



Sandia  
National  
Laboratories

NATIONAL  
SECURITY  
PROGRAMS

# Hypersonic Weapons Summit

## PROMOTING LEADERSHIP IN HYPERSONIC DEVELOPMENT AMONG RESEARCH INSTITUTIONS



*September 29, 2021*

Dennis Helmich | Director | Integrated Military Systems

Alex Roesler, PhD | Deputy Director | Integrated Military Systems

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.



# Bottom Line Up Front



- The design, development, test and production of hypersonic weapon systems requires the sustained effort and commitment of multiple stakeholders.
- Sandia, as an Federally Funded Research and Development Center (FFRDC), partners with other FFRDCs; we also rely heavily upon the stakeholders below to meet our deliverables.
- At times, different stakeholders play a bigger role than the others.
- The Nation is best served when we all work together to achieve this common goal.



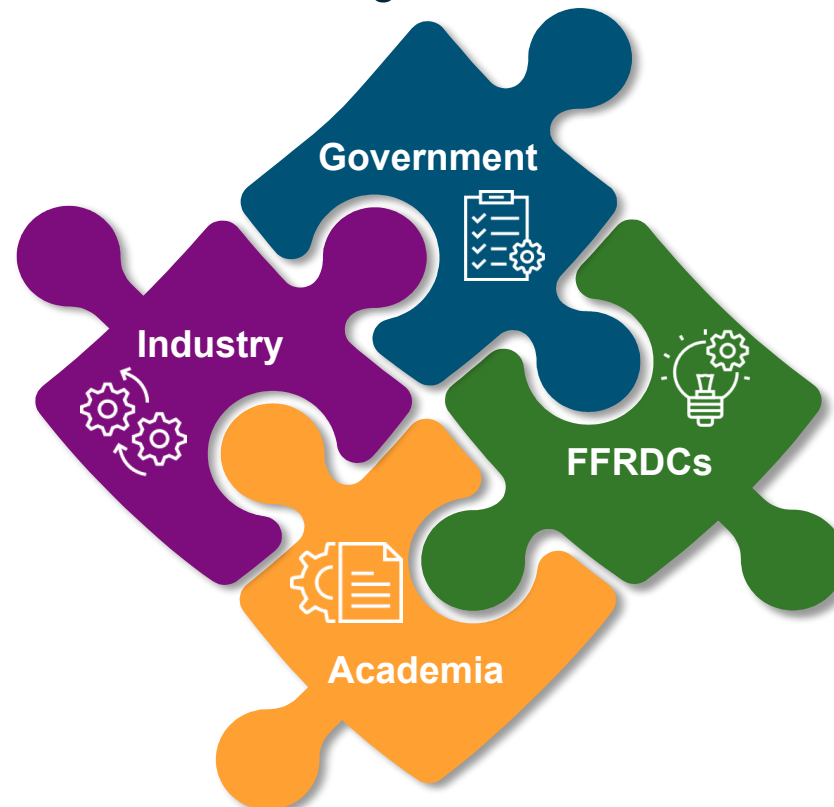
## Industry

- Technology Maturation
- Manufacturing
- Coordination



## Government

- Vision & Direction
- Advocacy
- Funding
- Coordination



## FFRDCs

- Research & Development
- Tech Maturation
- Integration
- Pathfinder Systems
- Coordination



## Academia

- Research
- Talent Pipeline
- Coordination



# Brief History of Sandia National Laboratories



# Sandia's History is Traced to the Manhattan Project



THE WHITE HOUSE  
WASHINGTON

May 13, 1949

Dear Mr. Wilson:

I am informed that the Atomic Energy Commission intends to ask that the Bell Telephone Laboratories accept under contract the direction of the Sandia Laboratory at Albuquerque, New Mexico.

