Virginia Tech
Advanced Propulsion and Power Lab
(VT APPL)

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Virginia Tech Advanced Propulsion and Power Lab

- Leveraging 40 years of advanced propulsion and power research
- A one-stop shop opportunity for Aerospace and Gas Turbine Companies to test and develop new technology

Groundbreaking April 2013

Mission Statement

"The Virginia Tech Advanced Propulsion and Power Laboratory will be the leading-edge facility dedicated to the study of jet propulsion and the internal design of gas turbine engines"

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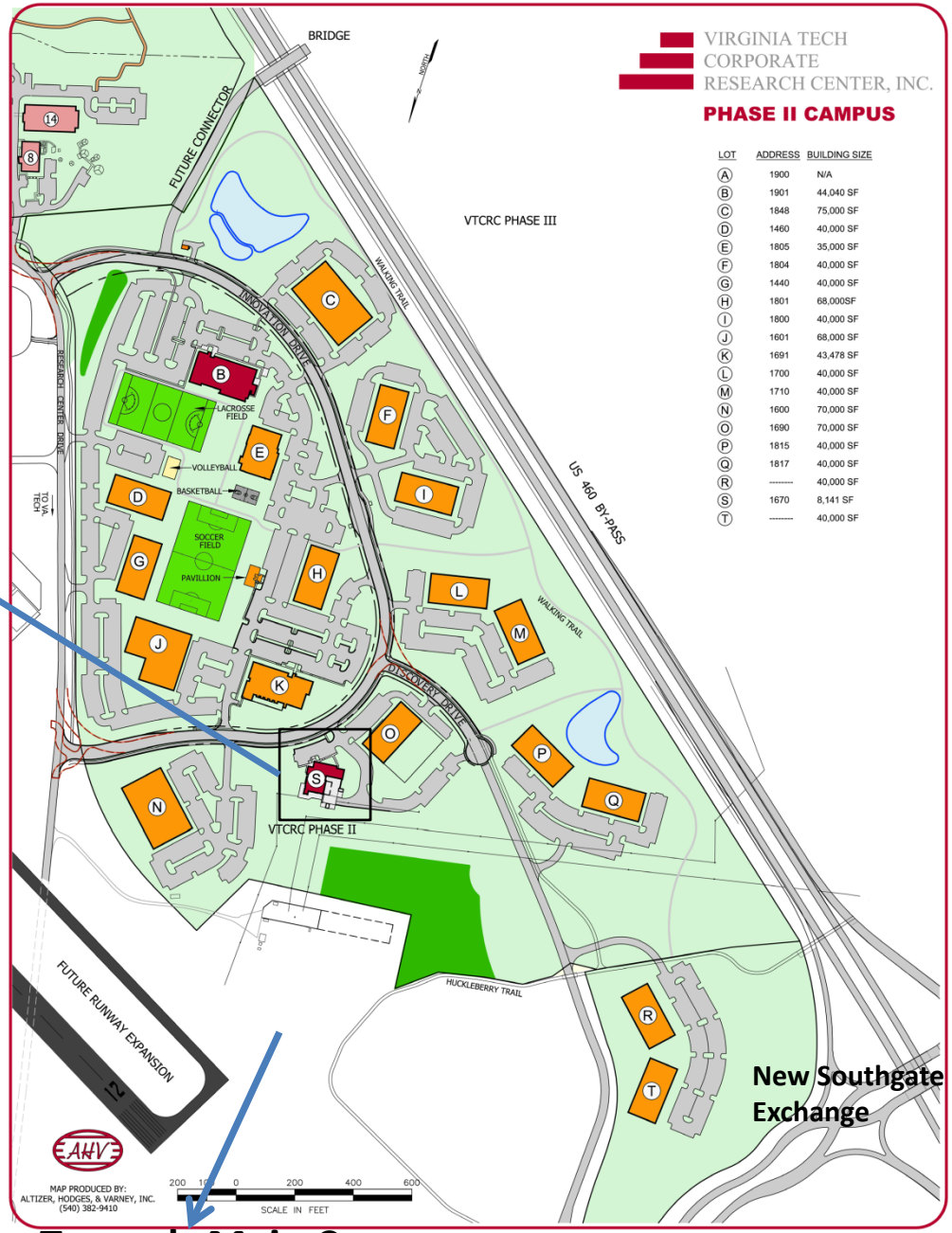
LOCATION

