Bigelow: Commerce meets Fiction

On July 12, 2006 Bigelow Aerospace launched its first inflatable space module Genesis-I (11.5 cubic meters volume) on a Russian Dnepr rocket according to the company's vision to "play a major role in drastically altering the current cost and availability surrounding commercial and public use of non-habitable and habitable space complexes".

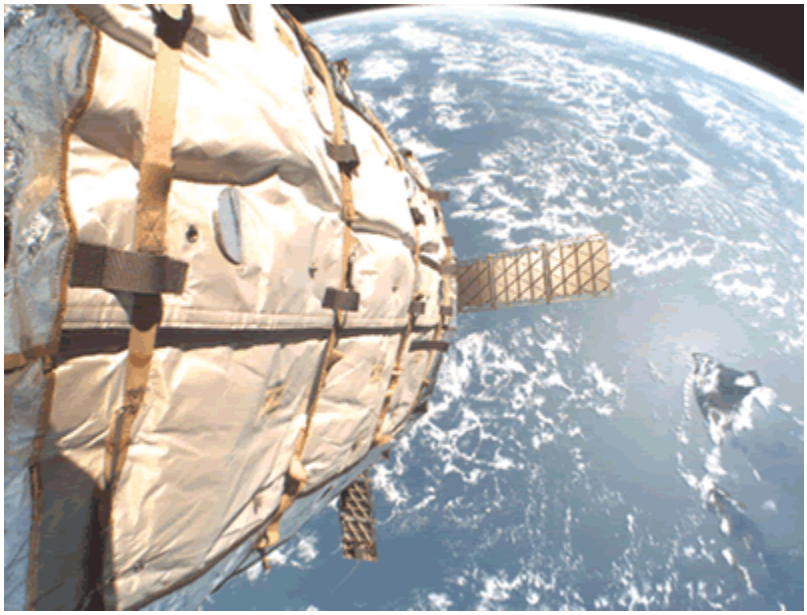

Figure 1: Genesis-1 in flight (Credit: Bigelow Aerospace)

The inflatable module concept is based on Johnson Spaceflight Center's (JSC) TransHab development for the International Space Station (ISS), later discontinued because of budgetary reasons. Bigelow Aerospace was founded 1999 by Robert T. Bigelow, owner of the "Budget Suites of America."

Comparing the start-up achievement of Las Vegas-based Bigelow Aerospace between 1999 and the first Genesis launch in 2006 with the schedule of the space station "Freedom," later better known as ISS, the strides of Bigelow into the space business are gigantic.

Figure 2: Robert Bigelow, Founder of Bigelow Aerospace
(Credit: Bigelow Aerospace)

Although dubbed as a "space-hotel company" Bigelow Aerospace is not in the hotel business exclusively: its goal is "to create structures for other people to use as hotels, laboratories, factories, corporate yachts, adjunct colleges, medical clinics, astronautical training facilities, or imaginative environments for public entertainment etc., etc., etc…"

The next launch announced for June 2007 will put Genesis-II into low earth orbit (350 nm). Both modules, (Genesis I & II) are not yet capable of supporting crew visits. A third module called

"Sundancer" (180 cubic meters), to be launched by the end of the decade (2009…2010), will be man-rated, accommodates 3 people and will be positioned in a 250 nm, 40 deg. inclination orbit to serve as the kernel for the future Commercial Space Complex (CSC). The next steps will expand the "Sundancer" with a propulsion module and docking node followed by the final full sized BA-330 module, providing 330 cubic meters of usable volume to complete the CSC around 2012 housing up to 6 persons.

Questions remaining open are the availability of commercial or other transport systems and the resolution of all the political and bureaucratic hurdles. To solve the transport problem Bigelow Aerospace has created an "American Space Price" granting $50M for a spacecraft with a crew of five docking twice to a Bigelow Aerospace expandable space habitat before January 10, 2010. For more information on Bigelow Aerospace please refer to **http://www.bigelowaerospace.com**.

SpaceOps News has been following Bigelow Aerospace's progress with ardent interest over the years and is summarizing the current status from an operations point of view. Mr. Bigelow was inspired to embark on the Commercial Space Complex (CSC) enterprise by his belief in "presences we can't explain" (J. Johnson, Times, Aug 2006).

The integral approach establishing not only the CSC but also solving the transport problems, coping with communication and ground infrastructure challenges as well as the resolution of all regulatory hurdles seems to be very efficient so far. However, it will be difficult to maintain the momentum and safeguard the further success.

