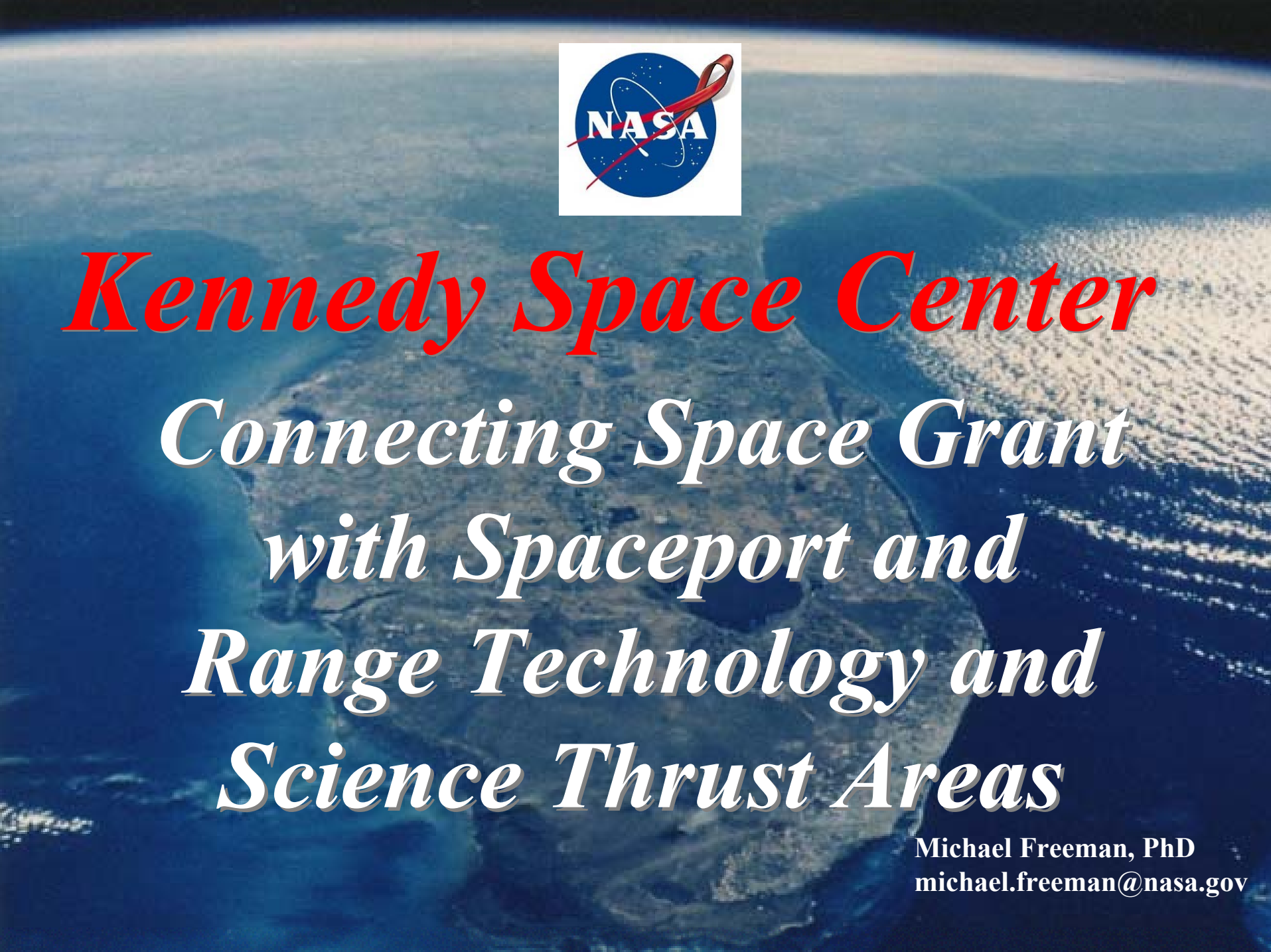

Kennedy Space Center

Connecting Space Grant with Spaceport and Range Technology and Science Thrust Areas

Michael Freeman, PhD
michael.freeman@nasa.gov

Kennedy Space Center

Future

Mission
- Space Launch Operations
- Spaceport and Range Technologies

Center of Excellence
- Launch & Payload Processing Systems

Guiding Principles
- Safety & Health First
- Build Reliance & Teamwork Everywhere
- Satisfy Our Customers Needs Anytime, Anywhere
- Environmental Leadership

Today

Opportunities to Connect with KSC Research

Faculty Programs

- NASA Faculty Fellowship Program (NFFP)
- **EPSCoR**
- Faculty Awards for Research (FAR - HBCUs and OMUs)
- Resident Research Associateship Program (NRC Post-Doc)
- **Space Grant Research Awards**
- SBIR/STTR
- **Sabbaticals**

Student Programs

- Graduate Student Researcher Program (GSRP)
- Harriet Jenkins Fellowship Program (HBCUs and OMUs)
- **Space Grant Fellowships and Internships**
- Undergraduate Student Research Program (USRP)
- Spaceflight and Life Sciences Training Program (SLSTP)

