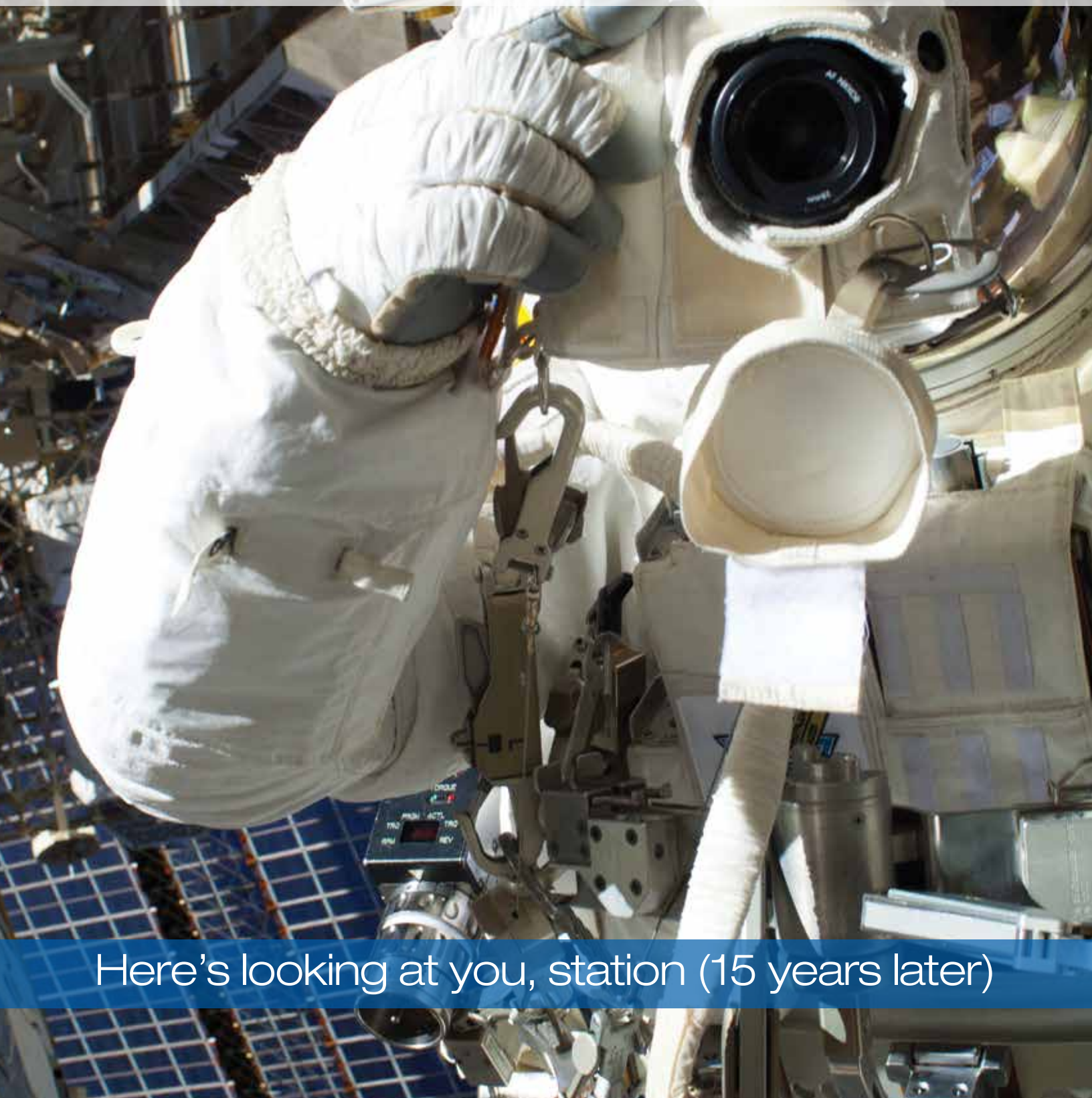
National Aeronautics and Space Administration

Roundup

LYNDON B. JOHNSON SPACE CENTER

Fall | 2013



Here's looking at you, station (15 years later)

Guest Column

In this edition…

NASA/PHOTO

Kirk A. Shireman
JSC Deputy Director

WE WERE LYING on our backs on the side of the road. The night was ink black and the temperature was a balmy 10 degrees Fahrenheit. We were watching the Leonids meteor shower from one of the darkest spots on the planet: Baikonur. The night was November 18, 1998. As I lay shivering and watching the meteor shower, I tilted my head to the side and looked north. About a mile away was the lighted Proton Rocket with Zarya on the fairing. The first piece of the International Space Station (ISS) was poised to start the next phase of human spaceflight two days later.

What a magnificent machine we have built together over the ensuing years! Under the leadership of NASA and Johnson Space Center, five partner agencies came together to build the largest, most complex spacecraft in history.

