COE CST First Annual Technical Meeting:

Air Traffic Control

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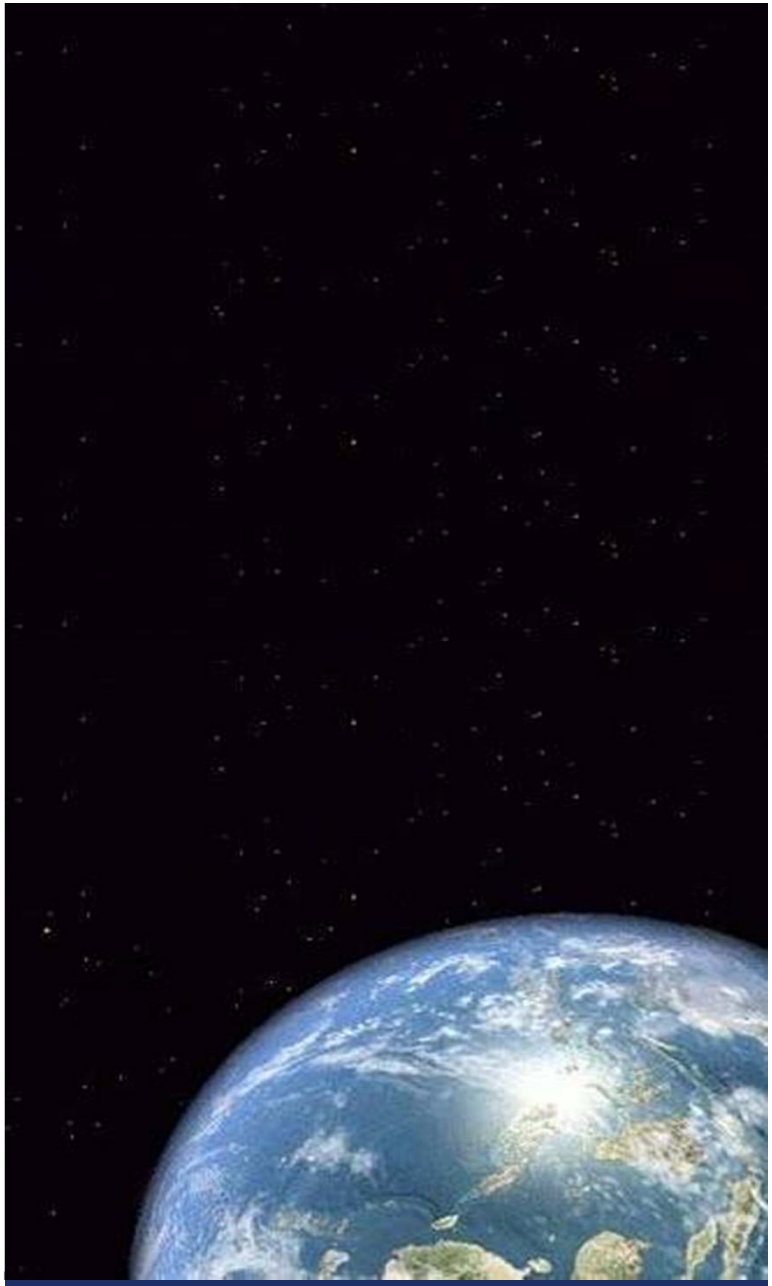

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Overview

- Team Members
- Purpose of Task
- Research Methodology
- Results
- Next Steps
- Contact Information

Team Members

- Dr. Nathaniel E. Villaire, Professor Emeritus
- Ms. Nicole Maillet, Research Assistant
- Dr. John Deaton, Professor
- Dr. Samuel T. Durrance, Professor
- Dr. Daniel Kirk, Associate Professor
- Dr. Tristan J. Fiedler, Associate VP for Research

Purpose of Task

- **Purpose:** Identify pertinent questions which must be answered if ***Commercial Space Vehicle (CSV)*** operations are to be integrated into the ***National Airspace System (NAS)*** using the existing the ***Air Traffic Control (ATC)*** system.
- **Objectives:** Examine the Airspace Related ***Federal Air Regulations (FARs)*** and ATC FAA Orders for Compatibility with CSV Operations.
- **Goals:** Identify Top Level Questions Which Must be Resolved for CSV Integration Into the NAS.

Research Methodology

1. **Identify** the CSV operational parameters affecting the NAS.
2. **Identify** the appropriate controlling FAA Orders & Regulations.
3. **Assist** the FAA and CSV operators by identifying specific questions affecting NAS/CSV integration.
4. **Develop** top level questions which must be resolved to effect NAS integration.
5. **Increase** the depth of information required for routine CSV operations in the NAS.

