

National Aeronautics and Space Administration



2020 Issue 1

THE NRP POST

A Publication of NASA Research Park

Carnegie Mellon University

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Flirtey

NRP Building 19, Room 128
Commencement Date: September 1, 2018

Flirtey is pioneering the drone industry as the first drone delivery service. Its company’s mission is to “save lives and improve lifestyles by making delivery instant for everyone.” Flirtey is making this happen by delivering essential items such as food, medical devices, AED’s, and urgent parts to individuals and companies. Flirtey has worked with numerous commercial and government agencies to be able to conduct deliveries of medicine to rural health clinics, ship-to-store deliveries of medical samples, and deliveries of retail and e-commerce items to consumer homes. The company made history in 2015 when it completed the first FAA-approved drone delivery on U.S. soil in collaboration with NASA at Langley Research Center. Flirtey is continuing to expand and improve its technology; its capabilities are truly changing the delivery service.



Silicon Valley AUVSI (Association for Unmanned Vehicle Systems International)

NRP Building 19, Rm 1010
Commencement Date: October 1, 2019

Silicon Valley AUVSI, Inc. is a non-profit organization serving Central and Northern California. The organization is dedicated to professional development, education, research of robotics, unmanned systems technology, and autonomy. Silicon Valley AUVSI partners with NASA and other industry change-makers to produce one-of-a-kind events and programming that serves a global audience. Many of the organizations volunteers, members, and partners are current and former NASA employees. Most recently, Silicon Valley AUVSI produced an incredible Urban Air Mobility Symposium in Building 3 on February 27, 2020. Dr. Eugene Tu, Dr. Parimal Kopardekar, Dr. William Chan, and others all spoke on various timely topics, providing insights into the future of mobility. The organization is led by President and Chairman Greg Deeds, CEO of Technology Exploration Group, and board members Jennifer Deeds and Werner Von Stein.

NRP Welcomes

Making Tracks in the Desert

By Marika Yang

Catherine Pavlov, a Ph.D. candidate in mechanical engineering, traveled to the Atacama Desert as a NASA Space Technology Research Fellow (NSTRF), to conduct experiments she modeled that aim to gain non-grasping functionality from space rovers.


The ground was dry, dusty, and rocky, with small rolling hills, peppered with the track marks of a rover. The place could have been the surface of Mars except that the sky was a bright, cloudless blue, and the temperature had reached 90 degrees. Catherine Pavlov was in the Atacama Desert in Chile, the driest non-polar desert on Earth and one of the best analogs for Mars on the planet.

Pavlov, the winner of a competitive NASA Space Technology Research Fellowship, was in the dry heat of the Atacama conducting experiments that aim to add additional functionality to space rovers. Pavlov's research centers around non-prehensile terrain manipulation, or put more simply, using non-grasping methods to interact with terrain. Basic examples of general

non-prehensile manipulation include moving a ping pong ball with paddles and a robot using its arm to clear a table.

"I look at how we can use the wheels of planetary exploration rovers to modify the environment around them," said Pavlov, a Ph.D. candidate in mechanical engineering advised by MechE Assistant Professor Aaron Johnson. "We are trying to expand what rovers can do both in a manipulation context and a mobility context."

Robotics systems used in space missions are extremely costly and made to optimize functionality and reliability while being lightweight and fuel-efficient. Adding a manipulator, with multiple motors and sensors, adds mass and complexity, two big things to avoid

A photograph of a rover with a manipulator arm in a desert landscape. The rover is positioned on a rocky, uneven terrain. The background shows rolling hills under a clear blue sky. The rover has large, treaded wheels and a complex mechanical structure on top, including a manipulator arm.

Pavlov tested her models on how a rover's wheels can modify the environment around them

“We are trying to expand what rovers can do both in a manipulation context and a mobility context.”

*Catherine Pavlov, Ph.D.
Candidate, Mechanical Engineering*

for space missions. Mass directly increases launch cost and requires more fuel.

