

Hypersonic Weapons Summit

PROMOTING LEADERSHIP IN HYPERSONIC DEVELOPMENT AMONG RESEARCH INSTITUTIONS



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NATIONAL
SECURITY
PROGRAMS

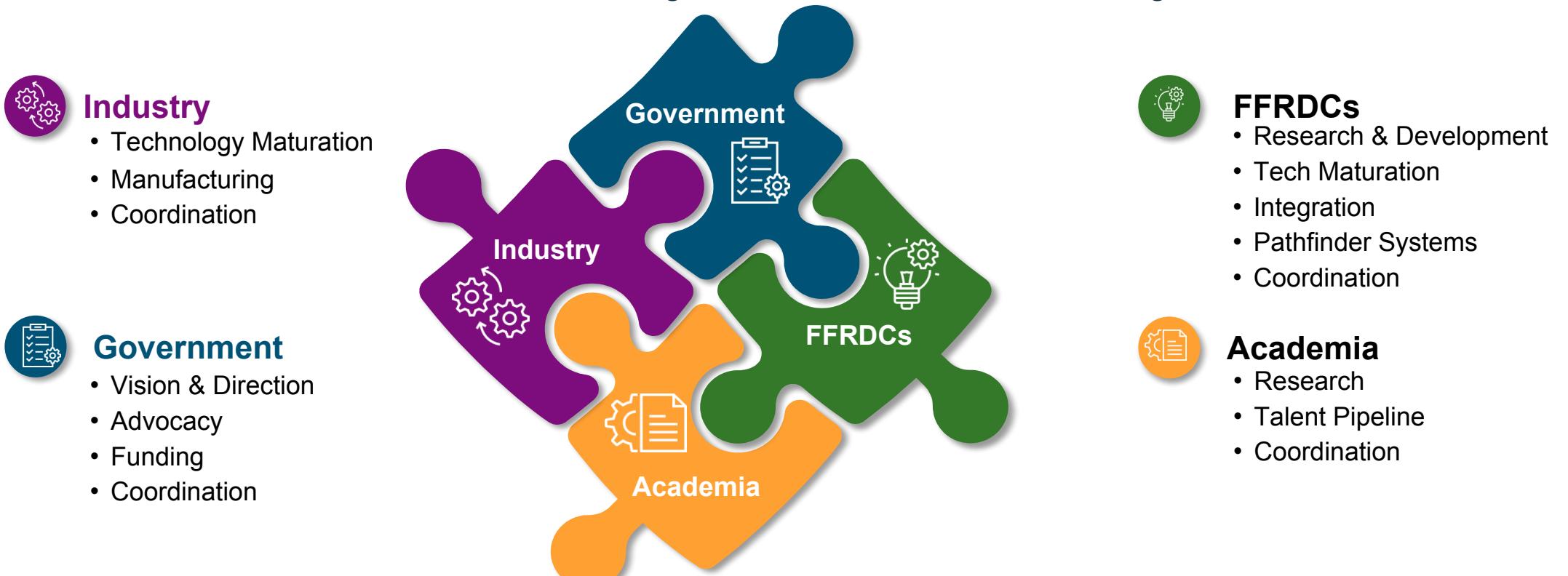
Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.





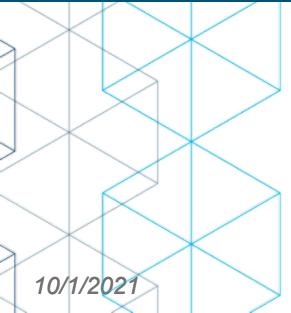
Bottom Line Up Front

- 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.

