Federal Aviation Administration
Office of Commercial Space Transportation
Commercial Space Transportation Advisory Committee
(COMSTAC)
November 5, 2021

Safety Working Group - Tasker Response and Discussion

Task: Review and provide comments on the Progress of Human Spaceflight Industry Voluntary Consensus Standards.

The Safety Working Group (SWG), in cooperation with human spaceflight operators on the COMSTAC and American Society for Testing and Materials International (ASTM) F-47, reviewed the guidance documents on the FAA website and provided a detailed mark up in MS Documents.

The documents were made available to the SWG and human spaceflight operators for comment and subsequently forwarded to the full COMSTAC. The documents will be made available to the public.

- In September 2020, COMSTAC submitted a report on the state of Human Spaceflight (HSF) industry voluntary consensus standards. The report concluded that:
  - While industry-led standards efforts have yielded progress, the pace has been insufficient to inform development of an HSF regulatory environment
  - FAA leadership is needed to facilitate rapid progress on an HSF safety framework
  - Published voluntary spaceflight safety standards are in minimal use by US commercial industry, but several should be investigated by the FAA as potential input to future regulations and/or guidance
- Per §50905 (c)(5), FAA is required to provide Congress a report by March 2022 identifying appropriate activities for establishing and implementing an HSF Safety Framework. In support of that effort, COMSTAC provides this update on the progress of HSF industry voluntary consensus standards since the September 2020 report.

Observations

- Since September 2020, the Human Space Flight (HSF) industry has gained significant experience
  - Three operators have conducted licensed HSF launches
  - Three missions have flown with commercial Spaceflight Participants
- Several standards organizations have been involved in furthering commercial spaceflight standards
  - American National Standards Institute (ANSI)
    - Held a December 2020 meeting on Standardization and the Commercial Industry, focusing on Space Situational Awareness, Space Traffic Management, and Orbital Debris Mitigation

    - No HSF specific topics were discussed, though the areas above indirectly contribute to human spaceflight safety
- International Organization for Standardization (ISO)
    - Though updates were made to orbital debris mitigation and launch system standards, the Space Systems and Operations Directorate (TC 20/SC 14) did not introduce nor update any HSF standards
    - While the American Institute of Aeronautics and Astronautics (AIAA)—lead US organization for ISO space standards development—includes participation by some commercial space companies, the HSF industry in general has not been significantly engaged in ISO activities
    - ASTM International Committee on Commercial Spaceflight (F47) made considerable progress on HSF standards/best practices development, including publication of one new standard, balloting of three, and initiation of seven more.
    - Figure 1. Shows updates since the September 2020 report.
    - International Association for the Advancement of Spaceflight Safety (IAASS) published a report, "Proposal for a Modern Industry-Government Partnership to Advance Commercial Spaceflight Safety" in August 2020, advocating for a Space Safety Institute to establish and manage an independent commercial human spaceflight certification program.
    - US contributions to IAASS have been primarily from government stakeholders, with little commercial industry participation.

Figure 1. ASTM F47 Space Flight Standards

Number	Title	HSF	Status
F3344-19	Standard Guide for Storage, Use, and Handling of Liquid Rocket Propellants		Published
F3377-19	Standard Terminology Relating to Commercial Spaceflight		Published
WK61254	Spacecraft Vehicle Types		In ballot
F3479-20	Failure Tolerance for Occupant Safety of Suborbital Vehicles	Yes	Published
WK70011	Crew Safety (orbital only)	Yes	In work
WK64814	Training and Qualification of Safety Critical Space Operations Personnel	Yes	In ballot
F3514-21	Standard Guidance for Space Data Exchange to Support Integration of Space Operations into Air Traffic Management		Published
WK65152	Classifying Safety Related Events	Yes	In ballot
AC402	Common Standard format for Launch site requirements		In work
WK70413	Space Data Exchange to Support Integration of Space Operations into Air Traffic Management		In work
WK76057	Medical Qualifications for Suborbital Vehicle Passengers	Yes	In ballot
TBD	Medical Human Orbital Flight Less than 30 Days	Yes	In work
WK73835	Guide for Spaceflight Occupant Safety and Emergency Training	Yes	In work
WK76298	Verification of Software and Systems for Commercial Space Flight Vehicles	Yes	In work
WK74019	Qualification for Safety-Critical Systems in Space Flight	Yes	In work
WK77620	Design of Suborbital Space Vehicles	Yes	In work
WK77622	Design of Orbital Space Vehicles	Yes	In work
WK74125	Crew Rest in Commercial Space Flight	Yes	In work

Findings

Multiple industry groups have been involved in furthering commercial space standards over the last year, though only ASTM International has actively advanced the development of HSF standards.

