ORBITAL COMMERCE PROJECT, INC.

Adhering to the FAA Guidelines for RLV Flight Crew Training

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Abstract

Developing a training center that uses conventional techniques and equipment would allow companies to effectively and efficiently train RLV flight crews. In February of 2005 the FAA released "Draft Guidelines for Commercial Suborbital Reusable Launch Vehicle Operations with Flight Crew". Section six outlines the suggested requirements for RLV crew training and contains common sense suggestions including that flight crews are trained in all flight and propulsion modes of the vehicle as well as emergency procedures. Through the use of standard flight training techniques such as simulators, multiple types of training aircraft and classroom instruction, flight crews can be thoroughly trained in all aspects of a suborbital flight. Also, a dedicated training center working with vehicle manufacturers could efficiently meet the other requirements listed in part six thereby ensuring that the training devices adequately represent a vehicle configuration/mission as well as keeping the program current and maintaining student records.

In the same way current commercial flight schools benefit students and prospective employers, a "part 141" type school could benefit the commercial human space flight industry. Students could earn certifications in a short amount of time in a focused environment while future employers would be assured that the student was thoroughly schooled in suborbital flight. The cost would be reduced for employers because they would not need to invest in training devices or incur the waste of trying to train students who are not able to handle the suborbital environment. A certified school would also reduce the liability to future employers by eliminating the risk of having a poorly trained crew and also insure that the graduating students have the ability, confidence and knowledge to be professional suborbital flight crew members.

Introduction

New commercial human spaceflight companies face a daunting challenge; they must develop a business and a market where none existed before. This problem is exasperated by the lack of infrastructure, little support and still evolving government regulations all of which is most evident when crew training is examined. The FAA is still developing training regulations, vehicles and training aides that directly apply to suborbital flight do not yet exist and current flight schools are unprepared to support the requirements of spaceflight. This leaves the individual manufacturers and space companies to bear the burden of developing and implementing training, which will be costly, time consuming and increase liability.

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Current air crews have the option of being trained at a "part 61" or "part 141" school. "Part 61" and "Part 141" refers to the section of the Code of Federal Regulations (CFR) under which the school trains. The basics of the different parts are as follows:

Part 61

- Outlines certificate and rating requirements pertaining to pilot certifications
- Lists what topics and areas must be covered
- Sets how much flight experience is needed for each certificate and rating
- All flights schools can train under part 61 without FAA approval

Part 141

- Flight schools with FAA certification
- Lists minimum personnel requirements
- Lists aircraft and facility requirements
- Requires a detailed course outline
- Requires documenting each student's progress
- Operates under strict rules
- Must maintain a high student pass ratio
- Certificates and ratings can be completed in fewer hours than under part 61

Essentially a school that operates under part 141 has been certified by the FAA and must meet a higher standard than one operating under part 61.

Overall training costs could be reduced by using different vehicles to teach different flight modes of an RLV as opposed to using the RLV for all training flights. Pictured above is XCOR Aerospace's EZ-Rocket. A more advanced version could be used to train students how to fly rocket powered craft.
Courtesy XCOR Aerospace

A solution to the training problem in the commercial human spaceflight industry would be to create and utilize a part 141 type school devoted to training RLV crews. Such a training center would relieve the burden of training from new space companies by shifting the costs of infrastructure to the school, eliminating the need to divert scarce resources into training and by meeting current and future FAA guidelines. In this way the "spaceflight" school would benefit new space companies just as existing schools assist current commercial carriers.

Spaceflight School

The FAA considers flight crews to be an integral part of the vehicle safety system and the "Draft Guidelines for Commercial Suborbital Reusable Launch Vehicle Operations with Flight Crew" released February 11, 2005 emphasizes this concept. The guidelines were written so that the crew will be able to safely operate the vehicle even under emergency conditions and covers from the environment inside the spacecraft to training for the crew.

Section six of the guidelines is devoted to the training of flight crew. To see how a spaceflight school would be advantageous to future space companies each sub-section needs to be examined and a determination made on how to meet the guideline.

