

Convergence of Space Tourist Processing and Suborbital Payload Processing in Spaceport Facility Design.

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Introduction: New spaceports to service the commercial spaceflight industry are in development with either new construction, refurbishment of existing facilities, or at the proposal stage for various locations around the globe. Functional requirements for design concepts for these facilities have mostly been centered on servicing the needs of the space tourist experience and processing the spacecraft for rapid turnaround. The advent of an expanded market for spacecraft operators offering suborbital payload services places additional unique requirements on facilities for functional design that optimizes operational concepts for processing either the tourist and/or the scientific payload.

Tourist or Payload Specialist Operations: Operational considerations from a facilities point of view vary widely between accommodating the tourist experience including family and friends, and the payload specialist experience overseeing a scientific payload. Spacecraft operators flying each category of passenger either together or as separate dedicated flights should consider the operational impact on their pre and post flight processing operations and implication for facilities design.

For the space tourist, many of the activities and processes within the building will be centered on the astronaut journey that progresses from initial reception through training, food service, launch and celebration. A segregation and hierarchy of users is likely integrated into facility design layout to maintain varying degrees of access and exclusivity. Meanwhile in the hangar area spacecraft flight prep and overhaul activities strive to progress at a sufficient pace to maintain a turnaround schedule for more than one flight per day. A sample of key systems and hardware requiring routine checks and flight prep for flight turnaround may include:

- Installation/change-out of rocket motors
- Fueling
- Change-out/charging of batteries
- Thermal Protection System (TPS) cleaning/ overhaul
- Decal re-application
- Oxygen servicing
- Environmental Control System (ECS) servicing
- Replacement of nose skid shoe
- Seat widgets
- General cleaning & interior/cabin overhaul
- Data download

- Placement of protective covers for vehicle windows and other miscellaneous

By contrast, payload processing for scientific sub-orbital flights adds to the above list with requirements for example, of clean room protective spaces for scientific payloads, additional degree of spacecraft resources and ground support equipment for payload integration into the spacecraft. These impact storage, floor space, work area and functional adjacency requirements, which in turn may influence processing turnaround timelines. Environmental implications may include new accommodations for hazardous waste management. Typical functional maintenance areas competing for floor space allocation include:

- Flight Prep and Overhaul
- Engineering & Maintenance
- Bench Testing/ Backshops
- Tools and Support Equipment
- Storage Operations
- Breathing Oxygen/ Liquid Oxygen
- NDI/ XRAY
- Cables/ Wiring
- Hydraulics
- Washing of Spacecraft
- Rocket Motors

Due to the sophisticated and complex nature of sensitive payloads, it may be necessary to accomplish the final prelaunch payload processing in a specially designed facility located close or adjacent to the main staging area. The requirements and characteristics of specific payloads will vary. Design of Class 10,000 or even Class 100,000 clean room bays, or something as simple as a clean tent area for payload processing are considerations for the facility design. A standardized payload container system may be employed, adding additional facility accommodation and spacecraft integration requirements.

Conclusions: A payload operations concept for science flights may be at odds with the flight profile for a typical tourist flight. The preferred concept of operations for science flights and integration of science passengers with other spaceflight participants (space tourists) may impact ground pre and post flight processes and flight turnaround scheduling. The degree of convergence of these two operational scenarios for space port and spacecraft operators should be considered in spaceport facility design and operations.