- While HSF standards development has accelerated, a great deal of progress is still needed to enable self-regulation
  - The speed of standards development is challenged by:
    - The rapid pace and expanding workload of lean commercial HSF companies placing competing demand on resources needed to support standards development
    - The need to communicate and negotiate consensus across a large and diverse group of stakeholders—not only commercial space operators, but also aviation veterans, academics, and aspiring HSF companies

- Even with a maturing collection of HSF standards, rulemaking will be a necessary element of establishing a safety framework upon expiration of the industry learning period

Recommendations

- FAA continues to support ASTM F47 in development of HSF industry voluntary consensus standards.
- FAA accepts Safety Working group comments and recommendations on the HSF guidance documents and consider them in the context of a future safety framework.
- FAA coordinates with ASTM F47 (and other standards bodies as applicable) on plans for future guidance documents:
  - This would help focus industry standards development efforts to accelerate progress and avoid potential duplication with FAA activities.
- In support of future rulemaking efforts, FAA utilize the proposed Space Rulemaking Committee to inform HSF guidance document needs assessment and prioritization.

Regulatory Working Group - Tasker Response and Discussion

Task 1: Part 440 Revisions in Progress

Request COMSTAC review and recommend improvements and changes to Part 440. Specifically, provide recommended language on thresholds used to determine MPL, the cost of a casualty, and what alternatives to insurance would industry recommend for operators.

- Draft paper on MPL thresholds and cost of casualty developed
- Sub-taskers require additional input
- **Propose completion for Spring 2022 – Due date moved to Spring 2022**

Task 2: Representation of Future ARCs

Propose what industries, organizations, and/or individuals should be represented on potential future Aerospace Rulemaking Committees in the following areas:

- Human Space Flight Regulatory Reform
- Launch and Reentry Financial Responsibility (Insurance) Reform

- **Observation:** ARC's will be critically important to the future discussion of HSF regulatory reform as well as insurance reform.

- **Finding:** The COMSTAC has discussed and reviewed appropriate representation on these future ARC's.

- Discussion
  - Intended to be a starting point as other organizations/companies may need to be added.
  - Included in the list are launch/reentry companies, spaceports, insurance types, and other relevant organizations.

- Specific individuals within organizations/companies should be identified later, closer to the creation of the ARC's.
- Some individuals will be critical to this discussion, such as individuals with particular space insurance specialization.
- Move to vote on the initial list of representation with the opportunity to provide additional recommendations later as the process moves forward.

- **Recommendation:** The following charts lay out the discussion thus far regarding representation on future HSF regulatory reform and insurance reform ARC's. The Regulatory Working Group seeks COMSTAC's approval of the initial list of recommended organizations and companies with the opportunity for COMSTAC to provide further recommendations as this process moves forward.

Task 2: ARC Representation

Organization	Human Spaceflight	Financial Responsibility (Insurance)
AIA	√	√
AXA AL	N/A	√
Axiom	√	N/A
Blue Origin	√	√
Boeing	√	√
CSF	√	√
Lockheed Martin	√	√
Northrup	√	√
Redwire	N/A	√
Relativity	N/A	√
Rocket Lab	N/A	√
SAS	√	**N/A**
Sierra Space	√	√
Space Florida	N/A	√
SpaceX	√	√
ULA	√	√
Virgin Galactic	√	√
Virgin Orbit	N/A	√
Astra	N/A	√
Spaceport America	N/A	√
Virginia Space	N/A	√
Marsh Space Projects	N/A	√

I&I Working Group - Tasker Response and Discussion

Task #1

1. Propose in detail, a spaceport grant funding mechanism.
2. Review past and current infrastructure grant funding mechanisms.
3. Propose improvements and best practices that will work for the spaceport industry.

Observations

- Spaceport development is not playing out in a vacuum
- U.S. space (and space launch) superiority is in danger of eroding due to increased attention and investment by our strategic competitors in their own space launch capabilities
- Strategic competitors are increasingly capable of competing directly with U.S. launch industry
- Now is the time to consider and implement new U.S. investments at FAA-licensed spaceports
- Now is the time to ensure the U.S. lead in the space domain – ahead of any potential future conflict

Findings

- The I&I WG agrees that a spaceport grant program is warranted to support the national launch infrastructure as supported by the ecosystem of U.S. spaceports
- Per feedback from this group and the public, the I&I WG is clear in its position that spaceports should not access the Airports Improvement Program (AIP) funding mechanism
- A "Spaceport Improvement Program" mirror of AIP would likely not have the desired impact for many years, or at least until spaceport users were paying enough into the program to provide for meaningful payouts for improvements and sustainment at spaceports -- that amount of inflow is likely still many years out

