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Hypersonics Overview

PRESENTED BY

George Leuenberger, Strike and Aerospace Systems

Billy Pinson, NSP Communications

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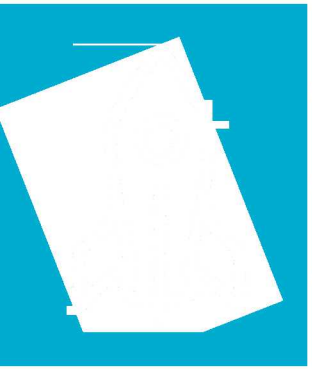
Hypersonics 101

Hypersonics 101

- Hypersonic is defined as five times the speed of sound.
- The speed of sound is about 750 mph* or about 1000 feet per second*.
- The speed of sound is the basis for a unit called Mach Number.
- A mile is 5280 feet, so the threshold for hypersonic flight is about a mile per second, or Mach 5.
- Advanced fighters fly at about Mach 3; the SR-71 flew about Mach 4. The fastest human-piloted aircraft (X-15) achieved Mach 6.7.
- For reference, earth orbital velocity is about 25,000 feet per second and provides an upper limit to the hypersonic flight regime.

*** At flight altitude**

Engineering Challenges



- Vehicle shape changes in hypersonic flight, creating challenges for flight control
- Difficult to simulate velocity, temperature, and Mach number on the ground
- Difficult to design sensors & actuators that can operate in a hypersonic flight environment
- Calculations are extremely time consuming

Different Hypersonic Systems

Boost-Glide Systems

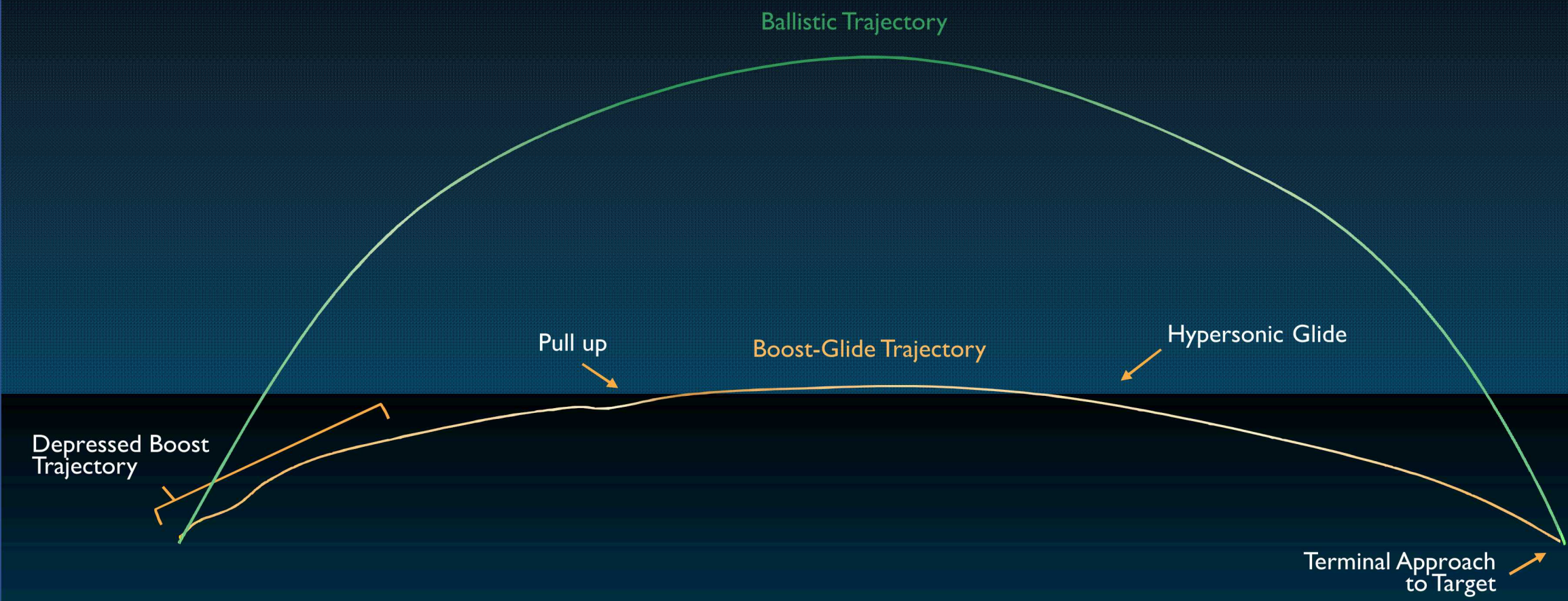
- Rocket boosted to velocity outside the atmosphere
- Reenters and establishes glide across upper atmosphere (near space)
- Cruise is typically between M 5 - 25
- Dives to target