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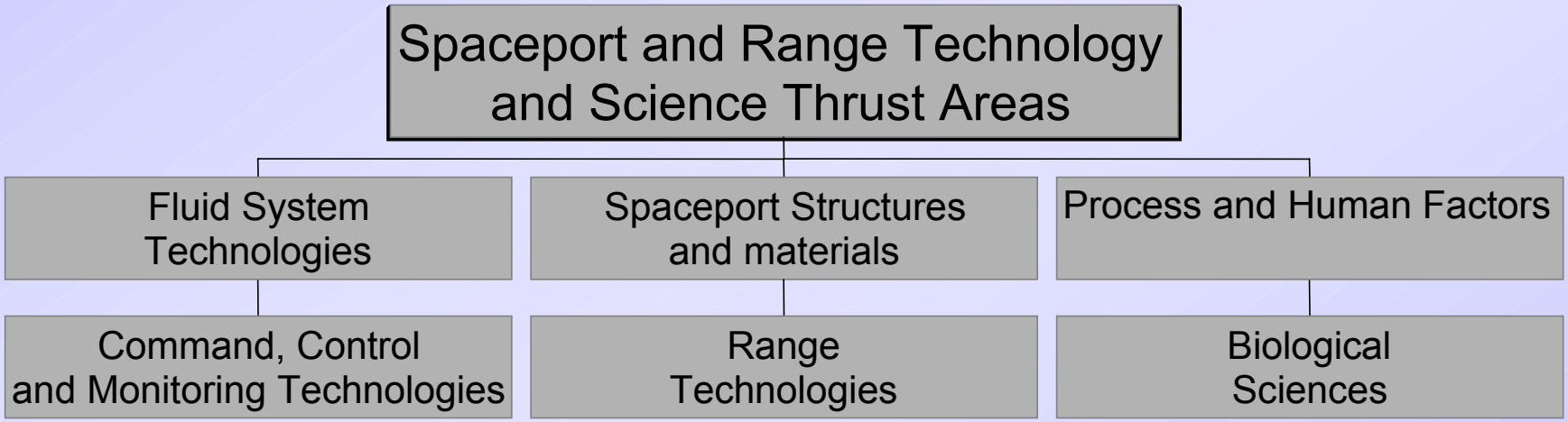


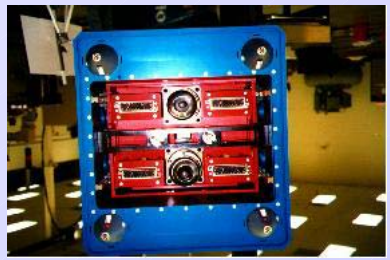
Fluid System Technologies

Current Activities

Cryogenic Storage, Distribution, and Servicing Systems

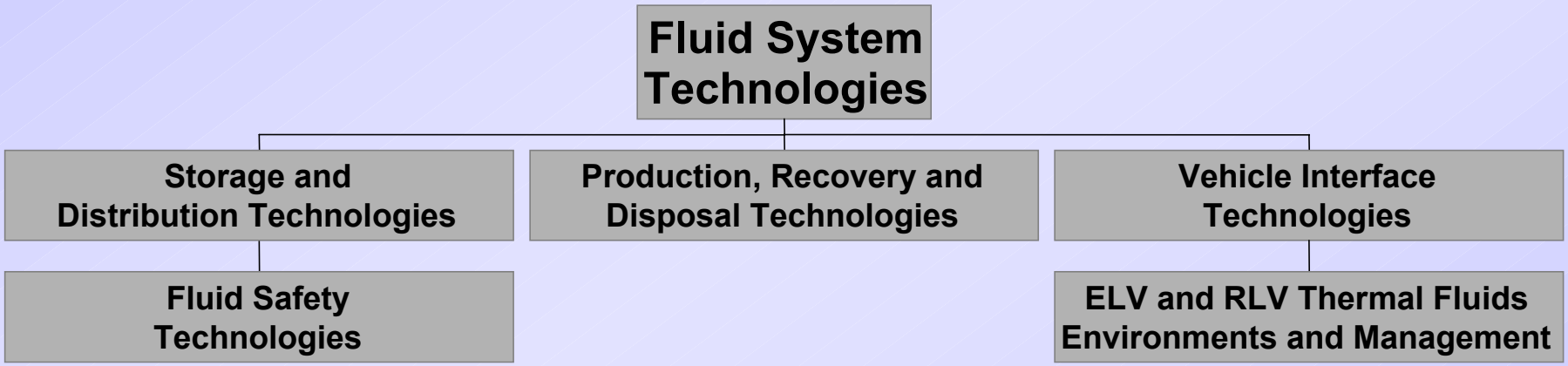
Cryogenic Technology Testbed

Umbilical Systems Test Stand



Smart/Automated Umbilical Development

Kennedy Space Center



Development areas include:

- Reduce thermal losses associated with cryogenic fuels
- Minimize maintenance and process monitoring costs
- Provide for safe operation of the spaceport
- Create efficient, adaptable technologies for the changing fluid needs of future spacecrafts

