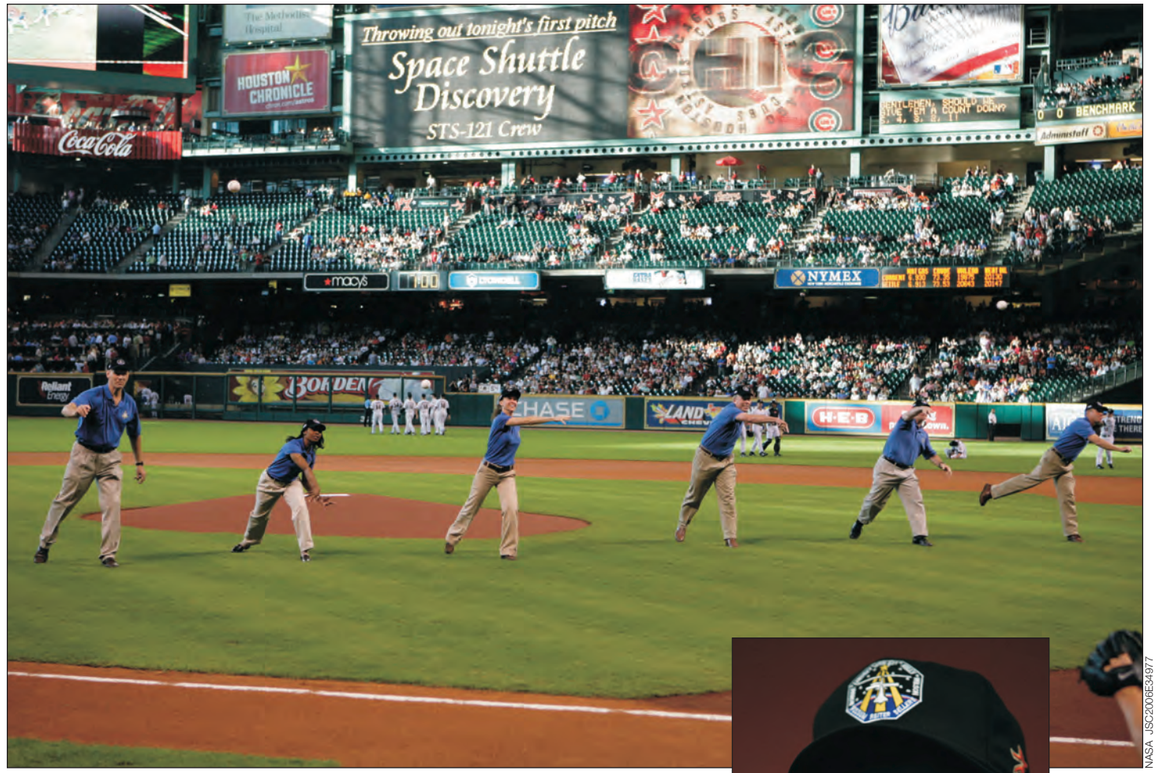
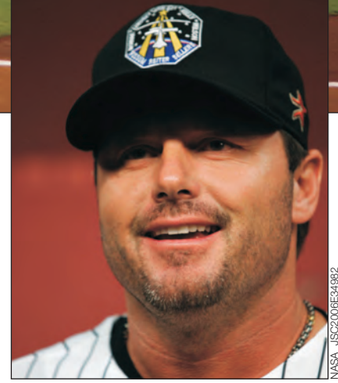


NASA JSC2006E54977

A day of *Discovery* with the Houston Astros

NASA was the guest of honor at the Houston Astros' Aug. 14 game against the Chicago Cubs. The crew of the STS-121 shuttle mission threw out the ceremonial first pitch, astronaut Tracy Caldwell sang the national anthem and the Astros sported the mission's patch on their caps during the game.



NASA JSC2006E54982

Pitcher Roger Clemens shows off the STS-121 hat in a pre-game press conference.

Space Center Roundup

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Roundup

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The shuttle and beyond

NASA begins the transition from the space shuttle to the next generation of space exploration systems that will take humans to the moon, Mars and beyond.

FROM THE

director

A MESSAGE FROM CENTER DIRECTOR MICHAEL L. COATS

Checks and balances

STS-121 was my first shuttle flight as JSC director. It was an opportunity to participate in and watch the process that positions us for a successful shuttle launch.

The Readiness Review, Launch Minus 2 Day Review and daily Mission Management Team meetings were well structured, highly professional and wide open to discussion and input from everyone. Most importantly, diverse opinions were not only encouraged but mandatory. I was amused when the media chose to characterize diverse opinions as "dissent." During earlier missions, the same media characterized the apparent lack of dissent and discussion as "monolithic" and "group think."