Recommendations

- DoT should implement a spaceport grant mechanism for the 21st century – such a program would include the following elements:
    1. Provisions for modest grant awards in the $1-$10 million range for capital improvements and sustaining costs associated with space launch/reentry infrastructure necessary for access or utilities (e.g. roads, water, power, etc.) at U.S., FAA-regulated launch and reentry sites
    2. Incentives for cost-sharing from state or local government (or from private company investments) by providing additional federal matching funds (up to a limit) -- defers to DoT on the correct match in line with other DoT programs -- most DoT grants programs are an 80/20 split (i.e. 80% federal match on a 20% investment)
    3. Inclusion of an award component based on activity level at the grantee's site
        – A tiered approach and/or recognition of operational sites vs. less mature sites in their development, contributions to the national launch infrastructure, and non-federal funding contributions

    - Support of government launch should provide a framework to ensure grant money is used productively
    - Recommend grant qualification include signed launch and/or reentry contracts, (commercial or government)
4. A minimum of $50 million provided in the first year with topline growth thereafter as appropriate to allow for meaningful awards to be made to grantees
    - This number is justified based on the costs associated with building and sustaining space launch infrastructure
    - I&I WG notes that building out such infrastructure with an eye towards use by multiple users can add significant additional cost to each shared item, particularly launch pads and their associated subsystems (e.g. utilities, commodities, etc.) – multi-use pads are not recommended at this time
    - Funding for these grants shall not be derived from user fees, and no spaceport should charge a separate fee for use of infrastructure funded via these grants (This does not however preclude spaceports from charging fees for other purposes)

- DoT should implement the spaceport grant program (and run it through FAA) due to its vast experience administering similar programs across other transportation modalities

- DoT should implement best practices from the other large grant programs it runs for similar forms of costly infrastructure, such as interstate highway programs, airport and seaport improvement programs, excluding funding derived via user fees

- By utilizing the systems and methodologies from other transportation domains, a spaceport grant program could be set up quickly and experience relatively minor growing pains.

- Administering such a program at DOT would have the additional benefit of contributing to the normalization of space transportation simply as another form of transportation

Task #2 - R&D

Examine how a fully electronic license application submission system might work for FAA/AST. Recommend best practices and industry preferences.

Observations

- I&I WG solicited input from existing COMSTAC members as well as the participation of the Commercial Spaceflight Federation and Global Spaceport Alliance through their respective membership communities

- COMSTAC received a briefing from the FCC on their continuing efforts to improve an existing electronic application system utilized in licensing of the electromagnetic spectrum to government and commercial users

- AST has already initiated much of the initial requirements development for the proposed License Electronic Application Portal (LEAP)

Findings

- Properly developed, the new AST application portal will reduce the likelihood of human error and miscommunication between the applicant and regulators

- Clear and defined metrics and milestones to measure and determine accountability for both industry and government

- Development of "custom software" is discouraged as its use tends to prove difficult to readily update and adapt to evolving technologies and requirements

- Where possible, utilization of existing commercial software packages capable of meeting AST licensing needs is encouraged

- Improved security requirements related to classified payloads, proprietary/intellectual property, and ITAR implications in an ever more international marketplace

- A secure web server system (as opposed to use of existing email channels) will enhance operational security for AST, industry, and its customers

- A point of compliance which may be deemed "complete enough" sufficient to progress to the next step in the licensing process is recognized as a desired goal

Recommendation

- AST should continue to aggressively pursue an efficient and transparent electronic licensing process with industry input
  - Focus should be on initial "small victories" with an understanding the process will be iterative over time to achieve optimal performance
  - Specific individuals should be hired or dedicated to this task
  - An aspirational goal for this effort is ultimately a system more akin to FAA flight plans, where it can credibly be referred to as "file and fly"

Task #3

Familiarize yourself with the evolving challenges at CCSFS and VAFB by reading the applicable reference documents (including the NSDC white paper). Document concerns, if any, on the information and assumptions in the reference documents.

1. Compose a broad list of commercial space transportation industry stakeholders that should be included in a discussion involving governance changes resulting from a new National Spaceport Strategy to address these challenges. Maintaining up-to-date infrastructure and efficient operations at these sites is essential to protecting public safety and is in line with FAA's primary public safety mandate. As a result, FAA plans to facilitate a stakeholder as well as an inter-agency discussion to identify issues surrounding the potential transfer of oversight of some logistical and administrative functions at CCSFS and VAFB from DoD to a non-DoD entity. From a commercial

perspective: who are the right stakeholders to identify the issues that will need to be considered and resolved in any change to the status quo?