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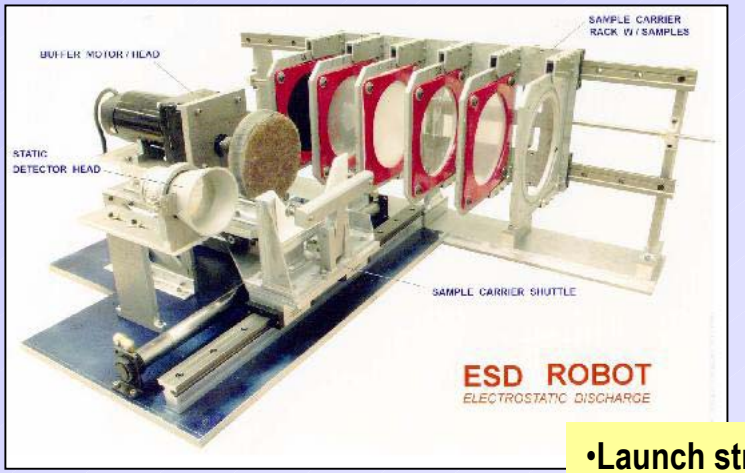
Fluid System Technologies High Priority Needs

1. **Advanced cryogenic** loading technologies, including systems that combine advances in component health management, automated process control, instrumentation and resource conservation (20d)
2. Payload **thermal and fluid** environment **modeling and prediction** capabilities (25d)
3. Extended propellant storage capabilities (30a)
4. Advanced, highly reliable, designed for safety, automated umbilical systems for all ground system to flight vehicle interfaces, including payload interfaces (smart umbilicals) (32b)
5. Improved GN_2 pipeline **gas filtration** capabilities. **Non-intrusive** helium flow rate/quantity **measurements**. Purge gas processes that reduce/eliminate the use of helium (38)

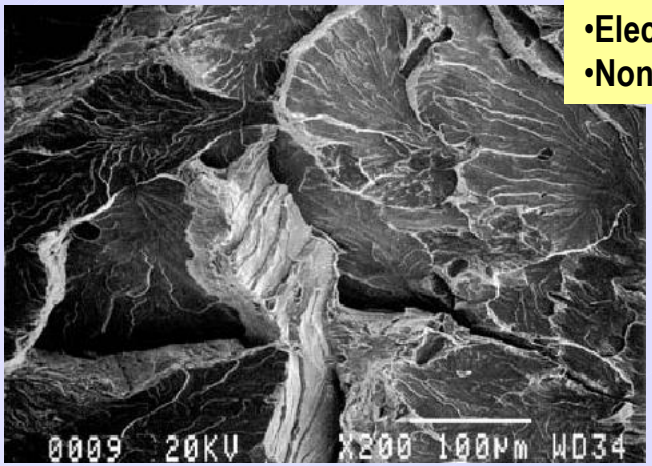
Contact: Bill.Notardonato@nasa.gov

Spaceport Structures and Materials

Current Activities



- Launch structures and Mechanisms
- Materials Science and Technology
- Corrosion Science and Technology
- Electromagnetic Physics
- Nondestructive Evaluation Technology



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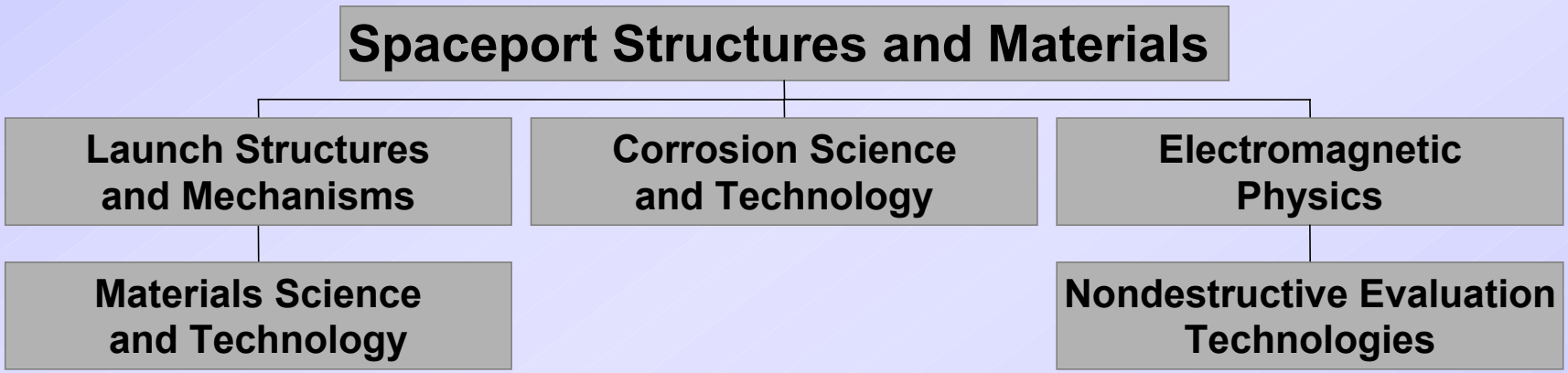

New materials development is critical to achieving:

- Reduced costs
- Increased reliability
- Higher flight rates

Technology development areas include:

- Corrosion abatement
- Static charge dissipation
- Non-destructive evaluation (NDE)
- Non-flammability

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Spaceport Structures and Materials High Priority Needs

