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July 15, 2004

NAVAIR evaluating novel airship for force protection missions

by Bill Swanson
SENIOR WRITER

When poet E.E. Cummings asked, "Who knows if the moon's a balloon," he should have consulted Steve Huett, NAVAIR's head of the Advanced Development Program Office for Airship Concepts, who probably would have responded, "Yes, E.E., the moon most definitely is a balloon."

Huett should know; just 18 days ago, he and Tim Buss, chief test pilot for 21st Century Airships, climbed inside a pale 62-foot-diameter, helium-filled, beach-ball-shaped airship tethered in a meadow on the back reaches of the St. Mary's County airport in Hollywood, Md., a few miles up the road from NAS Patuxent River. Buss fired up a trio of small 80-h.p. gasoline engines Velcroed to the sides and rear of the giant volleyball, and slowly lifted off the ground. In moments, the airship rose almost silently over Southern Maryland, looking from a distance like a full moon that didn't understand it wasn't a still summer evening but a busy Monday morning when most full moons ought to be on the other side of the planet.

In a three-hour demonstration/evaluation flight, Huett and Buss wafted up to more than 10,000 feet, while nearly two miles below several score of Navy, Marine, Air Force, Coast Guard and civilian government and industry officials and observers stood in the meadow craning their necks and monitoring the airship's progress. Thirteen months earlier, Buss and the airship's principle designer, Hokan Colting, officially set a world's altitude record for airships, taking the balloon up nearly four miles, to 20,453 feet above Gull Lake, Canada, more than 3,800 feet higher than the previous world's record.

The craft is called the AeroSphere SA-60 spherical airship, a paradoxical combination of "low-tech" and state-of-the-art. On the one hand, the SA-60 isn't much different or much bigger than history's very first balloons launched by the Montgolfier brothers in 1783 France. On the other hand, the SA-60 uses materials such as Spectra 1000, the high-strength polyethylene fiber used inside bulletproof vests and helmets and other high-tech armor; Velcro-ed and zippered "plug-and-play" modules to quickly reconfigure the SA-60 payload and capabilities; high-strength carbon fiber and light-weight metallurgy; diesel-hybrid (electric) and/or gasoline propulsion systems, and simple but state-of-the-art avionics. Probably the most unusual feature of the SA-60 is its cockpit; unlike almost every other balloon, airship, blimp or dirigible, the SA-60 incorporates the entire cockpit "inside the belly of the beast" rather than



Photo by Bill Swanson

One of the four zip-in "plug and play" modules of the AeroSphere SA-60 airship is the cockpit module, a kind of dome tent inside the balloon itself. Just above the small stepstool is the Plexiglas door panel leading to the "flight deck," which has two seats for the pilot and passenger, and all the aircraft's avionics and controls.

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hanging it underneath in a suspended or attached gondola. According to company literature, the absence of an external gondola means the airship can take off and land on water, making it history's first and only amphibious airship.

Unlike balloons and blimps, but like the dirigibles of the 1920s and 1930s, the crew of SA-60 can walk around inside the envelope of the airship, even in flight, but whereas crewmen 80 years ago climbed among girders and catwalks, walking inside the SA-60 is like being inside a giant "moon bounce." Once they leave the cockpit, the crew walk on the actual skin of the airship.

The corporate structure supporting the SA-60 is probably more complicated than the airship itself, and readers may need to consult a scorecard, so here goes: The company that built the SA-60 is Colting's 21st Century Airships, Inc., of Newmarket, Ontario, Canada; the SA-60 is Colting's 11th developmental prototype, and the research-and-development company holds the patent rights. Future prototypes and production models will be built by 21st's American partner firm, Techsphere Systems International, headquartered in Atlanta, with its manufacturing facility in Columbus, Ga. The marketing of the airship is being handled by Proximity Digital Networks, Inc., of New Orleans, a developmental holding company, and its wholly-owned subsidiary, Cyber Aerospace Corp., which is actually responsible for the sales and marketing. All four companies have cross-linked Web sites which describe the SA-60 and its related airship programs in detail. When Huett contracted to bring the SA-60 to Pax River for NAVAIR evaluation, the paperwork was with Cyber Aerospace. Cyber Aerospace's site has a three-minute video clip showing the take-off and landing of Buss and Huett's flight ([http://www.proxygen.com / 37/Editorial.asp?aff_id=37&this_cat=contact&action=list&type_id=750&cat_id=752C_id=772](http://www.proxygen.com/37/Editorial.asp?aff_id=37&this_cat=contact&action=list&type_id=750&cat_id=752C_id=772)).