3. Broadly define categories of spaceport facilities and services currently provided by DoD to commercial operators at CCSFS, and VAFB. For example, commodities provision, command transmitters, badging, etc.

4. Compile a list of general challenges governance changes at these sites may pose for the broader commercial space transportation industry, as well as for U.S. national security.

5. Consult with COMSTAC stakeholders and collect their feedback on how any governance changes at these sites may positively or negatively affect their operations. Include launch/reentry providers, payload operators, spaceports, industry associations, and any other stakeholder COMSTAC thinks may have an equity in such a concept.

Background

- The charter of the FAA and specifically the Office of Commercial Space Transportation directs AST IAW 51 U.S. Code Section 50901, (b) Purposes., paragraph 3 and 4 to:
  - (3) to provide that the Secretary of Transportation is to oversee and coordinate the conduct of commercial launch and reentry operations, issue permits and commercial licenses and transfer commercial licenses authorizing those operations, and protect the public health and safety, safety of property, and national security and foreign policy interests of the United States; and
  - (4) to facilitate the strengthening and expansion of the United States space transportation infrastructure, including the enhancement of United States launch sites and launch-site support facilities, and development of reentry sites, with Government, State, and private sector involvement, to support the full range of United States space-related activities.

- Further, 51 USC section 51501 established the office of spaceports under AST:
  - This office shall, support licensing activities for operations of launch and reentry sites, develop policies that promote infrastructure improvement at spaceports, provide technical assistance and guidance to spaceport, promote US spaceport within the Department, strengthen the Nations' competitiveness in commercial space transportation infrastructure, and increase resilience of the federal government and commercials customers.

- 2020 National Defense Authorization Act (NDAA) describes FAA involvement with DoD on range infrastructure:
  - SEC. 1609. PROGRAM TO ENHANCE AND IMPROVE LAUNCH SUPPORT AND INFRASTRUCTURE.
    - (a) IN GENERAL.—In support of the policy described in section 2273(a) of title 10, United States Code, the Secretary of Defense, in coordination with the Administrator of the Federal Aviation Administration, may carry out a program to enhance infrastructure and improve support activities for the processing and launch of Department of Defense small-class and medium-class payloads.

- (b) PROGRAM.—The program under subsection (a) shall include improvements to operations at launch ranges and Federal Aviation Administration-licensed spaceports that are consistent with, and necessary to permit, the use of such launch ranges and spaceports by the Department.

- While DoD continues to meet its national security space launch mission through capabilities at Cape Canaveral Space Force Station (CCSFS) and Vandenberg Space Force Base (VSFB), the DoD is limited in its ability to improve infrastructure and streamline operations to meet the growing commercial demand at these locations
  - The DoD recognizes the importance of maintaining and enhancing space launch infrastructure at the eastern and western federal ranges
  - Infrastructure is needed to support national security space, civil space, and commercial space missions
  - Launch cadence is increasing, particularly at the eastern range

- DoD is tasked by statute to provide excess capacity at these locations for commercial launch activities, which are licensed by FAA/AST
- When this decision was made years ago DoD operated the majority of launches from these sites, with commercial industry operating relatively few -- those roles have reversed and today commercial industry operates the majority of launches from CCSFS and VSFB
- Furthermore, DoD as a consumer of commercial launch is willing to address its role as a launch site operator
  - DoD envisions contracting for launch and insertion of spacecraft into orbit by a commercial vendor while not maintaining the launch site infrastructure that they only use occasionally
  - DoD postulates that this is in the best interest of national security and that their appropriated funds for infrastructure can be used more appropriately for strictly military operations

- DoD identified one possible means of achieving this mission transformation in the form of a new "National Spaceport Development Corporation" (NSDC) governance model for CCSFS and VSFB

Discussion

- COMSTAC engaged several subject matter experts (SMEs):
  - Gen Jay Raymond – Chief of Space Operations (CSO), U.S. Space Force (USSF)
  - Maj Gen Deanna Burt – Vice Commander, Space Operations Command, USSF
  - Brig Gen Stephen Purdy – Commander, Space Launch Delta 45, USSF
  - Robert Cabana – Former Director, NASA Kennedy Space Center
  - Janet Petro – Director, NASA Kennedy Space Center
  - Mr. Richard Lamb – Systems Director, The Aerospace Corporation
  - Commercial Spaceflight Federation (CSF) Spaceports Committee
  - Several COMSTAC Members and other companies

- COMSTAC addressed SMEs with several questions
  - For Operators: what are some of your current challenges operating at the E/W Ranges?