Via non-prehensile terrain manipulation, Pavlov is exploring how to utilize existing interactions with the world that were previously considered disturbances or accidents and use them intentionally. Rather than see wheel tracks on the ground as a consequence of driving, Pavlov treats the ground as a target for modification. In her research, she investigates how the rover’s wheel-terrain interaction can be used to move along slopes by leveling paths, making terrain compact, and removing material.

Pavlov developed a new model for this research. While models already exist for wheel-terrain situations, they focus on the mobility and driving ability of the vehicles, not the movement of the soil. Pavlov uses terramechanics to predict how deep a wheel sinks, so that her new model can predict where the soil goes after the wheel passes over it and the shape of the remaining trench.

In the summer of 2019, Pavlov spent time at NASA Ames, a major NASA research center in Silicon Valley, as part of the fellowship program. There, she

worked in model development and interfaced with rover software to set up sensors to track the rover in real time. In September, she joined NASA researchers in the Atacama Desert to test her model on the experimental KREX-2 rover in an environment similar to Mars. With little wild or plant-life and a rocky terrain of shallow slopes, the environment was a great substitute for Mars.

“The trenching experiments went well. This was the first time we tested it on a substrate that actually looks something like what we might expect to see on Mars. It was awesome to see it work.” Pavlov presented her research in a poster session at NASA’s research grant day on Capitol Hill in December 2019.

Currently in her fourth year of the Ph.D. program, Pavlov sees several different avenues for the future of the project, including variations in wheel and rover design, expanding to other terrain types, and adding other terrain manipulators. Conducting experiments at NASA Ames and the Atacama Desert gave her the opportunity to get out into the field, and Pavlov is looking forward to continuing her research.

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Bloom Energy hopes its efforts will save the lives of coronavirus patients with respiratory problems

Coronavirus: Tech Firm Bloom Energy Fixes Broken US Ventilators

BBC, By David Molloy
30 March 2020

A Californian company that usually makes green-energy fuel cells is due to deliver 170 repaired ventilators to Los Angeles by April 6th after transforming its manufacturing process.

An engineer at Bloom Energy downloaded the service manual and taught himself how to dismantle and rebuild them in a day, the Los Angeles Times reported.

They had been in storage since the H5N1 bird flu outbreak of the mid-2000s.

Bloom says it is now working to find other stockpiles of disused machines. On Saturday, as California Governor Gavin

Newsom visited the manufacturing plant, he said: “We got a car and a truck and had [them] brought here to this facility at 08:00 this morning.

“And Monday, they’ll have those ventilators back into Los Angeles all fixed. That’s the spirit of California.”

Mr. Newsom said the company had initially told him it would take a month to fix 200 ventilators, which help patients breathe if they are having difficulties due to Covid-19 or other diseases.

But he had replied: “We challenge you to do more and do better.” And on 22 March, the company’s chief executive,

KR Sridhar, sent the governor a photo of 24 finished ventilators ready to be certified for use.

Bloom Energy hopes its efforts will save the lives of coronavirus patients with respiratory problems.

Mr. Sridhar told CNBC: "We think we can do hundreds of ventilators, close to 1,000 ventilators a week of refurbishment. This is the fastest way we can take existing ventilators that are out there, get them working, get them back to the hospitals."

The strategy contrasts with that of the UK, which is seeking to make thousands of new machines in partnership with manufacturing companies. The UK has about

8,000 ventilators available and has placed orders for the same number again from existing manufacturers.

Dyson has also received an order for 10,000 units of a new design, if it passes regulatory hurdles.

But manufacturers have said they will not be able to meet demand if coronavirus infections peak in the coming weeks.

Link to BBC Story:

<https://www.bbc.com/news/technology-52094193>

Bloomenergy®

California's governor announced Bloom Energy's success at its Sunnyvale, California campus



NASA Administrator Discusses Value of In-Space Manufacturing Capabilities during visit to Made In Space

September 17, 2019

Last August, NASA Administrator, Jim Bridenstine visited Made In Space's Moffett Field facility, located on the campus of NASA Ames Research Center. Bridenstine's visit followed the recent announcement of the Archinaut One mission, a flight demonstration mission, awarded through NASA Space Technology Mission Directorate, that will see MIS technology develop the first self-assembling satellite on orbit. During the visit, Made In Space President & CEO, Andrew Rush highlighted the breadth of the company's technology portfolio that aims to develop manufacturing capabilities to support future exploration missions as well as catalyze the economy in low Earth orbit.