"We're interested in making NAVAIR a focal point for airship technology," Huett said, pointing out that the Navy already has "a rich history" in that technology. He was referring to the period of the 1920s, when the Navy led the way in pioneering American aircraft such as the rigid "dirigible" airships such as USS *Akron*, USS *Macon* and USS *Shenandoah*, and the 1930s, during which the Navy began to develop a new class of non-rigid, helium-filled blimps of what soon became the "K-class" blimps.

"Ground zero" for this program was at NAS Lakehurst, and during World War II the Navy deployed no less than 15 squadrons of K-class blimps along the Eastern Seaboard as far south as Brazil and on the west coast of Africa. These blimps were so successful at anti-submarine patrolling that no ship having a blimp patrolling overhead was ever sunk by a German U-boat. K-class blimps not only took part in surveillance, they were often on the shooting end of the ASW game. Several Navy blimps assisted surface ships in bombing and depth-charging submarines, and one blimp, K-74 (Lt. Nelson Grills and nine crew), got into a fire fight with a surfaced German sub stalking a tanker and a freighter one night in the Florida Straits in July 1943. Unsure if the sub was friend or foe, the K-74 decided to swoop down to 250 feet over it; if it was foe, it would fire at the blimp, which the sub soon did. The K-74 replied with a pair of depth charges and extensive machine-gun fire. The sub, U-134, won a Pyrrhic victory, successfully shooting down the blimp (nine of the 10 crew were later rescued). However, K-74, in addition to summoning reinforcements, had so damaged the sub it was unable to submerge. The German U-boat command ordered U-134 to return to Germany for repairs, but off the coast of France and still unable to submerge, it was destroyed by British bombers. The last blimp was retired from the Navy in 1962, ending more than four decades of development and service.

Huett's mission in bringing the 60-foot-diameter SA-60 to Pax River is two-fold. His primary mission is to act as a sort of "impresario," bringing various kinds of airship concepts and technology to Pax River, and inviting military and civilian scientists, technicians, engineers and leadership to familiarize themselves with the technology and think about possible applications. His

mission is "joint," so representatives from the Army, Air Force, Marines, Coast Guard, non-military government agencies and even civilian industry leaders are also invited. How any of those agencies may decide to use the technology is their business.

Huett's second mission within the Navy and NAVAIR is to evaluate the aircraft and find possible Naval aviation uses for the technology. He said that one possible mission for airships might be to supplement the Navy's H-60 fleet of helicopters now performing surface surveillance for the fleet, a mission those helicopters were never designed to perform. Consequently, the H-60s are accruing quite a bit of flight time and using resources. If it becomes possible to use airships to provide surface coverage over the fleet, then the H-60s can be conserved and used for their intended missions. If the airships turn out to be relatively inexpensive - as they in fact appear to be - then so much the better.

The SA-60 currently has about a 50-hour "loiter" duration, weighs about 4,500 pounds, has a payload capacity of about 500 pounds (not counting the two crew), has the option of flying unmanned, and costs about \$5 million.

