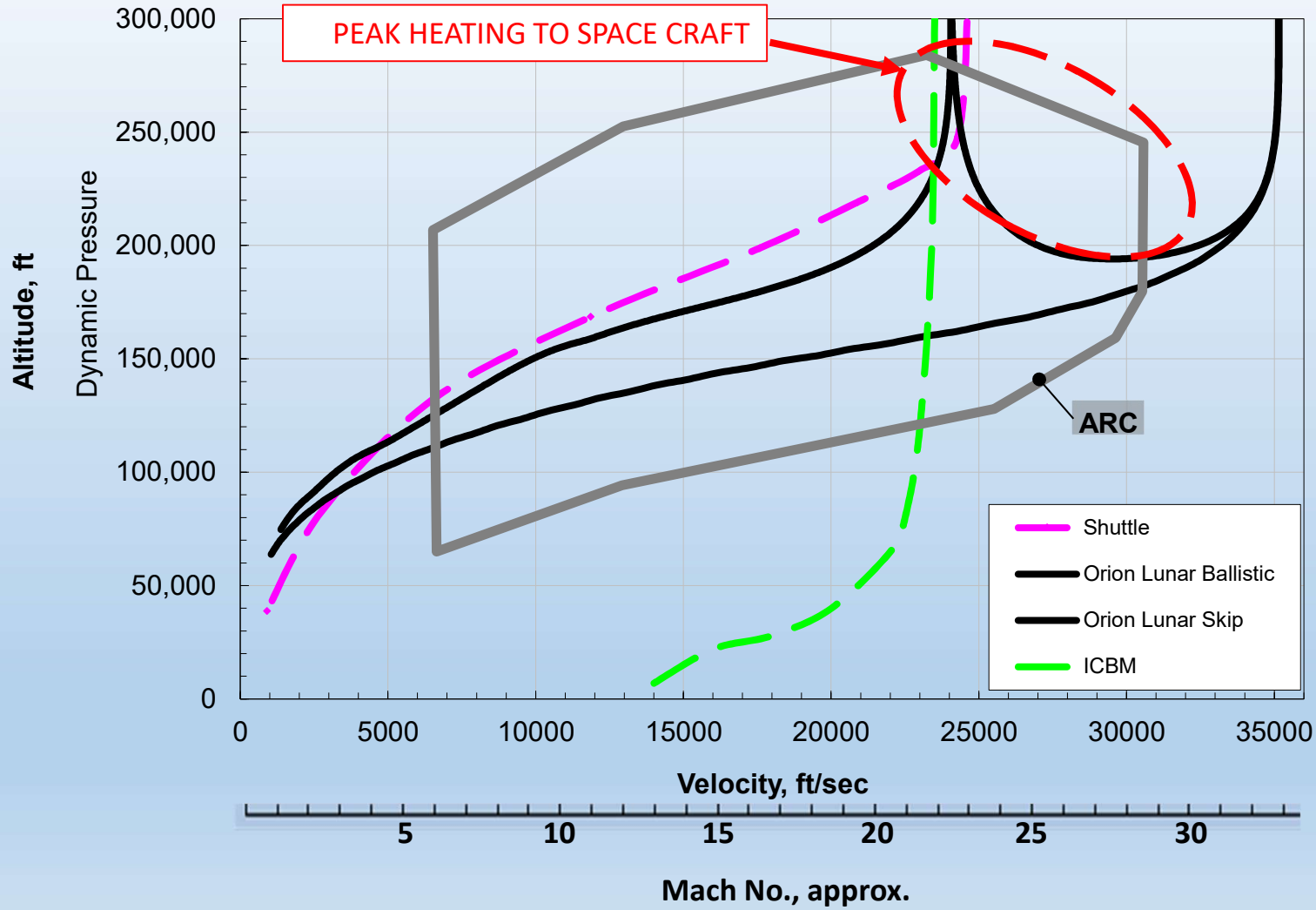
Not pictured:
- Arc heater coolant circulation: 12 500 gpm
- High pressure air storage; 1.2M CF
- Independent 20 MW power supply
- Control and isolation systems