Air-Breathing Systems

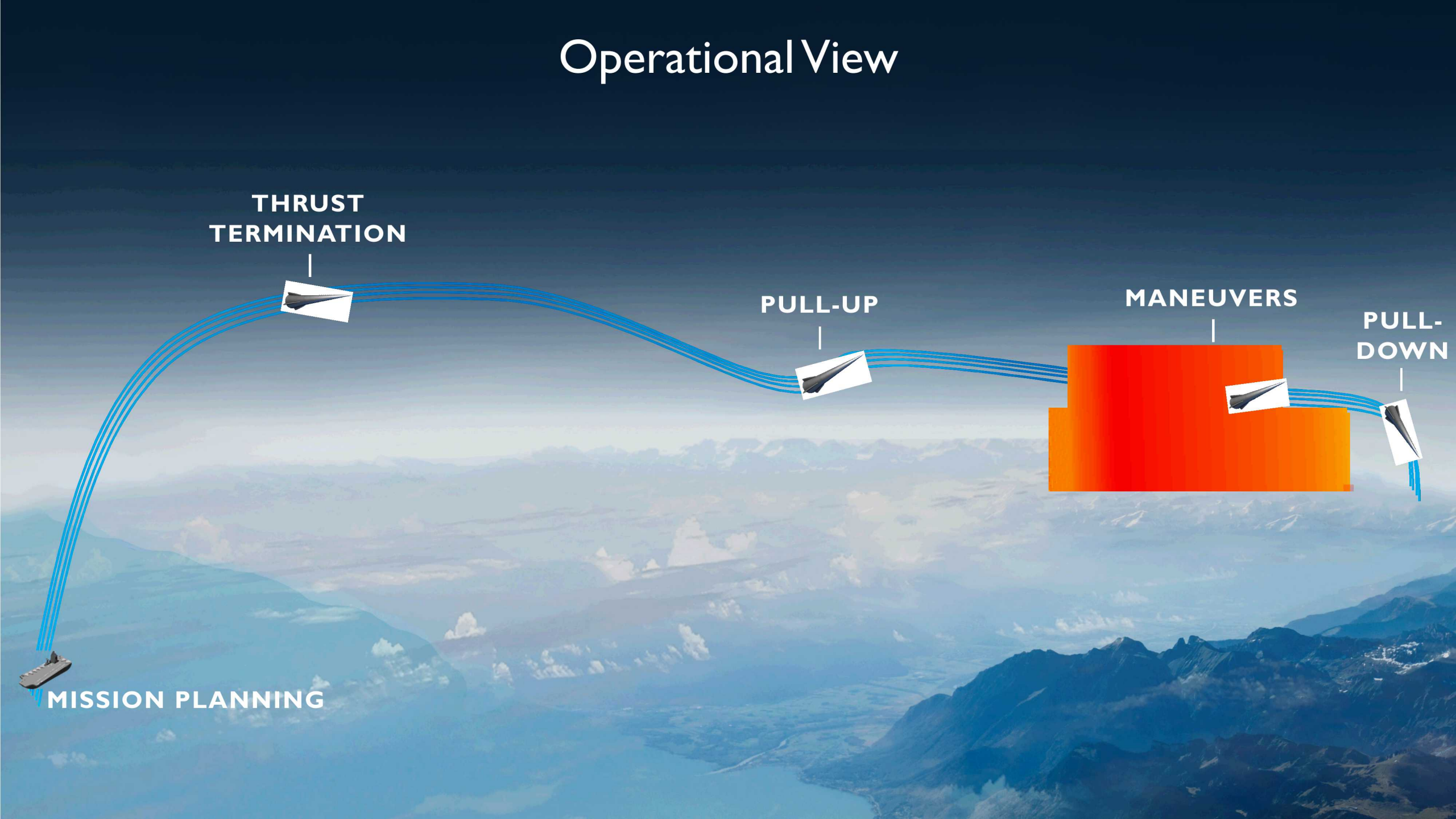
- Rocket boosted into altitude and velocity
- SCRAMJET propulsion cruise across upper atmosphere
- Cruise is typically between M 5 - 6
- Glides to target