1. Improved **wire inspection technologies** and **self-healing wire insulation**. New methods and technologies to detect potential wiring problems. (4)
2. Tools and techniques for **defect detection in composite materials**. Non-abrasive methods to determine structural integrity of bonded assemblies, especially non-metallic composites. (6a)
3. Clean, non-abrasive surface preparation and contamination reduction techniques. Technologies for maintaining clean systems. Tools and techniques to remove dust from surfaces of sensitive equipment used in clean rooms, payloads, solar panels, etc. (8b)
4. Technologies for low-cost, simple, reliable **contamination detection** for spacecraft (vehicle and payload) processing (13b)
5. Technologies to **detect water in** current and future **thermal protection systems**, including tile, blankets and composite materials (16b)

Contact: melanie.r.chan@nasa.gov

….more

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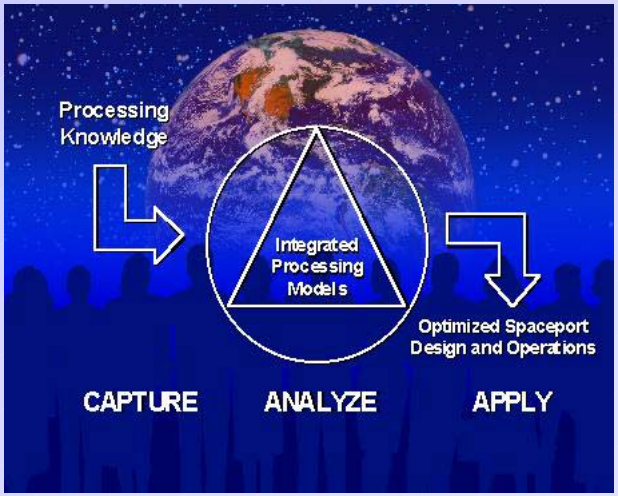
Spaceport Structures and Materials High Priority Needs

6. **Smart**, non-corrosive, self-healing, and/or robust **structures** (16d)
7. Technologies and systems enabling payload **acoustics** environment **predictions and reductions** (25c)
8. Advanced, reusable, highly reliable, designed for safety, non-pyrotechnic vehicle/propellant system interface and separation systems (30b)
9. Improved spacecraft transportation and handling technologies and systems. Mechanical assembly of spacecraft elements to support rapid response and high flight rates (34a)
10. Technologies to **monitor** the **electrostatic charge buildup** on surfaces. Technologies to accurately evaluate electrostatic charge decay properties of materials. Tools/techniques to determine the size, charge and concentration of electrostatically-charged dust contaminants. (34c)

Contact: melanie.r.chan@nasa.gov

Process and Human Factors Engineering

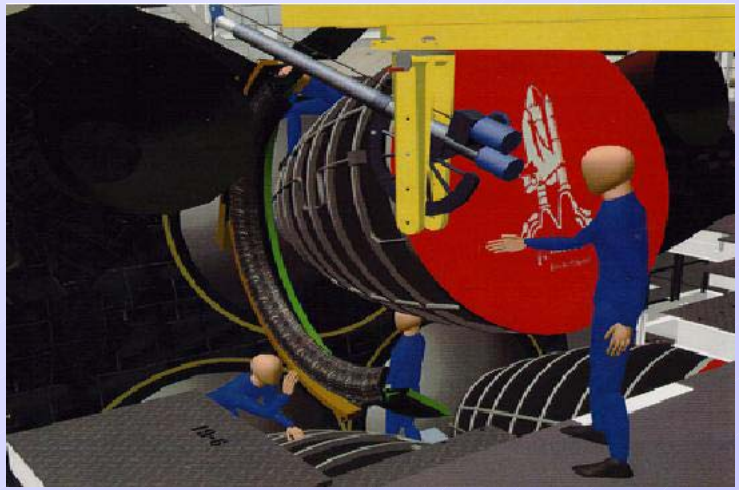
Current Activities



Process Simulation Modeling: Spaceport Systems Processing Model

Advanced Training and Procedure Systems: Body Wearable Computers

Work Methods and Measurement: Advanced Work Instruction Systems



Human Factors Engineering: Orbiter Dome Heat Shield Task Analysis

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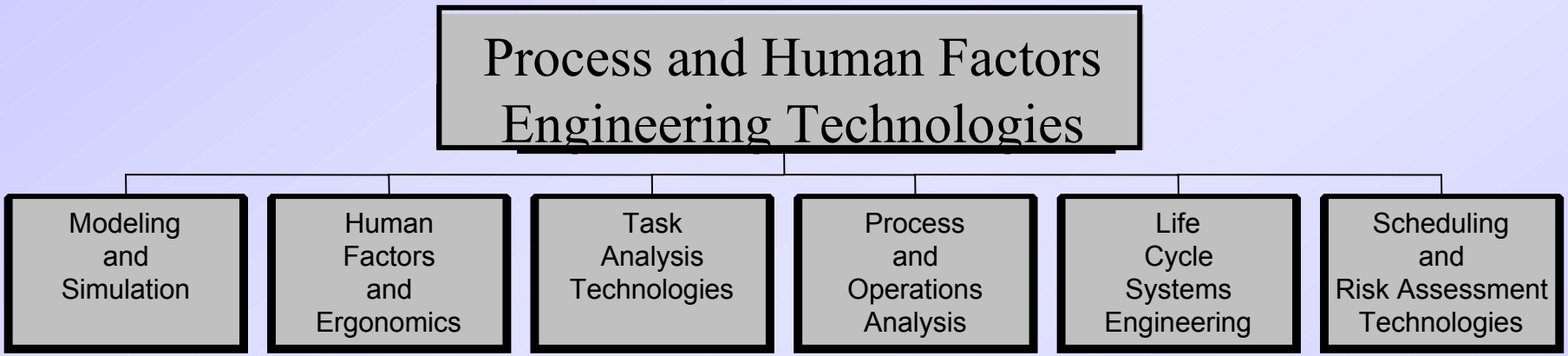