Research Methodology

Analyze Applicable FAA Orders and FARs for Questions in the Following Order:

- PREFLIGHT
- TAKEOFF
- DEPARTURE
- EXITING & ENTERING THE AIRSPACE
- ARRIVAL
- LANDING

Examples of Results

Preflight

Information Required by ATC for Flight in the NAS

- **VFR Flight Planning**
  - Twenty Nine (29) Areas Identified Needing Clarification
- **IFR Flight Planning**
  - Fourteen (14) Areas Needing Clarification Identified
- **General Information Required by ATC to Safely Clear CSVs into the NAS**
  - Fifteen Areas (15) Needing Clarification Identified
    - Example: "What will be required on the Minimum Equipment List for CSVs"?
      - Multiple Areas Needing Clarification Identified

Examples of Results

Takeoff

- **IAW FAR 91.143 – No aircraft may operate in areas specified by NOTAM for Space Flight Operations except when authorized by ATC.**

  - Question: What will the specific procedures be for issuing Space Flight NOTAMs?
  - Question: What airspace parameters will designated for the multiple types of CSVs?
  - Question: What will be the CSV category? (New Category of aircraft?)
  - Question: Can CSV operations be conducted under revisions to FAR 91 Subpart D (Special Flight Operations) or will a new Subpart be required?

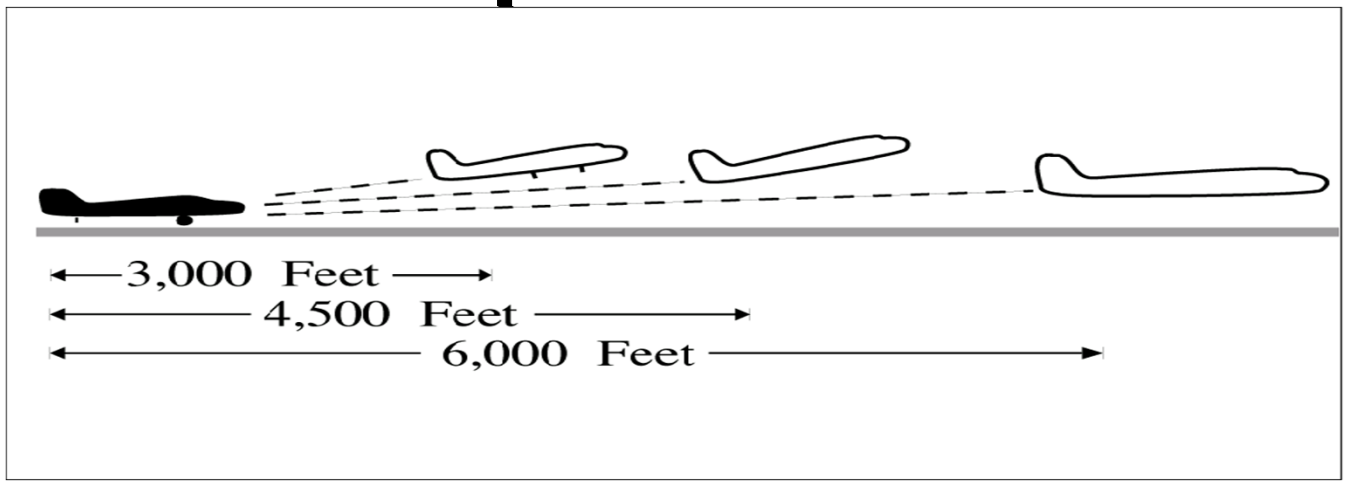
Examples of Results

Takeoff (Continued)

IAW FAA Order 7110.65T – All takeoff clearances are subject to specific separation standards between similar and dissimilar categories of aircraft.

- **Therefore, Integration of CSVs into the NAS will require ATC to provide separation service.**
  - **Under 3-9-1 ATC must provide specific information for separation.**
    - Question: What kind of weather, runway and atmospheric restrictions will be required?
    - Question: Will CSVs have a newly defined priority or will they be subject to the current ***"First come, first served"*** system?
      - ***(For example: Will CSVs be subject to Line Up and Wait separation procedures?)***

Example of Results



- ***NOTE-***
  Aircraft same runway separation (SRS) categories are specified in Appendices A, B, and C and based upon the following definitions:

  CATEGORY I- small aircraft weighing 12,500 lbs. or less, with a single propeller driven engine, and all helicopters.

  CATEGORY II- small aircraft weighing 12,500 lbs. or less, with propeller driven twin-engines.

  CATEGORY III- all other aircraft.

  - Question: Will CSVs fall under the ***"CATEGORY III – all other aircraft"*** group or will their characteristics be distinct enough to warrant different classification?

Example of Results

Departure

– *WAKE TURBULENCE*

IAW 7110.65T

- **Here is an example of the type of procedures and controls ATC must provide for aircraft operating in the NAS:**
  - Do not issue clearances which imply or indicate approval of rolling takeoffs by heavy jet aircraft except as provided in para 3-1-4, etc.
    - ***REFERENCE**-AC 90-23, Aircraft Wake Turbulence.*
  - Questions: Will a similar exception be included for spacecraft? What aerodynamic/operating parameters of CSVs will define separation requirements?
- ***NOTE- There are hundreds of similar questions which must be answered regarding takeoff, climb and standard instrument departures (SIDs) before CSVs can be integrated into the NAS.***

Examples of Results

Transiting the NAS to Space

IAW AIM-Chapter 1 Specific NAVAIDS are used to transit the NAS.

Participating aircraft can use a vast array of NAVAIDS ranging from basic NDBs to GPS and NextGen Equipment.