With the recent establishment of the Washington based "Personal Spaceflight Federation" (PSF), whose task is to address regulatory, legislative and policy issues an industrial organ tackling those problems is available. The danger is that with increasing industrial and political involvement the problems might be getting more complex, i.e. taking longer time than the 2010 goal would allow even with favorable support from FAA and NASA.

Bigelow is co-operating with Russia/Ukraine already by buying launch vehicles: converted SS-18 ICBM boosters silo-launched from the Yasny launch base. An expansion of international co-operation on a bartering basis is not on the horizon yet (ITAR regulations).

Bigelow Aerospace is prepared to invest $500M until 2015. This seems low compared to NASA (and other international agency's) project costs. Fall-back options might exist however are not known.

The Company employs a staff of approx. 120 people. Close support is rendered by professionals like former Astronaut Ed Mitchell and by Dr. William Schneider, developer of the TransHab architecture.

Figure 3: Bigelow control center (Credit: Bigelow Aerospace)

The idea of providing the space environment (in Bigelow terminology "high-tech hang time") to "everybody" (i.e. to nations with active space programs and multinational corporations) is very good: NASA's almost total resignation to perform science on the ISS might create an additional science market – on the other hand Bigelow would be competing against NASA and Russia as long as some paying commercial user would come along, the decisive factor being turnaround-time and cost in the end.

So far it is unclear whether the emphasis for customers using the BA-330 would be on the science/research side or on the space-tourism/entertainment side. Taking the location of Bigelow Aerospace (North Las Vegas) into account one probably could not exclude an expansion of "Las Vegas-entertainment" into space. Another entertainment factor on-board definitely would be watching the earth. The "panorama-windows"/cupola problems with inflatable structures have yet to be solved however; the "Sundancer" will be equipped with 3 windows already.
With growing space-tourism thrill expectations like EVA activities would have to be included as well. "Space-Adventures", a Vienna, VA -based company offers tourist space walks on the ISS already. During the recent flight of ESA Astronaut Thomas Reiter to the ISS (ASTROLAB) a French master chef has created some recipes for celebratory events on the ISS: "Volaille épicee, sauté de legumes à la Thai" or "Gâteau de semoule de blé fine aux abricots secs"--this could become "state-of-the-art" space food for VIP tourists as well.

Russia has set the price index with respect to paying customer fares to $20M a piece. Speculations are that a "hard-to-be-met" start-up offer of $8-15M per passenger could be expected from Bigelow Aerospace (including launch cost).

Very little is known about the planned operations concept for the CEC: security and safety, communications requirements & protocols, communications network(s), back-up control, automation vs. emergency operations, staffing and shift concepts. A high degree of automation on-board and on the ground is expected in order to reduce (manpower) cost in the long run. This is a problem the space operations community is struggling with since the early days of satellite and human spaceflight operations. It would be very worthwhile to see how Industry is tackling this problem.

It looks like the first BA-330 would fly in the vicinity of the ISS. In the late 1980´s the Europeans planned as part of a Program called "In Orbit Infrastructure" (IOI), to fly a "Man-Tended-Free-Flyer (MTFF) and a "Retrievable Platform" in the same orbit as the ISS for maintenance and "visiting" reasons. Similar activities between the ISS, the BA-330 and visiting vehicles could be possible – pending on the resolution of many compatibility

and interface issues.

Bigelow Aerospace is discussing options with Lockheed Martin for human-rating the Atlas-5, however the availability of commercial crew transportation is still unclear, Rocketplane Kistler and Space Exploration Technologies (SpaceX) are candidates for providing commercial transport as well. With NASA going back to the more conventional capsule concept for their "Vision for Space Exploration" – a "winged", reusable, horizontal landing vehicle is very unlikely to become available. For space tourism probably a bigger "market" could be attracted with an airplane-like vehicle allowing a more "conventional" handling of passengers.

Like pollution on earth, debris in space is hard to be controlled globally and growing unexpectedly. Debris is hazardous for human space flight. One would assume that inflatable structures are more vulnerable than aluminum modules. One of the goals of the Genesis-I flight is to gain more data on the performance of the 16 inches thick multilayer Kevlar-like skin.

After more than 7 months in orbit the Genesis-I structure is reported in top shape: the internal pressure levels show a lower leak rate than tested on the ground and externally no degradation of the debris shields or discoloration due to UV exposure are visible (Genesis-I Vehicle Performance Update, Bigelow Aerospace, February 2007).

Bigelow Aerospace, recipient of the 2007 Space Foundation Achievement Award, is the first commercial enterprise trying in earnest to open a commercial market with pretty good chances to add unprecedented aspects to human spaceflight and associated operations.

Joachim J. Kehr, Editor SpaceOps-News :: May 2007