Ames Research Center

INDUSTRY DAY
PRE-SOLICITATION CONFERENCE

Entry Systems Technology Research and Development (ESTRAD)

NASA Ames Research Center
MOFFETT FIELD, CA 94035-0001

CONFERENCE AGENDA

- 9:00am - 9:30am Registration
  - Rede Shifferaw & Rachel Jandron
- 9:30am - 10:30am Procurement Process Overview
  - AnJennette C. Rodriguez
- 10:30am - 12:00pm Statement of Work Overview
  - David Hash
- 12:00pm - 1:00pm Lunch Break
- 1:00pm - 3:00pm Tour of Facilities
  - Electric Arc Shock Tube Facility (Building N229)
  - Arc Jet Complex (Building N238)
  - Materials Development Lab (Building N223)

Process of Industry Day

- **This Industry Day/Pre-Proposal Conference is intended to:**
- Familiarize participants with the ESTRAD Statement of Work (SOW) requirements;
- Provide the current status of the ESTRAD acquisition;
- Permit potential offerors an opportunity to network and discuss teaming or subcontracting arrangements;
- Allow potential offerors an opportunity to submit questions regarding the recently posted draft Request for Proposal; and
- Allow industry representatives an opportunity to ask questions pertaining to the ESTRAD requirements.

General Guidance

- These slides shall not be interpreted as a comprehensive description of the Government's requirements. Please refer to the draft Statement of Work and draft Request for Proposal.
- Nothing discussed at this pre-proposal conference shall be construed as a revision to the draft Request for Proposal.
- If there are any inconsistencies between this presentation and the Final Request for Proposal, the Final Request for Proposal will govern.
- Communications blackout period will be invoked when the Final RFP issued.

QUESTIONS

Following the presentations and walking tour, all questions must be submitted in writing. All questions will be answered in a timely manner. All questions and answers will be made available on the NASA Acquisition Internet Service and Federal Business Opportunities websites.

Index cards have been provided to submit your questions.

All questions related to this pre-proposal conference or the draft Request for Proposal must be submitted to the Contracting Officer at **anjennette.c.rodriguez@nasa.gov** no later than September 9, 2014.

Electronic Posting

All documents pertaining to the ESTRAD Procurement can be found at the following links:

NASA Acquisition Internet Service (NAIS) Business Opportunities:
https://prod.nais.nasa.gov/cgibin/eps/bizops.cgi?gr=D&pin=21&=

OR

Federal Business Opportunities (FBO):
https://www.fbo.gov/index?s=opportunity&mode=list&tab=list&tabmode=list&=

These charts and the attendance list will be posted to the above sites.

FOIA Requests

- Freedom of Information Act (FOIA) Requests may be submitted electronically to Lubna M. Shirazi at foia@arc.nasa.gov
- No proprietary information will be disclosed.
- The NASA ARC FOIA Electronic Reading Room can be accessed at

  http://www.nasa.gov/centers/ames/business/foia/elec.html

Procurement Process Overview

Acquisition Branch For Center Operations
Code JAI

NASA Ames Research Center

ESTRAD Requirements Overview

- This will be a follow-on contract to the existing STRAD contract (NNA10DE12C), which has a performance period of April 01, 2010 through March 31, 2015.
- NAICS Code: 541712
- Small Business Administration Size Standard: 1000 employees
- DOD Contract Security Classification Specification (DD254)
  - Contractor Facility Clearance Level - Secret

Proposal Preparation

- Proposals shall be prepared in accordance with the Final RFP and subsequent written Amendments, if any.
- Ensure that all Amendments are acknowledged with the proposal submission.

Acquisition Schedule Tentative

• Synopsis Issued	February 07, 2014
• Draft RFP Issued	August 08, 2014
• **Questions/Comments Due**	**August 22, 2014**
• Industry Day/Pre-Proposal Conference	August 26, 2014
• Issue RFP	September 15, 2014
• Receipt of Proposals	October 29, 2014
• Contract Award	February 2015

- Please note that these dates are subject to change. Updated milestones will be provided if necessary.

Additional Information

Contracting Officer: AnJennette Contreras-Rodriguez
650-604-2147
anjennette.c.rodriguez@nasa.gov

Location of current information can be found online at the NASA Business Opportunities or Federal Business Opportunities websites. Please search using either the solicitation number **NNA14503443R** or the procurement title: **Entry Systems Technology Research and Development (ESTRAD)**

GENERAL PROCUREMENT INFORMATION

NASA may award a contract based solely on the initial offers received, without discussion of such offers. The initial proposals to the Government should contain the most favorable terms from a price and technical standpoint.

The terms of the Solicitation and Statement of Work will remain UNCHANGED, once posted as a final RFP, unless the Solicitation is amended in writing.

If Offeror's intent is to take exceptions to terms and conditions after proposal receipt, the proposal may be found ineligible for award and excluded from competition.

PLANNED AWARD INFORMATION

Intent is to award a single Cost-Plus-Fixed-Fee (CPFF) Contract

Potential 5-year contract period of performance:

- Two-year Base Period
- Three one-year Option Periods

SOURCE EVALUATION PROCESS

Note: Information is based upon Draft RFP and is subject to change.