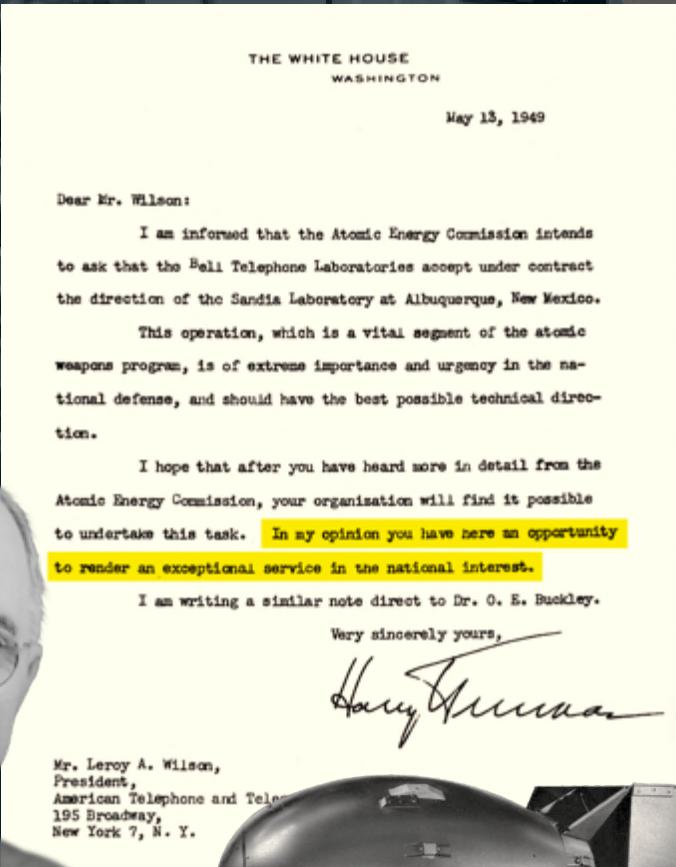




Brief History of Sandia National Laboratories



Sandia's History is Traced to the Manhattan Project



- 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



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



Advanced
Science &
Technology

Nuclear
Deterrence

Energy &
Homeland
Security

Global
Security

National
Security
Programs



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



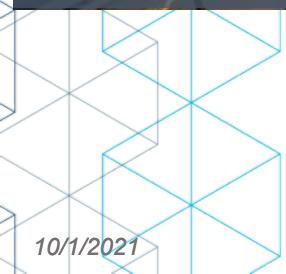
Facilitate the flow of people and ideas into and out of the Labs to remain on the leading edge



Maximize Public Good

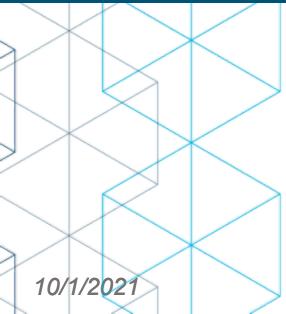


Enhance the local and national economy to ensure long-term competitiveness





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



Sandia's History in Hypersonic Glide Bodies



POST-WWII



Post-WWII:
Reentry Vehicles



10/1/2021

1970-1985



1970's:
Pre-SWERVE &
SWERVE

1985: Successful
SWERVE Flight Test

2003-2011



2003: Prompt Global
Response Grand
Challenge

2011: AHW-FT1A

2017-2020



2017: CPS FE-1

2018-2025:
Autonomy for
Hypersonics (A4H)

2020: CPS FE-2

2021-2023



Navy/Army CHGB
Product Transition
Navy/Army FT-3, JFC-1,
JFC-2

Missile Defense
Agency Advanced
Target
SHOTL

FUTURE



Sandia Design Agent
Role

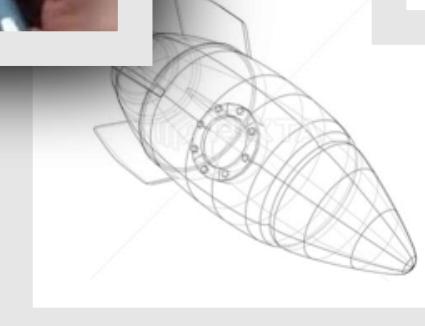
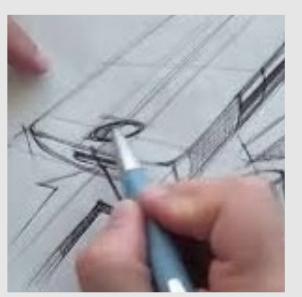
Sandia transfer of C-
HGB variants to
industry

Sandia's Roadmap
for the Future is
realized

Sandia Prototype Development: Concept to Test



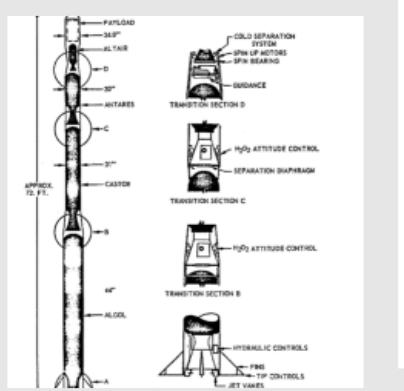
Concept



Sketch

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

Technical Spec



Component Builds

Environmental Test

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



Flight Test

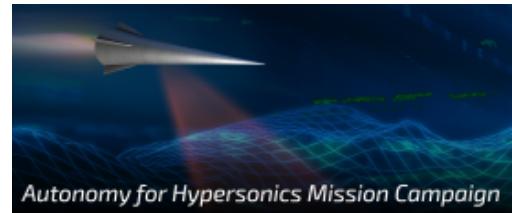
Access to the Kauai Test Facility allows Sandia to complete full flight tests on systems that started as initial concepts conceived by our engineers and scientists.