Why Hypersonic Glide?

Hypersonic systems fly distinctly different trajectories from Ballistic systems



Operational View



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

History of Hypersonics at Sandia National Labs

Sandia Winged Energetic Re-entry Vehicle Experiment (SWERVE)

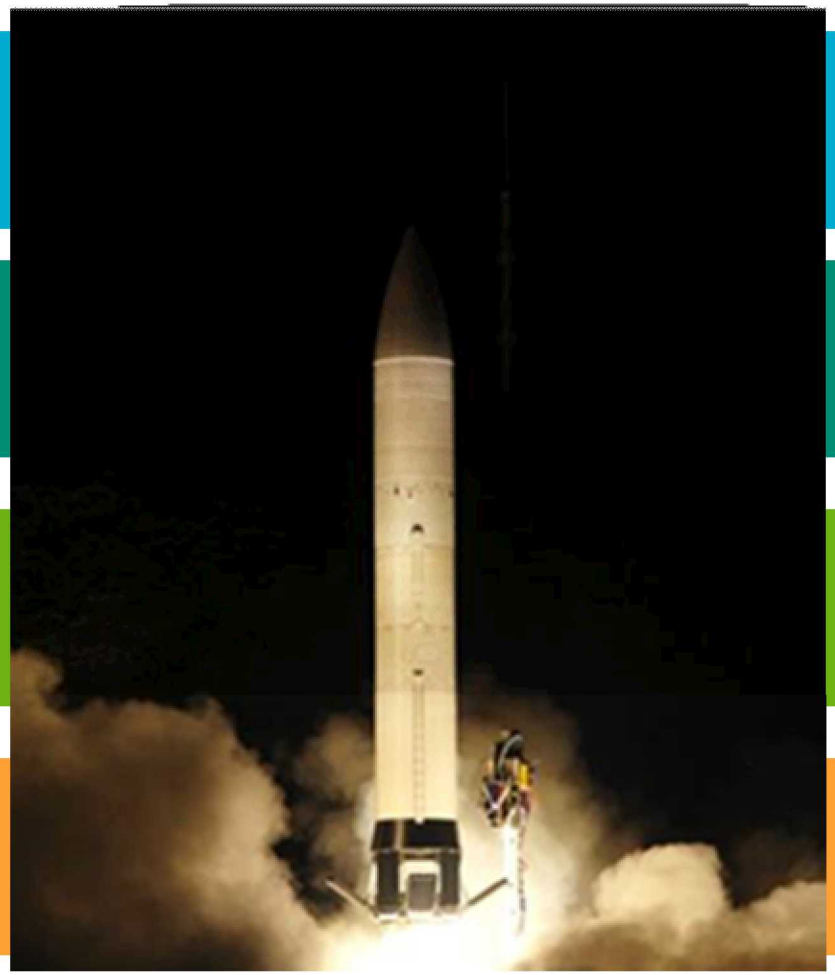
- SWERVE started in the 1970s and culminated with a successful flight test in 1985.
- The vehicle was launched from Sandia's Kauai Test Facility, in Hawaii, on a Strypi IX booster.
- The test demonstrated a sophisticated maneuvering reentry vehicle technology.
- The flight was the first step in the development of a long-range smart weapon system.