- Section L.6 - PROPOSAL PREPARATON—GENERAL INSTRUCTIONS - Outlines the information required to be included in the proposal:
  - Volume I, Mission Suitability Proposal;
  - Volume II, Past Performance Proposal;
  - Volume III, Cost Proposal.
- Section L.7 - PROPOSAL PAGE LIMITATIONS Outlines the page limits associated with various proposal sections and will be strictly enforced

SOURCE EVALUATION PROCESS (CON'T)

As stated in Draft RFP Section M, there will be three (3) Evaluation Factors:

FACTOR 1 – MISSION SUITABILITY

FACTOR 2 – COST/PRICE

FACTOR 3 – PAST PERFORMANCE

- The Mission Suitability Factor is evaluated at the subfactor level and is the only factor scored.
- The Cost/Price Factor is evaluated, but not scored
- The Past Performance Factor is evaluated and given a Confidence Rating

SOURCE EVALUATION PROCESS (CON'T)

Relative Importance of Evaluation Factors

Of the evaluation factors identified above, Mission Suitability is moderately more important than Past Performance, and Past Performance is moderately more important than Cost. Mission Suitability and Past Performance when combined are significantly more important than Cost.

EVALUATION FACTORS

Mission Suitability (Factor)

- The Mission Suitability Factor has a potential of 1000 points. The Mission Suitability Factor consists of two Subfactors that are scored:

  Subfactor 1 - Management Approach – 450 Points

  Subfactor 2 - Technical Approach – 550 Points

EVALUATION FACTORS (CON'T)

Cost/Price (Factor)

- The evaluated price will be the sum of the contract management requirements for the base period and all options, the IDIQ extended total price as reflected in the pricing sheets for the base period and all options, and the CPFF probable costs for the base period and all options.

- Evaluation of options shall not obligate the Government to exercise such options.

EVALUATION FACTORS (CON'T)

Past Performance (Factor)

Includes Significant Subcontractors (defined in Section L)

NASA will evaluate each Offeror's current/recent record of performing services or delivering products that are similar in size, content, and complexity to the requirements of this solicitation using the Levels of Confidence ratings.

Statement of Work Overview

Entry Systems and Technology Division
Code TS

NASA Ames Research Center

STATEMENT OF WORK

THERE ARE 8 SECTIONS WITHIN THE STATEMENT OF WORK

- Section 1: INTRODUCTION
- Section 2: SCOPE
- Section 3: APPLICABLE DOCUMENTS
- Section 4: CONTRACT MANAGEMENT REQUIREMENTS
- Section 5: TECHNICAL REQUIREMENTS
- Section 6: ASSOCIATED FACILITIES
- Section 7: DELIVERABLES AND REPORTS
- Section 8: PHASE-IN AND PHASE-OUT

Scope of Work

- The known minimum support needed in the next five years of contract performance will encompass the requirements for Contract Management (SOW Section 4).
- The IDIQ work will address currently unknown, but expected, requirements. The IDIQ task orders will be issued to address research and development projects that span across several integrally-related technical areas. The IDIQ encompasses requirements within six key technical areas (Section 5 of SOW):
  - Technical Operations (SOW Section 5.1)
  - Technical Project Management (SOW Section 5.2)
  - Aerothermodynamics (SOW Section 5.3)
  - Nanotechnology (SOW Section 5.4)
  - Entry Systems and Vehicle Development (SOW Section 5.5)
  - Thermal Protection Materials and Systems (SOW Section 5.6)
- Place of Performance:
  - The majority of the work will be performed on-site at NASA Ames, but the multidisciplinary nature of the work will require occasional support to be provided at other NASA Centers, or other installations if needed, in order to complete the mission.

STATEMENT OF WORK (CONTINUED)

MINIMUM REQUIREMENT SECTION : SECTION 4 CONTRACT MANAGEMENT REQUIREMENTS

- SECTION 4.1 Resource Tracking
- SECTION 4.2 Contract Compliance
- SECTION 4.3 Workforce Management and Allocation
- SECTION 4.4 Workforce Training
- SECTION 4.5 Risk Management
- SECTION 4.6 Health, Safety and Environmental
- SECTION 4.7 Quality Management and Assurance
- SECTION 4.8 Government Property Management
- SECTION 4.9 Travel Management
- SECTION 4.10 Resource Acquisition
- SECTION 4.11 Staffing Level Management
- SECTION 4.12 Employee Background Checks and Clearances