Research on:

- Process efficiency
- Overall system performance
- Risk assessment and life cycle engineering

Also focuses on human aspects of process engineering including:

- Ergonomics
- Human factors
- Human error analysis
- Human reliability analysis

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Process and Human Factors Engineering Technologies High Priority Needs

1. Technologies/capabilities to **improve** or automate **planning, scheduling and asset allocation** functions for spaceports and ranges. Resource (people, hardware, equipment, facilities, etc.) management and allocation. Schedule optimization techniques. (2b)
2. Spaceport/range operations management technologies for test, maintenance and verification tasks. **Advanced human factors and process analysis technologies**. **Intelligent work instruction** systems with automated task duration, resource and hazard data collection. (6b)
3. Technologies and tools for **modeling spacecraft (vehicle and payload) and spaceport flows, tasks, and processes**. Cost-effective technologies for **simulating and streamlining processes** to improve safety performance, life cycle cost performance, and responsiveness. Models of launch and landing scenarios. (8a)
4. Technologies/capabilities to automatically record the entrance and exit of all components within critical areas. **Electronic identification** for area access, equipment checkout/control and personnel identification. (13a)

more…

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Process and Human Factors Engineering Technologies High Priority Needs

5. Technologies for streamlined processes and **automated systems to recognize, measure, record and perform statistical process analysis** on dings/chips in nozzles and thermal insulation damaged during manufacturing, processing and/or flight (16c)

6. **Process improvements to** thermal protection system (**TPS**) waterproofing and densification processes that reduce hazard levels to personnel (specific near-term need). Automate spaceport TPS processes and support development of new TPSs that do not require waterproofing or densification (general longer-term need). (20a)

7. **Character recognition inspection systems** for vehicle and ground system inspections (using technologies such as automation, robotics, expert systems and neural networks) (25b)

more…..

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Process and Human Factors Engineering Technologies High Priority Needs

8. Predictive technologies to **model human factors and the effects of potential human errors** on spaceport and range operations. Technologies supporting human error analysis for investigating the combinations of factors contributing to degradation of worker abilities to perform tasks successfully. Technologies for analysis and quantification of human reliability in spaceport and range operations. Advanced methods to quantify human error probabilities in novel tasks and new situations with no previous experience base. (37)