Section analysis

Sub-sections (a) and (b) simply state that a RLV pilot should possess an FAA pilot certificate, with applicable ratings, and that all flight crew need to pass an FAA 2nd-class medical examination. Both of these requirements can be met utilizing existing flight schools, therefore a spaceflight school should make these guidelines requirements for admission.

Sub-section (c) "Each member of an RLV flight crew should be trained to operate the vehicle so that it will not harm the public."

This is the main point of the guidelines because the primary concern of the FAA is not the people who consentingly risk their lives in an experimental vehicle but rather the uninvolved public who may be hurt if something goes wrong. While a crash of a suborbital vehicle with loss of crew and passengers is bad, having it crash into a McDonalds is a disaster. The people in the McDonalds did not agree to the risk associated with flying in an experimental spacecraft and should be protected. Any training program should be designed to emphasize this outlook and a dedicated school may be in a better position to foster this type of attitude in the students than a company that is focused on other business aspects such as tourism.

Sub-section (d) details how the training should be performed, the type of training and reporting requirements

Sub-section (d)(1) "Prior to each mission, the RLV flight crew should receive vehicle and mission-specific training to cover all phases of flight by using one or more of the following: i) a method of simulation (operational and/or procedural), ii) an aircraft with similar characteristics for each phase of the mission where the similarity applies, iii) incremental expansion of the mission envelope, or iv) an equivalent method of training as approved by the FAA through the licensing and permitting process."

The most efficient way to train pilots is through the use of simulation and actual flight time. Simulation reduces the cost of "flight time" and allows students to make mistakes without endangering their lives, while actual flight time allows students to hone their flying skills and to become better acquainted with the craft. No matter what method is chosen infrastructure must be bought or built either in the form of vehicles or training devices or both. Even if the vehicles or devices can be used for other things in the business, for cash strapped start up companies, this could be a major diversion of needed resources. If a spaceflight school is utilized the school would incur these costs allowing the space business to concentrate its resources on their main business objective.

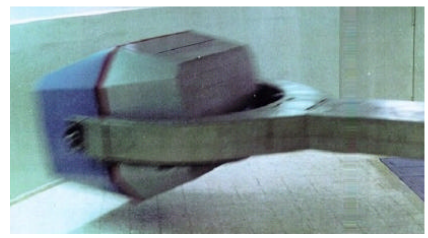
OCP's approach is to have simulators where students can learn basic flight characteristics of the vehicle as well as emergency procedures and three different vehicles to teach each phase of flight (boost, exospheric, landing).

Sub-section (d)(2) “The RLV operator should verify through test, analysis, inspection, or demonstration that any flight crew-training device used to meet the training program requirements realistically represents the vehicle’s configuration and mission.”

This could be extremely time consuming and expensive especially for a company that is not manufacturing the spacecraft. A spaceflight school will need to have close ties with manufacturers, have the necessary talent on staff and be versed in the FAA documentation requirements. RLV operators could simply meet this guideline by showing their flight crews have been through an FAA certified school and course. Also, by making use of a school, the liability for the accuracy of the training devices is transferred from the space company to the school.

Sub-section (d)(3) “RLV flight crew training should include nominal and non-nominal flight conditions. The non-nominal situations should include i) abort scenarios, ii) emergency operations, and iii) procedures that direct the vehicle away from the public in the event of a flight crew egress during flight.”

Non-nominal situations are best taught in simulation so that life and property are not endangered. By using flight simulators a student could learn how the vehicle will handle in an emergency as well as how to overcome the problem, a hypobaric chamber provides a controlled environment for depressurization training and a pool could be used for water egress. The capital costs for these training devices make sense for a training center that will use them on a regular basis but not for a standard space business that will use them once a month to once a year.



Training devices such as centrifuges, hypobaric chambers, ejection simulators and pools can be used to teach students emergency procedures. These type of capital costs are best bourn by a spaceflight school as opposed to a RLV operator engaged in space tourism.