1 MW = 750 homes



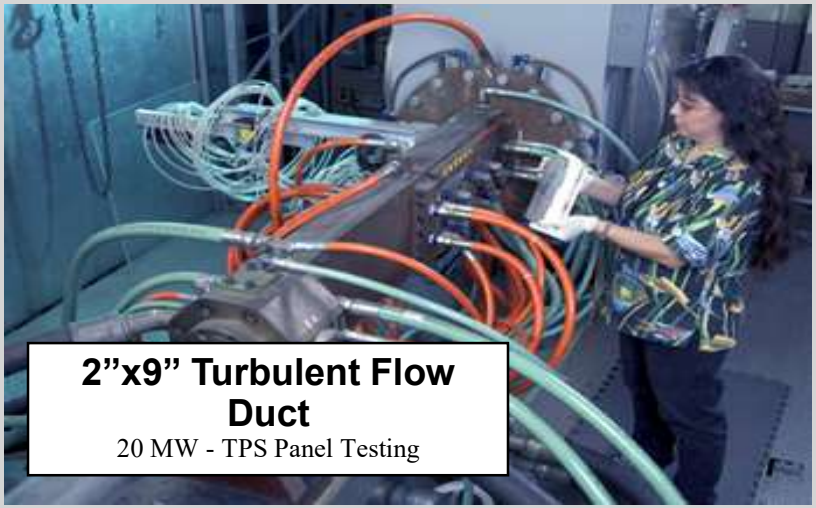
Four Active Test Legs, One set of shared Utilities

Simulation Envelope for Ames Arc Heated Wind Tunnels



NASA AMES ARCJET COMPLEX

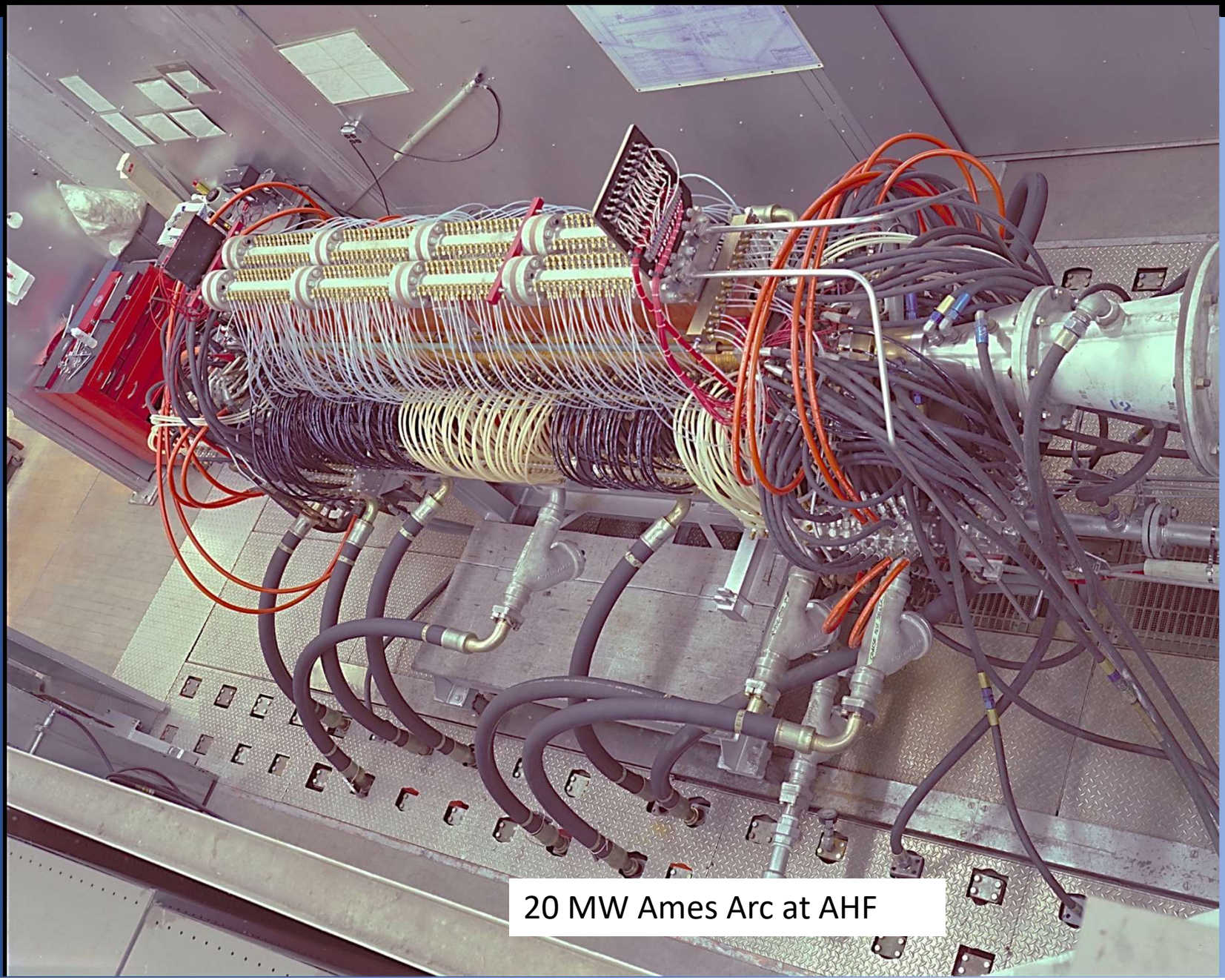
Aerodynamic Heating Facility
20 MW - TPS Free Jet Testing