The SA-60 is powered by a pair of 80-hp gasoline engines spinning propellers about 45 inches in diameter; these are mounted on each side of the airship and can rotate up and down. A third engine and propeller are mounted on the back of the airship but is not intended for propulsion; rather, this directs a stream of air against the balloon to eliminate boundary separation. All three engines are mounted on metal rings, which are attached to the skin of the balloon with nothing but Velcro strips; the entire engine mount assembly can be quickly and easily removed and replaced in minutes. The gasoline fuel came from a series of five-gallon jugs mounted on a platform inside the envelope, and the fuel was pumped up to the engines from there. Using the two main engines, the airship is maneuvered much the same as a twin-screw powerboat is maneuvered during docking, with one throttle held constant while the other is advanced or retarded to spin the airship left and right.

Huett and officials from the airship companies readily acknowledged that the SA-60 was severely underpowered, operating at about 40 percent of its capacity. The next prototype version will probably be a 72-foot-diameter model equipped with a diesel-hybrid system. A conventional diesel generator will be mounted inside the balloon near the bottom rear of the sphere; it will be started by compressed air and exhaust will be vented out a tailpipe. The generator will produce electricity that will be piped up to electric motors mounted on the sides; these will turn propellers that may be about seven feet in diameter. The airship will have solar panels to supply most of its electrical needs during daylight hours; the diesel generator will be used during nighttime and for high-speed maneuvering situations such as take-offs and landings.

The SA-60 came to the St. Mary's County airport packed into a tractor-trailer, and company officials claim one of its major advantages over conventionally cigar-shaped blimps is that it has a small "footprint," can be transported on a flatbed truck, and can be set up from scratch by a crew of only six people in less than 24 hours; by contrast, blimps and elongated airships have much larger footprints, require crews of 20 to 30 people at a minimum, require mooring masts, take several days to inflate (and so remain inflated all the time), and by virtue of their elongated shape have to be anchored as well as flown more like sailboats than balloons, with constant attention to wind speed and direction. Because a sphere presents the same aspect ratio to the wind no matter which direction it comes from, a sphere doesn't need to rotate around a mooring mast, and can therefore be anchored to the ground in a fixed position during bad weather. In addition the SA-60 can be inflated outside, while other airships must be inflated inside a hanger.

The interior of the SA-60 contains an inner Mylar bag filled with helium; on the ground, the bag occupies only a small portion of the inner volume. The rest of the balloon is filled with ambient air at a pressure of about 1-2 inches (water pressure), just enough to keep the sphere inflated. In the case of a high-altitude

balloon, the helium occupies only about 6 percent of the total volume of allotted space. As the balloon rises, the inner helium bag expands until it occupies up to about 85 percent of allotted volume; as the inner bag expands to 16 or 17 times its starting volume, the air is vented out of the outer shell to make room. Helium heats up faster than air, so sunlight beating on the balloon adds to the effect of helium expansion; this is called "superheat." Even though the SA-60 is not a "hot-air balloon" like the ones seen at the county fair using propane to heat and inflate the air bag, heat from sunlight is a major factor in flying an airship, whether manned or unmanned.

The SA-60 is built with four circular panels about 14 feet in diameter near the bottom of the sphere. Each panel has a giant zipper around it to secure Velcro panels together, so a panel can be quickly "peeled" in and out; the Velcro flap not only holds the panel in place, it provides airtight security. The entire cockpit module of the manned SA-60 occupies one such zip/peel-out panel; from the inside of the airship this module looks like an igloo or a dome tent. The cockpit module has an outer door, which is sealed when closed, to help maintain air pressure inside the inflated balloon. The module also has a "back door" which opens into the main part of the sphere; thus the cockpit module is also something of an airlock. While the crew tries never to have both doors open at the same time, doing so wouldn't be a disaster as it would be on submarine or a spacecraft, and one door or the other can be left open for long periods of time.

The cockpit module features two seats, one for the pilot and one for the passenger. The panel itself is nearly all Plexiglas or plastic, and the view is spectacular, like looking out a 14-foot porthole. The "igloo" tent part of the module is made of the same Spectra 1000 material as the outer skin; future models may build this module out of a high-strength carbon fiber.