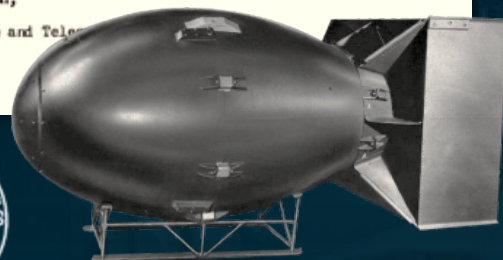
This operation, which is a vital segment of the atomic weapons program, is of extreme importance and urgency in the national defense, and should have the best possible technical direction.

I hope that after you have heard more in detail from the Atomic Energy Commission, your organization will find it possible to undertake this task. **In my opinion you have here an opportunity to render an exceptional service in the national interest.**

I am writing a similar note direct to Dr. O. E. Buckley.

Very sincerely yours,  
*Harry Truman*

Mr. Leroy A. Wilson,  
President,  
American Telephone and Telegraph  
195 Broadway,  
New York 7, N. Y.



- July 1945: Los Alamos creates Z Division
- Nonnuclear component engineering
- November 1, 1949: Sandia Laboratory established
- AT&T: 1949–1993
- Martin Marietta: 1993–1995
- Lockheed Martin: 1995–2017
- Honeywell: 2017–present



# Sandia is a Federally Funded Research & Development Center

A male scientist with dark hair, wearing safety glasses and a blue lab coat over a checkered shirt, is focused on a small, metallic component he is holding with his gloved right hand. He is in a laboratory setting, with various pieces of scientific equipment visible in the background, including a large cylindrical chamber and a complex mechanical assembly. The lighting is dramatic, highlighting the scientist and his work.

FFRDCs are long-term strategic partners to the federal government, operating in the public interest with objectivity and independence and maintaining core competencies in missions of national significance

Government owned, contractor operated

National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc.





# National Security is our Business

*For more than 70 years, Sandia has delivered essential science and technology to address the nation's most challenging security issues*



## PURPOSE

Render exceptional service in the national interest

## VISION

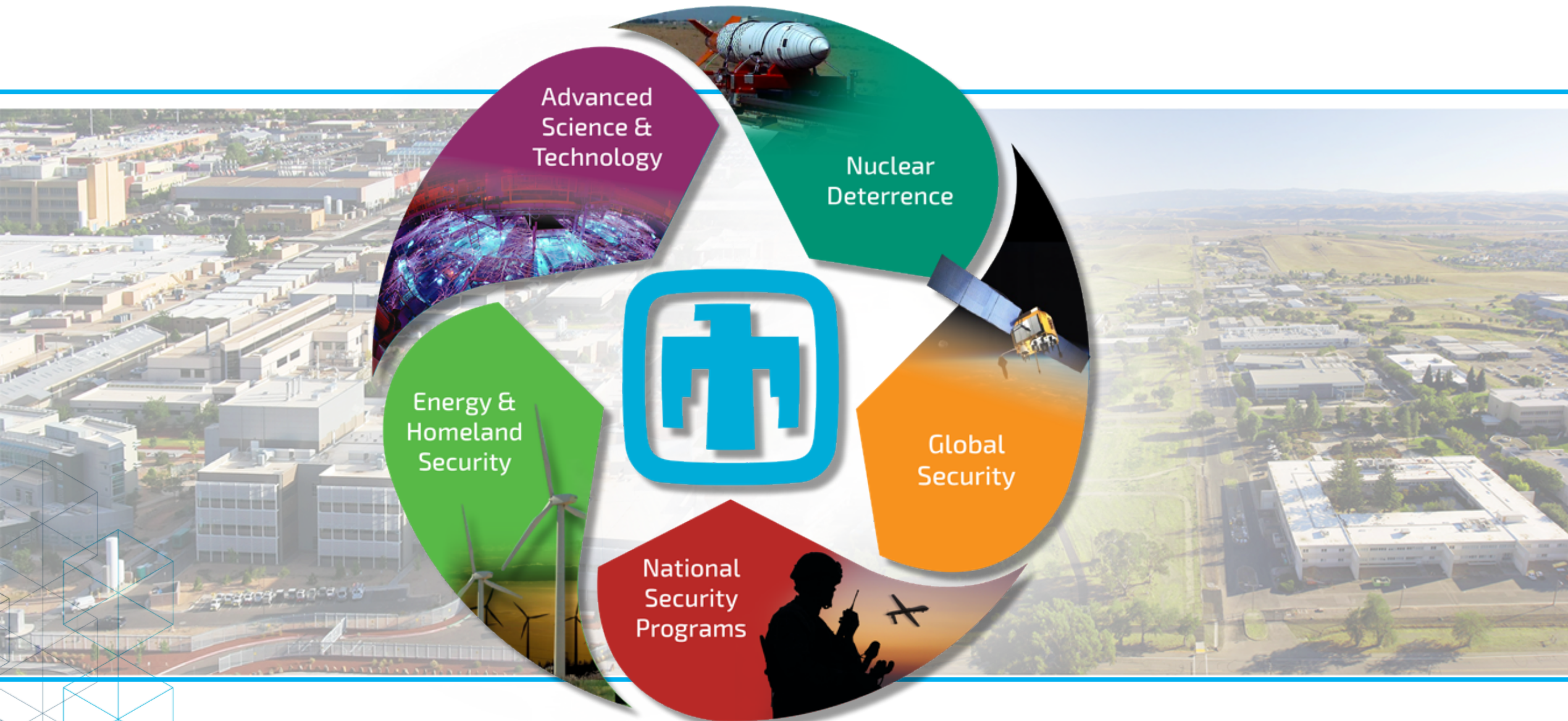
On behalf of our nation, we anticipate and solve the most challenging problems that threaten security in the 21st century