A successful space program requires a working environment where we are all free to express dissenting and diverse opinions without fear of repercussions. Gen. George S. Patton phrased it well: "If we are all thinking alike, someone isn't thinking." As space professionals we all have a responsibility to speak out as clearly and eloquently as possible, with the data to support our positions. We also have the responsibility to explain our rationale when we make a decision and to support the final decision when the appropriate individual makes it.

The NASA administrator, Mike Griffin, has made it clear that he expects everyone to state their positions clearly and forcefully. He is quite pleased with the "dissenting opinions" he hears at the pre-flight and in-flight reviews, and nobody on the space team should be intimidated by the media attention and occasional criticism that is an important and necessary part of our free society. The checks-and-balance system we use between the programs and the institution, including my center director responsibilities for independent technical authority, is designed to ensure all points of view are heard.

Although it may appear inconsistent, the fact is that in the space business, teamwork is invaluable and dissent is priceless!

FROM THE SPACE SHUTTLE TO THE ARCHITECTURE BEYOND, JSC IS...

Planning for shuttle retirement

The Vision for Space Exploration promises an exciting new future for NASA. It outlines a series of challenges that, over the next few decades, will push the agency and the country to the very limits of human ingenuity.

FULL STORY BEGINS ON PAGE 4

NASA GRC1039

"I want to stress that there is very important work to do in the existing programs and that this work has to be accomplished before we move on as an agency. Some employees will move to the new program now. Some will continue to grow in the active programs and move later. Some will work in both programs, and some will stay with the Shuttle Program until its mission is complete and later join the operational program for Constellation. There is more than enough work to go around as long as we stay focused and are successful."

Bill Gerstenmaier, Associate Administrator for Space Operations

NASA WILL MEET THESE CHALLENGES

one milestone at a time. With the success of *Discovery*'s mission in July and *Atlantis*' assembly flight, the Space Shuttle Program will be clearly on the path to complete the International Space Station, and another step closer to fulfilling its mission.

Even as the Shuttle Program focuses on completing the most complicated on-orbit assembly ever attempted and the station begins to realize a greatly expanded operational capability, the Exploration Systems Mission Directorate, through the Constellation Program, is bringing forth a new exploration architecture and the vehicles that will carry America back to the moon and on to Mars.

NASA's current human spaceflight activities are geared toward ensuring the success of this future architecture. The complexity of upcoming assembly missions will provide valuable technical lessons. Equally, they will provide unparalleled training for new engineers. During this transition period, growth in operational experience will continue and developmental capacity will be restored.

Although hardware tends to get the most attention when it comes to developing new programs, the ultimate driver of any program's success is its workforce. The knowledge and skills of the people in the Shuttle and Station Programs are invaluable assets to both current and future human spaceflight programs.

One of NASA management's greatest priorities is maintaining the capability to complete the assembly of the station (an essential component of the Vision) while striving to transition the workforce seamlessly, effectively and deliberately to new programs and projects. This priority is shared between the Exploration Systems and Space Operations Mission Directorates (Shuttle, Station and Constellation), as well as all NASA field centers and the agency as a whole.

ACROSS THE AGENCY

In response to a congressional request for insight into how NASA will realign to implement the Vision, the agency developed the "Human Spaceflight Transition Plan," which describes the overarching strategy for transitioning Shuttle Program resources. The plan also identifies management and board structures that will have authority to make transition-related decisions. The plan is available online at: **http://sspweb.jsc.nasa.gov/upgrades/transition/documents.htm**

A ground rule for the transition is that it must be accomplished in a manner that does not compromise the safety of ongoing flight operations. In addition, transition decisions should be made within the context of safeguarding the long-term viability of U.S. technical capabilities in anticipation of future challenges and opportunities.

Development of the transition plan was a daunting task, so NASA conducted a series of benchmarking research of large-scale, high-technology program transitions and/or closeouts that had been completed. The review subjects included the Titan IV rocket fly out, the F/A-18 fighter production closeout, and the Navy Base Realignment and Closure process, among others. These reviews allowed NASA to capture mistakes and lessons learned from previous experiences and apply them appropriately to its own transition situation.

Transition "Lessons Learned"
Benchmarking Research

- Very important to have a "going in" plan.
- Regulatory impacts, requirements and technical challenges must be understood early for any hope of effective management.
- Keep internal and external stakeholders appropriately informed about current progress and future work.
- Strong leadership is essential, especially when critical skills must be maintained for follow-on programs.
- Execution requires the use of smart program management tools.
- Contract structure must allow for flexibility.
- Transition is expensive and takes time.

