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KSC NEWS

tech transfer

Dr. Paul Schallhorn, chief of NASA's Environments and Launch Approval Branch of Kennedy's Launch Services Program, is working on the Slosh experiment, designed to improve rocket safety, efficiency. See pages 6-7 to learn more.

in this issue:

Photo credit: Anthony (Tony) Gray, QinetiQ North America

KSC Technology Transfer and its Impact on the Local Community

Mike Lester
KSC R&T Partnership Development Manager

"We truly expect KSC Technology Transfer to contribute to the recovery of our local economy in a meaningful way."

On October 28, 2011, the White House released a Presidential Memorandum entitled: Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses. With this memo, the President challenged all federal agencies conducting R&D to accelerate technology transfer and commercialization of federally developed technology to help stimulate the national economy.

The NASA Technology Transfer Program responded by asking the center technology transfer offices to reach out to – and work more closely with – their regional economic development organizations to promote the transfer of NASA technologies to the local private sector for use in the marketplace.

Toward that effort, the KSC Technology Transfer Office teamed with the Florida Space Coast Economic Development Commission (EDC) to host a technology transfer forum designed to increase our business community's awareness of available KSC technologies for transfer. In addition, the forum provided opportunities for commercial businesses to collaborate with KSC in technology development. (see article on page 12)

The forum, held on September 12, 2013, focused on KSC technology transfer and partnership opportunities within the Robotics, Sustainability, Information Technology and Environmental Remediation technology areas. The event was well attended with over 120 business leaders from the community. KSC Center Director Robert Cabana and the Center Chief Technologist Karen Thompson provided remarks, and several KSC lead researchers presented technical information and answered questions, which were not in short supply. Florida Today and the Orlando Sentinel ran news stories on the forum and both NASA TV and Channel 6 News filmed portions of the event.

Given the reaction by the media and local business to the forum, it is evident the community is recognizing the opportunities that NASA-developed technologies can provide to aspiring entrepreneurs and existing companies to bring new technologies to market, as well as the positive impact KSC technology transfer can have on the local economy.

We see even more evidence of this in the efforts by several other organizations to develop programs that provide aspiring entrepreneurs with the opportunity and training needed to identify the commercial potential of specific NASA technologies and develop business plans to exploit that potential. Several initiatives include Florida Startup Quest, CareerSource Brevard Energy Launch, Rollins College Entrepreneurial Scholar of Distinction Program, and a new effort led by the University of Central Florida Office of Research and Commercialization to stimulate new business growth in Florida based on NASA technologies. The KSC Technology Transfer Office has stepped up to support each of these programs and is providing them with the NASA technologies they need to help move the economy forward. ■

KSC Inspires Local Entrepreneurs

KSC's Technology Transfer Program has partnered with CareerSource Brevard, the area authority on workforce development, on two innovative training programs for aspiring Florida entrepreneurs, Startup Quest and Energy Launch. Program participants received eight weeks of specialized curriculum on how to create commercialization and business plans for an existing patented technology. The participants are placed on teams and each team has a local expert mentor to help them create the plans for a specific technology. KSC and other Centers provided technologies for the teams to choose from. The teams presented the plans to a group of the investors at the end of the program and the top three teams receive monetary awards.

Lisa Rice, CareerSource Brevard, and Jeff Kohler, Technology Transfer Specialist.

The Startup Quest Program was created in Gainesville, FL, in 2011. It was born from the partnership of FloridaWorks, the University of Florida's office of Technology Licensing, the Gainesville Area Chamber of Commerce, and several key business partners. The pilot program was so successful that in 2012 FloridaWorks joined 7 other Local Workforce Investment Boards including CareerSource Brevard, and applied for the Workforce Innovation Fund Grant through the US Department of Labor for statewide replication of the Startup Quest Program. They were successful in this endeavor and were awarded almost $12 million toward this statewide effort.