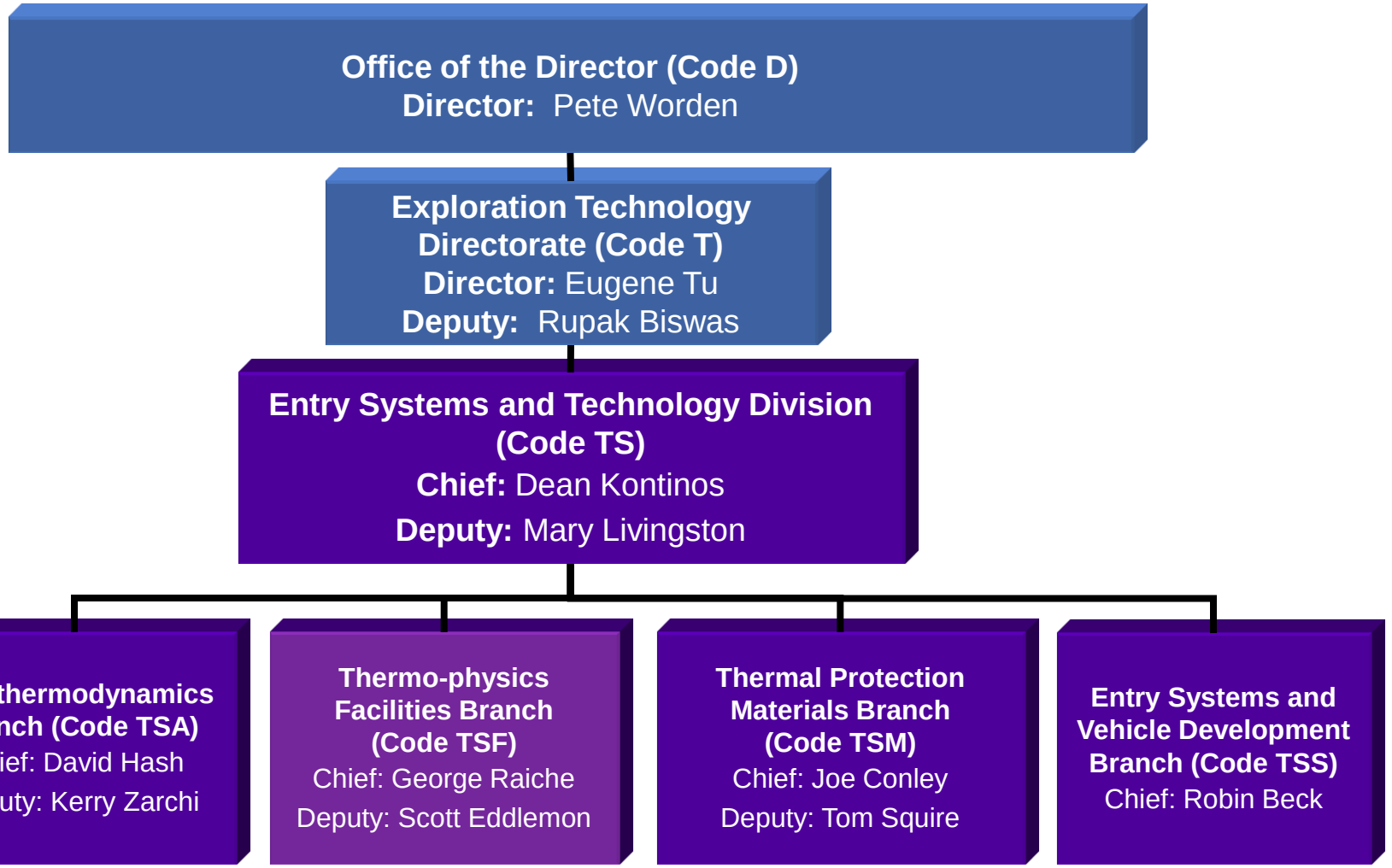
STATEMENT OF WORK (CONTINUED)

IDIQ SECTION : SECTION 5 TECHNICAL REQUIREMENTS

- SECTION 5.1 Technical Operations Support
- SECTION 5.2 Technical Project Management Support
- SECTION 5.3 Aerothermodynamics Support
- SECTION 5.4 Entry Systems and Vehicle Development
- SECTION 5.5 Nanotechnology
- SECTION 5.6 Thermal Protection Materials and Systems

NASA Ames Research Center

Entry Systems and Technology Division



NASA Entry Vehicles / Missions Supported by Code TS

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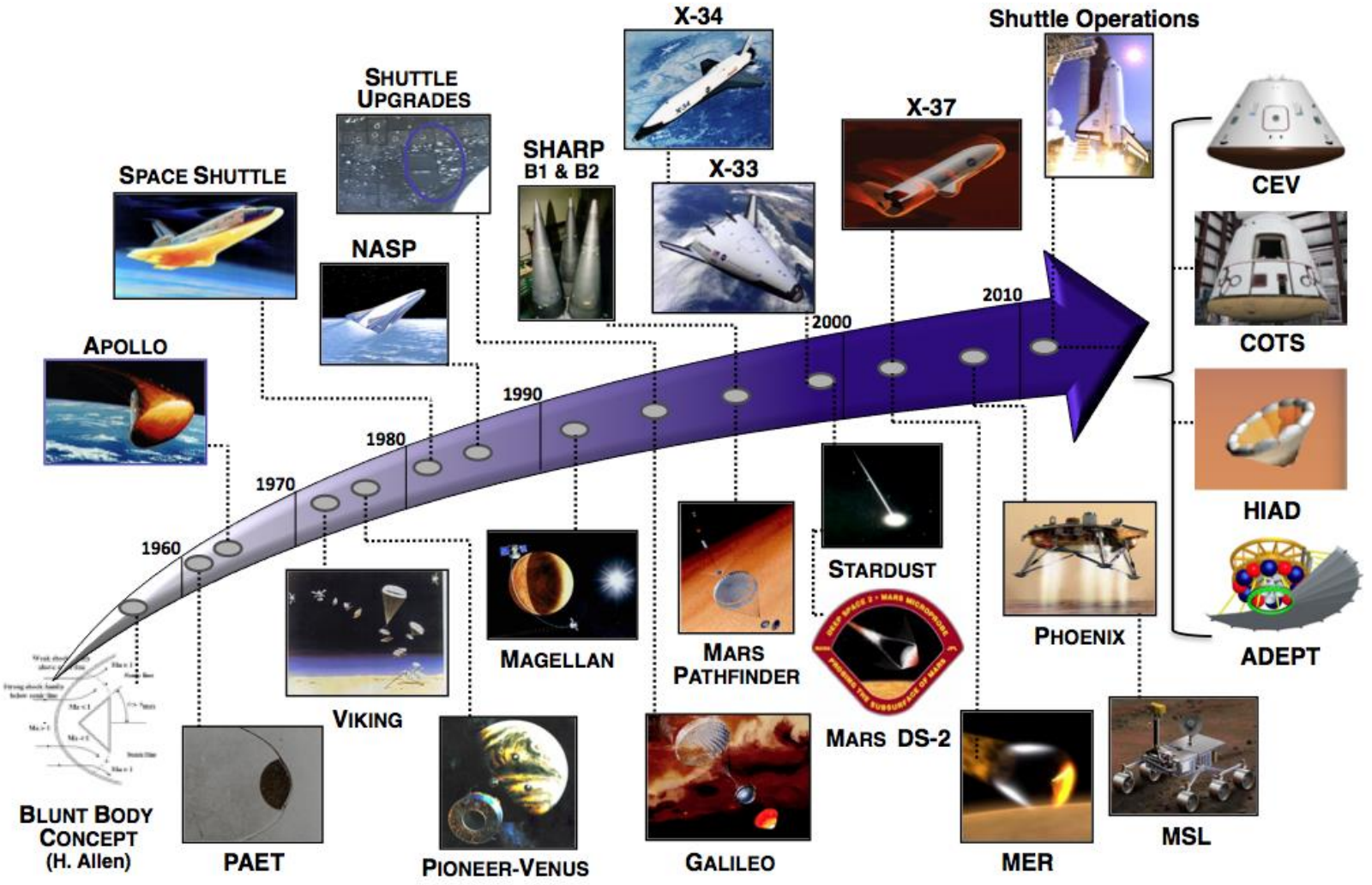