Sandia's Kauai Test Facility

History of Hypersonics at Sandia National Labs

Advanced Hypersonic Weapon I – Flight Test I (AHW FT1A)

- AHW FT-1A had a successful flight test in November 2011.
- The three-stage booster system and glide vehicle were developed by Sandia under the direction of the USASMDC/ARSTRAT.
- The test flight represented about four years of work for up to 200 Sandia employees across the Labs.
- **AHW FT-1A built upon a foundation of work from as long as 35 years ago, including SWERVE, the Strategic Target System (STARS), and the Tactical Missile System-Penetrator (TACMS-P).**



AHW-FT1A

History of Hypersonics at Sandia National Labs

Conventional Prompt Strike – Flight Experiment 1 Test (CPS – FE1)

- On behalf of the Department of Defense and Navy Strategic Systems Programs, Sandia conducted the FE-1 test from its Kauai Test Facility in October 2017.
- The Sandia team served as the lead technical integrator.
- The flight test collected data on hypersonic boost-glide technologies which will anchor ground testing, modeling, and simulation of future CPS concepts.

The Future of Hypersonics

Autonomy for Hypersonics

Hypersonics provide a lot of military utility

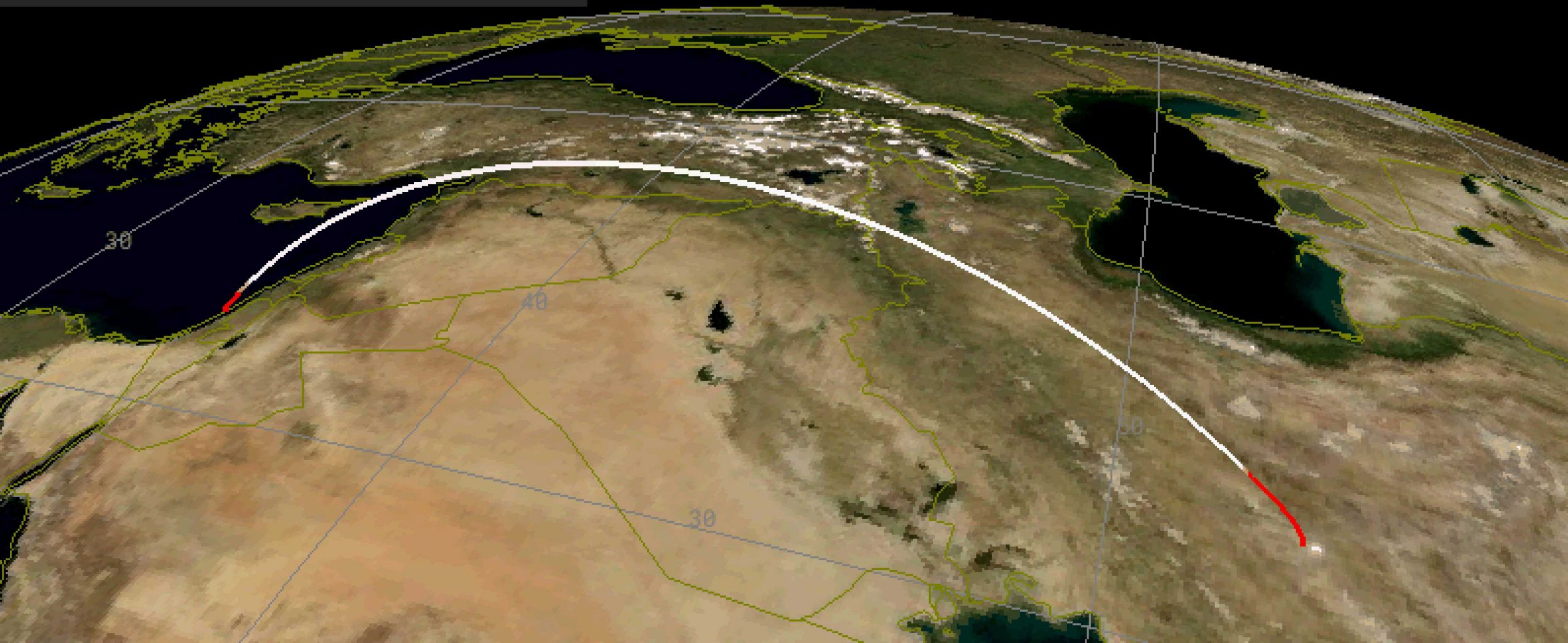
- Hypersonics offer survivability and utility at long/strategic ranges, since they travel at exceptional speeds and are less susceptible to anti ballistic missile countermeasures and other defensive systems