## MISSION

Our unique mission responsibilities in nuclear weapons create a foundation from which we leverage capabilities, enabling us to solve complex national security problems



# Sandia Has Five Major Program Portfolios





# Tech Transfer is Part of Sandia's Mission



*Tech transfer is a mission of the Labs and has wide-ranging internal and external impacts.*



## Enhance Mission Delivery



*Develop/deploy technologies for mission delivery, capacity creation, and supply chain benefits*



## Enable Innovation



*Facilitate the flow of people and ideas into and out of the Labs to remain on the leading edge*



## Maximize Public Good



*Enhance the local and national economy to ensure long-term competitiveness*





# Sandia's History of Boost-Glide System Development and Testing

# Sandia's History in Hypersonic Glide Bodies



POST-WWII

1970-1985

2003-2011

2017-2020

2021-2023

FUTURE



Post-WWII:  
Reentry Vehicles

1970's:  
Pre-SWERVE &  
SWERVE

1985: Successful  
SWERVE Flight Test

2003: Prompt Global  
Response Grand  
Challenge

2011: AHW-FT1A

2017: CPS FE-1

2018-2025:  
Autonomy for  
Hypersonics (A4H)

2020: CPS FE-2

Navy/Army CHGB  
Product Transition

Navy/Army FT-3, JFC-1,  
JFC-2

Missile Defense  
Agency Advanced  
Target

SHOTL

Sandia Design Agent  
Role

Sandia transfer of C-  
HGB variants to  
industry

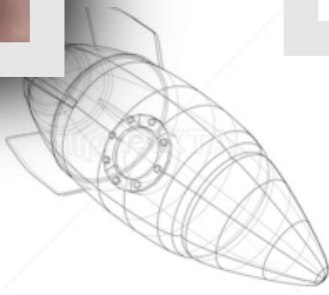
Sandia's Roadmap  
for the Future is  
realized



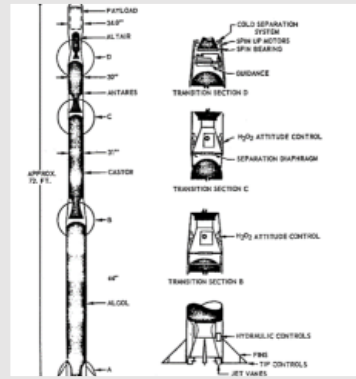
# Sandia Prototype Development: Concept to Test



## Concept



## Technical Spec



## Environmental Test

Sandia's environmental test facilities allow us to simulate real-world conditions prior to full flight test.