2”x9” Turbulent Flow Duct
20 MW - TPS Panel Testing

Panel Test Facility
20 MW - TPS Panel Testing

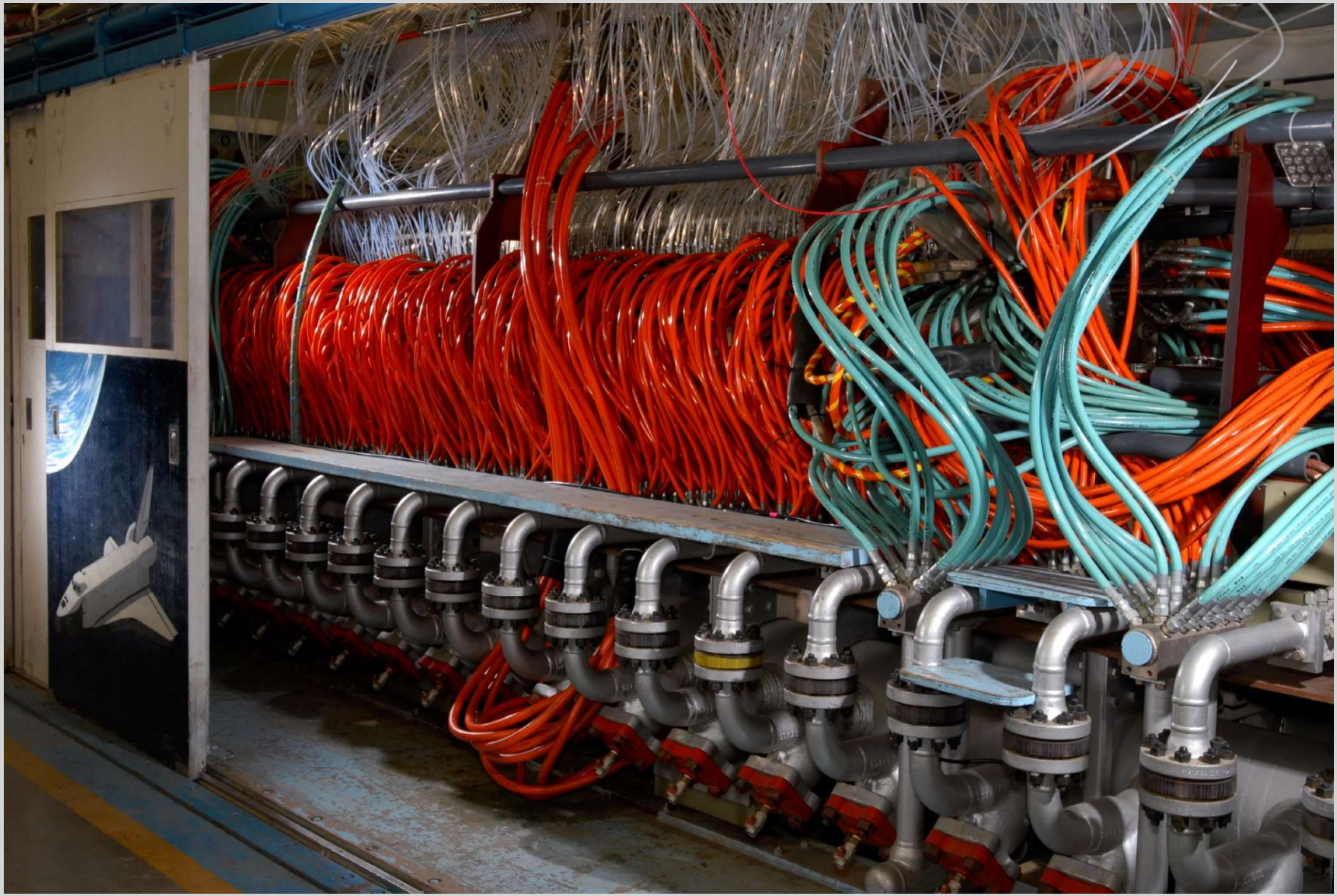
Interaction Heating Facility
60 MW - TPS Free Jet and Panel Testing