Entry Systems and Technology Division Marquee Innovations

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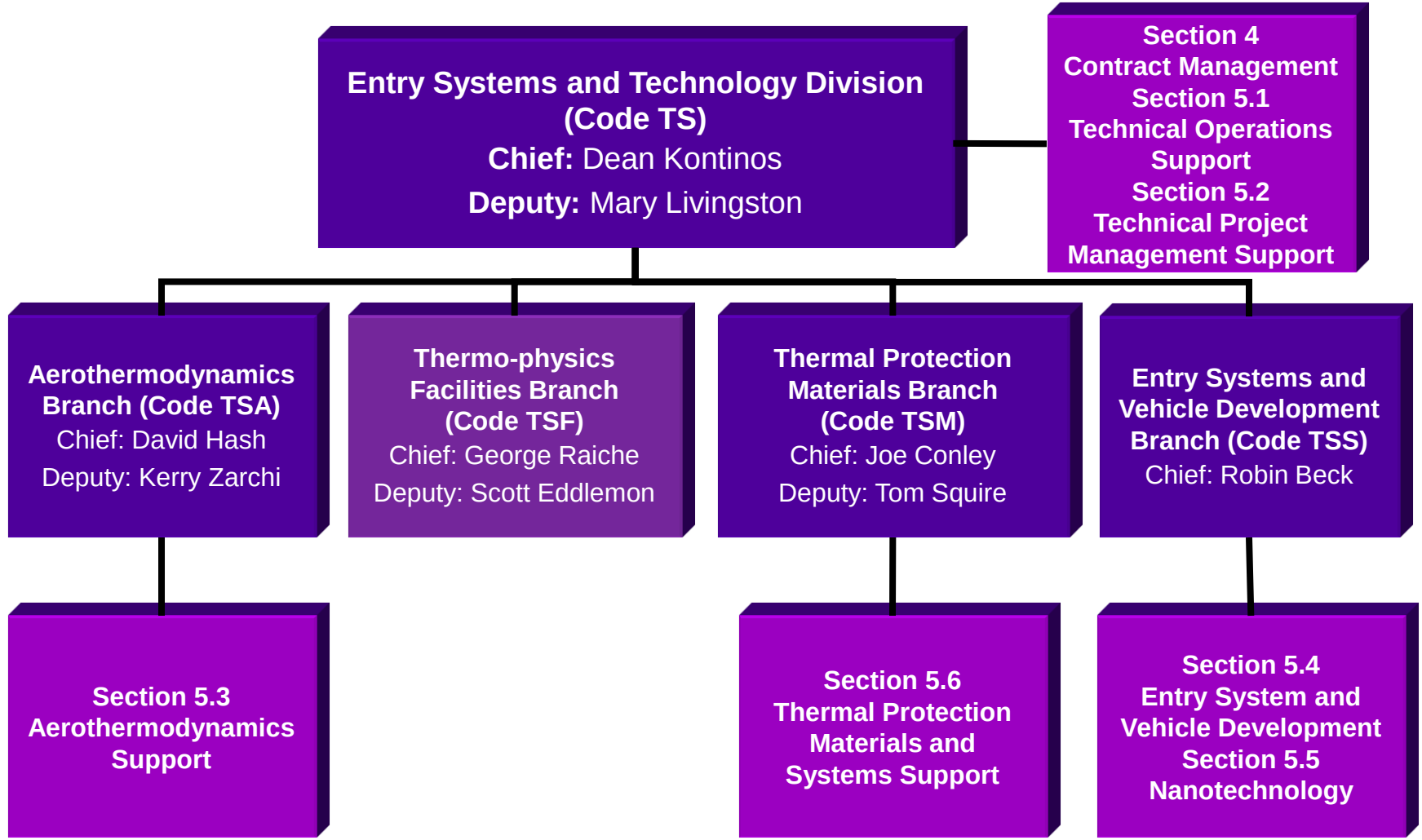
- Blunt body concept for realizable atmospheric entry
- Patent for constricted arc jet
- Atmospheric probe experiment for planetary atmosphere reconstruction
- Interaction Heating Facility concept for space shuttle program
- Shuttle tile coatings, advanced blankets and gap fillers (7 patents)
- Computational chemistry discipline
- NASA gas phase radiative emission and transport analysis code (NEQAIR)
- PICA/SIRCA family of lightweight ablators (*Government Invention of the Year*)
- Mainline aerothermodynamics analysis code DPLR (*NASA Software of the Year*)
- Mainline thermal protection material response code FIAT
- Material development and configuration of sharp leading edge entry vehicle
- TUFROC shape-stable, high-temperature TPS (*Government Invention of the Year*)
- First Nano Device flown in space in 2007 – Nano Chem Sensor Unit for trace chemical detection. (*Government Invention of the Year*)
- The smallest X-ray tube using carbon nanotubes.
- Carbon nanotubes/fibers biosensors for DNA, pathogen detection.
- Neuron implants using carbon nanotube chips.