Energy Launch is a cooperative effort involving CareerSource Brevard, NASA, and the Florida Institute of Technology (FIT). Energy Launch, like Startup Quest, is designed to train entrepreneurs to develop NASA/FIT energy-related patented technology for the purposes of expanding business and creating jobs. This program is funded by the Clean Energy Jobs Accelerator grant. The Space Coast Clean Energy Jobs Accelerator was one of 20 projects nationwide that is sharing a total of $37 million in federal funding. The projects will provide training for over 4,000 dislocated workers in Florida. ■

KSC's Dr. James Stanley's team captured 3rd place at the Energy Launch with Lisa Rice, CareerSource Brevard, far right (beside James Stanley).

licensing success

KSC Manufacturers Cryostats for Local Licensee

About the Technology

Cryostats are unique multipurpose thermal insulation test apparatuses that allow for the thermal performance characterization of cylindrical and flat specimens (e.g., bulk-fill, flat-panel, multilayer, or continuously rolled). They have the ability to measure performance over a full range of pressures (from high vacuum to no vacuum) and over a full range of temperatures (from 77K to 300K). Together with a team at Kennedy Space Center's Cryogenics lab, James Fesmire developed a series of Cryostats to test high-performance materials, such as aerogels, under real-world conditions. As a result, these instruments can be incredibly helpful to manufacturers that fabricate and test insulations, couplings, seals, or other devices at their production or laboratory facilities.

Brekke Coffman preparing Cryostat-200 for tests at NASA's Cryo Lab.

In today's world, efficient, low-maintenance, low-temperature refrigeration and thermal management is taking a more significant role in many industries, including the food and beverage, transportation (including space), energy, and pharmaceutical industries. The United States and many other countries have laws requiring commercially available insulation materials to be tested and rated by an accepted methodology. The new Cryostat methods developed at KSC go beyond the formal capabilities of the ASTM methods to provide testing for real systems, including full-temperature differences plus full-range vacuum conditions.

License to QinetiQ, N.A.

In 2012, the Kennedy Space Center Technology Transfer Office licensed the Cryostat-200 to QinetiQ, N.A., the prime contractor on the Engineering Services Contract (ESC) at Kennedy Space Center. Cryostat-200 is a cylindrical model Cryostat that includes a cold mass and accepts specimens up to 50 mm thick. QinetiQ, N.A., plans to manufacture the Cryostat-200 for materials manufacturers who can use the Cryostat for a broad range of thermal tests on high performance materials.

Making use of the unique knowledge and laboratory capabilities at Kennedy Space Center, QinetiQ, N.A., has hired ESC employees to fabricate the Cryostat-200 for its customers through the Center's Contractor Third Party Work (C3PW) Program. QinetiQ, N.A., plans to have units ready to sell in early 2014. ■

NASA QuickLaunch Licensing Tool

NASA recently released an online tool that makes the process of licensing easier for businesses and individuals interested in using NASA research to develop new products and services. The NASA QuickLaunch licensing tool provides public access to a select portfolio of patented NASA technologies for the purpose of licensing and commercial development. The tool is designed to simplify and speed up the licensing process with features such as preapproved terms and conditions (including a set initial fee and annual royalty), a streamlined process for electronic license agreements, and significantly reduced response and approval times. Tool users can search for technologies by NASA center or technology category, send questions directly to NASA licensing managers, and file their license applications online. The site, *https://quicklaunch.ndc.nasa.gov*, currently has 38 technologies available for licensing, with more technologies to be added in 2014. ■

Cryogenic Supply System Protects Crews from Hazardous Gases

The National Institute for Occupational Safety and Health (NIOSH), BSC Life Support, LLC and NASA's Biomedical Lab are partnering under a Space Act Agreement for the development of cryogenic life support systems. The device, Cryogenic Refuge Alternative Supply System (CryoRASS) and a smaller liquid air-filled backpack, called Cryo BA, have the potential to store more than twice the amount of breathable air than traditional compressed gas systems.