To incorporate these lessons and address other issues within the broad scope of transition, NASA headquarters established a Transition Control Board (TCB) and a Transition Working Group.

The TCB, managed by NASA Headquarters and involving all of the key stakeholders, handles tactical transition issues such as whether it is acceptable to shut down a unique manufacturing capability once it has fulfilled its Shuttle Program obligation, or how to handle funding gaps between the last need date for an asset and Constellation's first need date.

Headquarters also established the Transition Working Group to address specific areas of emphasis such as historical preservation, environmental remediation and legislative affairs. Just as the three program offices are working closely together, these integration forums at headquarters are ensuring that consistent, integrated guidance is flowing to all of the teams.

Transition issues are complex. Therefore transition planning will be an iterative, evolutionary process requiring tight integration between the shuttle team and those involved in developing future exploration systems. Careful implementation of the transition strategy will help ensure that NASA is properly aligned to execute the Vision for Space Exploration.

WITHIN THE PROGRAMS

Soon after the Vision was announced, the Shuttle Program began evaluating what hardware, infrastructure and workforce would be needed to support missions through 2010. Concurrently, the Station Program identified impacts and challenges of shuttle retirement on station logistics support and utilization after 2010.

In accordance with the Vision, the Shuttle Program will complete assembly by 2010, thereby meeting commitments to NASA's International Partners and solidifying the station as a world-class research facility to support NASA goals primarily focused on the Exploration mission.

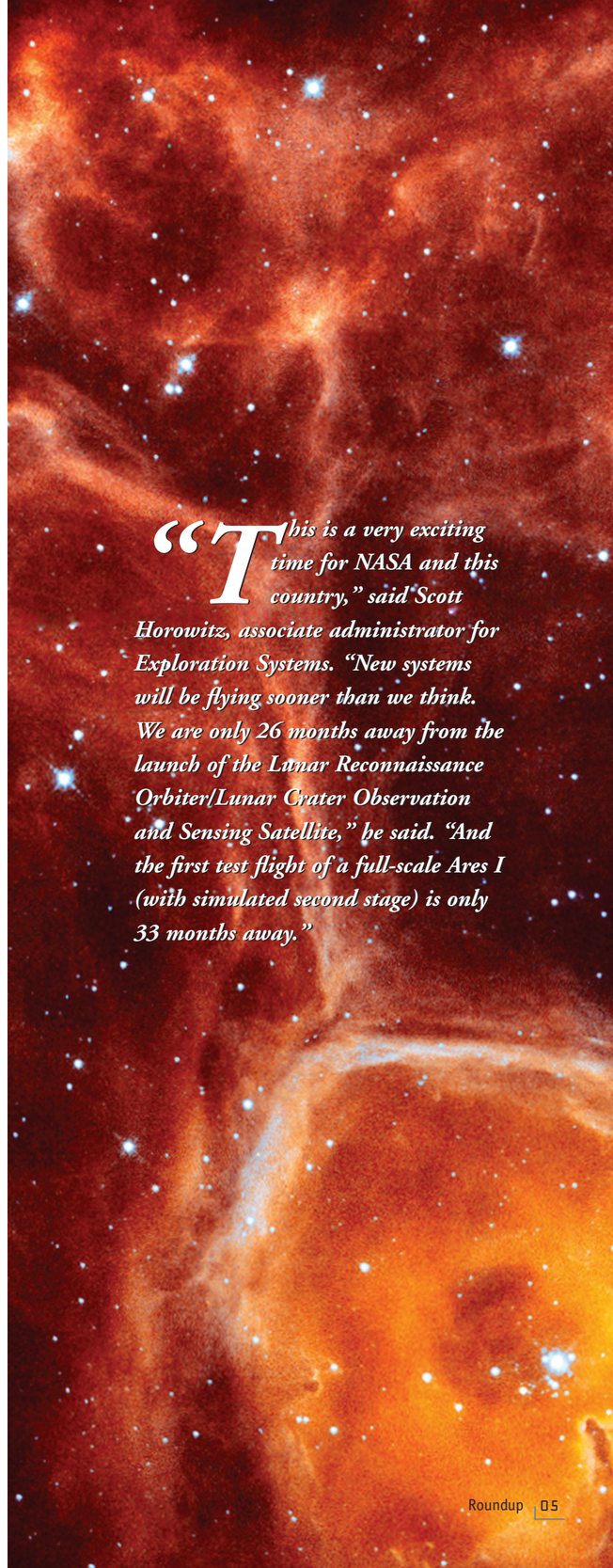
The Shuttle Program will play a crucial role in coordinating the smooth transfer of its assets and capabilities to the next generation of space exploration systems. This will require working through project, program, directorate and agency-level processes.