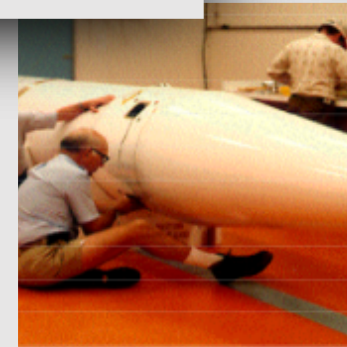
## Sketch

Sandia has that ability to take a concept from initial sketch all the way to a full flight test.

## Component Builds



## Hand Built Prototype



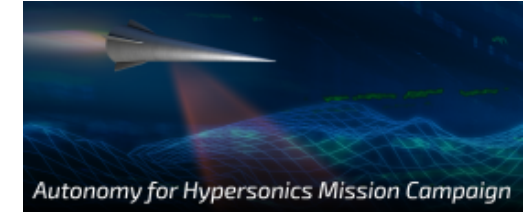
## Flight Test

Access to the Kauai Test Facility allows Sandia to complete full flight tests on systems that started as initial concepts conceived by our engineers and scientists.

# Sandia's Current Work in Hypersonics



## Sandia National Laboratories



- CHGB Design
- Tech Maturation
- Weapon System Integration
- Demonstration
- Testing



- CHGB Product Transition
- Tech Maturation
- Weapon System Integration
- Demonstration
- Testing



- Advanced Target Front-End
- Tech Maturation
- Lethality Analysis
- Demonstration



- Program Office Support
- Tech Maturation
- University Consortium for Applied Hypersonics Participation



- Program Office Support
- Tech Maturation







# The Future of Hypersonics



# Autonomy for Hypersonics



Hypersonics provide tremendous military utility

- Hypersonics offer survivability and utility at long/strategic ranges, since they travel at exceptional speeds and are less susceptible to anti ballistic missile countermeasures and other defensive systems

These systems will offer the most utility if they are able to:

- Utilize rapidly constructed flight plans (enable speed of action)
- Navigate without GPS
- Perceive their environment and adapt to it to increase survivability and to counter moving targets
- Employ tactics and engagement strategies that are highly effective in complex, rapidly evolving environments and heavily defended areas
- Cooperate with other hypersonic systems