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

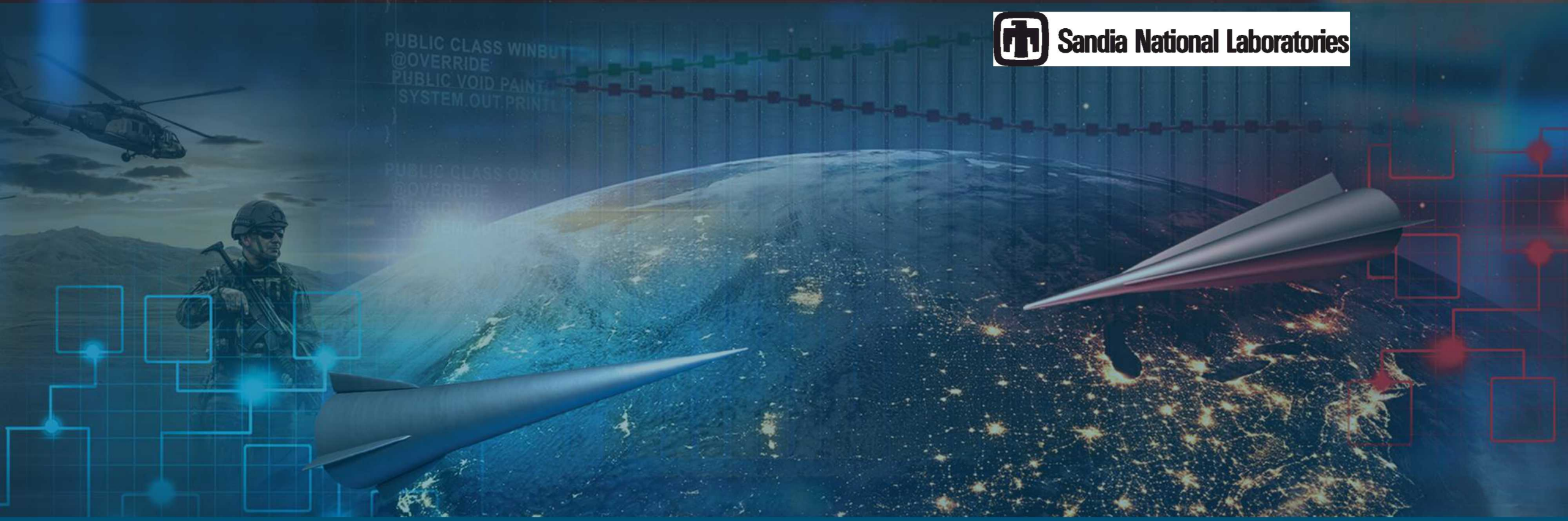
- Utilize rapidly constructed flight plans (enable speed of action)
- Navigate without GPS
- Perceive their environment and adapt to it to ir counter moving targets
- Employ tactics and engagement strategies that are highly effective in complex, rapidly evolving environments and heavily defended areas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

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.



