

TECHNICS

Brief notes about the world of science and technology at Southwest Research Institute

SwRI receives \$9.9 million from U.S. DOE to improve solar plant efficiency

Southwest Research Institute (SwRI) has been awarded \$4.9 million by the U.S. Department of Energy (DOE) as part of a \$9.9 million continuation contract to manufacture and test a high-efficiency supercritical CO₂ (sCO₂) hot gas turbo-expander and compact heat exchangers for concentrating solar power (CSP) plants.

The award was given through DOE's SunShot Initiative, a collaborative national effort to make the cost of solar energy competitive with other forms of energy by the end of the decade. This award continues a previous DOE project to design the sCO₂ expander. SwRI will lead a team of industry collaborators that includes Aramco Services Company, Bechtel Marine Propulsion Corporation, Electric Power Research Institute (EPRI), General Electric, and Thar Energy.

"Over the last two years, SwRI and its industry collaborators have

developed a highly efficient, multi-stage axial flow sCO₂ hot gas turbo-expander that advances the state of the art from laboratory size to a full mega-watt scale prototype," said Dr. Jeff Moore, manager of the Rotating Machinery Dynamics Section in SwRI's Mechanical Engineering

Division, and principal investigator of the project. A second objective of the project is to optimize novel compact heat exchangers for sCO₂ applications to drastically reduce manufacturing costs. The scalable sCO₂ expander design and improved heat exchanger will close two critical technology gaps and potentially provide a major pathway to achieve power at 6 cents per kilowatt hour, increasing energy conversion efficiency to more than 50 percent, and potentially reducing total power block cost to below \$1,200 per kilowatt installed. The project, which will be conducted in two phases, began in late December 2014 and will continue through mid-2016.

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SwRI wins EPA contract for emissions testing, analytical services

Southwest Research Institute (SwRI) has been awarded a five-year, \$20.16 million contract by the U.S. Environmental Protection Agency (EPA) to provide testing and analytical services related to vehicle emissions and fuel consumption.

Key areas of support include emissions characterization and technology assessment. SwRI can develop test procedures and equipment for regulated and unregulated emissions in light- and heavy-duty vehicles and components as well as marine, railway, aircraft, small engine, and other non-highway propulsion systems.

"The scope of this contract is quite broad," said Patrick Merritt, principal scientist in the Engine, Emissions, and Vehicle Research Division. "It encompasses 25 areas, from fuels and lubricants to engine and emissions characterizations, as well as economic studies, general rule-making support, and coordinating peer review meetings."

The contract also calls for evaluating vehicles to ensure compliance with current emissions and other regulatory requirements and safety testing powertrains, batteries, and emission control systems. Technical services include evaluating prototype vehicle propulsion systems and related control, data acquisition, and sampling systems.

The contract through the EPA's Office of Transportation and Air Quality (OTAQ) Assessment and Standards Division (ASD) uses SwRI's expertise in its Office of Automotive Engineering, which comprises the Engine, Emissions, and Vehicle Research Division and the Fuels and Lubricants Research Division.

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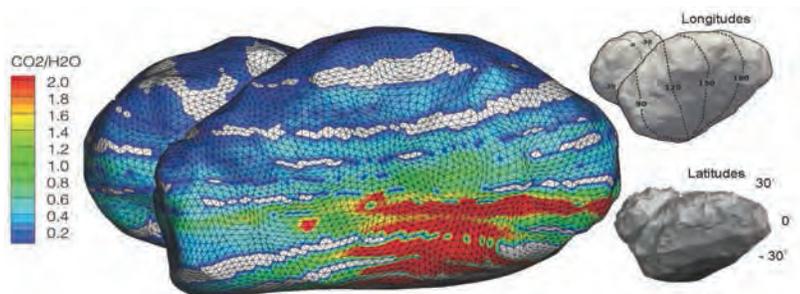


Rosetta data reveals more surprises about comet 67P

As the Rosetta spacecraft orbits comet 67P/Churyumov-Gerasimenko, an international team of scientists have discovered that the comet's atmosphere, or coma, is much less homogenous than expected and comet outgassing varies significantly over time, as reported in a paper published in the Jan. 23, 2015, issue of *Science*.

"If we would have just seen a steady increase of gases as we closed in on the comet, there would be no question about heterogeneity of the nucleus," says Dr. Myrtha Hässig, lead author of the paper titled "Time Variability and Heterogeneity in the Coma of 67P/Churyumov-Gerasimenko" and a postdoctoral researcher at Southwest Research Institute (SwRI) in San Antonio. "Instead we saw spikes in water readings, and a few hours later, a spike in carbon dioxide readings. This variation could be a temperature effect or a seasonal effect, or it could point to the possibility of comet migrations in the early solar system."

Rosetta scientists measuring the composition of comet 67P's atmosphere or coma discovered that it varies greatly over time. Large fluctuations in composition in a heterogeneous coma indicate day-night and possibly seasonal variations in the major outgassing species: H₂O, CO, and CO₂. After the European Space Agency Rosetta spacecraft rendezvoused with 67P in August 2014, it made headlines around the world landing a space probe on the comet's surface in November. The lander is now in hibernation, but the Rosetta orbiter continues conducting 11 experiments vital to understanding comets in general and comet 67P specifically, as it approaches the Sun.



"These large fluctuations in composition in a heterogeneous coma indicate diurnal or day-night and possibly seasonal variations in the major outgassing species," says Hässig. "When I first saw this behavior, I thought something may have been wrong, but after triple-checking the data, we believe 67P has a complex coma-nucleus relationship, with seasonal variations possibly driven by temperature differences just below the comet surface."

Rosetta is an ESA mission with contributions from its member states and NASA. Airbus Defense and Space built the Rosetta spacecraft. NASA's Jet Propulsion Laboratory (JPL) manages the U.S. contribution of the Rosetta mission for NASA's Science Mission Directorate in Washington, under a contract with the California Institute of Technology. JPL also built the microwave instrument for the Rosetta Orbiter and hosts its principal investigator, Dr. Samuel Gulkis. SwRI (San Antonio and Boulder, Colo.) developed the Rosetta orbiter's Ion and Electron Sensor (IES) and Alice instrument and hosts their principal investigators, Vice President Dr. James Burch for IES and Associate Vice President Dr. Alan Stern for Alice.

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SwRI's Walker named Fellow of American Institute of Aeronautics and Astronautics

Dr. James D. Walker, an Institute scientist in the Mechanical Engineering Division at Southwest Research Institute (SwRI), has been elected a Fellow of the American Institute of Aeronautics and Astronautics (AIAA).



According to AIAA, Fellows are "persons of distinction in aeronautics or astronautics, who have made notable and valuable contributions to the arts, sciences, or technology thereof." Walker's Fellow citation reads "for his pioneering analysis, development, and modeling of impact dynamics, penetration mechanics, and materials characterization in response to dynamic loading, with applications in defense and space." He will be formally recognized at the AIAA Aerospace Spotlight Awards Gala May 6 in Washington, D.C.

Walker's research efforts have focused on the mechanical response of a variety of systems and materials to impact loads. Much of his research centers on personnel protection ranging from vests worn by soldiers and police officers, to designs for ground vehicles, the International Space Station, and satellites.

The author of more than 100 papers and publications, Walker holds bachelor's, master's and doctoral degrees in mathematics from the University of Utah. Walker is an adjunct faculty member at The University of Texas at San Antonio, where he teaches graduate courses in mechanical engineering and mathematics.

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