# Autonomy for Hypersonics (A4H) Mission Campaign



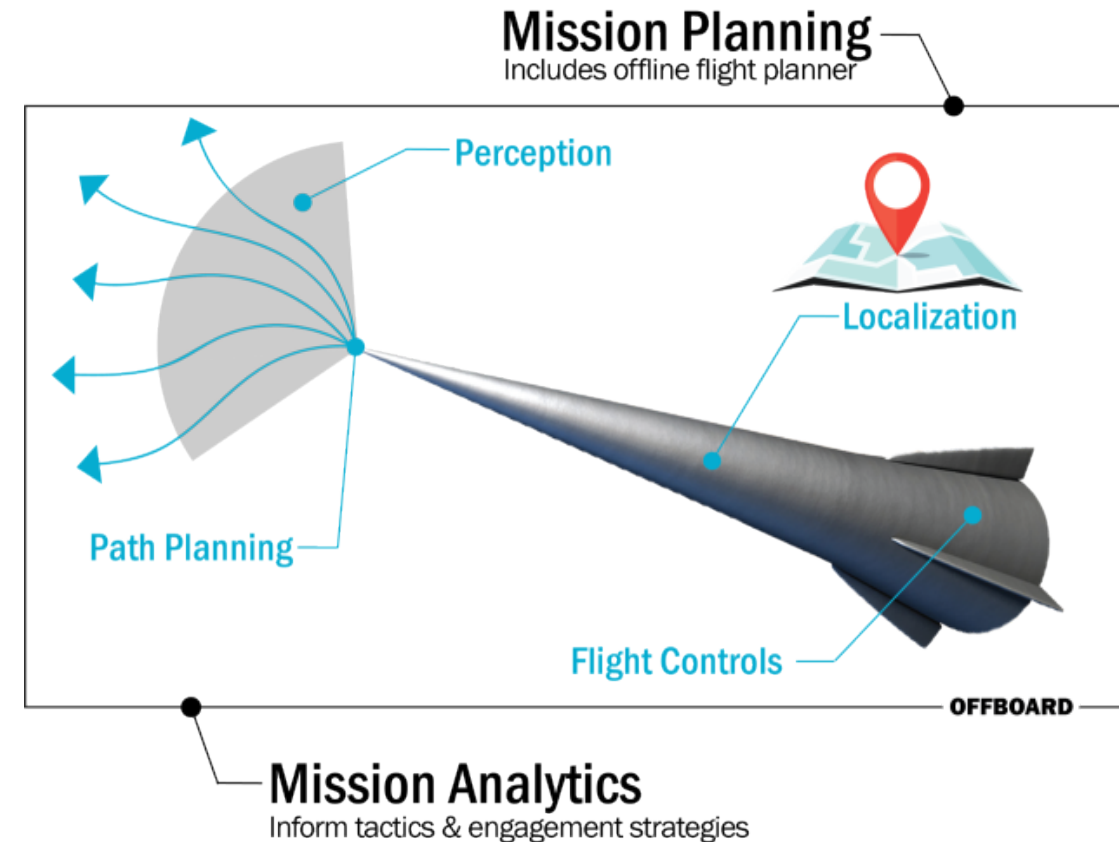
A4H will research and develop autonomous systems technologies that will enhance the warfighting utility of hypersonic flight systems

- Provide autonomous mission planning for rapid response to time-sensitive threats
- Enable adaptive, highly-maneuvering vehicles that intelligently navigate, guide, and control to targets



The developed autonomy solutions will strengthen conventional deterrence by enabling adaptive hypersonic systems that can:

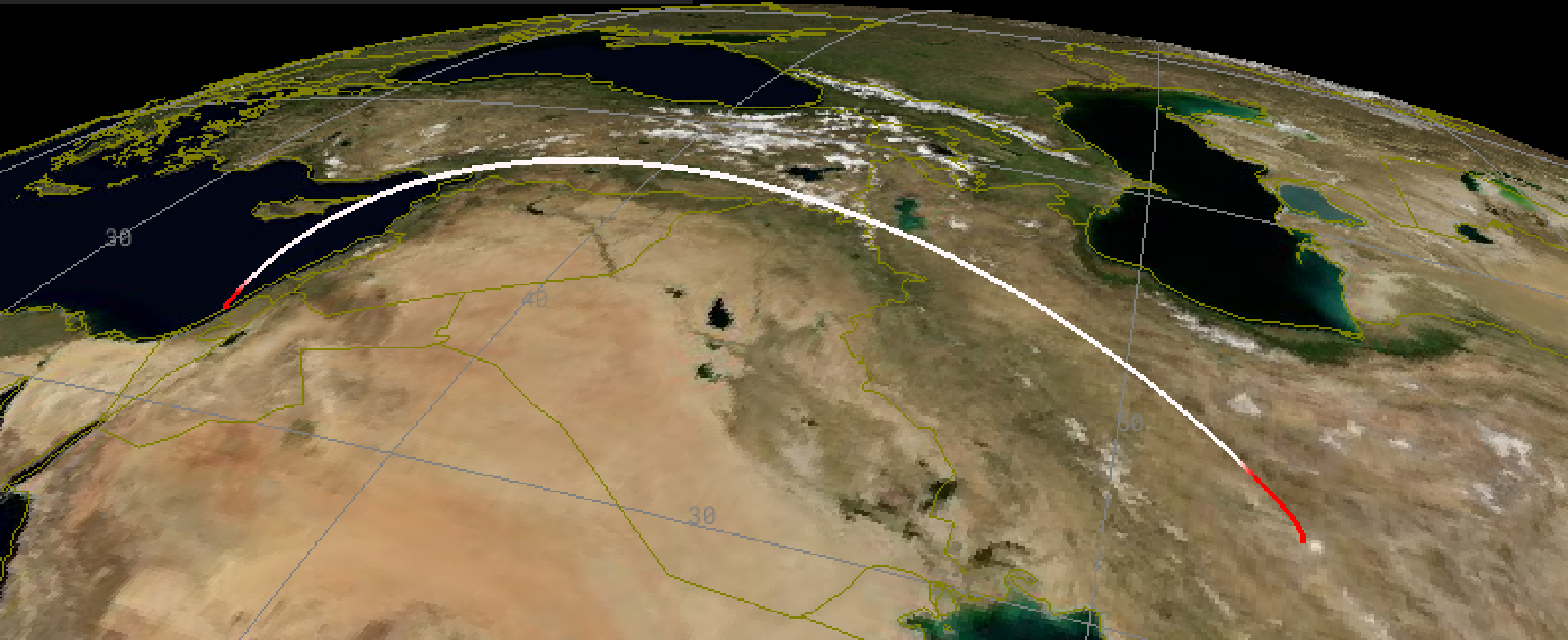
- Prosecute fleeing targets in GPS-denied environments
- Provide a defense against adversary hypersonic weapons