- Virginia Tech Corporate Research Center Phase II
- A 8,141 SF facility
- Located near Virginia Tech campus and local airport
- Overall budget for building - $4.0M



LOT	ADDRESS	BUILDING SIZE
A	1900	N/A
B	1901	44,040 SF
C	1848	75,000 SF
D	1460	40,000 SF
E	1805	35,000 SF
F	1804	40,000 SF
G	1440	40,000 SF
H	1801	68,000SF
I	1800	40,000 SF
J	1601	68,000 SF
K	1691	43,478 SF
L	1700	40,000 SF
M	1710	40,000 SF
N	1600	70,000 SF
O	1690	70,000 SF
P	1815	40,000 SF
Q	1817	40,000 SF
R	----------	40,000 SF
S	1670	8,141 SF
T	----------	40,000 SF

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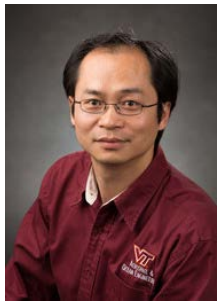
Timeline

- First discussion – April 2011 (Rolls-Royce Commonwealth of Virginia Initiative)
- Architect – LORD, AECK & SARGENT ARCHITECTURE
- April 2013 – Break ground
- June 2013 – First stage of construction
- June 2014 – Complete construction
- March 2015 – Operation ready

Faculty Team






- **Core Faculty**
  - **Srinath Ekkad**, Director, Thermal-Fluids, Thermal Diagnostics (Mechanical Engineering)
  - **Todd Lowe**, Fluids, Laser Diagnostics (Aerospace & Ocean Engineering)
  - **Lin Ma**, Laser Diagnostics, Combustion & Fluids (Aerospace & Ocean Engineering)
  - **Wing Ng**, Thermal-Fluids, Aerodynamics (Mechanical Engineering)
- **Other Faculty Expertise**
  - **Walter O'Brien**, Engine Testing and Diagnostics, Compressors (Mechanical Engineering
  - **Eric Paterson**, Marine Hydodynamics, CFD (Aerospace & Ocean Engineering)
  - **Joe Schetz**, Hypersonics (Aerospace & Ocean Engineering)
  - **Danesh Tafti**, CFD (Mechanical Engineering)
  - **Pablo Tarazaga**, Vibrations Sensing (Mechanical Engineering)
  - Additional faculty from Materials Science & Engineering, Industrial Systems Engineering, and Biomedical Engineering & Applied Mechanics may also get involved in the future

New hiring in Mechanical Engineering and Aerospace & Ocean Engineering will complement existing expertise





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Research Relevance

- Propulsion Systems
  - Commercial Aircraft Engines
  - Military Aircraft Engines
  - Rocket Systems

- Power Systems
  - Gas Turbine Power Plants
  - Marine Power Units

Building Details

Test Cells

- **Diagnostics & Instrumentation Cell**
- **High Speed Flow Test Cell**
- **Combustion Tell Cell**
- **Large Scale Rotor Rig Test Cell**
- **Jet Engine Test Cell**
- **Future Growth Test Cell**

Facilities

- Compressor with 180-psig and 3.5 lbm/s continuous flow
- Buffer storage tank – 5,000-gallon compressed air
- High pressure natural gas
- Storage tanks for jet-A
- Water supply at 500-psig with pump
- 480V, 100 A power supply to all test cells and bay area

VT APPL Finished Pictures (May 2015)

Front View

Rear View (from West)