The space station turns 15 years old in November, and it is a time for reflection—not of our past, but of our future …

- The ISS is being used for human research, fundamental science and technology development, and also as a platform for supporting the next phase in human exploration.
- The Orion vehicle is one year away from its first test flight. Work is finishing up on the first heat shield, and the operations team is flowing data from the Mission Control Center here in Houston to the vehicle avionics test facility in Denver.
- The Commercial Crew Program is on the cusp of releasing the Request for Proposal for the development of commercial transportation system(s) to carry our astronauts to the ISS.
- The entire center is working to become more lean, agile and adaptive to change as part of JSC 2.0, which will allow JSC and NASA to achieve all of our exploration goals.
- And much more …

Happy 15th birthday, ISS. I look forward to the next 15 years!

NASA/PHOTO

On the cover:

NASA astronaut Chris Cassidy, Expedition 36 flight engineer, uses a digital still camera during a spacewalk outside the International Space Station on July 16.

NASA/PHOTO

Photo of the month:

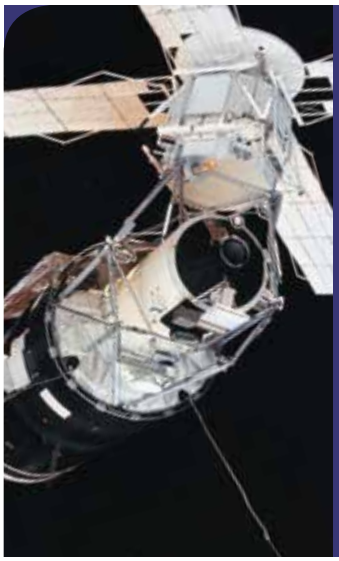
Morpheus (foreground) is an Advanced Exploration Systems vertical test bed vehicle being used to mature new, non-toxic propulsion systems and autonomous landing and hazard detection technologies. While testing was postponed on Sept. 5, Johnson Space Center could still locate a pot of gold at the end of it all (rainbow visible in the background).

By Janet Stewart

Forty years later, the International Space Station Program pays homage to the first space station

THIS YEAR MARKS THE 40TH anniversary of Skylab, the nation's original space station. Remembered for taking research to new heights and paving the way for future exploration into the solar system, Skylab's experiments proved humans could adapt to microgravity and function effectively in that environment for months at a time.

Skylab, launched May 14, 1973, atop a Saturn V rocket, served as a precursor to what we do in space today.



NASA/PHOTO SL3-114-01660

A close-up view of the Skylab space station cluster photographed against a black sky background from the Skylab 3 Command Module (CM) during the "fly around" inspection prior to docking. Aboard the CM were astronauts Alan L. Bean, Owen K. Garriott and Jack R. Lousma, who remained with the Skylab space station in Earth orbit for 59 days.

"When we started the Skylab Program, we had to make a lot of guesses about the best way to operate in space," said International Space Station Program Scientist Julie Robinson, Ph.D. "Everything from how to plan the day, to how to have the crew exercise, to how to operate instruments on a human-occupied spacecraft. Skylab helped us define the problems for long-duration spaceflight, and now the International Space Station is solving them one by one."

The nation's first space station served as the greatest solar and Earth observatory of its time, a microgravity lab, a medical lab and a home in the sky. Three Skylab crews completed more than 300 investigations to answer questions about our planet, the universe and living in space. The variety of research disciplines included human physiology, materials science, technology demonstration and even student experiments. As a result of Skylab's contributions, the current International Space Station is a world-class laboratory enabling scientific research in orbit for close to 13 years.

Astronomical observations returned from the Apollo Telescope Mount, the instrument rack that kept Skylab's array of eight solar telescopes pointed at the sun during a period of extraordinarily high activity, returned remarkable results. Skylab's first commander, Charles "Pete" Conrad, said his command of Skylab meant more to him than his walk on the moon, since he brought back an incredible amount of information from these solar telescopes on Skylab that nobody had seen before. Today, spectrophotometers mounted on the outside of the International Space Station measure solar irradiance, the energy from the sun that reaches Earth, significant to Earth-based and space-borne communications systems and our climate.

In addition to filming the sun, Skylab returned more than 40,000 photographs of the Earth, giving valuable data pertaining to geographical, forestry and oceanic industries. There now are more than 1 million photographs taken from the space station of our home planet with standard cameras, and thousands more with specialized cameras such as the Hyperspectral Imager. Specific studies including mapping the characteristics of tropical rain forests; agricultural crops, forests and rangeland areas; urban/developed areas; water resources; geologic features; and maritime/littoral zones, wetlands and coral reefs.

One key area of research traversing from Skylab to today's space station is the concern for body mass and bone density loss due to the microgravity environment. Scientists now know from these studies that sufficient resistive exercise and proper nutrition can maintain bone density during long-duration spaceflights.

Medical breakthroughs, like ultrasound training methods developed for use on station, have been used by the American College of Surgeons to teach imaging techniques to technicians, doctors and hospitals. These techniques have applications for diagnosing injuries and illnesses in remote locations on Earth, disaster areas and war zones.

Skylab's success can be attributed not only to the nine astronauts who made up the rotating crew, but also to the many ground-based teams who worked vigorously during the program.

"The space station was built around what we learned on Skylab," said astronaut Kevin Ford. "What they put up there for us, the way the modules were sized and the way they were constructed in space ... that all came out of what we learned from Skylab."