6.5 years | \$38M | Internal R&D Funds

# Mod/Sim Environment

To build the necessary AI, we need tools that aim to improve our ability to model key components of the complex environment.





# Sandia's Hypersonics of the Future Roadmap

## PRE-PROGRAMMED

Some autonomy, but entirely rules-based, unable to handle uncertainties/unknowns or adapt the flight plan on the fly

## POSITIONALLY AWARE

Coordinate seeking capability that is robust to the GPS contested environment

## POSITION ADAPTING

Coordinate seeking capability that is robust in the Non-GPS environment

## TARGET HUNTING

Robust capability to address relocatable and mobile targets

## SITUATIONALLY AWARE

Autonomous adaptation to maximize strike effectiveness or provide the ability to intercept incoming adversary weapons





# Product Transition



Sandia  
National  
Laboratories

# Overview of CHGB Product Transition and Industry Partnership

UNCLASSIFIED UNLIMITED  
RELEASE



Industry  
National  
Team

BLK 0



R&D SME



TRANSLATION  
TO INDUSTRY



INDUSTRY  
TRAINING ROUND  
(FT-3)



FE2



FT3

TRAINING

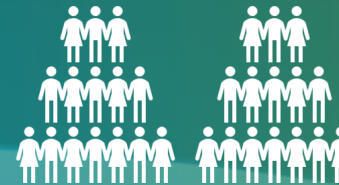
BLK 1



INDUSTRY  
TRAINING ROUNDS  
(DTA, JFC)



KNOWLEDGEABLE  
PARTNERS



INCREASED  
WORKFORCE



JFC-1

*FFRDC has a limited capability to duplicate advanced prototypes and leverages industry partnerships to produce multiple fielded systems*



PATHWAY TO  
INDUSTRY  
PRODUCTION

UNCLASSIFIED UNLIMITED  
RELEASE



# Transition to Industry Status & Updates



Design Agent



## Responsibilities :

- Ensures product satisfies program requirements within cost and schedule
- Works with the Production Agent (PA) to quickly resolve production issues and to implement process/producibility improvements

Production Agent



## Responsibilities:

- Configuration data management
- Processing/manufacturing engineering
- Continual process/producibility improvements
- Provides design for manufacturability principles to the Design Agent

Weapon System Integrator



## Responsibilities:

- AUR Integration
- AUR Flight Software
- Weapon system integration

Navy/Army, Sandia and our Industry Partners are actively working to improve the transition process by moving towards a common digital infrastructure, developing change control processes and revision controls, and improving design for manufacturability.