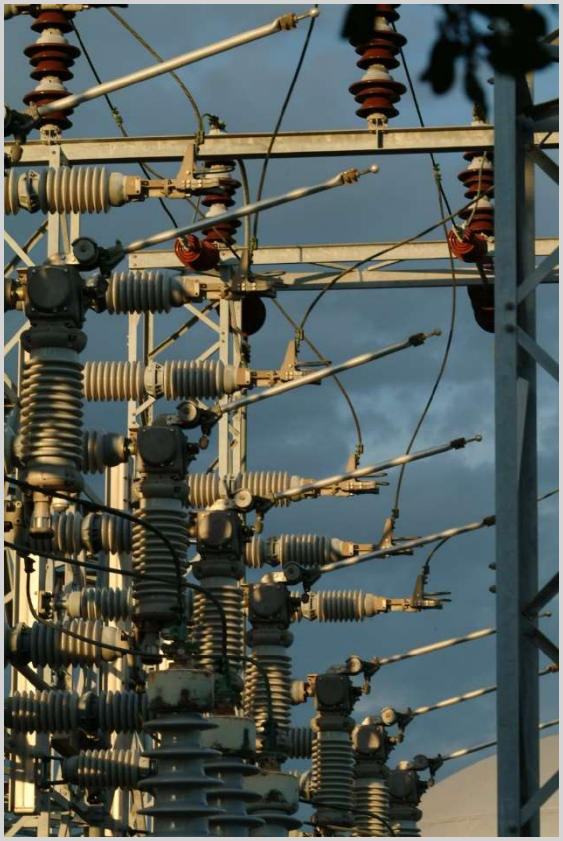
20 MW Ames Arc at AHF

Panel Test Facility

Interaction Heating Facility