- (See Historical Review for a discussion of NAVAIDS, RADAR and current ATC mission statement.)
  - Question: What NAVAIDS will be required by ATC for integration of CSVs into the NAS?
  - Question: Some models of CSVs are currently unable to react to ADS-B systems. Will CSVs have a separate set of ATC directives to effect separation when conflict with other participating users occur?
  - Question: What SIDs will have to be developed through TERPS for the various types of CSVs ?
  - Question: How will emergency ABORTs of CSVs affect the safety of other participating users of the NAS?
  - Question: Should high speed, high altitude climb corridors dedicated to CSV operations be developed?
  - Question: How will ATCT handle the transfer of control to the ARTCC?
    - This will involve extensive study of current and proposed LOAs between controlling entities.
    - This may involve developing new procedures specifically designed for CSVs.
    - Specific procedures limited to CSV operations may generate jurisdictional and "customer" conflicts.

Examples of Results

Transiting the NAS to Space

IAW AIM Chapter 3, Section 2, Controlled Airspace is Defined

- **Current airspace classifications include Classes A, B, C, D, E and Special Use.**
  - Question: Since CSVs will be climbing well above FL600 where normal airspace control is terminated, will the CSVs require a new class of airspace above FL600?
    - Question: If a new class of airspace is implemented, what NAVAIDS will be used to define and navigate the airspace?
    - Question: What are the details required by ATC for LOA s between impacted ARTCCs?
    - Question: What special equipment will the CSVs require to assure positive vehicle separation from all other users of the airspace in transition areas?
- **Special Use Airspace**
  - **Each category of Special Use Airspace has specific control parameters and user procedures.**
    - Question: What will be the operational restrictions of a new category of airspace?
    - Question: Which agency(s) will have jurisdiction over a new category of airspace? (FAA, NASA, DOD, Other?)

Examples of Results

Transiting the NAS from Space

SEPARATION STANDARDS

- IAW AIM 4-4-11 ATC effects separation of aircraft vertically and longitudinally.
  - Question: What will be the separation parameters for the separation of CSVs from the various categories of aircraft using the NAS?
  - Question: What kind of adjustments can be used to effect separation of CSVs from other traffic during the reentry phase of flight? (Speed, turns, altitudes, holding, etc.?)

IAW AIM 4-4-16 & 18 Participating aircraft are expected to use TCAS and ASD-B to assist in separation.

- Question: Will the CSVs be equipped with usable TCAS and ASD-B systems which the CSVs can use in assisting ATC in separation of aircraft during reentry?
- Question: If TCAS and ASD-B is used, what special programming of the CSVs' equipment is required?

Examples of Results

Arrival

IAW AIM chapter 5, section 4: Arrival Procedures

- **5-4-1. Specifies Standard Terminal Arrival (STAR), Area Navigation (RNAV) STAR, and Flight Management System Procedures (FMSP) for Arrivals.**
  - Question: Will standard instrument approach procedures (STAR) be developed for CSVs to facilitate transition between en route and instrument approach procedures.

- **5-4-3. Details Approach Control** - Approach control is responsible for controlling all instrument flight operating within its area of responsibility.
  - Question: Will Approach Control be able to sequence CSVs in conventional traffic patterns?

- **5-4-8. Special Instrument Approach Procedures** - Instrument Approach Procedure (IAP) charts reflect the criteria associated with the U.S. Standard for Terminal Instrument [Approach] Procedures (TERPs) development.
  - Question: Will CSVs use Special Instrument Approach Procedures (IAPs)?
  - Question: Will CSVs use conventional NAVAIDS or require specialized equipment for dedicated IAPs?
  - Question: How will CSVs be controlled during air traffic emergencies involving civil, military and commercial aviation vehicles?

Examples of Results

Landing

- IAW 7110.65T Landing clearances are governed by a variety of runway separation rules, meteorology conditions and vehicle performance capabilities. Controllers have many tools to assist them in making safe landing decisions. Numerous questions regarding landing the highly specialized CSVs must be addressed before integrating CSVs into the NAS.
  - Question: Can CSVs be sequenced in a standard arrival pattern?
  - Question: Can CSVs be maneuvered to alternate runways or landing pads if conflicts occur?

- **3-10-6. Defines the concept of "ANTICIPATING SEPARATION".** Landing clearance to succeeding aircraft in a landing sequence need not be withheld if you (ATC) observe the positions of the aircraft and determine that prescribed runway separation will exist when the aircraft crosses the landing threshold.
  - Question: Can controllers "anticipate separation" with CSVs during normal traffic operations?

- Wake Turbulence and Separation is a concern for landing. Wake turbulence was discussed in the Takeoff section of this presentation, and similar questions arise when identifying pertinent questions that musty be answered if CSVs are to be integrated into the NAS

Next Steps

- **Divide the applicable FARs into smaller groupings for fine analysis of their effects on CSV operations.**

- **Divide the applicable FAA Orders on ATC and Airspace into smaller groupings for fine analysis of their requirements in controlling CSV operations.**

- **Begin construction of a guide for FAA which will help the organization address the problems presented by integration of CSVs into the NAS.**

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