- Who would most be effected by a change to the status quo of spaceflight operations?
- What are some issues you see if a transfer of oversight of some logistical and administrative functions at the E/W Ranges from DoD to a non-DoD entity?
- What are some challenges that changes to governance at these sites pose for the broader commercial space transportation industry?

- COMSTAC reviewed relevant documentation:
  - U.S. Space Force Range of the Future 2028 Strategic Intent – February 2020
    - Evolve Eastern and Western range capabilities for multiple users simultaneously
    - Deliver equitable access to resources while improving upon services and infrastructure
    - Transform the Range business model to accommodate industry while preserving capabilities
    - Evolve and integrate ranges into national space transportation and commerce systems
  - National Spaceport Network Development Plan – Global Spaceport Alliance, June 2020
  - A National Spaceport Strategy: A White Paper Prepared for the Chief of Space Operations, United States Space Force; August 2020
    - Lack of funding for infrastructure maintenance, range upgrades and expansion
    - Competition for resources with an increased launch cadence
    - Statutory language limiting the DoD's ability to accept outside funds for infrastructure
  - Launching Forward – KSC Multi-Use Spaceport – Bob Cabana, KSC

Overarching Observations and Challenges

- Launch is critical to the U.S. and a diversity of options is needed
- Complex issues, multiple stakeholders affecting governance and economics
- Pace of launch picking up so collaboration and urgency is needed
- Current approach doesn't address the larger issue of a lack of a National Spaceport Strategy
- No one solution to our national space launch enterprise is ready to proceed forward at this time
- Absent agreements and solutions, range deterioration increases risks, decreases competitiveness, and creates potential issues with safety

- **Financials/costs**
  - Intent appears for range upgrades to be paid by commercial launch providers (at least in part) via an indirect cost structure
    - Indirect cost increases could cause prices to go up significantly, impacting competitiveness
    - Without equitable and appropriate cost-sharing, changes could prove unfair to some providers -- frequent users may be dis-incentivized if they have to pick up a majority of the cost to the benefit of competitors

        - Providers trying to optimize the "government service vs. do-it-yourself" trades for range services could opt out if they are forced to pay more for services, thus making a smaller pool of funding
        - Launch providers have choices: if the government ranges are not efficient and inexpensive, they could go elsewhere, build their own facilities, develop less expensive ranges, etc.
    - The "by the drink" model of service procurement works well so long as prices are kept under control
    - Federal funds should be used to support federal infrastructure
    - Requirement for use of DoD personnel for simple tasks is expensive and unnecessary e.g. setting up roadblocks; gets expensive when the launch provider has to pay the government to set up

- **Shared infrastructure**
    - Proposed multi-user pads and infrastructure not currently compatible with most commercial launch solutions
        - Different engines, propellant types, support structures, hold downs, etc. are very specific to a rocket's design
        - Meeting a "rocket plug and play" design on a shared use pad would likely suboptimize that system unless the operator is already using a "clean pad, slab of concrete" design
        - High launch cadence and risks imposed by multiple users make a shared use pad is not practical impractical
    - Relationship between DoD, KSC and Space Florida is confusing and difficult -- companies at times don't know with whom they are negotiating

- **Other spaceports**
    - Concern regarding potential unfair competition to commercial spaceports, especially inland spaceports, if federal ranges are upgraded with federal funds absent a commercial spaceport grant program

- **Legislation**
    - The law could be changed to allow the government to fund infrastructure that could be used for commercial as well as other purposes

- **Additional challenges**
    - Launch availability
        - While polar launch at the Cape is an enabling, flexible capability, it is difficult from the perspective of seasonal weather patterns and onshore winds which need to be considered
        - Very narrow launch windows exist so as to not violate conservative range safety rules for protection of launch infrastructure
        - A reassessment of those requirements and assumptions is a must to make polar launches practical

Recommended Next Steps

- An activity should be formed to address a strategy for the nation's eastern and western ranges – the members of such an activity should include but not be limited to the following stakeholders:

• Office of SecDef	• Commercial Entities, Including Launch Providers
• U.S. Space Force	• National Aeronautics and Space Administration
• Dept of Commerce	• National Oceanic and Atmospheric Administration
• Dept of Transportation	• FAA Office of Commercial Space Transportation
• Dept of State	• Environmental Protection Agency
• Dept of Interior	• National Reconnaissance Office

- A National Spaceport Strategy should be created to ensure the best outcomes for the collective U.S. national security, civil, and commercial launch enterprise