SOW Technical Requirements Mapping
NASA Ames Research Center
Entry Systems and Technology Division



Aerothermodynamics Branch (TSA)

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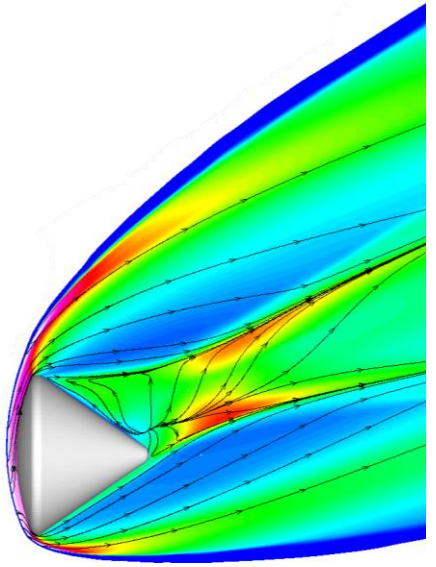
The Aerothermodynamics Branch leads the development of technologies that support the design of advanced entry systems. The Branch provides integrated modeling, simulation, and testing capabilities in the areas of aerothermodynamics, shock layer radiation, and heat shield sizing. The Branch is responsible for development, testing, and application of new processes and methodologies for TPS analysis and design, entry environment uncertainty, margin and risk analysis, traceability of ground-based testing to flight, and multi-disciplinary analyses. The Branch actively develops and matures computational and experimental methods and techniques to maintain our state-of-the-art capabilities in entry systems analyses.

The key activities of the branch include:

- Aerothermal and aerodynamic CFD analysis for entry vehicles
- Arc jet facility flow modeling and characterization
- Shock layer radiation modeling
- Aerothermal testing and data analysis
- Development of non-intrusive diagnostic techniques
- Integrated high fidelity aerothermal/material response model development
- Aerothermal/TPS engineering tool development



Entry Systems and Vehicle Development Branch (TSS)

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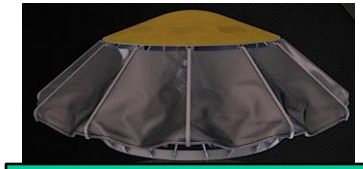
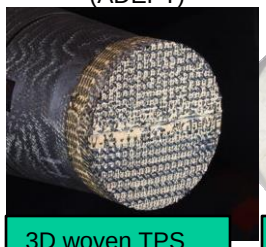
- Mission studies for infusion of new technologies
- Systems engineering for development of new material systems and new entry vehicle systems
- Development and evaluation of seam techniques for new advanced thermal protection material systems
  - 3D woven materials
  - Conformal ablative materials
- Design and assembly of Manufacturing Demonstration Units (MDUs) and Engineering Test Units (ETUs) for new advanced TPS materials
- Design of chip-based data acquisition systems for use in-situ during testing and/or flight
- Develop nano-material based electronics and sensors for earth science, planetary science, human exploration, and medical applications
- Develop nano-material based energy harvesting and storage systems for both human and robotic missions

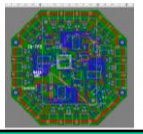


Adaptable Deployment Entry Placement Technology (ADEPT)

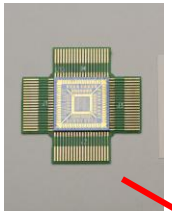


3D woven TPS

Conformal Ablator



Data Acquisition on-a-chip

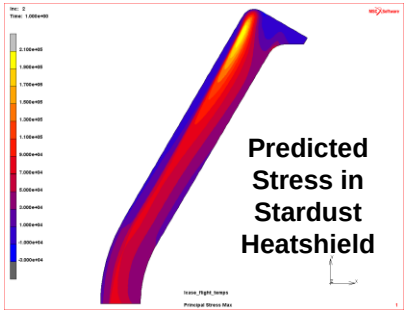


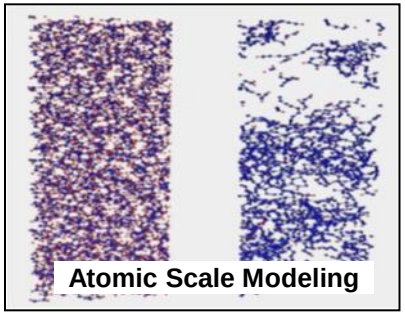
Cell phone nano chem sensor

Thermal Protection Materials Branch (TSM)

- Combine processing, modeling, analysis, and testing to develop and qualify thermal protection system (TPS) materials for NASA missions
- Research and development efforts in both ablative and reusable TPS materials and systems
- Experimental Activities
  - Material processing
  - Material characterization
  - Material testing
- Analysis and Modeling Activities
  - Thermal-structural finite element
  - Material response
  - TPS sizing
  - Multi-scale computational materials