During the tour, Archinaut One satellite technology and its core manufacturing and assembly subsystems were on display. The presence of these transformative new technologies sitting in the shadow of the company's first zero-gravity printer and a subsequent commercial 3D printer, AMF, was a subtle reminder of the rapid progress that has been made over the last five years. Made In Space has led the charge in developing advanced in-space manufacturing systems and that progress has not gone unnoticed. During his closing remarks, Bridenstine highlighted several key points on the value of in-space manufacturing and how technologies like Archinaut One will enable future exploration missions, like Moon to





Made In Space President & CEO, Andrew Rush with Administrator of NASA Jim Bridenstine

Mars, to be executed safely, efficiently and cost-effectively.

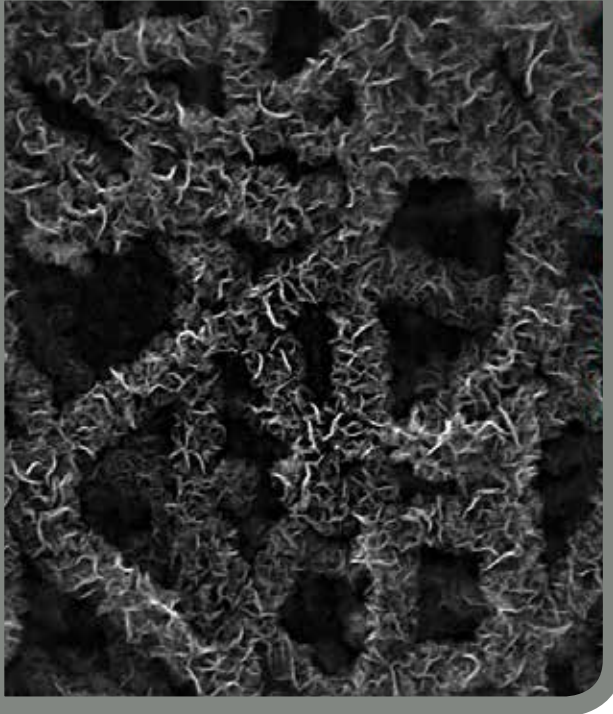
Bridenstine referred to in-space manufacturing as an “absolute game-changer” for the Agency which underscores the long-term value of Archinaut technology—creating space-optimized structures and assemblies on orbit. In space manufacturing technology, such as capabilities represented in the Archinaut One flight demonstration allows the entire industry to circumvent the design constraints and volume limits imposed by the launch environment. This opens the door to a multitude of space-optimized complex structures ranging from expansive antenna and large apertures to advanced, large-scale space telescopes.

NASA’s exploration roadmap for Moon to Mars will employ new platforms like Gateway and others that will benefit from in-space manufacturing capabilities. Additionally, future exploration missions will rely on

local manufacturing capabilities in order to maximize in-situ resource utilization. Through this lens, Bridenstine commented that in-space manufacturing allows NASA to “optimize what we’re trying to achieve.”

Building infrastructure off the planet without having to launch critical components is crucial when looking at NASA’s exploration goals. NASA’s partnership with MIS has benefited the agency by delivering unprecedented capabilities quickly. Within five years, MIS, in partnership with NASA, progressed from launching industrial 3D printers to the International Space Station to developing a self-assembling satellite.

As echoed during Bridenstine’s visit, the potential of Archinaut technology and near-term applications could yield a big impact on NASA’s exploration goals and transform capabilities across the entire industry.



Producing Hydrogen Peroxide When, and Where, it's Needed

By Emily Durham

Does a material exist that can be used to selectively, reliably, and efficiently form hydrogen peroxide whenever and wherever it's needed?