Large Test Cell

Standard Test Cell

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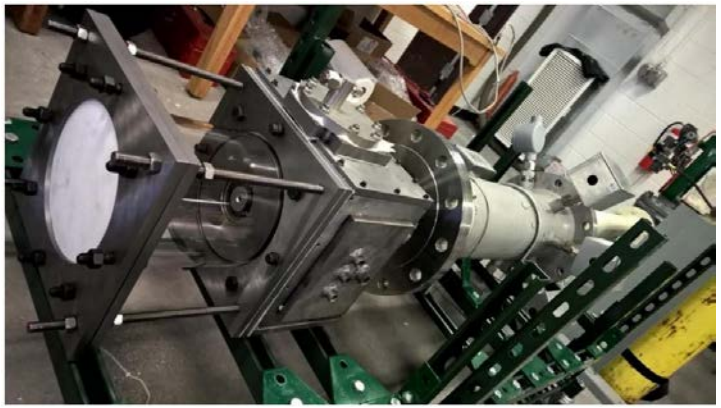
Transonic Blowdown Rig

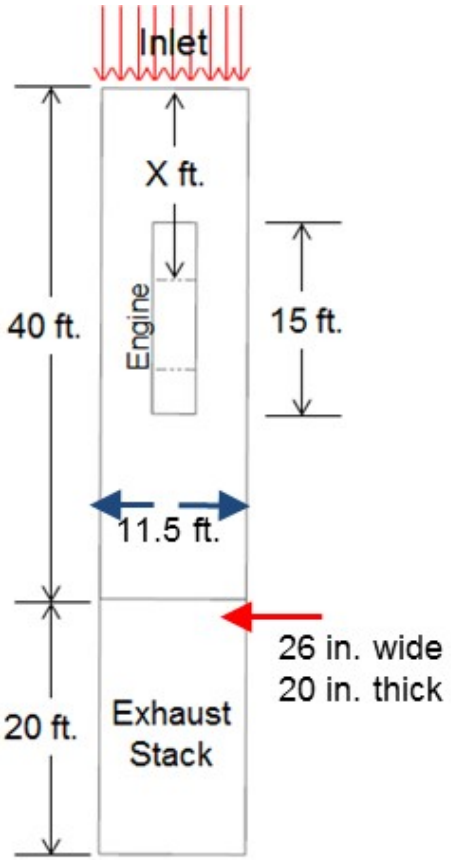
- Provides high Mach number flows for short duration experiments