The investigations performed aboard Skylab, much like the work performed on today's space station, will continue to help extend our reach into the solar system.

Happy anniversary, Skylab. Thank you for the paving the way.

Fifteen years after the first element launch, station is a bustling research platform committed to science investigations. Here, in the space station's Columbus laboratory, Expedition 36 Flight Engineer Chris Cassidy performs an ultrasound on European Space Agency astronaut Luca Parmitano, flight engineer, for the Spinal Ultrasound investigation.

NASA/PHOTO ISS036E035750

Houston-area high school students stick—and stitch—together for space station

By Hayley Fick

WITH EXPEDITION 36 Flight Engineer Karen Nyberg's plans to quilt in space gaining attention on Pinterest and a recent Google+ hangout about the role fashion plays in spacesuit design, it has become obvious that the arts and sciences are closely tied together in space exploration.

Thanks to High School Students United with NASA to Create Hardware (HUNCH), realizing unique and unexpected ways to contribute to human spaceflight can begin as early as high school.

NASA/JAMES BLAIR JSC2013E057381

From left to right: JSC Deputy Director Kirk Shireman, fashion design teacher Darlene Parsons, Oak Ridge High School principal Tommy Johnson and ISS Utilization Manager Joel Montalbano.

Darlene Parsons, a fashion design teacher at Oak Ridge High School in Conroe, Texas, teaches students to manufacture Cargo Transfer Bags (CTBs) for the International Space Station (ISS) using heavy-duty sewing machines donated by the HUNCH program.

In the past four years, Oak Ridge High School has manufactured more than 100 CTBs that were used to carry precious cargo to station.

Schools from 17 different states participate in the HUNCH program, but HUNCH Project Manager Stacy Hale said that Oak Ridge High School is a stitch above the rest.

"Oak Ridge High School is the most successful family and consumer science program we have," Hale said.

During an award ceremony at Oak Ridge High School on June 7, Kirk Shireman, deputy director of the ISS Program at the time and now Johnson Space Center's deputy director, presented the school with a student-made CTB that was flown to the orbiting laboratory, a certificate of flight signed by an astronaut and a montage signed by ISS Program Manager Michael Suffredini.

"NASA and ISS really appreciate the great work you and your students have done," Shireman said.

The CTB presented to the school flew to the space station aboard ATV-3 in October 2012 and stayed aboard until it was returned home on the Space X Dragon 2, which was recovered from the Pacific Ocean in March 2013.

Not all hardware created by students in the HUNCH program gets flown to space. Most student-made hardware is used by NASA for training purposes on Earth.

"If you fly it, it has to be the very very top quality," Shireman said.

Students in Parsons' class had to undergo special training to learn how to manufacture hardware that is Class 1 flight ready, and were required to score a 90 or above on tests in controlled storage, linear measurement and stitch inspection before they could begin working on the CTBs.

Parsons has 150 total students in different class periods working on the CTBs. Students were broken into groups to accomplish each step of assembling a CTB. Some mastered certain skills better than others, so the students were placed in each group based on their ability.

"There is a position for every level of student," Parsons said.

One group was tasked with measuring and cutting the parts of the bag out of Nomex, a flame-resistant material necessary for avoiding fire hazards in the oxygen-rich environment of the space station.

Another group used heavy-duty sewing machines with thick thread to stitch each of the 48 parts together. Trips to the labs at JSC helped students learn the importance of each piece. The labels help astronauts identify what is stored in each bag since they all look the same, and the Velcro helps make sure the bags don't float all over the space station.

The last group inspected every last stitch of the final product to make sure it met Class 1 quality control standards.

George Kessler, HUNCH Program softgoods expert, said the students are not just learning how to assemble the CTBs, they're learning valuable career skills.

"They're learning teamwork, how to follow a process and all checking each other's work," Kessler said.

HUNCH was founded in August 2003 under the premise that high school students could fabricate cost-effective training hardware for NASA. An important byproduct of creating hardware for NASA is promoting student interest in science, technology, engineering and math studies.

For more information on HUNCH, go to: http://www.nasahunch.com

NASA/JAMES BLAIR JSC2013E057379

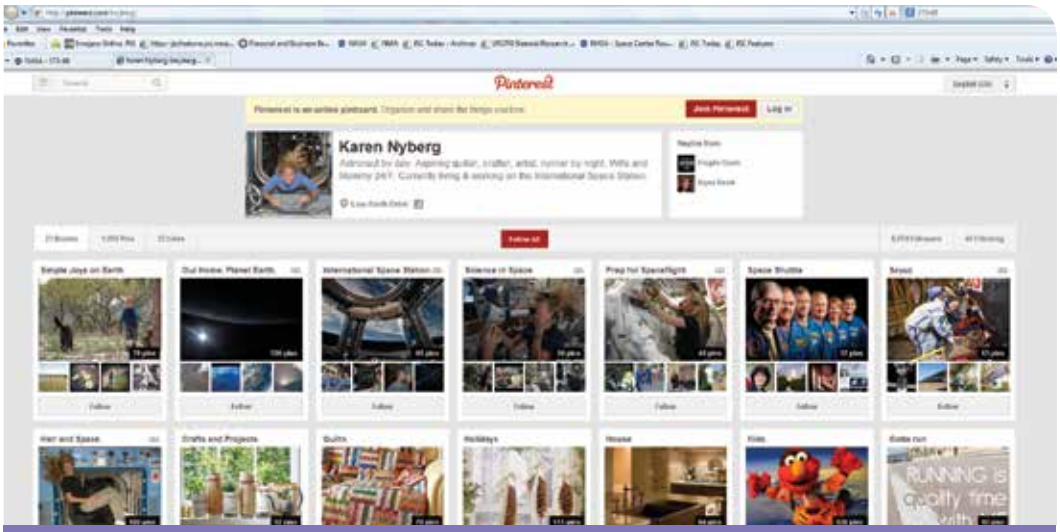
Shireman presents a student-made CTB that spent five months aboard the space station to the teachers and staff at Oak Ridge High School during an end-of-the-year award ceremony. The CTB was made by Parsons' fashion design students participating in NASA's HUNCH program.