NIOSH is funding the project in hopes that the liquid air-based system could change the way coal miners seek refuge or flee from underground disasters. CryoRASS and CryoBA work by drawing air into a closed environment, then vaporizing and circulating it back to the user. NASA has used the cryogenic technology in its rescue crew SCAPE suits, short for Self-Contained Atmospheric Protective Ensemble, since the Mercury program in the 1960s.

Refuge chambers are designed to provide 96 hours of breathable air but the CryoRASS could "easily exceed the minimum requirements, allowing more time for the miners to be rescued," said KSC lead engineer David Bush. Another plan is being discussed to build refill stations in the mines spaced out about 90 minutes apart so crews could walk out of a disaster situation with the personal CryoBA backpacks.

Bush and his team continue to advance and refine the cryogenic technology and are gaining some attention from the Agency's newest human spaceflight programs. The team has met with the Technology Transfer Office and discussed the different options for commercializing the technologies. BCS Life Support will lead the commercialization and marketing efforts for the technologies once they are fully developed and tested. They will target the mining and aerospace industries initially. ■

KSC lead engineer David Bush demonstrates a Cryogenic Breathing Apparatus at the Mine Engineering Conference in the NIOSH booth.

Slosh Experiment Designed to Improve Rocket Safety, Efficiency

By Bob Granath, NASA's Kennedy Space Center, Fla.

Since Robert Goddard's first launch of a liquid propellant rocket in 1926, experts have worked to perfect engine propulsion systems. As launch vehicles have grown in size, fuel and oxidizer tanks have become more complex, resulting in unexpected changes in thrust, potentially endangering flight crews and mission success. A team of scientists and engineers at NASA's Kennedy Space Center is now studying how to better understand this phenomenon and reduce its potential impacts to flight safety.

As the large Saturn V rockets were being tested for the Apollo Program in the late 1960s, up and down oscillations of the launch vehicle, called the "pogo" effect, sometimes resulted in potentially dangerous variations in engine performance. The anomaly resulted in changes in acceleration due to differences in fuel pressure and flow rates, possibly placing additional stresses on the vehicle.

According to Paul Schallhorn, Ph.D., chief of NASA's Environments and Launch Approval Branch of Kennedy's Launch Services Program, larger rockets are now expected to operate in more varied environments from high g loads to zero gravity.

"The issues we see now go well beyond the pogo effect," he said. "Upper stages are now firing multiple times and operating in microgravity after reaching space. We need to have a better understanding of how propellants 'slosh' around in their tanks so we can compensate for changes in a rocket's performance."

The current inability to accurately predict fuel and oxidizer behavior can result in unnecessary caution, requiring extra propellant to be added. A better understanding of fluid slosh could not only decrease this uncertainty, but increase efficiency, reduce costs, and allow additional payloads to be launched.

Schallhorn is now serving as principal investigator for research to gain more reliable data on the slosh anomaly. To further understand liquid propellant slosh, engineers at NASA have teamed up with researchers at the Florida Institute of Technology, (FIT) and the Massachusetts Institute of Technology (MIT).

The Slosh Project is funded by NASA Space Technology Mission Directorate's Game Changing Development (GCD) program. GCD is designed to investigate innovative ideas and approaches that have the potential to

Paul Schallhorn, Ph.D., chief of NASA's Environments and Launch Approval Branch of Kennedy's Launch Services Program, far right, with Dr. Daniel Kirk (FIT - PI), front left. Back row (left to right): Dr. Hector Gutierrez (FIT), Jacob Roth (NASA LSP Environments & Launch Approval Branch), Gabriel Lapilli (FIT doctoral student), and Brandon Marsell (NASA LSP Environments & Launch Approval Branch).

revolutionize future space missions and provide solutions to significant national needs.

"I believe the results from this experiment can help rocket launch companies design better tanks and control systems which will make a significant impact," said Stephen Gaddis, Director for the Level II Game Changing Development Program located at NASA Langley Research Center.