Hand Built Prototype

Sandia's Current Work in Hypersonics



Sandia National Laboratories



Autonomy for Hypersonics Mission Campaign



- 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



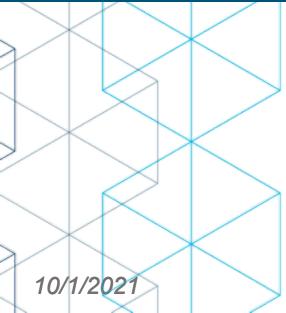
- Program Office Support
- Tech Maturation
- University Consortium for Applied Hypersonics Participation



- 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



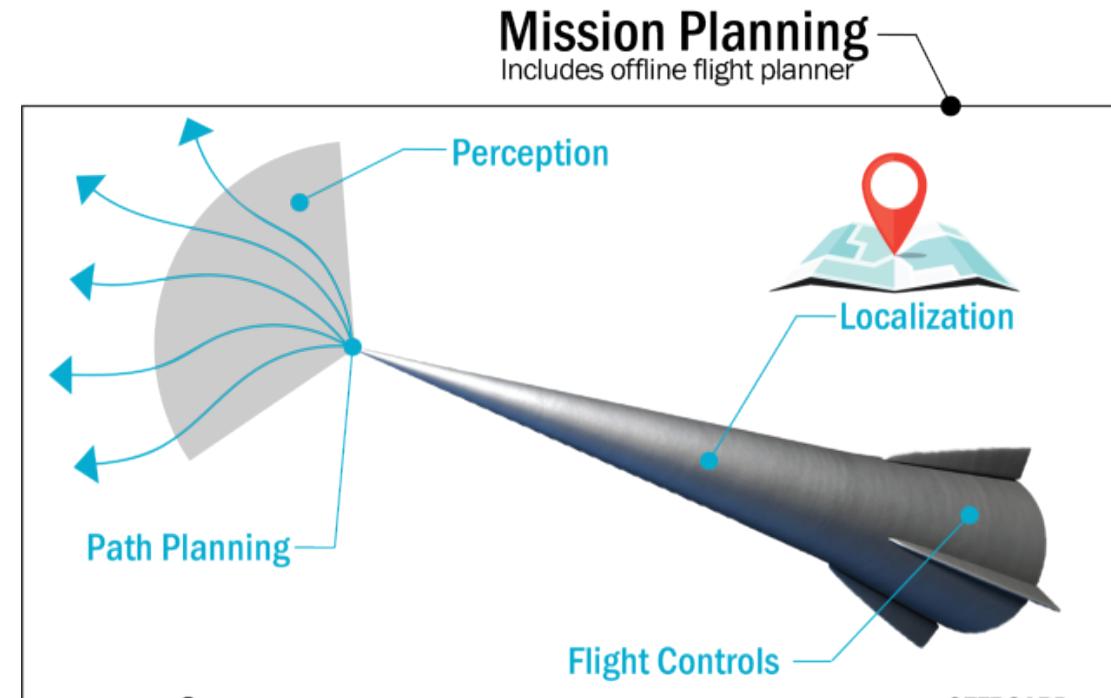
A4H will research and develop autonomous systems technologies that will enhance the warfighting utility of hypersonic flight systems