The human spaceflight programs and mission directorates are encouraging close relationships between the three programs. In addition, the co-location of program management at Johnson Space Center facilitates communication and the identification and appropriate disposition of transition assets.

Over the next several years the Shuttle, Station and Constellation Programs will work together to define an efficient transition of people, hardware and facilities. Last-need dates, first-use dates, specifics of flight manifest and processing schedules are all necessary inputs to the transition process and for providing accurate strategic guidance for budgeting.

The Shuttle Program is in the process of completing a strategic assessment of all capabilities as a basis for its closeout plan. The Station and Constellation Programs will determine the usefulness of these capabilities and identify when they are needed. Gaps and overlaps will be managed by the TCB.

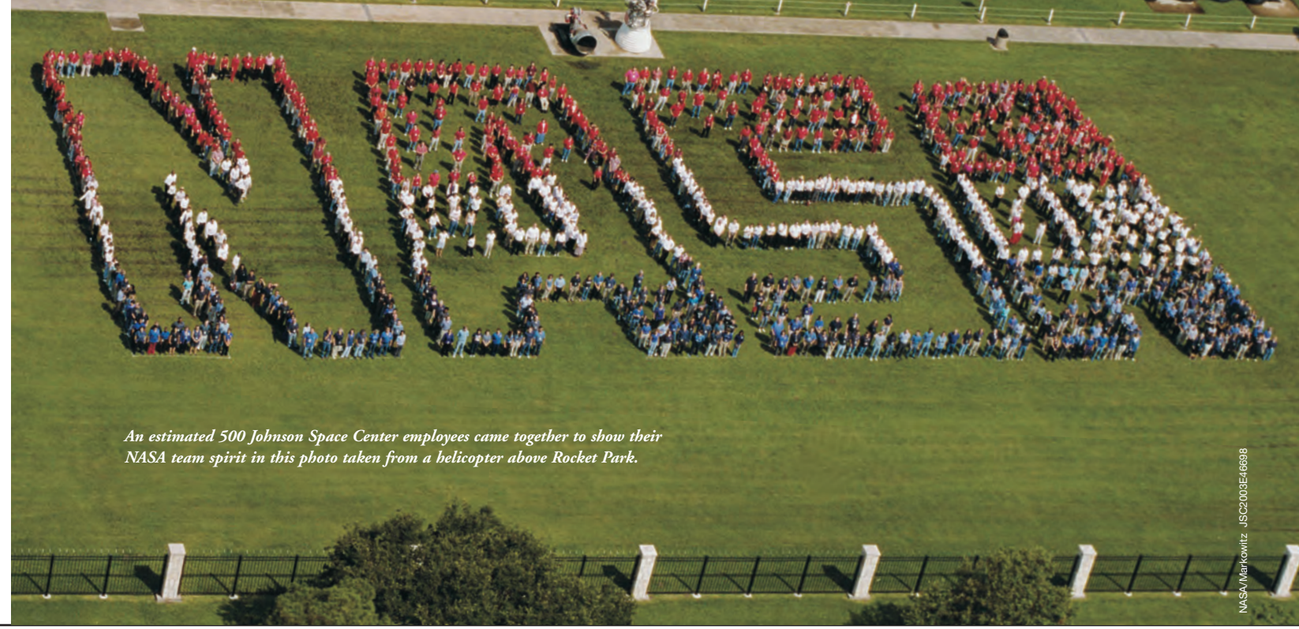
continued on next page



DID YOU KNOW...

The Space Shuttle Program

- occupies 640 facilities valued at over $5.7 billion, nearly one-fourth of the value of NASA's total facility inventory?
- uses over 900,000 line items of equipment worth over $12 billion and dispersed at hundreds of locations nationwide?
- employs over 2,000 civil servants and more than 15,000 contractors, and accounts for over 3,000 members of the various centers' general and administrative workforce and service pools?
- has nearly 1,542 active suppliers and more than 3,000 qualified suppliers throughout the country?



An estimated 500 Johnson Space Center employees came together to show their NASA team spirit in this photo taken from a helicopter above Rocket Park.

NASA/Marko Kitz JSC2003E46898

The Shuttle Program further focused on its transition responsibilities by naming Deputy Space Shuttle Program Manager Robert Lightfoot as its transition manager and chartering an integration team within the program office to support the transition effort. Additionally, all of the shuttle project offices have identified transition managers responsible for planning and implementing project-specific transition activities.