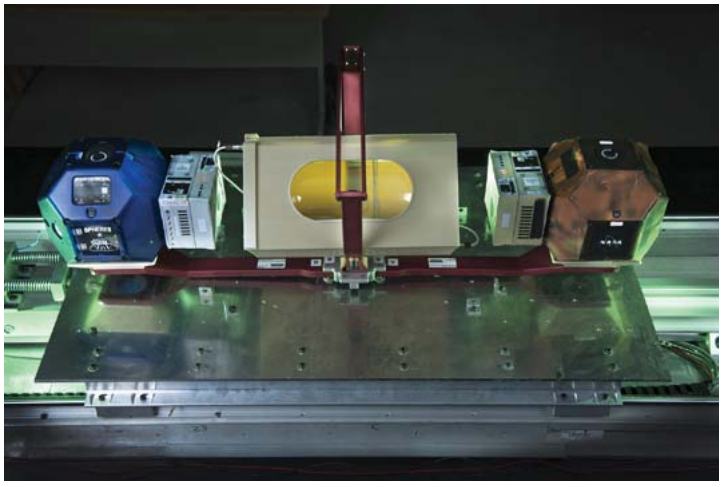
A key element of the team's studies is an experiment involving the Synchronized Position Hold, Engage, Reorient, Experimental Satellites, or SPHERES, which are already operational on the space station. The Slosh experiment was carried to the International Space Station aboard a Cygnus spacecraft atop an Antares rocket as part of the Orbital 1 Commercial Resupply Services flight launched from the Mid-Atlantic Regional Spaceport at NASA's Wallops Flight Facility in Virginia on January 9, 2014.

The hardware for the Slosh experiment was developed by students at Florida Tech. Once on board the space station, astronaut crew members will assemble the package. The SPHERES will be attached at opposite ends of a metal frame. In the center of the frame is a clear plastic 18" x 8" pill-shaped tank that is partially filled with water.

The SPHERES are bowling-ball-sized robots that use small carbon dioxide gas thrusters to maneuver as they free-float inside the space station. They operate on a set of well-defined instructions for various maneuvers.

"Modern computer models try to predict how liquid moves inside a propellant tank," said NASA's Brandon Marsell, co-principal investigator on the Slosh Project. "Now that rockets are bigger and going farther, we need more precise data. Most of the models we have were

Astronaut Rick Mastracchio holding the SLOSH unit in the International Space Station.



An assembled SLOSH experiment.

validated under 1 g conditions on Earth. None have been validated in the surface tension-dominated microgravity environment of space."

Scientists have had success accurately validating how propellants perform on the ground. However, in the absence of gravity, the physics changes drastically and liquids behave differently.

NASA's Jacob Roth, also a co-principal investigator on Slosh, explains that the reactions of fluids will be photographed by a pair of high-resolution cameras that will record the movement of the liquid inside the tank as the experiment is pushed around by the SPHERES robots.

"The free-floating experiment will perform typical upper-stage vehicle maneuvers within the station," he said. "The liquid will be photographed and measured with the data transmitted back to Earth for use in validating current computational fluid dynamics models."

Additionally, several inertial measurement units will accurately record the position of the experiment as it moves within the space station. While water has some different properties than rocket fuels and oxidizers, Schallhorn says it should be close enough.

"We've tested water, liquid hydrogen, hydrazine, and other propellants in 1 g and aboard a zero-g aircraft," he said. "In this case we'll use water because of the inherent hazards of cryogenic and hypergolic fuels. By comparing the actions of water in microgravity to what we see in 1 g, we can calculate what that would mean for actual rocket propellants."