What's your (space)craft?

How crafting is helping those at Johnson Space Center

By Tammie Letroise-Brown

ARE YOU A PINNER? (On Pinterest, that is.) Well, if you are, you might have noticed there is a certain pinner aboard the International Space Station, sharing her love of quilts. That's right—NASA astronaut Karen Nyberg is thousands of miles above us, aboard the orbiting laboratory, crafting along with many of us the world below. People might be surprised to know that an astronaut would have this kind of soft skill, but quilting is not just for the "tea and crumpet" set. It's one of the many passions of folks who work here at Johnson Space Center and turn to a softer, more artsy skillset when not managing out-of-this-world assignments.



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See what crafter and astronaut Karen Nyberg is up to on Pinterest at http://pinterest.com/knyberg.

Take, for example, Heather Bergman. Bergman is a project manager at JSC, and her passion is crocheting and cross stitch when she is not at work.

"I really use crocheting as more of stress relief—mainly as something to keep my hands busy," Bergman said. "While I sit in front of the TV, I'll crochet to relax and decompress."

Bergman is inspired by Nyberg's crafting and was moved to find out that the explorer has a Pinterest page.

"That's so cool," Bergman said. "Crocheting, quilting … these are dying skills that the younger generation is not very interested in. I think it's awesome Karen is bringing this back into the forefront."

NASA/BILL STAFFORD JSC2013E079767

From left to right, crafters Heather Bergman and Holly Cagle pose with some of their creative work.

That sentiment was echoed by Bergman's colleague Holly Cagle, an International Space Station deputy system manager.

"It seems in the last few years, there's been a surge of interest in handmade arts and crafts and sustainable living, such as gardening and canning," Cagle said. "Things that were once thought to be 'old fashioned' and necessary for survival are suddenly now very 'in vogue,'" Cagle said. "It's really cool to be crafty."

Cagle's craft of choice is quilting. She is even a part of a once-a-month "quilty lunch," where a group of JSC quilters and crafters gather to share ideas and show off their crafts. The group still meets on-site, and all crafters are welcome.

Cagle also finds her craft as a means to release the tension of the day while doing something fun and productive.

"I was so excited to see Nyberg on orbit with her quilt squares, needle and thread," Cagle said. "Hopefully, we'll get to see the finished product."

Interestingly, quilting and other craft projects share similarities with engineering development projects.

"A need or desire is identified, a pattern is designed and developed, materials are procured, project phases and milestones are reached (cutting, piecing, basting, quilting, binding, labeling) and, finally, your project is complete and ready for implementation," Cagle said.

And, hobbies beget other hobbies. Cagle has more passions, such as canning and jewelry-making.

"I'd love to have my own canning and specialty-foods company someday," Cagle said. "I make habanero jams and jellies and enjoy sharing my love of food with others."

Who knew that quilting would be one of the new "it" hobbies in space? One thing for sure is that with Nyberg sharing her crafting adventures—as well as space adventures—a more technical crowd is being exposed to the intricacies and joys of soft skills. For some, that is a whole new world worthy of being explored.

International Space Station celebrates 15 years after first element launch

By Catherine Ragin Williams

BY ITSELF, THE EVENT WAS UNASSUMING. A Russian Proton rocket launch on Nov. 20, 1998, sending a 42,600-pound pressurized module 240 statute miles above the Earth, where it would await Space Shuttle *Endeavour* and the STS-88 crew. But it was actually something more—the genesis of a new spaceflight program and a way to study our planet and solar system minus the ever-present and cumbersome force of gravity. It was a new dawn.

NASA/PHOTO S88E5156

The mated Russian-built Zarya (left) and U.S.-built Unity modules are backdropped against the blackness of space over Earth's horizon shortly after leaving *Endeavour's* cargo bay.

A destination wedding

That module, Zarya (Russian for "sunrise"), was the first piece of the International Space Station (ISS). Also known by a blander moniker, the Functional Cargo Block (FGB), the FGB would provide a nucleus of orientation control, communications and electrical power while the station waited for its third element, the Zvezda service module. (Zvezda would serve as crew quarters and an early space station core.)

But before Zvezda would be the Unity connecting node provided by the United States, just days after Zarya's fiery ascent.