The Shuttle Program has hosted several technical interchange meetings on various transition topics to assess existing agency capabilities in areas related to human capital management, real and personal property disposition, data archiving, historical preservation and environmental remediation.

At all levels, standing control boards have been established to provide insight and guidance and to enable decisions on important transition issues.

JOHNSON SPACE CENTER

The JSC Transition Integration Panel (JTIP) has been established as a forum for the planning, coordination and integration of transition-related activities among the Shuttle, Station and Constellation Programs and JSC as a whole.

The JTIP includes equal representation from Shuttle, Station and Constellation Programs, as well as from the Center Operations Directorate. Representatives from all affected JSC directorates and organizations are included to ensure a comprehensive planning effort. The JTIP membership is included on the Web site.

The panel functions in a three-tiered approach.

The first tier addresses the development and implementation of divestment plans for the shuttle elements and direct support organizations based at JSC. The Orbiter Project Office, Mission Operations Directorate and White Sands Test Facility have already presented preliminary transition plans, and the other organizations will be documenting their plans this fall.

The second tier establishes a working forum for multi-program coordination and integration among the Shuttle, Station and Constellation Programs. This includes topics such as cost-sharing, risk management and asset transfer agreements.

The third tier incorporates center-based functions, including property disposition, environmental, historical and archiving activities, and the resulting workforce impacts. A center-wide facility utilization review is underway to identify future needs and update the JSC Master Site Plan accordingly.

All three tiers combined will generate a comprehensive plan for transition at JSC.

Future communications will update the community on planning and implementation activities at JSC and across the agency. For this plan to be successful, it is imperative to have open discourse relative to transition activities ongoing at the center, program and agency levels.

It is key for the workforce to be part of the communication process. Employees are encouraged to provide feedback or ask questions concerning this article or any transition topic via the JTIP Web site at **http://sspweb.jsc.nasa.gov/upgrades/transition/jscInt/jscInt.htm**.

Comments or questions can be submitted anonymously, or a name can be provided for direct response.

TRANSITIONING INTO THE FUTURE

Managing the retirement of the shuttle is particularly challenging since NASA will conduct a series of complex station assembly missions and possibly a Hubble servicing mission while simultaneously exploring and developing future transportation alternatives. Parallel operations and development activities will require that NASA find new ways to use existing shuttle workforce, hardware and infrastructure assets efficiently and effectively.

In conjunction with these activities, NASA will identify shuttle capabilities required for new Exploration systems and preserve them for potential future use. The agency also will identify capabilities no longer required for near-term missions or future vehicle development so that associated resources can be allocated to other investments while ensuring those important contributions to the history of human spaceflight can be recorded and preserved.

Transitioning from the space shuttle to the architecture beyond in a way that ensures continued safety in ongoing operations is the primary goal of the agency and JSC. To accomplish this task, attention will focus not only on maximizing the efficiency with which resources are used, but also respecting the workforce, while protecting critical national capabilities that will be needed to support the Vision for Space Exploration.

JSC Transition Integration Panel Objectives

- Develop and implement divestment plans for JSC-based shuttle elements and support organizations.
- Provide an integrated assessment of functional capabilities across the center (i.e. equipment, facilities, suppliers, and workforce) by
- Be the established communication forum to ensure that all stakeholders assess the impacts of transition activities.
- Make coordinated recommendations to address/mitigate the issues.
- Identify gaps and overlaps in need.
- Serve as the JSC pre-board for items moving through the transition board process.
- Coordinate "down and in" and communicate "up and out."

For more information on the Space Shuttle Transition Program, visit:

http://sspweb.jsc.nasa.gov/upgrades/transition/jscInt/jscInt.htm

INFLATABLE MODULES FULL OF POTENTIAL

Beyond balloons

by Kendra Phipps

The next time you're packing a suitcase for a long trip, consider getting some help from an expert in inflatable space modules.

The beauty of these modules is their ability to be launched in a folded state and then expanded, or "inflated," in orbit. They can wind up three times larger than their original launch size.

"The shuttle has limited volume. The cargo bay is only so big," said Chris Johnson. "But we can fold this (inflatable module) up and get three times as much volume. We're maximizing launch capacity." Johnson, Crew Exploration Vehicle (CEV) Parachute Test Vehicle project lead, was a member of the Johnson Space Center team that designed, built and tested an inflatable module called TransHab in the late '90s.

Any vacationer would love to squeeze three times as many swimsuits or souvenirs into a suitcase, but in space, the benefits of this technology go far beyond convenience.

For long-duration missions to the moon or Mars, astronauts will need lots of room—not just for the additional supplies and equipment needed, but also for their psychological well-being.