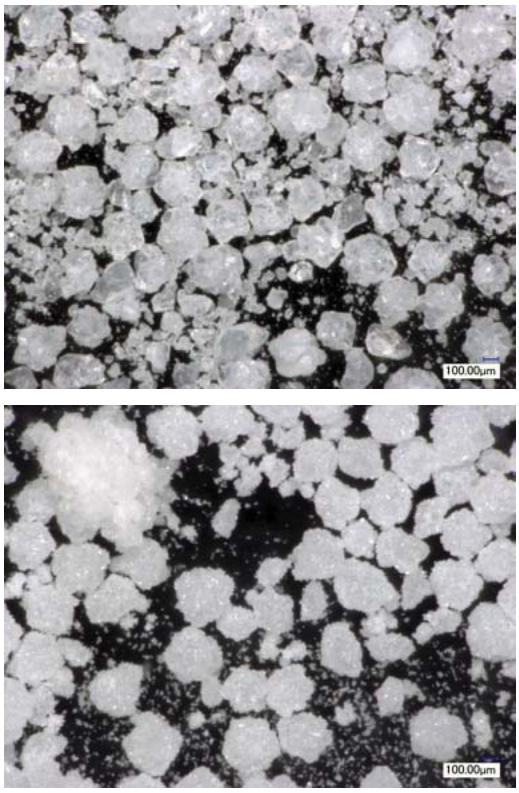
The data will be used to check computer simulations currently predicting rocket performance, ultimately leading to launch vehicles and spacecraft that are more reliable, cost effective, and safer. ■

new technology

Ammonia Capture/Recovery System

What is it?

The Ammonia Capture/Recovery System is a new system designed to selectively capture ammonia from wastewater using an inexpensive capture media that is highly selective for ammonia. Once the ammonia has been filtered out of the stream, the capture media can be regenerated for reuse in the system. In short, the system is a unique and efficient way to separate wastewater into products that can be used for fertilizer and clean water.



Our media before (top) and after (bottom) treating an ammonia waste stream.

Why was it needed?

NASA's Ammonia Capture/Recovery System was developed for potential use as part of the Environmental Control and Life Support Systems (ECLSSs) on the International Space Station. ECLSS conditions require low power usage and the avoidance of high temperature and pressure operations. Current state-of-the-art for ammonia removal involves biological processes or ion exchange, which currently do not meet NASA's ammonia capture/recovery needs.

What makes it better?

The Ammonia Capture/Recovery System for wastewater has a higher bulk ion capacity than traditional absorbents, and it is effective under varying influent ammonia concentrations. The selectivity of ammonia over other cations is also orders of magnitude higher than other absorbents, which allows for higher ammonia capacity and reduced sizing requirements. In addition, the system allows for the regeneration of the capture media, which can then be easily reused by the system so there is little waste from the process. Contact time is generally 20-30 minutes with an additional 20-30 minutes required to regenerate the capture media, so the process is relatively quick compared to current processes. Finally, the Ammonia Capture/Recovery System has a longer expected lifetime, is less expensive, and uses fewer consumables than typical ion-exchange resins that are the current state-of-the-art.

How might it be used?

Although the Ammonia Capture/Recovery System was developed for smaller-scale, space-based applications, the technology is scalable for larger industrial and municipal wastewater needs. As fertilizer prices continue to increase, the agricultural market may have an increasing need for inexpensive ways to generate fertilizer. In addition, businesses in the food processing industry that generate high nitrogen wastewater may also have a need for this technology.

Technology Transfer Status

The Ammonia Capture/Recovery System is patent pending, and it is available for licensing to industry. The Ammonia Capture/Recovery System could potentially be used to treat wastewater streams from food processing plants, swine/dairy farms, fertilizer plants (urea), chemical plants, textile production (wool), and municipalities. ■

KSC's Legal Team Critical to Success of Technology Transfer

The NASA intellectual property (IP) legal team is facing new challenges with the implementation of the America Invents Act (AIA) which transitioned patent filings in the United States Patent and Trademark Office from a first-to-invent system to a first-to-file system. They are also supporting the increased emphasis and associated efforts by NASA to transfer NASA owned IP (e.g., patents and copyrights) to industry for commercialization purposes. Attorney Shelley Ford is leading the team at Kennedy Space Center (KSC) within the Office of the Chief Counsel (OCC) and serves as KSC's Patent Counsel. Assisting her with IP legal responsibilities are attorney Lou Shernisky, patent paralegal Ginger Arrington, and ethics paralegal Dawn Feick. The IP legal team works closely with the Technology Transfer Office to ensure KSC's inventions with the highest commercial potential receive proper IP protection so they can eventually be licensed to industry.