Combustion Test Cell

- Will house two combustion test rigs



Jet Engine Test Cell



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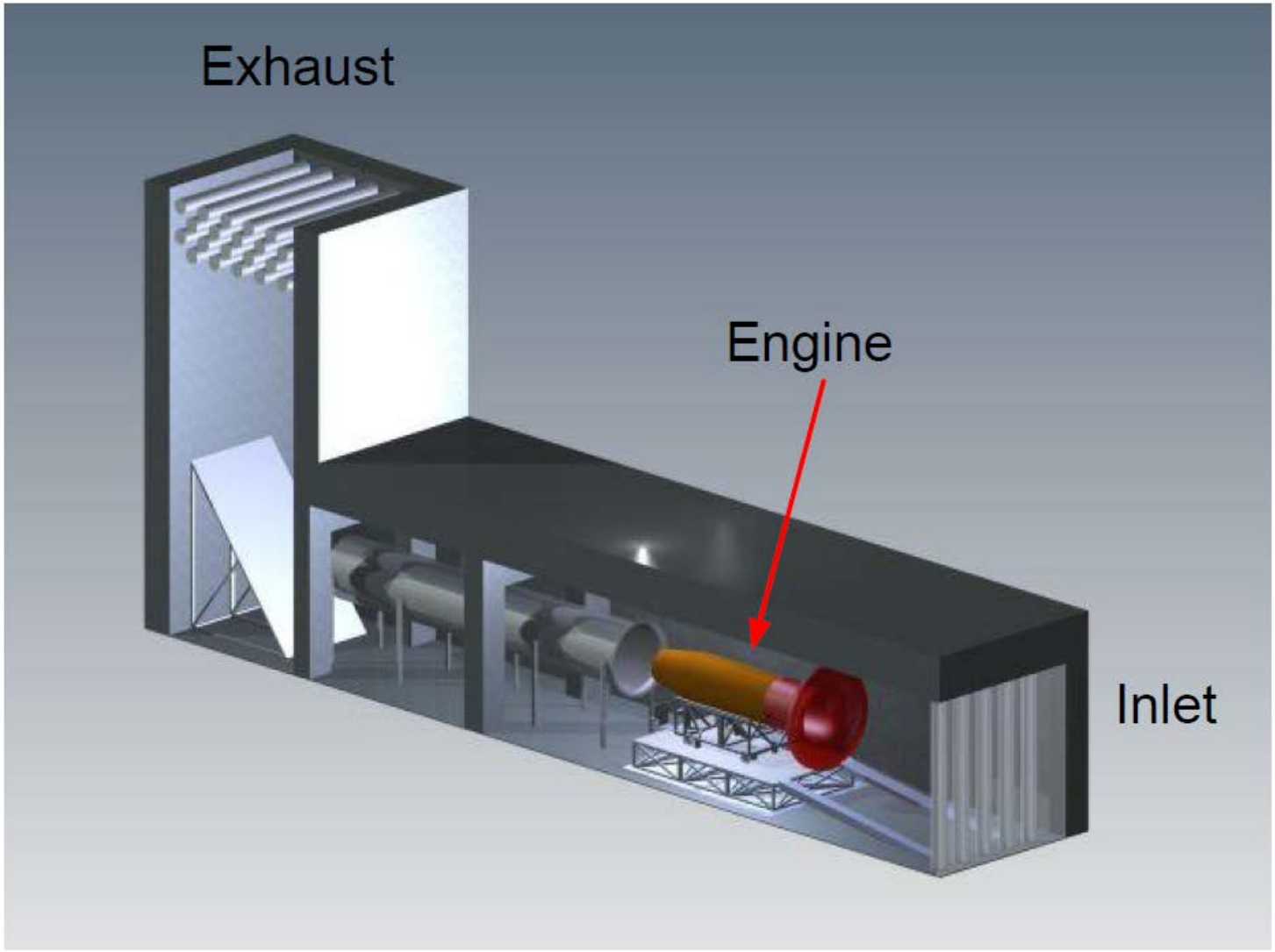
Final Jet Test Cell Design



Rolls-Royce University Technology Center (UTC) for Advanced System Diagnostics Designated: April 2014

- Advanced Diagnostics Development
- Non contact and minimally invasive (e.g. fibre optic sensors etc.) methods
- Deployment to flying test beds
- Support to other UTCs for concept testing on engine test bed – AE 3007 Engine
- Virginia Tech current research is on inlet and exhaust systems – focused on particle ingestion and behavior

Selected Ongoing Projects

- Rolls-Royce (S. Ekkad, W. Ng, K.T. Lowe, L. Ma) - $430K/year
  - Non-contact Thrust Measurement
  - Inlet Particle Count and Mass Measurement
  - Sand and Dust Ingestion Effects on Hot Gas Path Components
  - Engine Test Cell
- Department of Energy (S. Ekkad) - $325K/year
  - Combustor Heat Transfer
  - Advanced Cooling Configurations
- Honeywell (W. Ng, K.T. Lowe, S. Ekkad) - $160K/year
  - Turbine Endwall Aerodynamics
- Solar Turbines (W. Ng, S. Ekkad) - $175K/year
  - Turbine Blade Tip Cooling
  - Combustor Cooling
- Pratt & Whitney (K.T. Lowe) - $170K/year
  - Total Temperature Probe Design Space Extension
- Wyle/NAVAIR (K.T. Lowe, W. Ng) - $283K/year
  - VT Response to Wyle RFQ: Naval Air Technical Information Systems Interoperability & Reliability Airworthiness Products, Subtask: *In Situ TACAIR Exhaust Velocimetry for Noise Reduction* “