The big brown bottle of hydrogen peroxide (H_2O_2) is a staple of the modern medicine cabinet, always on hand for first aid needs. Lesser known uses of hydrogen peroxide include disinfecting hospital equipment and fueling spacecraft. Yet, as common and beneficial of a substance as it is, hydrogen peroxide is surprisingly hard to produce and transport.

Currently, hydrogen peroxide is made through what's known as the "anthraquinone process." This method is energy-intensive, requires large-scale production, and produces large quantities of carbon dioxide (CO_2) as a byproduct. While directly reacting hydrogen and oxygen to make hydrogen peroxide would be ideal, thermodynamics prefers to form the more stable water (H_2O) over hydrogen peroxide.

So the challenge becomes: does a material exist that can be used to selectively, reliably, and efficiently form hydrogen peroxide whenever and wherever it's needed, so that transporting it isn't necessary?

A team of researchers from Carnegie Mellon University has set out to meet that difficult challenge. Associate Professors Venkat Viswanathan (mechanical engineering) and Tzahi Cohen-Karni (biomedical engineering/materials science and engineering) are leading an effort to develop a cheap, renewable, and sustainable method of creating hydrogen peroxide. The team has published a paper in ACS Catalysis on the work.

"The most difficult thing about hydrogen peroxide is transporting it," explains Viswanathan. "Hospitals and space missions have particular

"We believe this project will continue to substantially advance U.S. manufacturing capabilities in the aerospace and aviation industries." Venkat Viswanathan, Associate Professor, Mechanical Engineering

uses for hydrogen peroxide, including rapid sterilization and as an oxidant. Transport of hydrogen peroxide to hospitals can be dangerous and complicated, and you can't take gallons of oxidants into space due to weight restrictions, so with our method we hope to provide the capability of making hydrogen peroxide when you need it, wherever you are."

For several years, Cohen-Karni and his lab have been developing a technique of growing graphene in a 3D topology, leveraging defects in the material to grow what he calls "fuzzy graphene." Graphene, which is a form of carbon, is also highly abundant, cheap, and renewable. Cohen-Karni's method allows graphene to grow away from a surface, rather than along it, creating long, thin, flaky graphene structures that look somewhat like nanoscale pine trees.

Graphene has an impressive ability to transport electric charge. Building on Cohen-Karni's fuzzy graphene research, the team found that graphene-based materials with lots of edges, like the ones found at the tips of each fuzzy graphene flake, are highly reactive for synthesizing hydrogen peroxide. So fuzzy graphene, an electrically conductive material with many edges, is the perfect candidate for this new and improved method of hydrogen peroxide generation.

Viswanathan's research over the last several years has explored the exact properties needed of a catalyst to selectively create hydrogen peroxide from hydrogen and oxygen. Using the Titan, one of the world's best transmission electron microscopes, the researchers showed that catalytic reactions happen right at the edge of each flake, not on the flat surfaces. The team demonstrated that they can control the kind of catalysis that occurs on fuzzy

graphene, selectively creating either hydrogen peroxide or water as they choose by activating the sites at the tips of each flake.

"We can now, really controllably, make hydrogen peroxide with high selectivity," says Cohen-Karni. "We are now able to make mostly hydrogen peroxide, and not that much water. Thermodynamics really wants hydrogen and oxygen to form water when catalyzed, so being able to catalyze so selectively, with 94% of the outcome being hydrogen peroxide, means our process is highly novel."

Other researchers on the paper include MSE Ph.D. students Daniel San Roman (first author) and Raghav Garg; MechE Ph.D. student Dilip Krishnamurthy (co-first author); Director of CMU's Electron Microscopy & Materials Characterization Facility Noel Nuhfer; Los Alamos National Laboratory's Hasnain Hafiz; and Rensselaer Polytechnic Institute's Michael Lamparski and Vincent Meunier.