"There are positive psychological aspects of a large structure," said Jasen Raboin, CEV Parachute Assembly System project manager and another member of the original TransHab team. "NASA will need something bigger than what we've done before."

Put simply, crew morale benefits from more interior space—whether in a transit vehicle or a surface habitation module. Using technology developed during TransHab, inflatables have potential as both.

While TransHab was originally designed as a transportation module, the team was asked to adjust it for use on the International Space Station. The team pulled together additional experts and came up with a module that Raboin says could have "almost doubled or tripled the stowage space of the station." Their ideas even passed the tough inspection of NASA long-timers such as Chris Kraft and Max Faget. But in 2000, the project fell victim to budget cuts.

"NASA had other bills to pay," said Raboin, "so we had to disband it and put the project and the technology on the shelf."

The good news was that inflatable module technology had proven its potential. The team had been able to build three full-scale units and put them through the wringer: The first two units were pressure tested in the Neutral Buoyancy Laboratory to verify restraint layer strength, and the third unit was tested in Building 32's vacuum chamber to verify folding and inflation techniques.

"We were showing that it was feasible, and the technology could be applied in the future," said Raboin.

"You mean a balloon?"

The word "inflatable" doesn't exactly conjure up images of cutting-edge spaceflight technology. Most people probably associate space exploration with cold, hard metal.

"That's the biggest mindset to overcome," said Johnson. "You say 'inflatable' and people think, 'You mean a balloon?'"

However, these modules are just as strong as traditional metal structures. Inflatable modules consist of layer after layer of protective materials such as high-tech synthetic fabrics and carbon-fiber composites. For instance, TransHab's inflatable shell contains nearly two dozen layers and is a foot thick.

"We provide as much micrometeoroid protection as any spacecraft NASA's ever flown," said TransHab team member and shuttle engineer Gary Spexarth. That protection comes from layers of ceramic fabric called Nextel alternated with thick layers of foam. This design would cause an incoming piece of debris to shatter upon impact, getting smaller and weaker with each layer. This protection, along with additional integrated layers, also keeps the extreme temperatures of space at bay.

The module's air is held in by bladders, the shape is held by super-strong webbing material and the inside "wall" is made of fireproof Nomex cloth and puncture-resistant Kevlar felt.

Another advantage of inflatable spaceflight technology is the vast array of possible configurations.

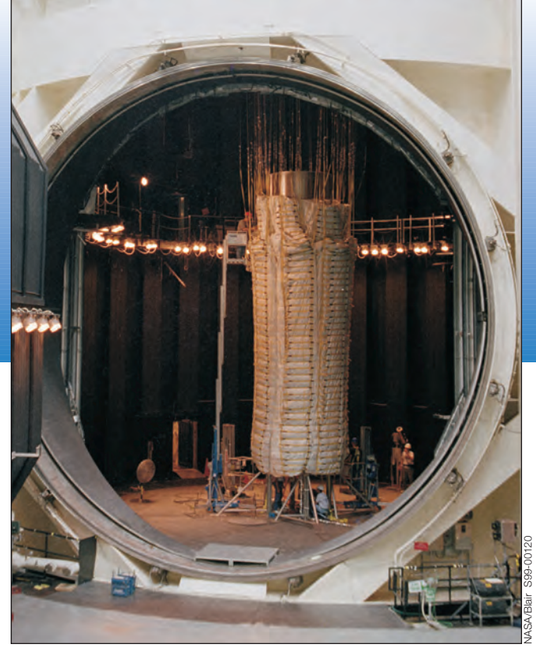
"Inflatables don't have to look like TransHab," said Spexarth. "They could be tunnels, airlocks, stowage modules or all kinds of shapes."

A match made in space

Although the TransHab design has not yet been used in space by NASA, inflatable structures and technologies have continued evolving through partnerships with the private sector.

In 1999, hotel entrepreneur Robert Bigelow read a magazine feature about TransHab and decided he wanted to build something similar, possibly leading to a hotel in space someday. He built a facility in Las Vegas and got started.