Evolution of Hypersonic Strike Capability



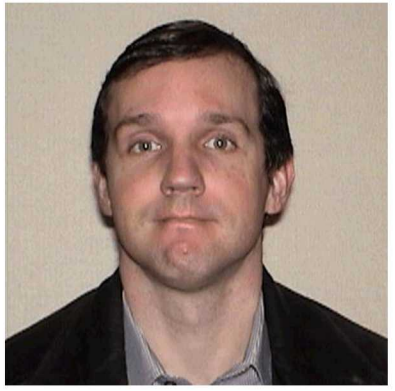
Hypersonics Technical Writing and Communications Overview

Who We Are - 5400 Technical Writing Team

Todd Heinrichs

Becky Cox

Billy Pinson



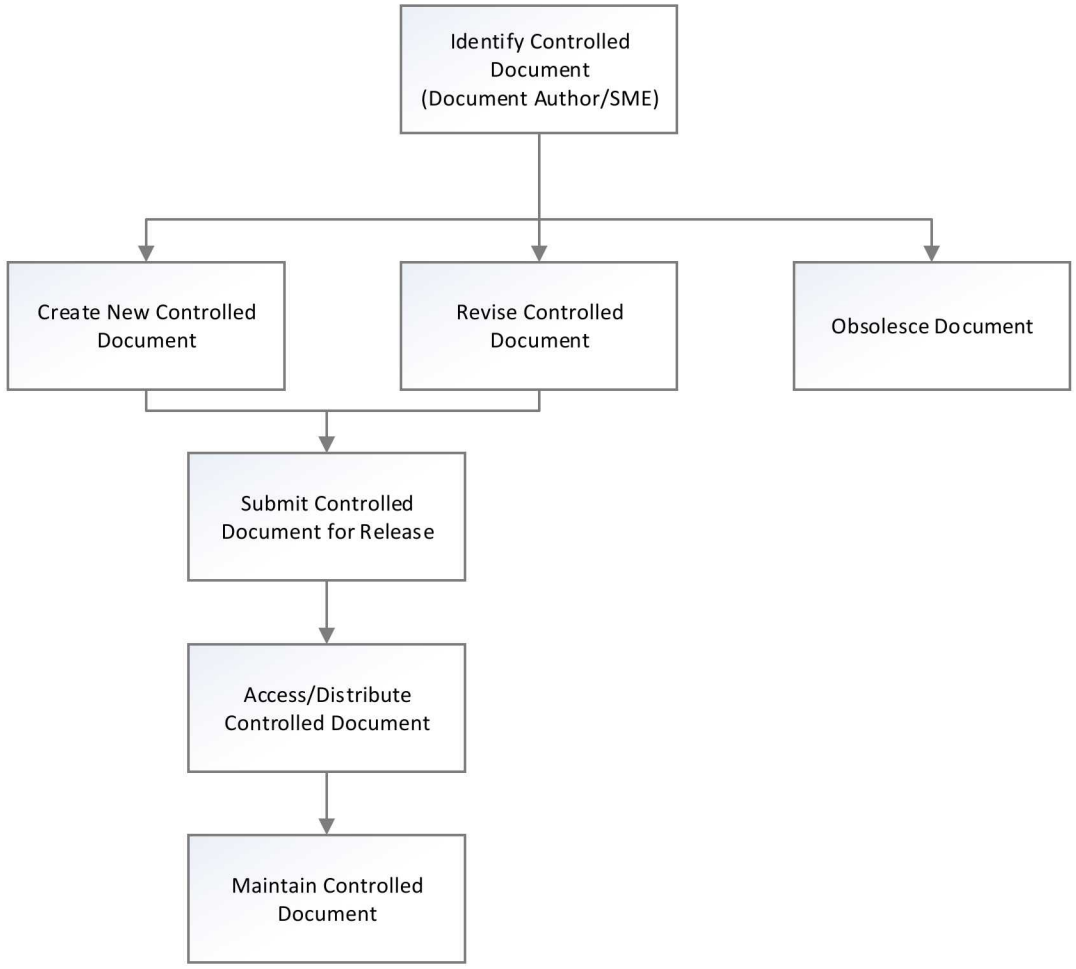
Lindsey Kibler

What We Do

The 5400 technical writing team supports all phases of Hypersonics program development.