"We were in the control center in Houston that night to watch Zarya launch, along with a good number of people from the program," said Bill Bastedo, who is currently senior vice president of Booz Allen Hamilton. At the time, Bastedo had the technically demanding task of launch package manager for Unity, also known as Node 1. "It was actually, for us, exciting to have Zarya on orbit so we could get our chance to execute our mission."

Then, a marriage

STS-88 carries the distinction of being the first space station assembly mission, and Kennedy Space Center Director Bob Cabana was its commander.

"We definitely knew there was no margin for error on that first mission—we had to be successful," Cabana said. "We also knew that it wasn't all on the crew. This was a team effort, and everyone was giving it all they had to ensure success. We had the privilege of following Node 1 from an aluminum shell in Huntsville to a fully functioning spacecraft on orbit."

Three years before Unity's launch, Bastedo was leading the teams that developed Unity and her two pressurized mating adaptors.

"We had to work closely with the Kennedy Space Center, the Space Shuttle Program Office and the Mission Operations Directorate (MOD) to plan the launch, on-orbit operations for the 14-day mission and define every detail of how we would assemble it on orbit," Bastedo said.

With Unity being the first U.S. component of the space station, Bastedo's teams and Cabana's crew set the standard for future space station assembly missions.

"I was very confident in our ability to dock the two," Bastedo said. "I was most worried about making sure we could verify that Unity, the mating adaptors and the FGB, Zarya, all worked as a system together and we could safely leave it on orbit, because it was going to be about a six-month gap until the next flight. It turns out it was a lot of worry about nothing, because it almost went flawlessly."

Indeed, Mission Specialist Nancy Currie did so well at operating the robotic arm with Unity at the end that Cabana admitted it was "a little like watching grass grow."

"Nancy did a superb job using the robotic arm to get Unity out of the payload bay with about an inch-and-a-half clearance, and then properly position it so we could attach it to the docking station," Cabana said. On Dec. 6, 1998, Zarya was captured and mated with Unity, beginning assembly of a capable research platform for the world.

"It was a testament to the hard work of the entire team when we sent the commands from the aft flight deck of *Endeavour* to activate the systems

NASA/PHOTO S88E5118

The attire of NASA astronaut Bob Cabana, left, and Roscosmos cosmonaut Sergei Krikalev stands out brightly against the whiteness of the pressurized mating adapter connected to Zarya. Cabana and Krikalev were joined by crew mates on this day in installing needed equipment aboard Zarya and the Unity connecting module.

NASA/PHOTO S88E5143

On Dec. 12, 1998, NASA astronaut James H. Newman, mission specialist, works at the edge of the Unity connecting module during the STS-88 mission's third and final spacewalk. The solar array panel on the Zarya module is at right.

"It's rare for us working on a 24x7x365 program, dealing with anomalies and continuing to produce scientific results, that we take pause and take stock of what we are accomplishing. This Nov. 20, we will be celebrating 15 years of ISS on-orbit operations; so I ask that you do take pause and celebrate that your efforts have sustained a peaceful partnership of many agencies and nations, have executed flawlessly the construction and operation of mankind's most complex technical project and have produced benefits to humanity that are only now being understood. Thank you all for your tireless efforts."

- International Space Station Program Manager Michael Suffredini

and everything worked perfectly," Cabana said. "In retrospect, we never really focused on the enormity of the task. We worked with the ground team to focus on learning all we could and being prepared for any contingency to make sure we were successful."

STS-88 also included Extravehicular Activities (EVAs), or spacewalks, including a contingency deploy of a Russian antenna that did not automatically unfurl.

"This was the beginning of a phenomenal string of EVAs in the assembly of the ISS that many believed was not achievable," Cabana said. "The ISS EVA team has done a truly remarkable job, from start to finish, in proving the importance and the ability to do complex assembly tasks and handle contingencies in the vacuum of space."

An international affair

Though two hunks of metal were symbolically joined and rotating in the eerie expanse of low-Earth orbit, it would be a few more days until a true international connection.

"Actually, when we berthed them together, it wasn't as emotional for me as the day we opened the hatch between the two, which was a couple days later," Bastedo said. "Once they were connected, we did the electrical and data checks from the ground. It was normal business up until we opened the hatches and had American astronauts and a Russian cosmonaut all in both volumes together. I was with the Program Office team in the Customer Support Room, and one of the things I remember most clearly from that mission was that there wasn't a dry eye in the room at that moment."

Finally entering station was a special moment felt very keenly by the shuttle commander.

"Prior to the mission, I was continually asked by the media who would be the first person to enter the space station, and I never said," Cabana recalled. "It had always been my plan that Sergei (Krikalev) and I enter together as a sign of international cooperation and the importance of our partnership.

"The two days that we spent inside the station removing launch restraints and preparing the modules for the first ISS crew were absolutely the best. I think the log book entry that I made that night still captures the sentiment of the entire crew and the importance of what we were doing:

December 10th, 1998

Activation of the International Space Station by the crew of the Space Shuttle 'Endeavour' *STS-88, ISS 2A.*

From small beginnings, great things come. Today we ingressed for the first time the 'Unity' and 'Zarya' modules. May the spirit of International cooperation in space exploration continue to grow, as the Space Station grows, taking us on to the Moon, Mars and beyond.