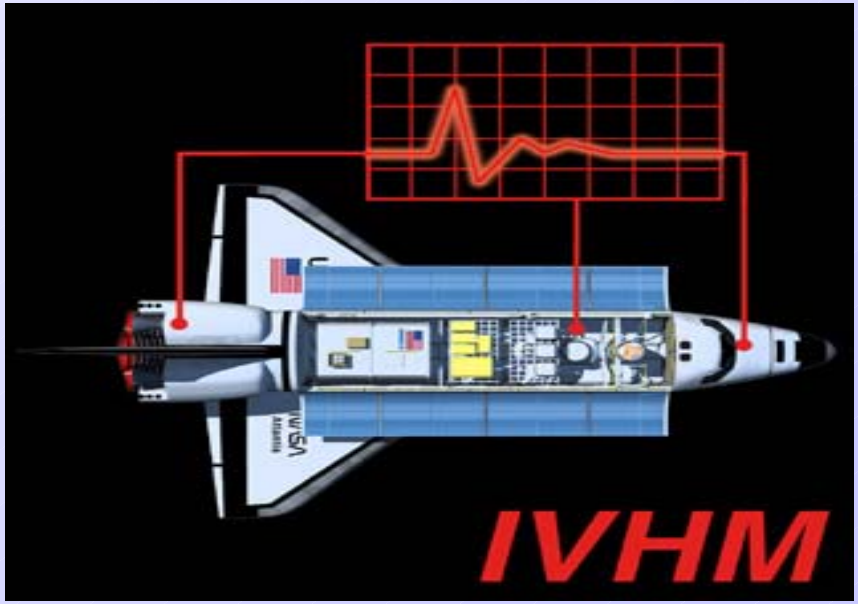
Contact: Martin.J.Steele@nasa.gov

Command, Control & Monitoring Technologies

Current Activities

Checkout and Launch Control System

Informed Maintenance:
Integrated Vehicle Health Monitoring



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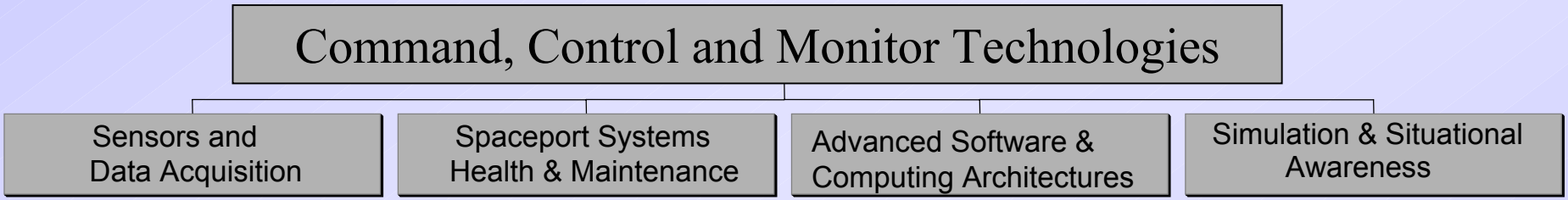

- Develop technology that enables future affordable, responsive and safe spaceports
- Reduce the cost of access to space while increasing safety
- Reduce and eliminate unique interface and infrastructure requirements
- Support robust, fault tolerant designs in both software and hardware systems

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Command, Control and Monitor High Priority Needs

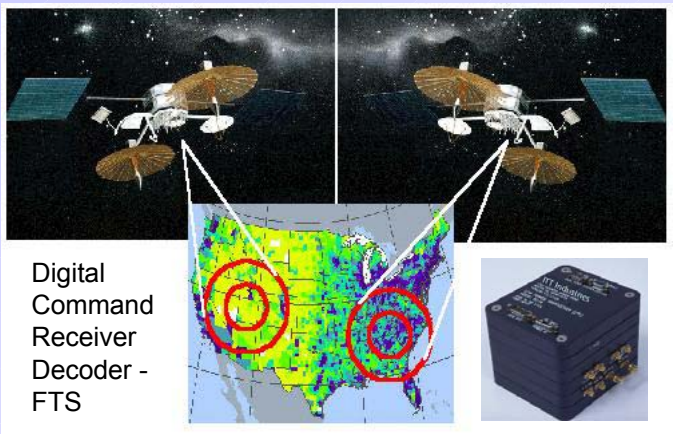
1. Better (remote, wireless) **leak detection of hazardous gases** (1)
2. Integrated Vehicle Health Maintenance (**IVHM**) (2a)
3. **Non-invasive Flight Readiness Verification** (5)
4. Analytical Tools for mission analysis (8d)
5. **Advanced Communications** Technology (13c)
6. High Data Rate Communication (16a)
7. Common Ground Infrastructure for multiple vehicles (20c)
8. **Auto-verification of** loaded **software** (24)
9. Remote and Distributed testing (25a)
10. **Advanced measurement technology** (**non-intrusive**, better representation of environment) (25e)
11. **Wireless avionics networks** (34b)