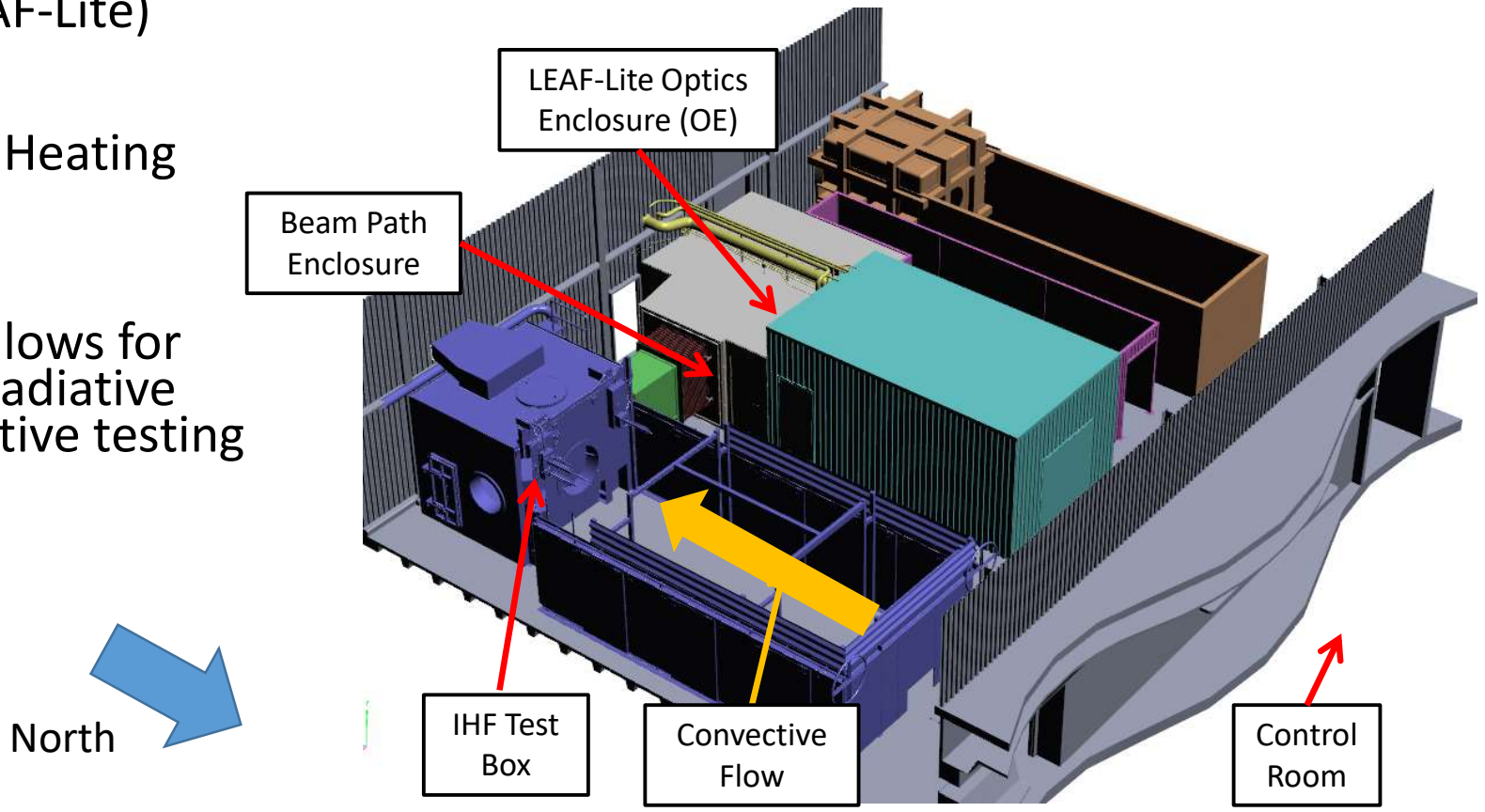
The rest of us



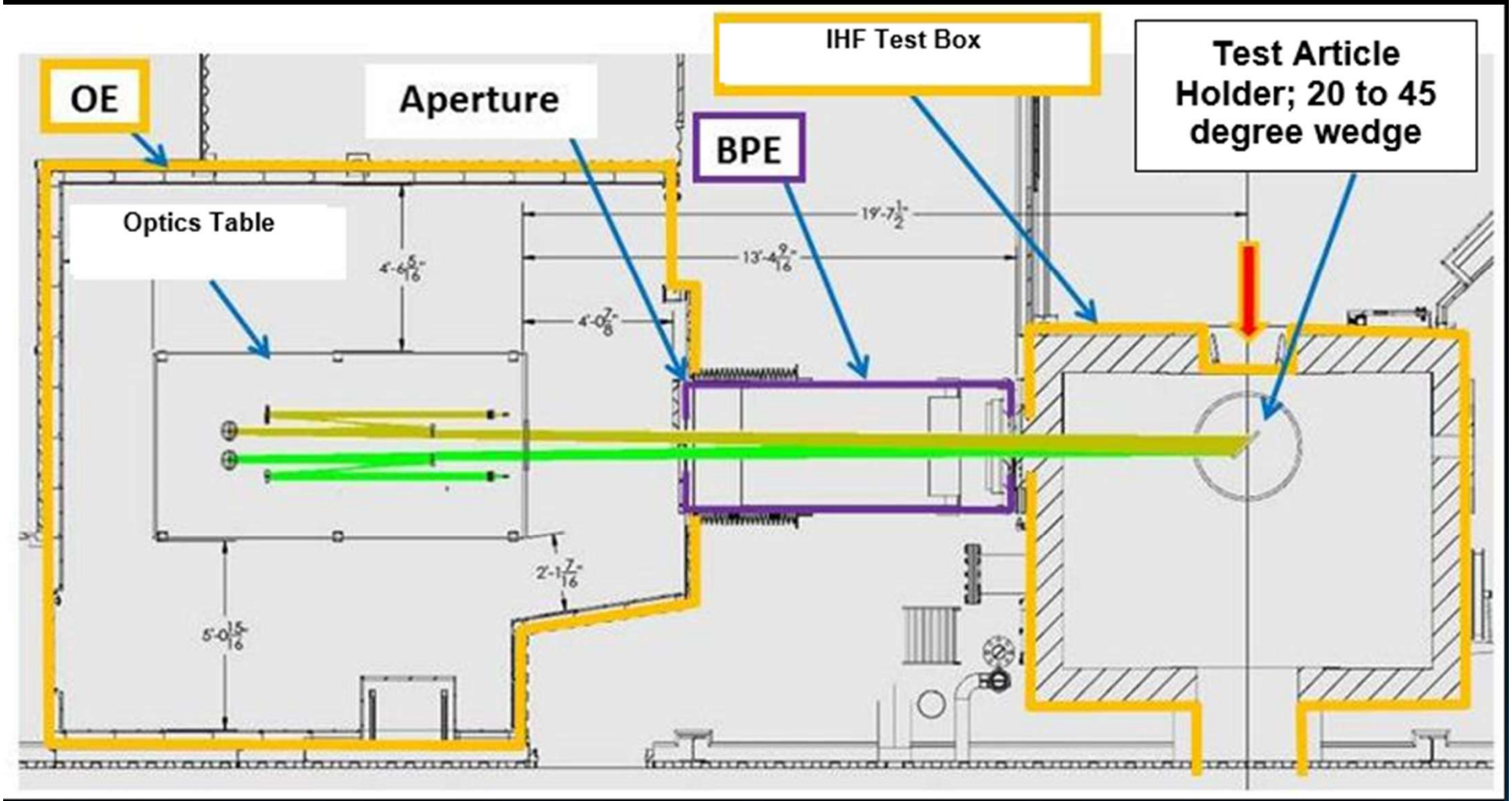
Water Piping ?