The crew of Endeavour

signed

Bob Cabana, Rick Sturckow, Jerry Ross, Nancy Currie, Jim Newman, Sergei Krikolev"

Fifteen years crystallizes cooperation and discovery

"When we were doing it, we actually felt it like it we were doing something much bigger than building hardware to fly," Bastedo said. "As hard as it was to develop the hardware, test it until we felt it was perfect and plan every mission detail with MOD, we found that it was even harder to be first space station element to be developed and to figure out how to do everything that all subsequent flows would do for the first time. We felt we did that very well and left the program in a good place. Looking back on it, I don't think I've changed my opinion that this was a something much bigger than another space shuttle payload deployment mission. We had such a large team distributed from coast to coast, all singularly focused on getting this done right and on schedule, that it became more than a job. I think that we all felt that after all the years of planning space station, all of

NASA/PHOTO S88E5085

STS-88 Mission Specialists Nancy J. Currie and Sergei Krikalev use rechargeable power tools to tighten and loosen nuts onboard the Zarya module, which they entered on Flight Day 8.

us felt that it was our destiny to deliver on the dream of all those that came before us to establish a permanent presence in space and to help make the world a little bit smaller place by creating this platform for international collaboration."

NASA/PHOTO

The first space station element, Zarya, launches on a Russian Proton rocket on Nov. 20, 1998, to await a rendezvous with *Endeavour*.

Time has flown for the engineering marvel.

"It's hard to believe it's been 15 years since we joined Unity and Zarya in orbit and laid the cornerstone for the International Space Station," Cabana said. "Station is truly an engineering marvel and a testament to what we can accomplish when we all work together. I think one of the most enduring legacies will be the international cooperation we have achieved in building and operating it. It has provided us the framework for how we will move forward as we explore beyond our home planet, not as explorers from any one country, but as explorers from planet Earth. We have seen great results in areas such as biotechnology, Earth and space sciences, human research, the physical sciences and technology being accomplished in this remarkable laboratory in space. It takes time, but I truly believe there will be even greater amazing breakthroughs that come from it, especially in the field of medicine. The ISS is the engineering test bed that enables us to prove the systems we need and deal with the crew health issues that must be solved for us to actually go beyond Earth for extended periods of time, when we eventually go to Mars and beyond."

NASA/PHOTO IS88E5030

Mission Specialist Currie gently mated the 12.8-ton Unity connecting module to *Endeavour's* docking system late afternoon on Dec. 5, 1998, successfully completing the first task in assembling the new International Space Station. Deftly manipulating the shuttle's 50-foot-long robot arm, Currie placed Unity just inches above the extended outer ring on *Endeavour's* docking mechanism, enabling Mission Commander Cabana to fire downward maneuvering jets, locking the shuttle's docking system to one of two Pressurized Mating Adapters attached to Unity.

The latter part of 1998, when the building blocks for station came together, will always remain a pinnacle for Bastedo and Cabana.

"Getting the first piece on orbit and up and operating, and watching the rest of it go together, it was terribly gratifying," Bastedo said. "I'd stay up late watching NASA TV and watching things being assembled on the subsequent missions."

Station has been, and continues to be, unforgettable

"I have been blessed to be part of this exceptional NASA team for many years, and I fondly look back on STS-88 as one of the highlights of my career," Cabana said. "We got the ISS off to a great start, and the team never slowed down and continues to forge ahead in so many areas aboard the ISS. I distinctly remember debriefing then JSC Director George Abbey in his office after the mission. I said, 'George, I don't know how I can top this flight.' His reply: 'I don't know why you'd want to try.' I've been wearing a tie to work ever since."

Orion suiting up with a next-generation **spacesuit**

By Mark Carreau

FOR THE FIRST TIME in more than two decades, NASA is submerging a spacesuit of the agency's own design in the test waters of Johnson Space Center's Neutral Buoyancy Laboratory (NBL).

Regular sessions underway at the NBL with test astronauts and engineers are intended to prepare a familiar version of the lifesaving garb for a new role as a baseline launch-and-entry suit for the Orion Multi-Purpose Crew Vehicle.

The Modified Advanced Crew Escape Suit (MACES), an upgraded version of the distinctive orange Advanced Crew Escape Suit (ACES) that astronauts donned for the launch-and-entry phases of shuttle operations, may also qualify for Orion-based Extravehicular Activities (EVAs), or spacewalks.

"So, where we start is we say, 'OK, we have this suit,'" said Dick Watson, JSC's subsystem manager for the Orion spacesuit. "We have modified ACES to fit Orion, and now we are asking the question: What additional modifications can we make to improve it for spacewalk capabilities?"

It's been some time since JSC engineers and astronauts gathered in the former Weightless Environmental Training Facility at JSC to evaluate the Mark III and AX-5 prototypes, two NASA candidates for an International Space Station spacesuit. Ultimately, an evaluation team decided to modify the shuttle's Extravehicular Mobility Unit (EMU) for the space station role instead.