Contact: Bob.Waterman@nasa.gov

Range Technologies

Current Activities

Space Based Range

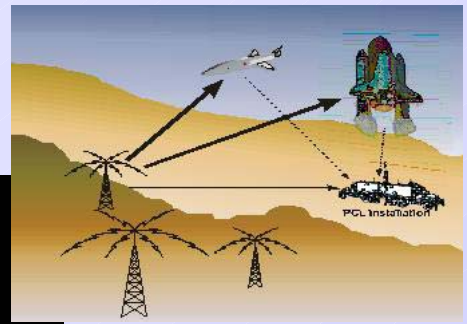


Digital Command Receiver Decoder - FTS

Low Power TDRSS Transceiver

Spaceport (Ground Based) Range Systems

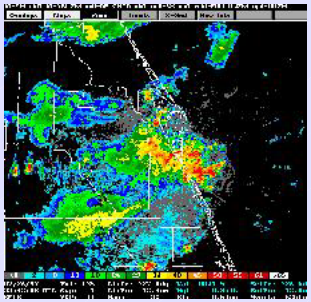
Passive Coherent Location



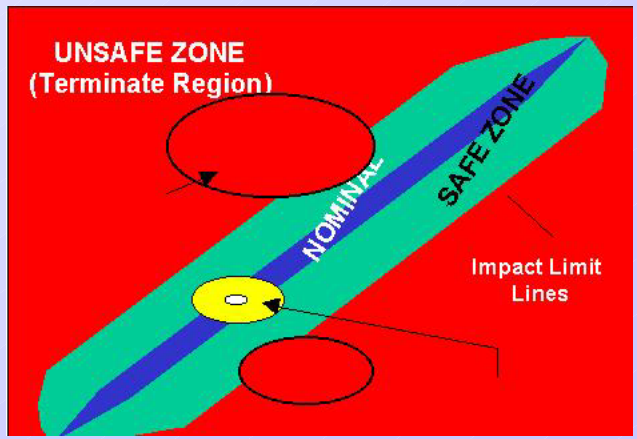
Autonomous Flight Safety

Range Information Systems Management

Decision Models and Simulation

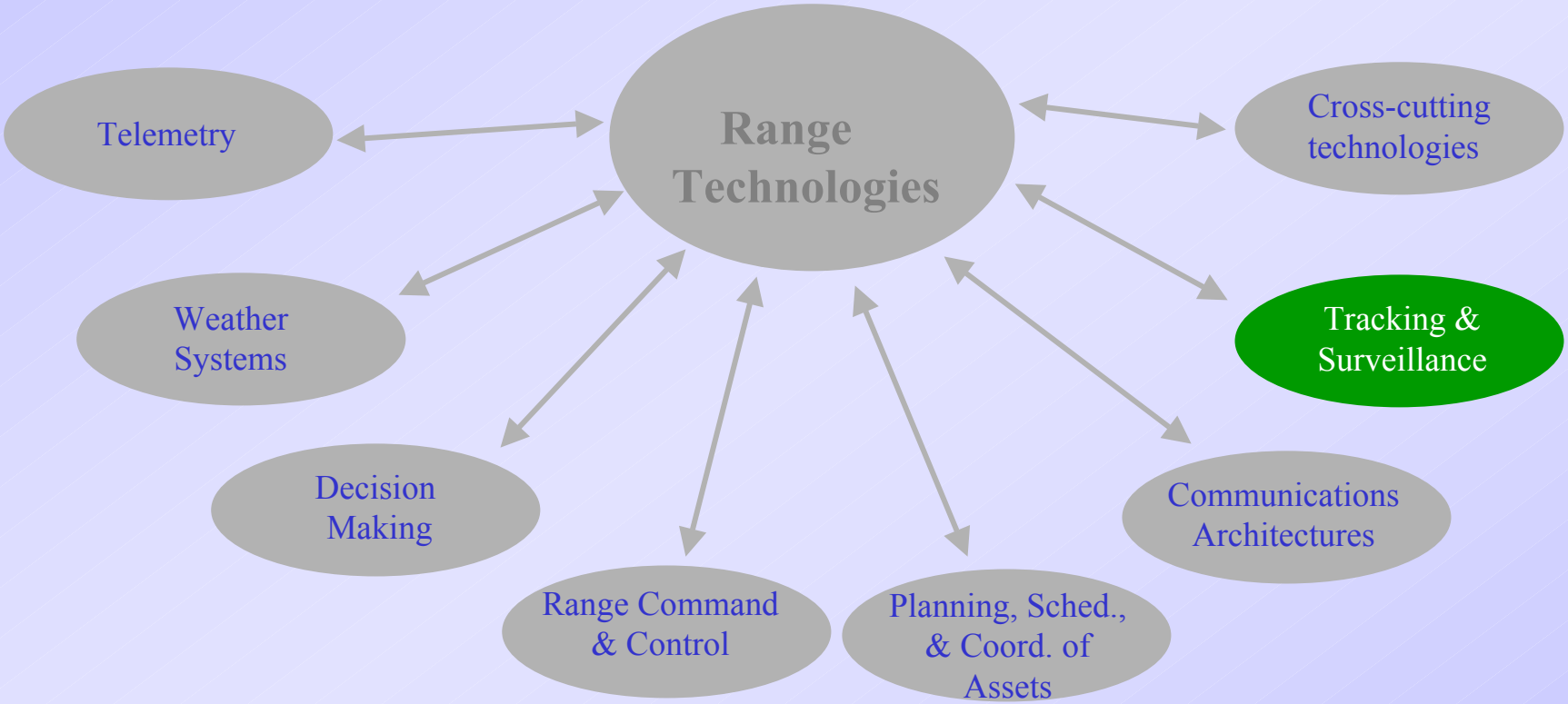


Weather Instrumentation and Systems



Development of unique technologies to:

- Provide control
- Supply measurement data
- Ensure safety of launch and test operations



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Range Technologies High Priority Needs

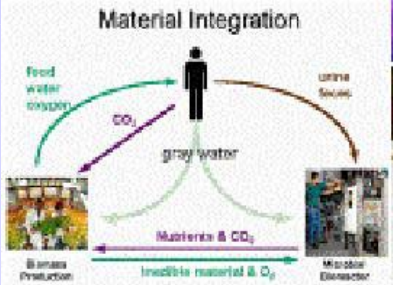
1. Technologies/capabilities for **automated mission data feedback** (including vehicle performance data, and weather and atmospheric information (8c)
2. **Localized weather forecasting** capabilities supporting pre-launch, launch, landing and range operations. Mesoscale comprehensive weather/hazard assessment models (12)
3. TDRSS compatible transceiver that can be used on existing and future launch vehicles to receive flight termination commands transmitted through space-based assets (digital command receiver decoder) (20b)
4. Reentry landing systems and **airspace management techniques**, including the desired tracking and monitoring systems (32a)

