

UNM fosters new space power research —
and empowers future engineers

(Em)powering the next

Exploring the deepest reaches of space, driving a rover on Mars, and establishing human outposts on the moon require incredible feats of engineering. One of the most important engineering challenges is developing the technology for reliable, safe, long-lasting, and lightweight power systems to sustain missions in space for 10-15 years, or even longer. When it comes to space nuclear power technologies, the University of New Mexico is leading the way.

While some energy sources like solar energy can't be sustained for missions too close or too far from the sun, one source is sustainable: nuclear power. UNM has an internationally recognized academic program in space nuclear power and thermal propulsion since 1984. Mohamed El-Genk, Regents' Professor of chemical and nuclear engineering and founding director of the University of New Mexico Institute for Space and Nuclear Power Studies (UNM-ISNPS), has helped lead the program from the start. "We have the best academic program in the country

in space nuclear power and thermal propulsion in terms of the breadth of our research, research productivity, and technical expertise," says El-Genk.

Next Generation Technology

El-Genk, other ISNPS researchers, and students are currently developing the next generation of space nuclear power systems for ambitious exploration missions to the farthest planets in the solar system. "If we want to explore Mars or the ice resources on the moons of Jupiter such as Europa and Ganymede, we need serious power for that," says El-Genk. "We design safe and reliable nuclear power systems for destinations where solar energy is nonexistent."

Research teams at UNM-ISNPS are focusing on three space reactor designs that avoid single-point failures: the liquid metal-cooled Scaled Compact Reactor (SCoRe); the gas cooled Submersion-Subcritical Safe Space reactor (S⁴) designed to operate with multiple Closed Brayton Cycle (CBC) Engines; and the liquid

metal heat pipe cooled Scalable AMTEC Integrated Reactor System (SAIRS). These reactor designs feature redundancies to ensure continued operation of the power system — and the mission. Safety and longevity are also key factors. "These reactors are designed to remain safe in case they are submerged in wet sand and flooded with seawater, following a launch abort accident," says post-doctorate candidate Jeff King. "Passive cooling using heat pipes, designing light-weight heat rejection radiators, and dynamic simulation of space power systems with either static energy conversion or turbo-machinery, are other major focus areas for research at UNM-ISNPS," explains Jean-Michel Tournier, assistant research professor.

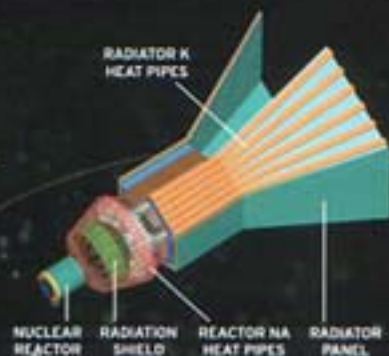
Space-oriented research is only half the research equation for UNM-ISNPS faculty, graduate and undergraduate students. They're also working on next generation reactors for the renaissance of nuclear power for domestic energy production and for sustaining a hydrogen economy; better thermal management of electronic equipment;

OPPOSITE RIGHT: Regents' Professor of Chemical and Nuclear Engineering Mohammed El-Genk founded the UNM Institute for Space and Nuclear Power Studies.

LEFT: SAIRS Light weight 100 kW_e power system with AMTEC energy conversion for future NASA Space exploration missions, developed at UNM-ISNPS.

CENTER: El-Genk says the outreach program is the most valuable part of STAIR.

RIGHT: El-Genk with members of ISNPS research team, Assistant Research Professor Jean Michel Tournier, Jack Parker, Ph.D., Dr. Jeff King Post-doctorate fellow, and Steven Hatton, M.S.



generation

and the advanced fuel cycle for reducing nuclear waste generated by commercial reactors. El-Genk says the UNM-ISNPS not only advances engineering research and education in cutting-edge areas, but also supports the larger educational mission of the university. "The University does research that benefits society and mankind, while preparing the next cadres of the trained workforce," explains El-Genk. "Fostering innovations in energy development and improving the efficiency of current power sources is one way the university achieves that goal." He adds that another way the university helps the community and the nation is by encouraging the next generation of students to pursue careers in engineering and the sciences.

A Successful Forum

Both of those goals coalesce at UNM-ISNPS, established in 1984 as a research organization that focuses on advancing space and nuclear power technologies and promoting the peaceful use of nuclear energy. ISNPS provides a variety of educational and research opportunities for both graduate and undergraduate students. Since 1984, more than 45 Ph.D. dissertations and master's theses have been completed at ISNPS.

ISNPS convened its annual international meeting, the Space Technology and Applications International Forum (STAIF), in mid-February in Albuquerque.

Approximately 600 people attended, including congressional representative Heather Wilson, administrators from NASA, and leaders from industry, researchers and engineers from DOE laboratories, universities, government, and both domestic and international organizations. The meeting hosted five concurrent conferences covering diverse areas in space technology and exploration and featured exhibits, paper presentations, and awards.

Jeff King not only presented two papers at STAIF, but also received the Manuel Lujan, Jr. Student Paper Award for his paper presented at last year's meeting. "Attending STAIF is good professional experience," says King. "It has been an inspiration and a focus throughout my graduate career because it brings together a wide range of people within my field and allows me to make contacts within the space power community." Two other UNM students received awards and recognition at the conference — Paul Howard Smith and Steven Saavedra both received the General Ernest Hardin Scholarship.

The Next Generation of Engineers

STAIF goes beyond the standard conference format of workshops and presentations to include a valuable educational component for future engineers and scientists. Each year the forum sponsors a design competition



and a special session for middle and high school students from throughout New Mexico. "This year, more than 65 students entered their designs for a moon-based resort. The winning students and their teachers received monetary awards, and all participants earned accolades from STAIF attendees," says Steven Hatton, M.S. He and Jack Parker, Ph.D., helped organize the outreach activities.

"To me, the outreach program is the most valuable part of STAIF," says El-Genk. "If we can make a difference in even one of these students' lives, then we're successful." Through their outreach and research, El-Genk and other ISNPS researchers and students are not only developing the next generation of space and nuclear power systems, they're empowering future engineers to follow in their footsteps. ♦