**EMPLOYING ONBOARD VIDEO FOR ENHANCING SUBORBITAL RESEARCH.** R. W. Ridenoure, Chief Executive Officer, Ecliptic Enterprises Corporation (Pasadena, CA, and Moffett Field, CA, rridenoure@eclipticenterprises.com).

**Introduction:** For any of the emerging human-rated aerospace systems designed for flight operations in the suborbital regime, selective placement and use of onboard video systems promises to enhance overall situational awareness and flight documentation, and ultimately the effectiveness of suborbital research conducted during such flights.

**Motivation:** Capturing activities and events onboard human-rated aerospace systems has been integral to the civil U.S. human space program since the Mercury launches, first using exclusively conventional film technologies and later film and video. This practice continues to this day on Shuttle and International Space Station.

Video systems first developed in the early and mid-1990s to provide onboard views for various uncrewed U.S. launch systems (Pegasus, Atlas, and Titan IV) were eventually adapted for use on Shuttle External Tank during its (suborbital) ascent phase, with the first launch in late 2002. No further Shuttle launches with this onboard video system were firmly planned as of early 2003, but the *Columbia* orbiter breakup during reentry precipitated a series of decisions at NASA which made such onboard video systems standard equipment for providing enhanced onboard situational awareness on all Shuttle launches, starting with the Return-to-Flight launch in mid-2005.

During the post-*Columbia* Shuttle hiatus, similar onboard video systems captured multiple dramatic views (live and recorded) of the pioneering, privately developed *SpaceShipOne*/*White Knight* suborbital aerospace system as it captured the X-PRIZE (see photo).


The experiences and lessons learned from these two examples and other less visible ones provided most of the impetus for treating onboard video systems not as discretionary capabilities, but required.

**Key Factors to Consider:** Suborbital researchers contemplating the use of onboard video during their flights should consider various key factors, which will be highlighted.

*Provider.* Does the host vehicle come with onboard video capability, or does the researcher have to provide it? Or Both?

*Control.* To what degree does the video system need to be manually controlled by the researcher or host vehicle crew, via commanding by ground-based operators, or via autonomous means? Are there important operational constraints to factor in?

*Sensor Suite.* How many cameras are required, and where should they be placed? What types of sensors, lenses and optical characteristics are needed? Are lights needed? How about supporting engineering data?

*Data Transport.* How many live video feeds are required? How many recorded? Is data compression an issue? Playback? Editing? What's the downlink frequency and allowed bandwidth? What sort of ground-based assets are required to receive the downlink, capture it and display it?

*Architecture.* Does the system support a series of research flights? Can it work on different host platforms? Is it integrated with the researcher's equipment, the host platform or both? How is it tested before the flight? Does it scale (up or down)? Is it modular enough to accommodate technology modifications and advances? Is it easily maintainable?

*Programmatic.* What does the system cost (non-recurring and recurring)? Does it have any flight heritage? How long does it take to acquire and integrate with the host platform? Can intellectual property be protected? Are there any licensing, policy or ITAR issues?

**Near-Term Prospects:** Examples of how onboard video can be employed to enhance suborbital research will be discussed, using likely near-term host platforms and research objectives as "case studies" for consideration. The current state of technology and important trends will also be addressed.