Common Hypersonic Glide Body

# Case Study: CHBG Transfer to Industry



## Partners



Sandia  
National  
Laboratories



## Objective

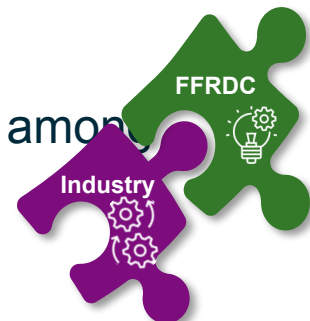
- Transfer the CHGB to industry partners for production

## Outcomes

- Successful transfer of CHGB to industry partners embedded at Sandia
- Staff exchanges among partner institutions aided in technology transfer, bridging cultural differences, and enhancing communication

## Lessons Learned

- Product transition is challenging; upfront investment (in time and funding) will ensure that things run more smoothly
- Leadership must be willing to embrace partnerships
- Embed partners at each location
- Take steps to bridge the cultural divide among organization
- Communication is key



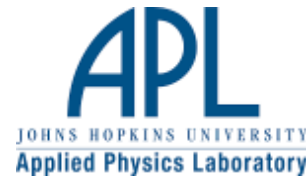
# Case Study: Flight Test of CHGB



## Partners



**DRAPER**



## Objectives

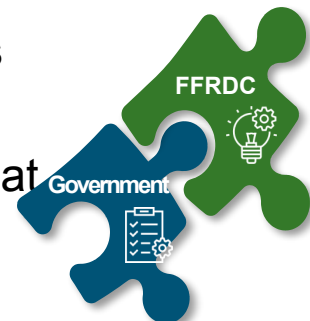
- Develop hypersonic glide vehicles for three services of the Department of Defense in a compressed timeline
- Transfer the Common Hypersonic Glide Body to industry in support of DOD's national security objectives

## Outcome

- Successful flight test
- Greatly expanded number of partners
- Conventional Prompt Strike FE-1 (10.30.17)
- Division of responsibility across multiple partners

## Lessons Learned

- Early coordination among all stakeholders is critical
- Communication is essential to success
- Clarify roles and responsibilities early
- Make efforts to bridge cultural differences among partner organizations
- Allow partners and stakeholders to do what they do best





# Case Study: A4H University Consortium



## Partners



## Objectives

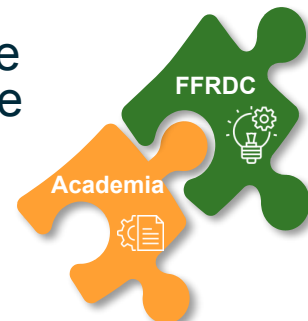
- Provide national security applications (i.e. hypersonics) that would benefit from the foundational research being conducted at the universities
- Promote and attract collaborative research and education programs with university partners
- Build a hypersonic talent pipeline into the national laboratories (FFRDCs)
- Provide hands-on experience for students and bridge the gap between basic and applies research

## Outcome

- Several joint research products are currently underway – including projects funded by external government sponsors
- Two Postdoctoral Fellowship Programs have recently been established at Sandia
  - AutonomyNM Fellowship
  - HOT 4 Hypersonics Fellowship

## Lessons Learned

- Ensure university collaborators understand there may be limitations on what can and cannot be published upfront
- Encourage regular meetings between the university and Sandia researcher
- Find additional opportunities to continue good university partnerships beyond the life of the A4H mission campaign



# Final Comments



- Leadership support at all levels – local and national– is essential
- Partnerships – and good partnering principles – are critical to our success
- Independent peer review will result in a more robust and technically sound outcome and ultimately, elevates us all
- Ongoing coordination among the various stakeholders is a must
- We must support national programs in integration efforts
- Strive to balance tech maturation with immediate needs of establishing a deployable capability
- Good partnerships thrive on commitment and trust

We work best when we work together