Lab Facilities





SOW SECTION 5.1 Technical Operations Support

- 5.1.1 Technical Editing Services
  - Provide technical assistance for preparation of graphics and presentation materials including displays, posters, brochures, manuals, publications, presentations and website development.
- 5.1.2 Document Management
  - Manage the Division's archival records, publications, and other documents.
- 5.1.3 Operations Analysis
  - Provide support for the Division technical operations, including support to resource and workforce analysis, and provide interface to support data calls, and safety and mission assurance requirements.
- 5.1.4 Publications Services
  - Provide administrative support in the development of non-technical publications, such as marketing plans, strategic plans, and reports; control and preparation of forms and documentation; and management of laboratory and office supplies.
- 5.1.5 IT Support Services
  - Provide specialized computer system administration and software support necessary for the fulfillment of the research being performed under this contract. Research office and laboratory space, computer hardware, and software, that are deemed necessary for the direct fulfillment of the task orders, will be provided by the Government.
- 5.1.6 Procurement Services
  - The Contractor may purchase, with CO approval, and in accordance with the Subcontracts clause at FAR 52.244-2, any materials (consumables and non-consumables) necessary for the fulfillment of the task requirements.

SOW SECTION 5.2 Technical Project Management Support

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- 5.2.1 Project Development
  - The Contractor shall provide support in all phases of project development. These tasks include: creating proposals documents, developing implementations plans and schedules, assessing project feasibility, and assessing technology readiness.
- 5.2.2 Project Implementation
  - The Contractor shall provide support for all phases of project implementation. These tasks include: performing trade studies and analyses, assessing project requirements, developing and assessing system architecture designs, refining project requirements and specifications, evaluating and refining project resource and schedule estimates and the basis of estimates, assessing implementation plans, performing system design and development, and developing risk assessment and management plans.
- 5.2.3 Project Monitoring
  - The Contractor shall provide support to assist NASA in monitoring project performance. These activities include: configuration management of critical project data; tracking milestones, schedules, budgets, and performance measurements; and performing cost control, contract/subcontract financial management, and resource allocations.

SOW SECTION 5.3 Aerothermodynamics Support

- 5.3.1 Aerothemodynamics Model Development
  - The Contractor shall support the validation, optimization, and application of new Computational Fluid Dynamics (CFD) algorithms in support of thermochemical model development, including gas-phase kinetics, thermal nonequilibrium, transport, and surface chemistry models, that will allow the design, development, and certification of advanced Earth-to-orbit and planetary entry vehicles.
  - The Contractor shall also develop, validate and apply radiation heat transfer calculation methods for the simulation of shock layer and wake radiation for blunt body hypersonic flows.
- 5.3.2 Entry Vehicle Design Support
  - The Contractor shall support aerothermal environment prediction, and TPS sizing analysis and design for hypersonic vehicle development projects, such as the Orion crew vehicle, including the application of CFD methods and other modeling capabilities.
  - In addition, the Contractor shall perform systems analysis on vehicle systems to help guide investment of efforts in the Entry Systems and Technology Division, including support of design activities of the Center.
- 5.3.3 Experimental Capabilities Support
  - The Contractor shall perform calibration/validation experiments in concert with theoretical aerothermodynamics for the validation of thermochemical modeling efforts. They shall support the development and application of advanced, state-of-the-art, diagnostics for real-gas testing and data acquisition in shock tubes, ballistic ranges, and arc-jets. They shall design models for ballistic range testing and conduct experiments in the range. Finally, the Contractor shall develop and apply models for the simulation of the flow in high enthalpy facilities, for the characterization of facility capabilities and traceability of test conditions to flight.

SOW SECTION 5.4 Entry Systems and Vehicle Development

- 5.4.1 Systems Engineering and Design
  - The Contractor shall provide systems engineering support to develop heatshield designs, including the development of small probe heatshields for arc-jet test specimens, inflatable decelerator structures, and various flight test articles. They shall also support the design and build of large scale Manufacturing Design Units (MDU), and provide support for mission design studies.
- 5.4.2 Ground and Flight Testing
  - The Contractor shall support the assembly and instrumentation of small probe arc-jet test models. They shall also support the execution and post-test analysis of various ground tests.
- 5.4.3 Flight Data Reduction
  - The Contractor shall support planning data reduction from flight instrumentation to determine the heating and other conditions on the vehicle during flight, and development or improve any data reduction software as needed.
- 5.4.4 TPS Materials Development
  - The Contractor shall support the development of carbon fiber stitching techniques for emerging entry systems technologies.

SOW SECTION 5.5 Nanotechnology

- 5.5.1 Chemsensor Development
  - The Contractor shall support research to determine the suitability of carbon nanotube based chemsensor to meet future NASA needs. They shall also test the efficacy of existing chemsensor for detection of a variety of gas signatures critical in ECLSS applications, crew health diagnostics and detection of life on other planets.
- 5.5.2 Biosensor Development
  - The Contractor shall support research to determine the suitability of carbon nanotube and carbon nanofiber based biosensor to meet future NASA needs, and test the efficacy of existing biosensor for detection of a variety of bio-signatures critical in ECLSS applications, crew health diagnostics and detection of life on other planets.
- 5.5.3 Nanoelectronics
  - The Contractor shall support research to develop nanomaterial based printed electronics and sensor devices to meet future NASA needs, and develop methodologies and instrumentation to support in-space manufacturing of nanomaterial based electronics and sensor devices.
- 5.5.4 Energy harvesting and storage
  - The Contractor shall support research to develop nanomaterial based energy harvesting and energy storage devices to meet future NASA needs.