Can history repeat with MACES rather than a clean sheet approach stepping into the Orion EVA as well as a launch-and-entry role? Much depends on the NBL testing in the months to come. Currently, Orion's first piloted mission is not envisioned until 2021. The range of spacewalk tasks Orion crews might be assigned and the tools they would require have yet to be fully addressed.

"At this point, we've been very successful at showing this could work," Watson said of early spacewalk assessments using the MACES suit.

NASA/PHOTO JSC2012E108321

Len Groce (left) looks on as Angela Lesser (suited in MACES) evaluates the spacesuit's pressurized translation capabilities in microgravity conditions aboard the Zero G Corporation's 747 aircraft.

NASA PHOTO

Test subject Richard Watson tests the body-positioning abilities of the MACES, a garment that will be worn by astronauts during future deep space missions, while underwater.

ACES, and now MACES, trace an ancestry to the flight suits developed by the David Clark Co. of Worcester, Mass., to keep the pilots of high-altitude military aircraft alive in a regulated, low-altitude-pressure environment should their vehicles experience a sudden decompression.

The transformation from ACES to MACES largely escapes the eye. Nonetheless, it's significant because it involves the way astronauts breathe once their helmet visor is closed.

Aboard the shuttle, pure oxygen entered the ACES. The air exhaled by the astronauts entered the crew cabin through a regulator, quickly raising the oxygen levels to concentrations that could accelerate a fire. Typically, shuttle crews sealed their visors for no more than 20 minutes.

Orion missions will take astronauts far from Earth, where risks increase. An impact with a micrometeorite could breach the spacecraft, for instance, forcing the astronauts to don and wear their suits for several days as they attempt repairs or made their way back to Earth.

MACES is configured for compatibility with Orion's life support systems, which allow the air exhaled by the astronauts to enter the cabin. Scrubbers remove carbon dioxide and moisture from the cabin air and add oxygen as needed.

(continued on page 12)

Spotlight: **Bill Foster**

Ground Control (GC) Officer in the Mission Operations Directorate (MOD), Honeywell Technology Solutions, Inc.

Q: Coolest part of your job at Johnson Space Center?
A: Being part of the Flight Control Team for human spaceflight.

Q: It's been said that you have been the heart of Mission Operations at JSC for a long time. What keeps you passionate about your work in this directorate?
A: I would not classify myself that way, but rather part of a large team responsible for the plan-train-fly aspects of U.S. human spaceflight. If anything, I am a torch bearer for the culture and history of the MCC (Mission Control Center). As a GC, I have control of the front screens and have created welcome home displays for many of the shuttle flights I supported, as well as hundreds of welcome displays for guests to the MCC, ranging from professional athletes, musicians, members of royalty, scientists, actors and politicians. I helped bring back the tradition of team photos and photo documentation of the MCC during missions, which had virtually ended after the move to the new shuttle control room in 1995, and have been involved in coordinating plaque-hanging ceremonies since 1997. I am frequently asked about the history of the MCC and to provide tours. I also frequently speak to Space Center Houston tours and have served as the interface to them for the banners in the space shuttle room since 2005.

Q: What personal achievement are you most proud of?
A: My family first. Other than that, I am an Eagle Scout, was president of a National Management Association chapter, chaired a United Way campaign and was on the board of several local charities. Since becoming a GC, I have received the Silver Snoopy, Space Flight Awareness launch honoree, hung the plaque for STS-105 and received a Foundations of MOD award. I was commissioned as a Kentucky colonel in 2003, complete with large ornate certificate from the governor of Kentucky, but never found out why. What I am most proud of at work, though, is helping to create the spaceflight memorial emblem to honor the crews of Apollo 1, *Challenger* and *Columbia*. After the *Columbia* accident, I asked Mike Okuda, a graphic artist with "Star Trek," for help with this. The emblem ended up on the back cover of the Columbia Accident Investigation Board report and now hangs in the MCC with the Apollo 1, *Challenger* and *Columbia* plaques.

Q: What would people be surprised to know about you?
A: I drove tractor trailers for Foley's while getting my degree, and continued on weekends after starting at NASA. I also drove a mock-up train for Foley's, a Kubota tractor with a locomotive façade and four large cars. My youngest son would sit on my lap as we drove in the Thanksgiving and rodeo parades, both Houston Rockets' victory parades, and even had former first lady Barbara Bush onboard once for a special event in the medical center.

Q: If you could trade places with any other person for a week, famous or not famous, living or dead, real or fictional, who would it be?
A: A week on the International Space Station would be awesome—will trade with any crew member!

Q: What is your favorite indulgence?
A: Time with the family. Sometimes there is a shortage of opportunities with our schedules at work.

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Q: What subjects interested you while growing up and in school?
A: English and physics.

Q: What seemingly "little things" bring you joy?
A: Watching nature, especially thunderstorms, and gazing out the window of an airplane.

Q: What is your favorite way to spend a Saturday?
A: With my family.

Q: Describe yourself in three words.
A: Husband, father, GC.

Q: What is the best piece of advice you've heard?
A: Watching my father's work ethic.

Q: When did you first become interested in space and why?
A: I grew up following the Mercury, Gemini and Apollo missions, read Heinlein and Asimov, among others, and of course was a big fan of the original "Star Trek" series.