After a couple of years, Bigelow's interest in inflatable modules and NASA's lack of TransHab funding converged into a mutually beneficial arrangement called a Space Act Agreement. The



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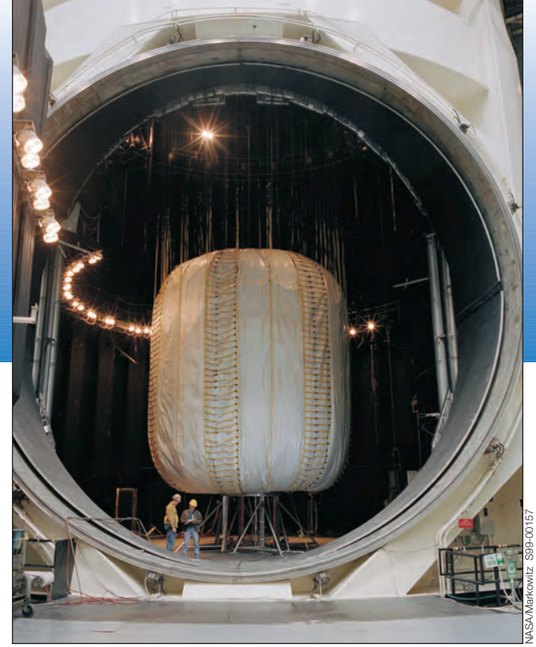

NASA/Markowitz S99-00157

In these 1998 images, a full-scale TransHab test unit is shown in Building 32's vacuum chamber—first in its compacted launch state, and then in its inflated operational state.

TransHab team members had moved on to other projects at JSC, but under the new agreement, they were requested to visit the facility in Las Vegas a few times per year to offer advice to Bigelow Aerospace.

"He had some degree of success, but it wasn't going to get him to large-scale hotels in space," said Johnson. Seeking further support from JSC, Bigelow purchased a building near Ellington Field in late 2004. Johnson, Raboin, Spexarth and colleague Glenn Miller—now in JSC's Structural Engineering Division—helped transform the building into an inflatable module production facility.

The company had also licensed the rights to the patents for several TransHab technologies and materials. Interpersonal Act Agreements were arranged so that JSC's inflatable module experts could work side-by-side with Bigelow Aerospace full-time.

It became a truly symbiotic relationship: Bigelow's team gained invaluable expertise and experience from the JSC employees, while the team in turn had the chance to take the existing TransHab technology to the next level.

"We had the expertise and made it available to the commercial sector," said Raboin. "They're putting up the resources to help us further the technology."

For example, the partnership has allowed the JSC experts to develop micrometeoroid protection that is just as strong, but more cost-effective. Further advancements included a design for adding windows to the modules and an improved method of folding the structures for launch, both of which were successfully proven in recent tests.

In the year and a half that the two groups worked together full-time, three inflatable module test units were manufactured at the Clear Lake facility. Two were pressure tested in Las Vegas, and the other module test unit demonstrated shell folding and inflation at the Clear Lake facility.

Bigelow launched its first module, Genesis 1, on July 12 aboard a Russian rocket. Shortly after launch vehicle separation, it was expanded to full size and underwent a series of systems tests. The company plans to launch additional test modules and larger spacecraft in the future.

"Back to the front burner"

The launch of the Bigelow module is very much a success story for NASA as well as for the company. The collaboration between the two is an example of the kind of partnerships that the agency hopes to build on the path to the Vision for Space Exploration. It will take lots of innovation—from government and private enterprises alike—to get back to the moon and on to Mars.

"NASA can't do all of this alone," said Michele Brekke, director of JSC's Technology Transfer Office. "NASA wants to develop relationships with industry to enable and facilitate commercial involvement in space."

Spexarth says that NASA also benefits from the recent launch because of the increased awareness of, and renewed interest in, inflatable spaceflight modules.

"TransHab had been (in) the backs of people's minds for years," he said. "The fact that (Genesis is) up there orbiting, it kind of brings the technology back to the front burner again. It opens people's eyes that this is feasible."

The TransHab team members said they hope that the strength, size and adaptability of inflatable modules play an important role in upcoming Exploration missions.

"Absolutely!" said Raboin when asked if he thought the technology would be a part of the Vision. "I don't see how it can't be."

When your job depends on...

crying wolf

by Catherine E. Borsché

We have a fire is not a statement anyone would relish hearing, especially if the person saying it were an astronaut in an International Space Station module while on orbit. Although the real-life scenario is nightmarish, it is the duty of the training teams in the Environmental Control and Life Support Systems (ECLSS) Group and the Station Training Lead (STL) Group to work with crews on potential, life-threatening emergency hazards. The goal of the training is to familiarize the crew with emergency scenarios by using a combination of classroom instruction and actual drills so, in the case of a catastrophe on orbit, handling it would be instinctual.

The training is basically broken down into two elements.

"The ECLSS Training Group provides what's called emergency introductory training, which (is) the basics of how to run the procedures, how to use the equipment, what you do in certain mockups—all the basic introductory how-to stuff," Clinton Balmain, station training lead for United Space Alliance, said. "Once they're done with that they hand the crew over to the STL Group, and we handle the emergency proficiency training. We take the skills they learned in the classes and reinforce and build on them. They get to actually use (those skills) out in the Building 9 station mockup."