Combined convective and radiative heating

- Laser Enhanced Arc-jet Facility (LEAF-Lite)
- Interaction Heating Facility
- LEAF-Lite allows for combined radiative and convective testing

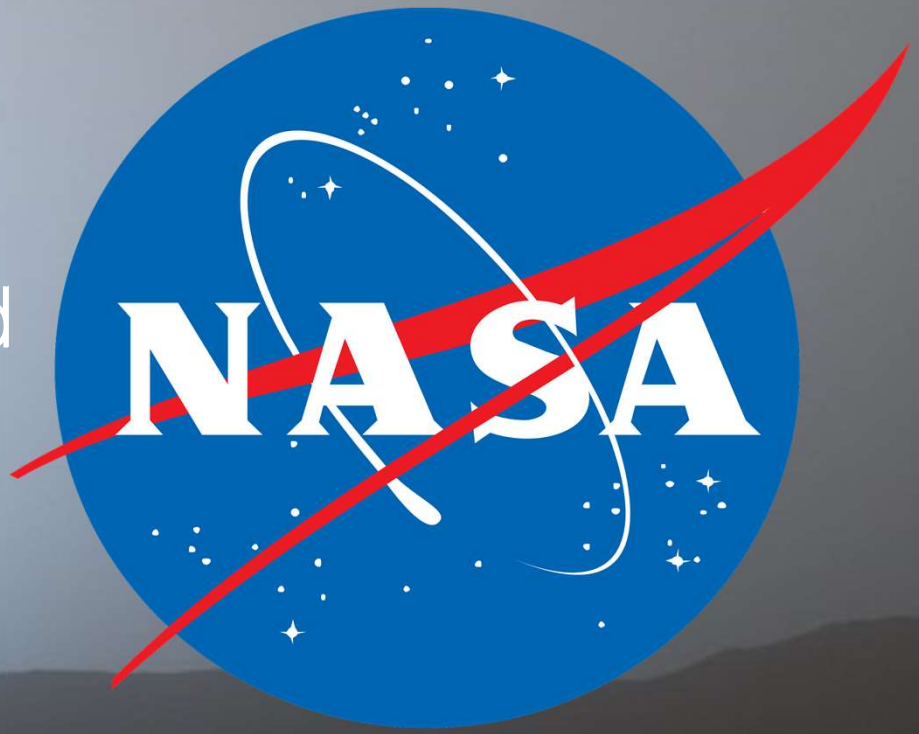


Beam Delivery




Insert AJC video here

National Aeronautics and Space Administration



Ames Research Center
Entry Systems and Technology Division

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Sunset on Mars – NASA/JPL MSL