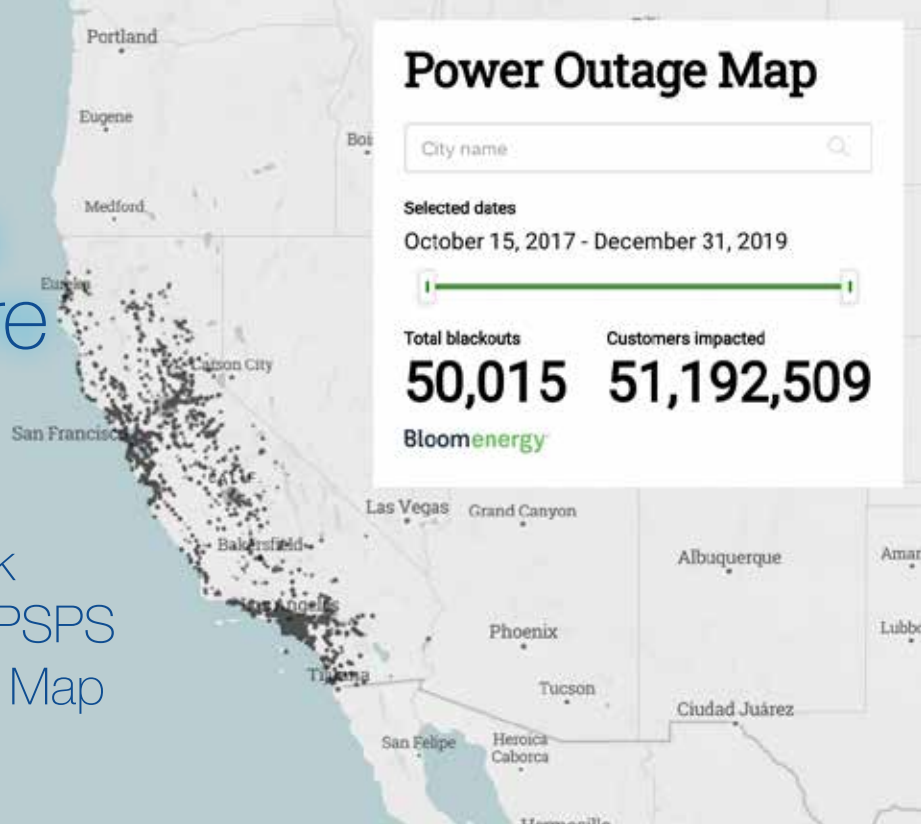
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**Carnegie
Mellon
University**

Bloom Energy Helps Customers Prepare for Wildfire Season

SAN JOSE, Calif., January 10, 2020 By Natalia Blank

Bloom Energy Launches Quick Deploy Microgrid Program for PSPS Readiness and Power Outage Map



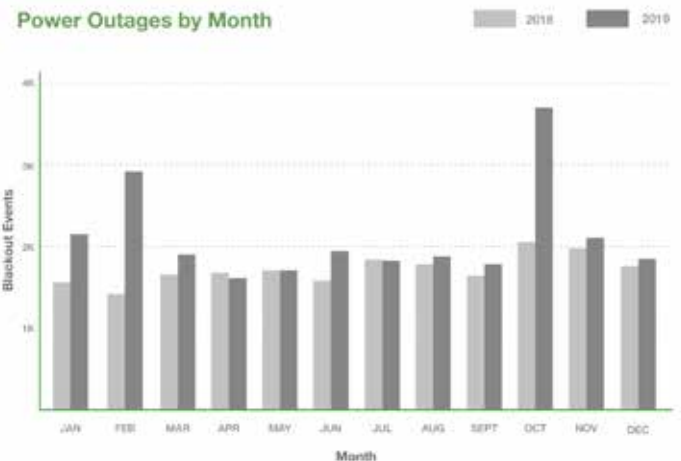
Bloom Energy announced today a new Quick-Deploy Microgrid Program to help customers prepare for future wildfire seasons with permanent AlwaysON Microgrids for their facilities. This program will enable customers to deploy a resilient microgrid infrastructure prior to the anticipated start of the 2020 wildfire season as well as receive clean electricity at a predictable cost to mitigate the impact of utility rate increases.