Shelley joined the nation's space program as a KSC team member in 1996. She began her career with United Space Alliance (USA) as an airframe engineer and eventually joined NASA in 2005 as a member of the Shuttle Operations and Integration Division where she continued her work on the Space Shuttle Program. After becoming the NASA Vehicle Manager for Endeavour, Shelley pursued and received a law degree from Barry University School of Law, and after the final flight of Endeavour joined OCC as an Assistant Chief Counsel. Shortly after joining OCC she was recruited by the former Patent Counsel, Randy Heald, to join the IP legal team and Randy encouraged her to take the Patent Bar exam. Randy mentored Shelley for several years which equipped her with the critical knowledge needed to manage KSC's IP and allowed a seamless transition into the Patent Counsel role. "I welcome the challenge of working with KSC's innovative workforce." Shelley says, "The Center has a wide assortment of technologies and inventions and it is my job to make sure they are protected."

Shelley Ford, KSC Patent Counsel, and Lou Shernisky, Assistant Chief Counsel.

"We are very fortunate to have the legal expertise of Shelley and Lou as well as the other members of their team, Ginger Arrington and Dawn Feick. We are especially grateful for their herculean efforts over the last year to protect our inventions under the new patent laws."

David Makufka, Director of the Technology Transfer Program at Kennedy Space Center.

Lou moved to Cocoa Beach, Florida from Pittsburgh, Pennsylvania to join the legal team as Assistant Chief Counsel. He received his law degree from the University of Virginia and previously worked as a Law Clerk at the United States Attorney's Office for the Western District of Pennsylvania. "In law school, I never expected to work for NASA," Lou admits. "But I'm thrilled to be part of the KSC team. How many lawyers have the opportunity to see rocket launches in the middle of their day or are paid to read about missions to Mars and the exciting technology that will get us there? Technology transfer is an important function of government research generally and, in the case of NASA, the commercialization of space, which helps the Agency fulfill one of its statutory purposes." "Also," he adds, "the weather is much better in Florida!" ■

Physicist Happens Upon Rain Data Breakthrough

By Steven Siceloff, Kennedy Space Center

"It's not often that you're studying lunar dust and it ends up producing benefits in weather forecasting," said Phil Metzger, a physicist who leads the Granular Mechanics and Regolith Operations Lab, part of the Surface Systems Office at Kennedy Space Center, but that's exactly what happened.

A physicist and researcher who set out to develop a formula to protect Apollo sites on the moon from rocket exhaust may have happened upon the way to improve weather forecasting on Earth. While working in his backyard during rain showers and storms, John Lane, a physicist at KSC, found that the laser and reflector he was developing to track lunar dust could also accurately determine the size of raindrops, something weather radar and other meteorological systems estimate, but do not measure.

John Lane looks over data recorded from his laser system as he refines his process and formula to calibrate measurements of raindrops.
Photo credit: NASA/Jim Grossmann

The genesis of the research was the need to find out how much damage would be done by robotic landers getting too close to the six places on the moon where Apollo astronauts landed, lived, and worked. The breakthrough came because Metzger and Lane were looking for a way to calibrate a laser sensor to pick up the fine particles of blowing lunar dust and soil. It turns out that rain is a good stand-in for flying lunar soil.

"The Apollo sites have value scientifically and from an engineering perspective because they are a record of how these materials on the moon have interacted with the solar system over 40 years," Metzger said. "They are witness plates to the environment."

The special quantity measured by the laser system is called the "second moment of the size distribution," which results in the average cross-section area of raindrops passing through the laser beam.

Lane said the additional piece of information would be useful in filling out the complex computer calculations used to determine the current conditions and forecast the weather.

"We may be able to refine (computer weather) models to make them more accurate," Lane said. "Weather radar data analysis makes assumptions about raindrop size, so I think this could improve the overall drop size distribution estimates."

As research continues into the laser sensor, Lane expects the work to continue on the weather forecasting side of the equation, too. Lane already presented some of his findings at a meteorological conference and is working on a research paper to detail the work. "This is one of those topics that spans a lot of areas of science," he said. ■

Best of Luck to Pat!