Courtesy ETC

Sub-section (d)(4) “If a vehicle relies on multiple control and/or propulsion modes, the training program should include training in each mode, including the transition between modes, so that the crew is able to retain vehicle control.”

Simulation and actual flight time are the best way to meet this requirement. OCP believes that to do it economically requires three different types of training vehicles for the actual flight time. While a suborbital vehicle could be used for all aspects of the flight training, the operational costs become prohibitive to multiple training flights, which could lead to under trained flight crews. By utilizing multiple craft, a vehicle that has a lower operational cost can be used to teach a specific flight mode allowing the student more flight time. As an example; OCP will use a standard piston powered aircraft for unpowered landing training. The operational cost of this aircraft is relatively low and will allow the student to perfect their landing technique over multiple flights. The next phase of training would use a converted aircraft that is propelled by rocket engines to train the student on the boost phase. While the cost is higher than the piston powered aircraft it is still less than a flight in the spacecraft. Finally the student would fly the RLV but because the techniques had been perfected in other craft, the number of flights needed for proficiency is dramatically reduced.

As stated before, the diverting of the capital needed to develop and build these types of training craft from the core business could be disastrous to a new space company.

Sub-sections (e), (f) and (g) deal with continually updating the training program and the documentation needed to ensure that each crew member has been properly trained. The adherence of these sub-sections becomes significant if there is an accident and the company is defending their position to the FAA and in court. Documents proving that the crew had completed an up to date and certified training course would help the company avoid liability associated with crew actions.

Just as with the other guidelines it will cost RLV operators scarce resources to fully implement the regulations suggested in these sub-sections.

Other Advantages

While a spaceflight school could save a space business capital costs and time, it does have other intangible advantages:

Uniformity – Each student receives the same training allowing prospective employers to be able to better compare abilities form one job applicant to the other. This will reduce wasted time on individuals who are unable to handle the stresses of suborbital flight and insures that companies are able to identify the better qualified candidate.

Faster improvement of training courses – A school will be involved in training on a daily basis; as more students pass through the courses the instructors and administrators will learn through application what works and what doesn't. Just like any other business the school will quickly implement new procedures to take advantage of this knowledge so that it can be more efficient.

Focused training – Students will have less distractions in a spaceflight school where the only activity is training. This will improve retention of lessons and reduce the amount of time needed for training.

Higher quality of education – The school will not be under outside pressures, such as pending flight schedules, to accelerate the course or even pass questionable students. It would also allow students to take extra time at a task if needed.

Conclusion

The commercial human spaceflight industry would benefit from a "part 141" type of spaceflight school. By utilizing a spaceflight school, new businesses would not need to build or purchase training devices lowering their initial capital cost, they would reduce the time to market entry by not having to train flight crew from scratch or waste time on the individuals who are unable to handle suborbital flight and companies would share liability with the school in the event of an accident. Students also benefit by having a more focused training experience, more time in the air and higher quality courses.

About the author
George Tyson is a longtime supporter of the commercial use of space. His first experience with a space program occurred in college where he was part of the cooperative education (co-op) program working with NASA as an engineer in the Solid Rocket Booster (SRB) Operations Department. He worked on the first two shuttle flights (STS-1,STS-2) and it was while working with NASA that he realized that a program that truly utilized space would have to be commercial and not government.

George was a Director within Space Frontier Operations, Inc. (SFO) for over 6 years helping them develop a space commercialization plan. The plan was all-inclusive in that it specified no reliance on government programs, equipment or sites. All vehicles, launch sites and space assets were to be privately owned for commercial purposes. It was during this time that George presented papers at the 38th and 39th Space Congress in Cape Canaveral on privately funded space programs.

In 2002 George resigned his directorship within SFO to pursue other avenues within the private space realm. This included co-authoring a book entitled "Other Worlds: A Guide to Privately Financed Space Programs and Space Activists in the U.S." and the founding of Orbital Commerce Project (OCP) a company dedicated to training personnel for the commercial human spaceflight industry.

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