California recently instituted intentional outages called Public Safety Power Shutoffs (PSPS) with the objective of reducing wildfires and improving public safety. As such, businesses are increasingly taking power security into their own hands, considering the “cost of not having power” instead of just the “cost of power.”

These blackouts have been deemed as California’s “new normal” for the next 10 years or longer. Since October 2017, these PSPS events have resulted in a reported 2,374 outages affecting 2.3 million customers. And these are long outages – the longest planned event during the two-year span lasted six days, and the average duration was nearly two full days.

As a result, companies are turning to microgrids as a solution to safeguard their operations. Bloom Energy is a leading microgrid provider with 89 microgrids deployed globally.

Bloom Energy also announced a new Power Outage Map, which allows users to see the number of blackouts and customers impacted in California since October 2017. Bloom Energy, working with Bluefire Studios, a company that monitors utilities throughout the country, created the outage map, which currently has data for all blackouts that affected at least 100 customers in California during the two-year-plus period, and is planning on expanding to additional states and other outage-prone areas.



Businesses in California can now assess their risk on a city-level in a matter of seconds to inform their energy resiliency strategy.

It's not only engineered power shut-offs that are leaving Californians in the dark: since October 2017, the outage map shows there have been more than 50,000 blackout events in the state affecting the equivalent of approximately 51 million customers. To get the full picture and review further insights, please visit the Power Outage Map.

About Bloom Energy

Bloom Energy's mission is to make clean, reliable, and affordable energy for everyone in the world. The company's product, the Bloom Energy Server, delivers highly reliable and resilient, always-on electric power that is clean and sustainable. Bloom's customers include twenty-five of the Fortune 100 companies

and leaders in cloud services and data centers, healthcare, retail, financial services, utilities and many other industries. For more information, visit www.bloomenergy.com.

Disclaimer

The current Power Outage Map is dated from October 15, 2017 through December 31, 2019. Based on the data through this time period, it may or may not be indicative of future outages.

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Bloom Energy CEO K.R. Sridhar

Bloomenergy[®]

Eugene L. Tu announces appointment of Verron “Ron” Brade

MESSAGE FROM CENTER DIRECTOR

I am very pleased to announce that, upon the retirement of Ms. Robin Aube in February 2020, Mr. Verron “Ron” Brade will serve a detail-assignment as the Ames Center Associate Director. Ron will begin his transition to Ames starting in January, and will have an opportunity to work directly with Robin prior to her retirement. In this role he will provide executive leadership and share responsibility for the overall direction and management of the Center.

Since September 2019, Ron has served as the acting Associate Administrator for the Mission Support Directorate (MSD) at NASA HQ, and has held the position of Deputy Associate Administrator for MSD since November 2017, where he supported leadership and integration of NASA mission support functions with an annual budget of over \$3 Billion. In these roles, Ron was responsible for Agency-wide mission enabling functions comprising Human Capital Management, Strategic Infrastructure including Construction of Facilities, Procurement, Protective Services, Headquarters Operations, the NASA Shared Services Center, and NASA Partnerships including Space Act Agreements.

From 2007 until November 2017, Ron served as the Director of the Office of Human Capital Management (OHCM) at NASA’s Goddard Space Flight Center (GSFC). During that time, he led transformative change efforts in both the Goddard and NASA HQ operational human resource offices to increase quality of service, accountability, and established human capital analytics capabilities.

Prior to being the Director of GSFC’s OHCM, Ron served as the Chief of Goddard’s Information Services Division providing leadership and support during its transition into the current Information Technology and Communications Directorate (ITCD). From 2002 to 2004, as the Deputy Chief of the Procurement Operations Division, Ron performed overall planning of Division operations and exercised administrative and technical responsibility. He has also held Contracting Officer positions in procurement at the National Reconnaissance Office (NRO), the National Institute of Standards Technology (NIST) and NASA Headquarters.