Pat Pilola served as an active voting member on Kennedy Space Center's Research and Technology Management Board (RTMB) representing the Engineering and Technology Directorate. In addition to meeting weekly with the RTMB where he provided valuable insight on research and technology matters (to include advising KSC researchers who presented potential proposals), Pat was a change agent to help foster significant research and technology contributions to benefit NASA missions. Pat was a pleasure to work with at KSC, and now we are enjoying continued collaboration with Pat following his return to JSC in his current position as the JSC Engineering Directorate Manager, Project Management and Integration Office

Technology Transfer Benefits KSC's Environmental Cleanup

By Linda Herridge, Kennedy Space Center

In early November 2013, contractors used a groundwater treatment technology developed at Kennedy Space Center (KSC) to treat subsurface contaminants at the center's Reutilization, Recycling and Marketing Facility (RRMF). Constructed in the late 1960s for the storage and recycling of equipment and chemicals, the site is contaminated with the chlorinated solvent tetrachloroethene, also known as PERC.

During a nine-day period, the center's Remediation Program injected Emulsified Zero-Valent Iron (EZVI) into an area of approximately 2,200 square feet to a depth of 27 feet below ground surface. Project Manager Anne Chrest of KSC's Operations Directorate worked with technicians from Jacobs Engineering Group and CORE Engineering and Construction, Inc., to inject over 9,000 gallons of EZVI into the treatment area. The site will be monitored for several years to track remediation progress in order to determine if additional injections will be needed to achieve cleanup target levels.

This project is unique because it is the first use of EZVI to treat a contaminated site at a NASA facility. Developed by scientists at KSC and the University of Central Florida, EZVI is one of NASA's most licensed and deployed technologies. Licensed by nine companies, EZVI garnered NASA's Government Invention of the Year and Commercial Invention of the Year awards in 2005 and was inducted into the Space Technology Hall of Fame in 2007. The technology has been used in 17 U.S. states as well as in France and Japan. ■

A technician monitors the injection process.

Technicians inject EZVI into the ground in two locations.

Technology Transfer Forum

In September, the Economic Development Commission of Florida's Space Coast and Kennedy Space Center held the inaugural Technology Transfer Forum at the Courtyard by Marriott in Cocoa Beach, Fla. This event, attended by over 120 innovators and business leaders from area companies, showcased several opportunities available at KSC for licensing and codevelopment with a focus on robotics, sustainable living, environmental remediation, and modeling and simulation. Several speakers from KSC presented information on NASA-developed technologies and KSC laboratory capabilities that are available to commercial companies. The event's keynote address, was given by KSC Director Bob Cabana and focused on the importance of partnerships, such as those between NASA and companies now operating in former shuttle facilities at KSC. The forum's ultimate goal is the creation of partnerships between area businesses and NASA to push forward the commercialization of NASA technologies and help infuse those technologies into companies' products and services. ■

Lew Parrish, Technology Transfer Specialist

2013 Best of KSC Software

The 2013 Best of KSC Software Award is designed to recognize outstanding software developed by KSC teams for the purpose of serving the KSC mission. Software developed by civil servants and/or contractors is considered, providing there is a NASA intellectual property interest. Awards are grouped under two general categories: KSC Institutional and KSC Mission. Institutional software is designed to support and improve KSC business processes, and Mission software is designed to support and enhance KSC scientific and engineering mission. The 2014 Best of KSC Software competition will be held later this year. For information on this award program, e-mail Megan Victor megan.e.victor@nasa.gov. The 2013 Best of KSC Software Award winner was ***Workers Health At A Glance.*** Runners up: Institutional Category, *Q-KESS Query & Answer*; and Outreach Category, *XA07 Mission Quiz.* ■

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This magazine seeks to inform and educate civil servant and contractor personnel at Kennedy Space Center about actively participating in achieving NASA's technology transfer and partnership goals.

Please send suggestions or feedback to the editor.

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