Contact: Richard.A.Nelson@nasa.gov

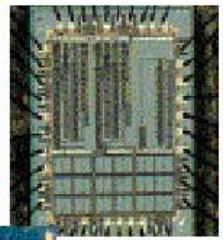
Biological Sciences

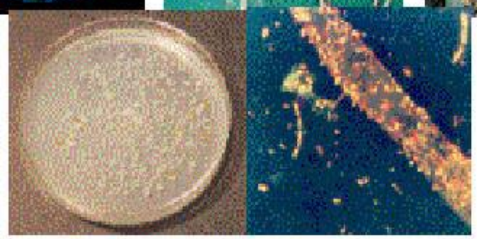
Current Activities

Bioregenerative Life Support System

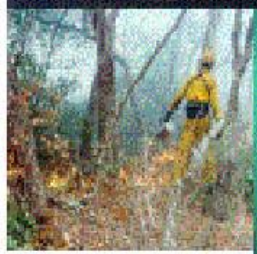


Fundamental Biology





Ecological Monitoring



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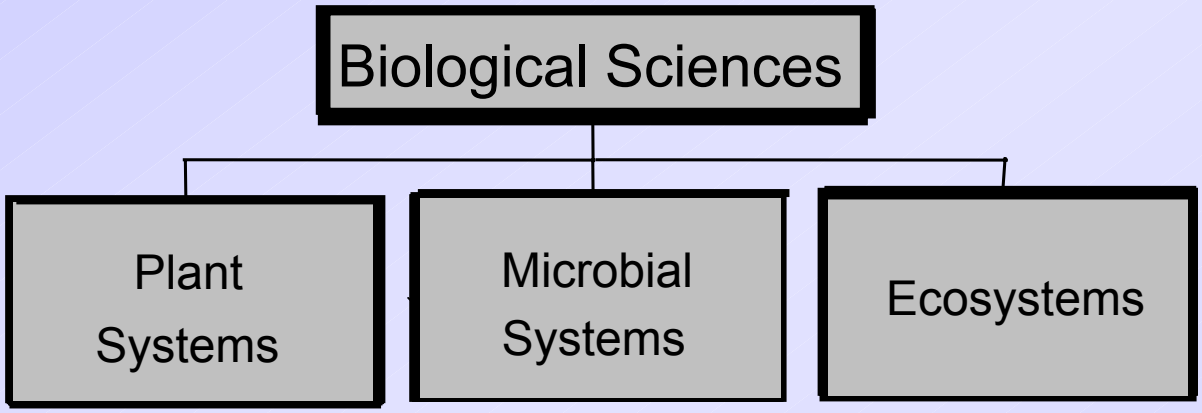


Goals

- Develop fully integrated, regenerative systems that provide air, water, food and resource recovery from wastes
- Obtain fundamental knowledge of the evolution and development of terrestrial organisms and ecological systems in altered environments
- Obtain fundamental knowledge of the genomic and structural development of microbial communities in closed systems
- Gain scientific understanding and develop technologies to support sound management and conservation of our Spaceport Technology Center's ecological resources

Demographic Challenges

- The U.S. home grown student pipeline is shrinking
  - Industry demand for S&E skills is increasing
  - Minority representation is only one-third of the representation in the U.S. population at large
- Current NASA S&E Workforce
  - Average age is 46
  - Average retirement age is 61
  - 50% have obtained a Master's degree or Ph.D.
  - 59% are in positions at GS-14 and higher
  - 37% are classified as Aerospace Engineers
  - 25% will be eligible to retire by September 2008

Targeted Competencies

- Identified “At-Risk” based on information from NASA’s competency management system

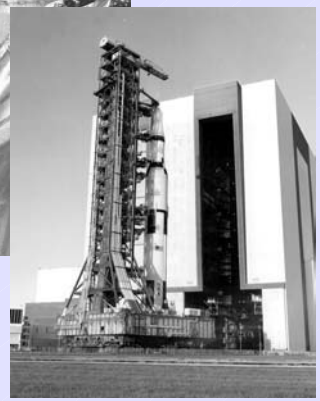
Systems Engineering
Test Engineering
Mission Assurance
Human Factors
Nuclear Engineering

Integration Engineering
Design & Development Engineering
Quality Engineering & Assurance
Business Management
Mission Execution

To Apply:

http://www.nasajobs.nasa.gov

KSC's Reputation

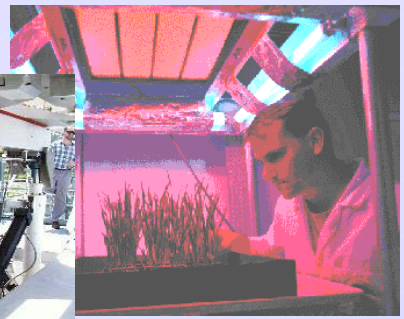


We:

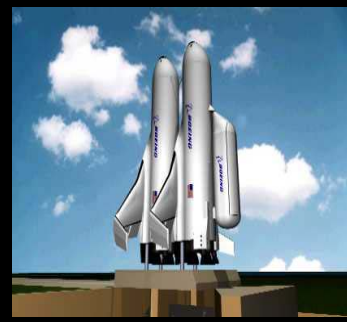
"Make it Work"

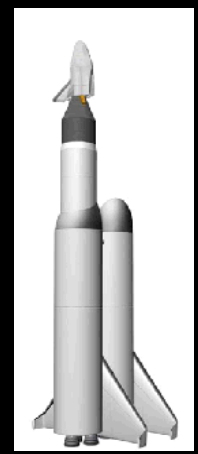
"Prepare for the Next Generation…"

"Pursue Innovative Business Partnerships"



Spaceport of the future





RLV Concepts

The United States

The Earth

Advanced Spaceport and Range Technologies will benefit current and future spaceports on the Earth, moon, Mars, and beyond

The Solar System

And the Universe