Johnson Space Center is home to Building 9, a unique facility where life-sized mockups of station modules and the space shuttle serve as valuable practice arenas for astronauts before missions. In these mockups is where the real scenario training comes into play. The astronauts are not being taught anything new, but they are there to practice and put it all together with their fellow crewmates using real procedures and high-fidelity hardware to see how they really respond to emergency situations.

In the mockup, the teams rely on a variety of equipment to enhance the realism of their emergency training.

"We have a large pressure gauge we use for rapid depressurizations, so the crew can look at this gauge and tell, based on how fast the pressure is going down, how long they are able to stay onboard," Balmain said. "We do have a smoke machine. It's a standard disco, '70s fog machine, but we've got it set up and use it to dump smoke into the module to obscure the crew's vision."

The training in the smoke-filled module can be compared to the training conducted by the airline industry.

Cosmonaut Sergei K. Krikalev, Expedition 11 commander representing Russia's Federal Space Agency, participates in fire procedures training in the International Space Station mockup in the Space Vehicle Mockup and Training Facility at Johnson Space Center.

"It's a very similar setup to what the airlines use. In fact, one (airline) uses a similar machine to do flight attendant training. It enables them to practice what to do when you've got a plane full of people and there's smoke in the cabin," Josh Matthew, Expedition 14 ECLSS training lead for United Space Alliance, said.

The emergency scenarios training encompasses three types of emergencies: fire/smoke events, rapid depressurizations and toxic releases.

"Within those scenarios, we do different variations. We have the smoke versus the light haze, and you see immediately what it is and go handle it, all the way up to an open flame. We have rapid depressurization, where the crew has anywhere from six hours to 30 minutes until they need to leave (the module)," Balmain said. "And for toxic releases, anything from a leaky battery—something that you just kind of wipe up and throw in a trash bag—all the way up to ammonia in the atmosphere."

Rapid depressurization is usually caused by micrometeorites or other types of orbital debris that can penetrate the station.

"A half-inch hole gives the crew only a 30-minute to an hour-long reserve time, so it doesn't take a lot," Balmain said.

"Fortunately anything that big is being tracked," said Stacy Cusack, Expedition 15 ECLSS training lead for Barrios Technology. "It's the really, really tiny ones that are harder to track. Anything that could cause a big enough hole, they'll move out of the way for."

The training groups know that their mocked-up emergencies have a big impact in the overall confidence of the crews going into orbit.

"In the simulations, sometimes they have to power stuff down and bring down the entire mockup, so we will actually turn off the lights in the mockup. Now they're in smoke and it's dark, and we have masks that they put on to obscure their vision and their communication so that they learn what it's like to try to talk with this big rubber mask on," Balmain said.

"What I've always noticed is it's very interesting during cases that use (smoke) versus ones that don't," Matthew said. "In the cases that do use it, the crew moves much quicker. You can tell just by watching the crew that there is a different level of realism just in the way they respond. Even for a case where they don't necessarily have to go into the module that's full of smoke at the outset, when they see that visual indication is there, it helps to get them in the right frame of mind."

There are many training scenarios that make it obvious just how "real" it seems inside the mockup.

"We had a student very recently where we were doing a fairly drastic case with lots of smoke, and he was kind of on his own and the other two crew members were isolated…and I looked at him and his hands were shaking," Balmain said. "I had never seen that before in a student. But he was in the moment, and that adrenaline was going so much that he was physically responding to the environment around him."

Cusack also recalls a similar situation.

"We've seen some more things when we pretend one of the crew members is incapacitated. The emergency will call for one of them to be injured, and that is another way to definitely get different reactions. It certainly gets the heart rate up, and they start working really hard," Cusack said. "It changes everything."

The emergency scenarios training encompasses about 20 to 25 total hours for a particular crew, and the training takes place both at JSC and in Russia. Different instructors come to teach the crews depending on the type of emergency scenario being practiced. For instance, since fires are often electrical in nature, there is an electrical systems instructor on hand to oversee the drill. Toward the end of the training, mission operations personnel, such as a lead flight director, CAPCOM and others, come in to piece it all together.

Emergency scenarios training is a necessary element to safety in space exploration.

"Emergency training is in some ways a lot like drivers' education was. The classroom training we provide the crew is a lot like the classroom portion of drivers' ed.—you're learning the rules of the road, how to work the car, how to do certain things," Matthew said. "The scenarios training out in Building 9 (is) really the behind-the-wheel, on-the-road-type training, where you've got instructors with you and usually a car full of people. That's the correlation. We provide the rules up front, and then we do our best to go out and learn to drive."