Deliverables :

- Technical Work Documents (TWDs)
- Procedures (~300 procedures developed and used for FE-1)
- Program-Level Documents(System Engineering Plans, Environmental Specifications, Interface Control Documents [ICDs])
- Test Plans
- Test Reports
- Templates



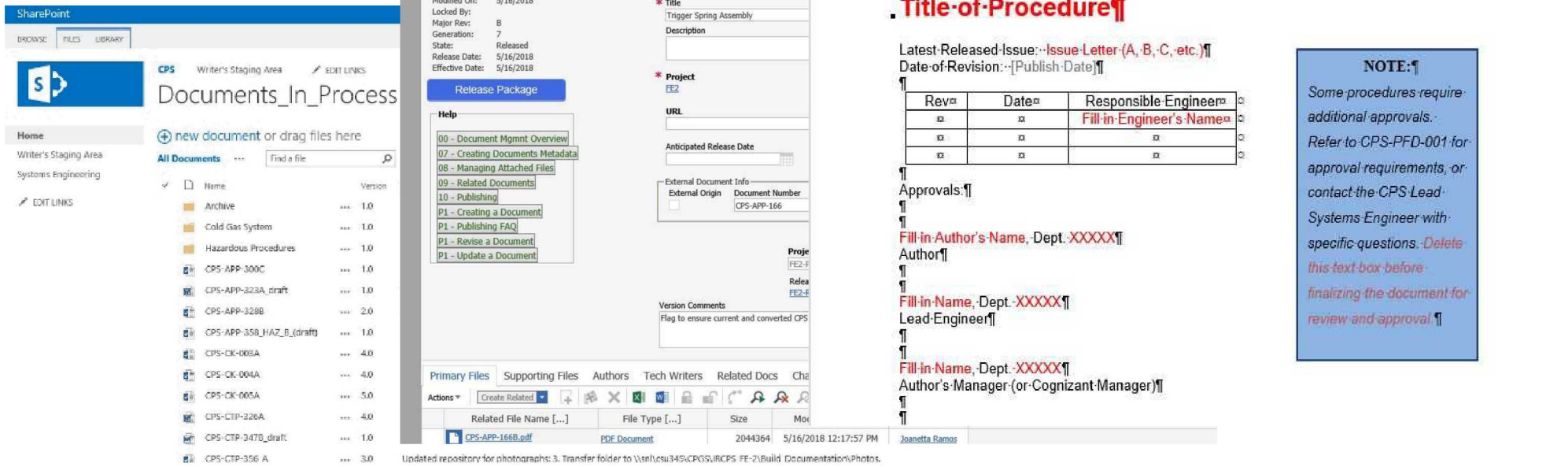
CPS FE-1 Technical Writing Support

The Conventional Prompt Strike (CPS) Flight Experiment-1 (FE-1) program was the first Hypersonics program at Sandia with full technical writing support for the duration of the program.

The technical writing team edited, routed for approval, published, and stored over 400 program documents and procedures.

Challenges:

- Fielding support
- Hazardous procedures



Support of Integrated Military Systems Programs

Technical writing support of the hypersonics program impacts its mission success. This same support is given to other programs in the Integrated Military Systems Center.

- Targets and Countermeasures Associated Objects
- Kauai Test Facility
- High Operational Tempo
- Environment, Safety, and Health
- Mission Assurance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Questions