Ron is a 2009 and 2014 recipient of NASA’s Outstanding Leadership Medal. In June 2008, he was selected into NASA’s SES Career Development Program and has completed Harvard University’s Senior Executive Fellows Program. Ron received his Bachelor’s Degree from Virginia Tech and Master’s Degree in Public Administration from George Washington University. Ron and his wife Angela have 3 children: Bianca (20), Beau, (17) and Brielle (12).

Please join me in welcoming Ron to the Ames leadership team.

Eugene L. Tu
Director

A portrait of Mr. Verron “Ron” Brade, a Black man with a short beard and mustache, wearing a dark suit, light blue shirt, and orange tie. He is smiling slightly. The background of the portrait is a dark, starry space scene. The background of the entire page is a night view of a launch complex with a rocket on the launch pad, illuminated by lights, and a tall service tower. The lights are reflected in a body of water in the foreground.

*Mr. Verron “Ron” Brade
Ames Center Associate Director*

NASA Ames Photo Ops



On December 18, 2019, USGS Leadership Visited NASA Research Park and the Building 19 USGS Space.

Mejghan Haider, Director of NRP, provided a tour of NASA Research Park.

Pictured Above:

Jane Reid, Deputy Regional Director, USGS Southwest Region

Jared Bradley, Director, GSA Portfolio Management Division, Pacific Rim Region

Colin Williams, Director, USGS Geology, Minerals, Energy, & Geophysics Science Center

Dan Brown, Regional Commissioner, GSA Public Building Service, Pacific Rim Region

Allison Azevedo, GSA Deputy Commissioner

David Haase, Director, GSA Real Property Utilization & Disposal Division, Pacific Rim Region

Mark Sogge, Regional Director, USGS Southwest Region

Stuart Burns, Assistant Commissioner, GSA Portfolio Management Division



IN MEMORIAM: Farewell Rose Lesslie

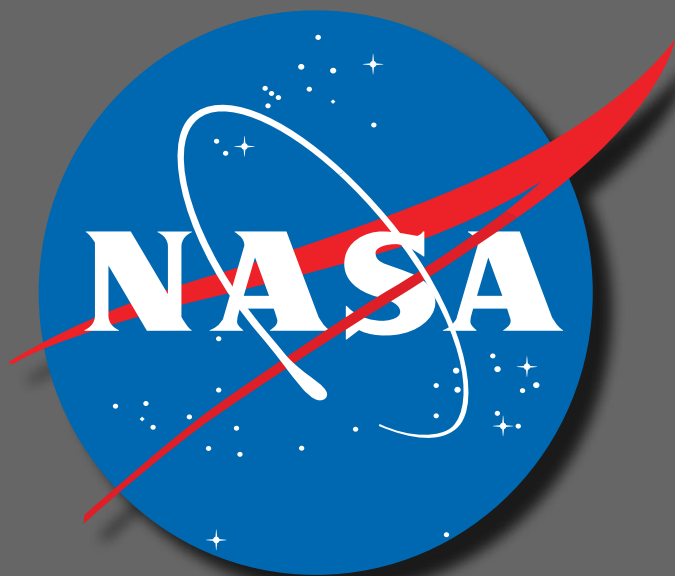
The Moffett Field Historical Society and Museum lost one of its oldest and long-standing members. Rose Lesslie was a very special person. For years, Rose was a docent at the museum, giving a voice to the past by sharing personal stories.

She was 17 when she began her career at NASA Moffett Field, working for the Special Services Department. She later moved on to the Airframe Build-Up Department in Hangar One, building Navy blimps during World War II, truly earning her the title of "Rosie the Riveter." It was here at Moffett that she met and married her Marine, Kermath, after his return from the war. They settled in Mountain View and raised a family. In 1994, as the Navy left Moffett Field, Rose joined several stalwarts in establishing the Moffett Field Historical Society, which opened its museum in

1995. Rose became a volunteer at the museum, giving tours and educating visitors on Moffett Field and lighter-than-air operations. Rose passed on October 30, 2019, joining her husband. She was 93 years young.

Learn more about Rose and her legacy in her Oral History Center interview through the Bancroft Library at Berkeley: https://ohc-search.lib.berkeley.edu/catalog/MASTER_1689





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