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

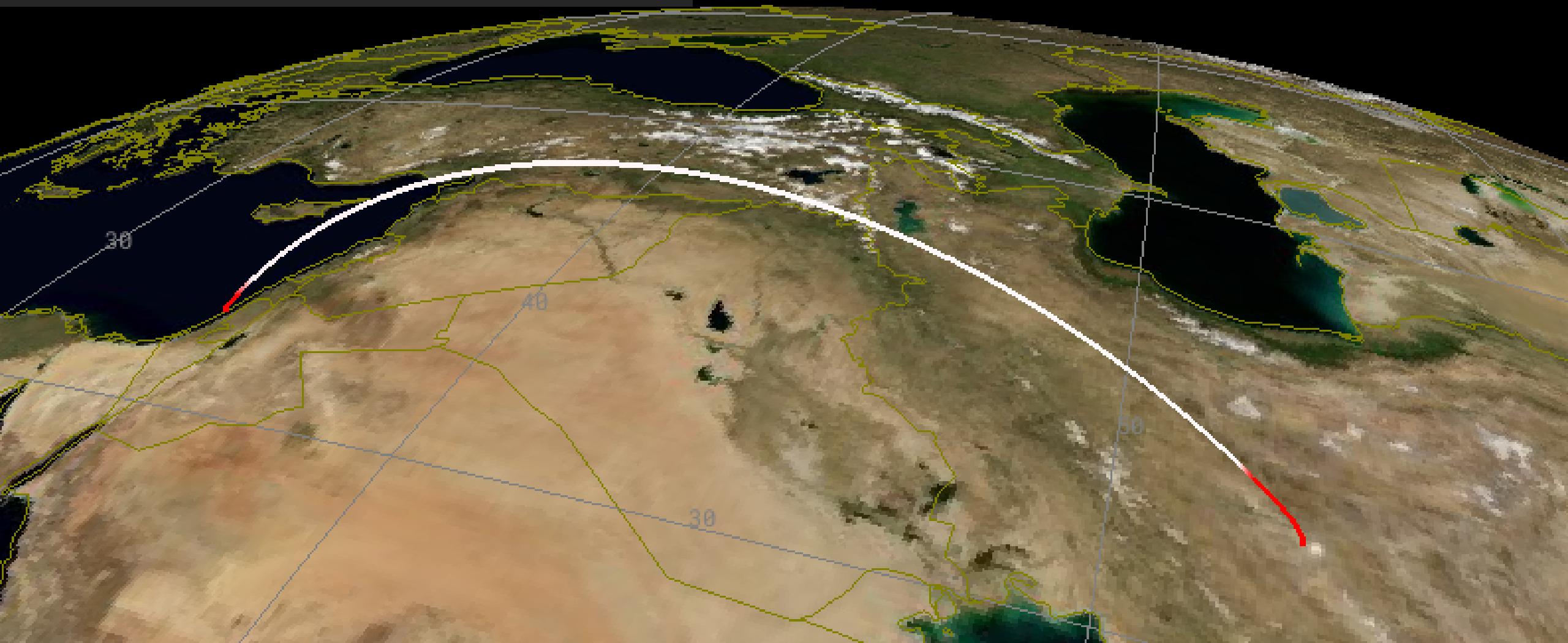


Mission Analytics
Inform tactics & engagement strategies

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

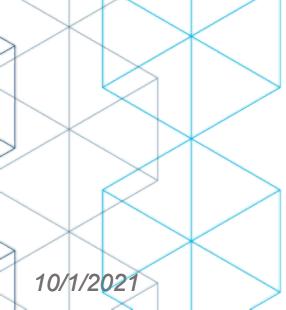
SITUATIONALLY AWARE

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





Product Transition





Sandia
National
Laboratories

UNCLASSIFIED UNLIMITED

RELEASE

Overview of CHGB Product Transition and Industry Partnership



Industry
National
Team

BLK 0



R & D SME



TRANSLATION
TO INDUSTRY



INDUSTRY
TRAINING ROUND
(FT-3)



FE 2 FT 3

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

Sandia National Laboratories

**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

Dynamics
A L3Harris Company**Responsibilities:**

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

Weapon System Integrator

LOCKHEED MARTIN

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

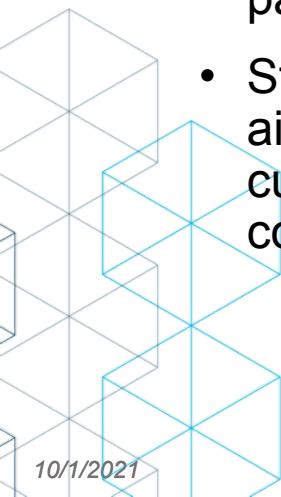


Sandia
National
Laboratories



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

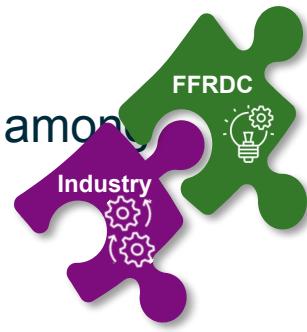


Objective

- Transfer the CHGB to industry partners for production

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



Sandia
National
Laboratories



Lawrence
Livermore
National
Laboratory



D R A P E R

APL
JOHNS HOPKINS UNIVERSITY
Applied Physics Laboratory

Outcome

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



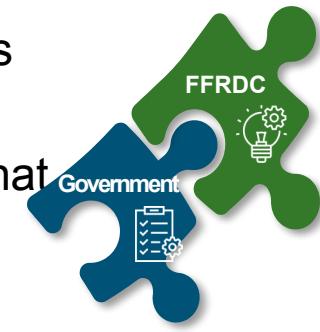
10/1/2021

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

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

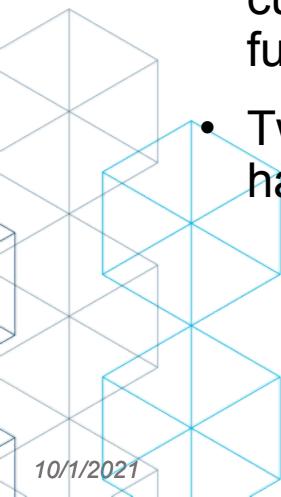


Partners



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



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 applied research

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