Q: What is your favorite memory at JSC or of the space program?
A: Flying in the Vomit Comet (KC-135 version); riding along for dives in the Shuttle Training Aircraft at Kennedy Space Center (KSC), Edwards Air Force Base and White Sands Space Harbor (WSSH); driving an M-113 tracked vehicle around launch pad 39B; riding in the open door of a NASA Huey flying low around KSC; racing down the runway at WSSH in a convoy van; and, of course, supporting 44 space shuttle ascent and entry shifts from the MCC. I was even able to get onboard the USS Enterprise (NX-01) a few times and meet Captain Archer, Scott Bakula, and played an Apollo-era flight controller in Gene Kranz's "Failure is Not An Option" documentary (about one second of on-screen time, I think).

Q: What is NASA currently doing that has you most excited?
A: I'm looking forward to the future of human spaceflight as we progress beyond low-Earth orbit. The pace is slower than I had hoped, and I may end up watching from the sidelines, but I know it is coming.

Johnson Space Center hosts Pumps and Pipes

TEAMS FROM NASA, Jacobs Engineering and Raytheon at Johnson Space Center partnered with members of BayTech and the Bay Area Houston Economic Partnership to host the mid-year meeting of Pumps and Pipes, a collaborative effort between three of Houston's largest industries to find synergies in each other's expansive technology portfolios.

Held at the Neutral Buoyancy Laboratory, the conference focused on connecting professionals from the medical, oil and gas and aerospace industries to explore each other's "toolkit," looking across industry for complementary technologies that could provide innovative solutions to problems. As part of this, NASA showcased a "Top 10" of its current technology projects, including cold storage, augmented reality, telerobotics, fuel cells, ice drilling and water cleanup.

During the opening ceremonies, JSC Director Ellen Ochoa was named as one of the joint directors of Pumps and Pipes, while former astronaut Scott Parazynski was appointed to the partnership's board of advisors. In her opening remarks, Ochoa touched on the numerous beneficial partnerships JSC has formed with businesses outside of NASA.

"JSC has placed an emphasis on our commitment to being engaged outside our fence by creating the Strategic Opportunities and Partnership Development Office," Ochoa said. "This office facilitates a variety of relationships locally, statewide and nationally, helping us to expand relevance of NASA technology to life on Earth."

Some of the resultant technologies from these partnerships include a new fiber-optic monitoring system for oil rig platforms, improvements in the transportation of critically ill newborns and new uses for NASA-developed robotic systems for patient rehabilitation and prosthetic devices.

NASA/PHOTO

Pumps and Pipes taking place at NASA's Neutral Buoyancy Laboratory.

JSC's new rodeo: wrangling asteroids

NASA /PHOTO

This concept image shows an astronaut retrieving a sample from the captured asteroid.

IT IS ALONG THESE SIDEWALKS and within these buildings that planning already is underway to send astronauts farther than they have ever gone before—this time to retrieve samples from an asteroid that almost certainly is made up of ingredients from the early solar system.

The JSC-led team is putting the pieces together for a 24- to 30-day mission culminating in the return of samples from an asteroid placed in a stable lunar orbit, waiting to be harvested.

The building blocks and creativity for designing such a mission is located at one place on Earth—here at JSC. Shaping those blocks into a mission leading to an asteroid really began almost 50 years ago, when the center opened to cradle America's human spaceflight training and flight control activities.

Learn more about the Concept Analysis Team, who helped determine if an asteroid is indeed in our future, and how Orion will connect the dots along the path. Read the full-length article in JSC Features: http://go.usa.gov/DQGQ

Roundup

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Orion suiting up with a next-generation spacesuit

(continued from page 9)

NASA/PHOTO

NBL diver Craig Shannon outfits test subject Richard Watson with weights during the first manned NBL test of NASA's MACES.

"We know what MACES was designed for," Watson said. "Now we are asking the question: Where can we tweak the design and maybe make it do more?"

Efforts to convert ACES to MACES began about four years ago, when it was decided that about 70 shuttle-era pressure suits could be used as prototypes for Orion garments rather than discarded.

Unlike the EMU with its rigid upper torso and bearings within the shoulder, waist, arm and wrist joints to facilitate mobility, MACES is fabricated from restrictive layers of airtight fabric. Adding rigid components could lead to crew injuries if the spacecraft is jolted.

NBL work with MACES got underway in March. Evaluations using the Active Response Gravity Offload System developed to simulate weightless conditions on the ground, and later test flights aboard the Zero G Corporation's 727 aircraft to assess the suit's mobility, performance and safety, set the stage.

Test engineers and astronauts, including Watson, entered NBL waters in MACES for the first time in May. With the help of divers, the test team has been "weighing out" the garment to establish a neutral buoyancy for the work ahead.

"Over the summer, we will be adding enhanced gloves and perhaps enhanced mobility, elbows … possibly bearings in the lower arms to enhance flexibility there," Watson said.

"All the while, we must keep in mind this suit must keep its heritage for safety during launch and entry. We have to launch and land on every mission. An EVA may be more of a rare case. It's a balancing act for us."