SOW SECTION 5.6 Thermal Protection Materials and Systems Support

- 5.6.1 TPS Materials Development
  - Pursue development of advanced reusable and ablative TPS materials, including ceramic composites, ceramic/polymer composites, rigid and flexible TPS, insulations, coatings, and surface treatments. Material samples will be fabricated and tested to determine the optimum processing conditions. Optimization will consider material performance, fabrication safety, cost and other factors. Develop and document material processing specification.
- 5.6.2 Lab Management
  - Manage operations in the materials development and materials characterization labs, including scheduling the maintenance, repair, and calibration of lab equipment. The equipment includes a scanning electron microscope (SEM), IR spectrometer, X-Ray diffraction unit, energy dispersive X-Ray analyses unit, inductively coupled plasma spectrometer, laser particle size analyzer, TGA, side-arm reactor, and other general lab equipment and fixtures. Investigate new lab equipment acquisitions.
- 5.6.3 Material Characterization Services
  - Perform material characterization tests as required in support of materials development research and project activities. This work includes, but is not limited to, measurement of material composition, thermal and mechanical properties, SEM imaging of microstructures, decomposition chemistry kinetics, and surface optical properties.
- 5.6.4 Test Model Fabrication Services
  - Fabricate, modify, and inspect TPS material samples for ground testing and flight. Design and fabricate instrumentation to measure material performance in both ground tests and flight. Machine metals and ceramics, spray coatings, apply adhesives, and work with flexible insulation as needed. Travel may be required to install, repair, and inspect articles off site.

SOW SECTION 5.6 Thermal Protection Materials and Systems Support (Continued)

- 5.6.5 Material Test Operations Services
  - Provide test engineer support for materials testing in the arc-jet complex. Activities include all aspects of testing, such as development of test plans, coordination with test facility operators, evaluation of test feasibility, design of test models and instrumentation, and managing pre- and post-test analysis.
- 5.6.6 Thermal/Mechanical Analysis Services
  - Apply computational tools to analyze the thermal and mechanical response of TPS materials, components, and assemblies for both ground test models and flight designs under various reentry loads. Commercial software, such as MSC.Nastran and MSC.Marc, may be used in these analyses.
- 5.6.7 Material Response Modeling
  - Apply exiting ablating material response computational tools to predict the performance and thickness requirements of TPS materials, under both ground test and flight heating environments. This work utilizes in-house material response codes, FIAT and 3D-FIAT, written primarily in FORTRAN. Develop new software routines to improve the modeling fidelity of exiting material response tools, and create new tools as necessary. Support efforts to develop software tools to analyzed coupled CFD and material response behavior.
- 5.6.8 Engineering Design Services
  - Provide engineering design support for development of arc-jet and other test models, and flight hardware. These tasks require the use of computer aided design software, such as SolidWorks and ProE. Design engineers are also required to coordinate with test principal investigators and other project support staff, and good communication skills are essential.
- 5.6.9 Computational Materials Services
  - Provide support for computational materials research by developing first-principles approaches for prediction material properties and performance. This research uses in-house developed software and other existing software tools to model material behavior from the atomistic level to the continuum level. Additional activities include the development of research plans, and coordination and cooperation with other researchers and project managers.

SOW SECTION 6.0 Associated Facilities

- Electric Arc Shock Tube (EAST)
- Ballistic Range Complex
- Arc Jet Complex
- Sensor & TPS Advanced Research (STAR) Lab
- Materials Development Lab
- Materials Characterization Lab

Electric Arc Shock Tube (EAST)

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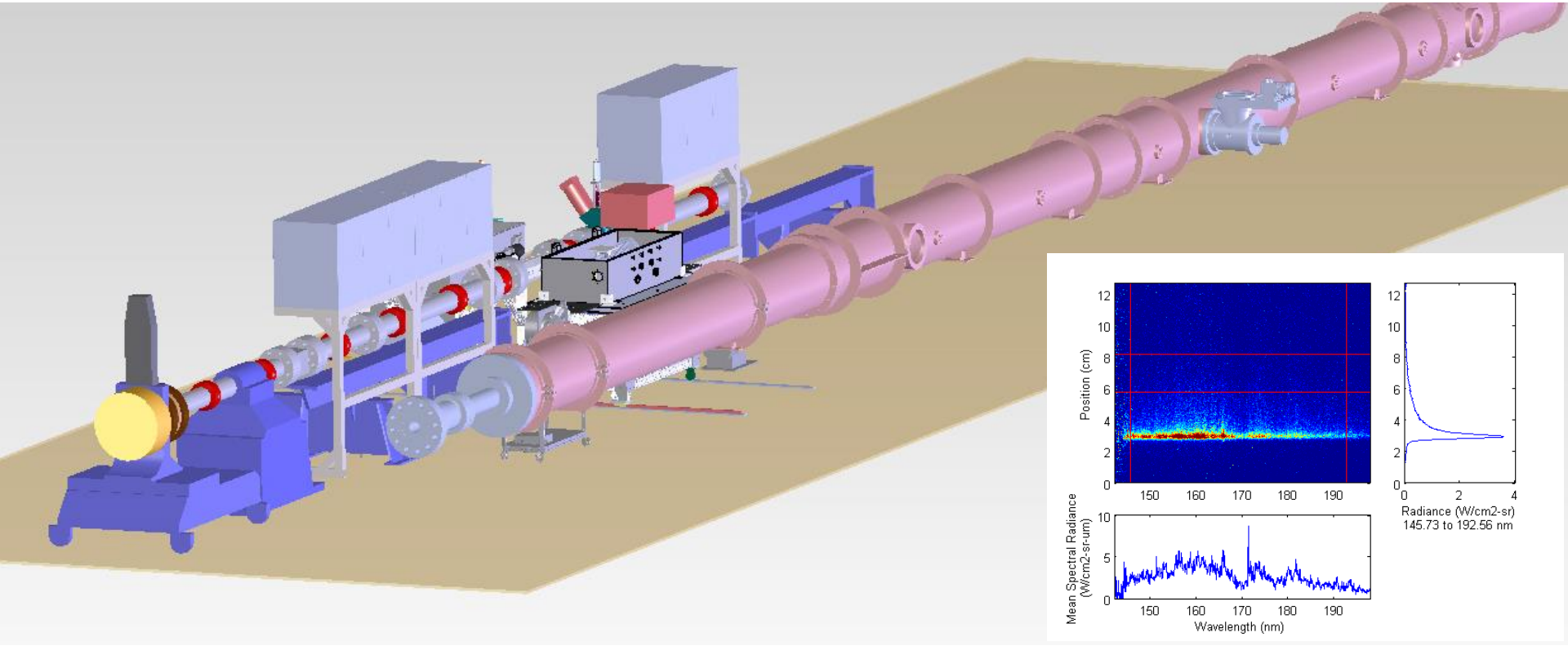
Facility characteristics:

- Versatile shock tube used to generate shock-heated gas conditions experienced by planetary entry vehicles
- Simulates entry velocities (shock speeds), pressures, and gas compositions for entry into Earth and other planetary atmospheres
- 1.2 MJ electric arc driver
- 4” diameter Aluminum Driven tube
- 24” diameter Stainless Steel Tube under refurbishment

Capabilities and instrumentation

- Shock speeds from 3 km/s to 46 km/s
- Shock radiation, kinetics, and ionization studies
- Four spectrographs for simultaneous, spatially resolved measurements of absolute spectral radiance from the near infrared through the vacuum ultraviolet
- High-resolution shock speed measurement instrumentation



NASA Ames Free Flight Ballistic Range

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Free-Flight simulation of entry aerodynamics and aerothermodynamics

Models vehicles, launched from a gun, fly ballistic trajectories through quiescent test gas. Test gas composition and pressure selectable to simulate flight through various planetary atmospheres. Aerodynamic stability determined without wake interference of model support.

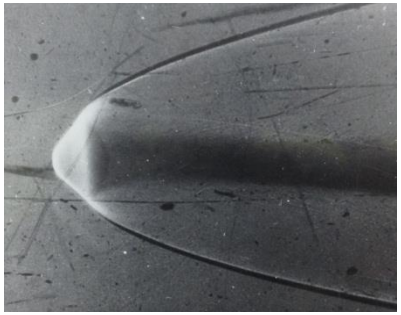
Performance Envelope:

Velocity:	0.2 km/s to 8.5 km/s
Static Pressure:	$4x10^{-5}$ to 1 bar
Test gas:	Air, N_2, CO_2, He/H_2, Ar, etc.
Reynolds number:	$0.03x10^6$/m to $500x10^6$/m
Max model diameter:	0.038 m (hypersonic speeds)
	0.06 m (speeds < 2 km/s)

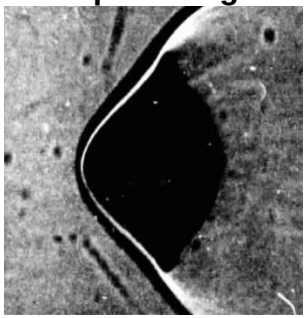
Galileo Probe Free Flight Testing

Shape change of carbon-phenolic models measured in high-radiative-heating environments
(1 MW/cm^2 achieved by flight through Xenon)

Shock Radiation

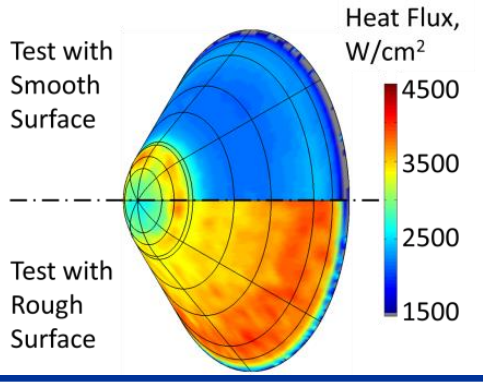


Shape Change



Heat Flux Augmentation due to Roughness

Effects of surface roughness on convective heating to probe geometries measured at various conditions and test gases



Materials Laboratories

- **TPS Materials Development Laboratory**
  - Development of new ablative materials
    - Woven substrate materials
    - Light-weight ablators
    - Flexible/conformal ablators
  - Investigation material chemistry, such as new infiltration polymers
  - High temperature material processing (UHTCs)
- **Materials Characterization Laboratory**
  - Characterization of chemical, mechanical, thermal, and microstructural properties
  - Measurement of ablation performance, such as decomposition rates, char yield, etc.
  - Processing of materials for test and characterization

Sensors & TPS Advanced Research (STAR) Lab

Ames Research Center

- Development and fabrication of reusable TPS materials
- Design and manufacturing TPS instrumentation for flight and ground test
- Design, instrumentation, and assembly of arc jet test models and model holders
- Coatings and surface treatment development and application
- 3D printing and CT scanning capabilities
- Machining of TPS components using CNC mills
- Thermal vacuum and shake table testing capabilities (coming online)

High Temperature Furnaces

CNC Mill