News Wire from Idaho National Engineering and Environmental Laboratory – Home of Science and Engineering Solutions

Welcome! This is the latest feature edition (11th for 2003) of the **INEEL News Wire**, which delivers news about key issues and current advances in both research and technology at the multiprogram Department of Energy's Idaho National Engineering and Environmental Laboratory (INEEL), located in Idaho Falls, Idaho and operated by Bechtel BWXT Idaho for the U.S. Department of Energy. Published by the INEEL Communications Directorate, it delivers news to your desktop and is available at http://www.inel.gov/newswire/, along with an archive of all previous editions.

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December 8, 2003 – **"Atoms for Peace – Observing 50th Year" – A SPECIAL ANNIVERSARY FOR IDAHO,** BY DR. JAMES A. LAKE
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A SPECIAL ANNIVERSARY FOR IDAHO
By Dr. James A. Lake, INEEL Associate Laboratory Director for Nuclear Energy

Idaho Falls, December 8, 2003 – Golden anniversaries are invariably special occasions. Successfully negotiating the twists and turns that accompany the passage of a half-century is a testament to vision, persistence, adaptability and innate quality. It is also cause for acknowledgement – whether for a marriage, a business or major world event.

The event that merits our collective attention this day occurred in New York, but the importance of Idaho's role in enabling the event and in carrying its spirit forward to today can't be overstated. On December 8, 1953, President Dwight D. Eisenhower, one of the most admired military and political leaders of the 20th century, literally had the eyes and ears of the world on him as he addressed more than 3,000 delegates in the United Nations General Assembly. He seized the moment to challenge the world to move beyond military use of the atom – toward Atoms for Peace.

In his landmark address, he established the official policy of the United States regarding atomic energy. President Eisenhower pledged that the United States from that day forward would devote its efforts to putting the "miraculous inventiveness of man" to work to free the atom from its military casing and "adapt it to the arts of peace." He said experts would be mobilized to "apply atomic energy to the needs of agriculture, medicine and other peaceful activities. A special purpose would be to provide abundant electrical energy to the power-starved areas of the world." President Eisenhower proclaimed, "The United States knows that peaceful power from atomic energy is no dream of the future. That capability, already proved, is here now – today."

The president was able to offer this assurance of reality because of the ingenuity and accomplishments of scientists and engineers here in Idaho who had been hard at work on the goals of "Atoms for Peace" since 1949. The best and brightest minds from the University of Chicago and Argonne National Laboratory, from Clinton Laboratory in Tennessee and other proud institutions came to Idaho to prove the promise of nuclear power. On a cold night in December 1951, those nuclear visionaries produced usable amounts of electricity from nuclear energy for the first time anywhere in the world. Less than two years after President Eisenhower's "Atoms for Peace" address, these same Idaho pioneers powered an entire city – Arco, Idaho – with nuclear-generated electricity for the first time in U.S. history.

Throughout the history of the Idaho laboratory, these nuclear pioneers, and those who later joined them, maintained a matchless legacy of innovation and accomplishment. Here in Idaho, they designed and built 52 mostly first-of-their-kind nuclear reactors – establishing at one time, the largest concentration of reactors anywhere in the world. Building on this expertise, new materials were developed, the safety basis for the world's fleet of nuclear power reactors was established and new uses of the atom that President Eisenhower envisioned were demonstrated.

Idaho's "Atoms for Peace" research and development led to the production of radioisotopes that are used to assure the safety of industrial products and to diagnose and treat medical conditions. Cancer treatments were advanced through Idaho work in the field of neutron radiotherapy. Adaptation of nuclear technologies led to development of devices used to identify weapons of mass destruction, and even to clean up oil spills.

Idaho remains at the forefront of 21st century efforts to carry on President Eisenhower's Atoms for Peace initiative. We, at Idaho's national laboratory, have had our historic role as the nation's leading center of nuclear energy research and development reaffirmed by the U.S. Secretary of Energy. We have been assigned the role of leading U.S. efforts to develop the next generation of nuclear power systems – systems that are safer and more efficient than anything now in use, and also able to produce clean hydrogen.

The employees at Idaho's national laboratory are committed to performing this new national priority work safely, professionally and with great care for the protection of our environment. The December 8 anniversary of Atoms for Peace marks the beginning of a new era for nuclear energy, supplying clean, secure and affordable energy to support growing world energy demands – Atoms for Peace and Prosperity.

More information on The Atoms for Peace Anniversary at: http://www.inel.gov/

UAVs Take Flight Over Idaho

Idaho Falls, December 4, 2003 – The plane banked and turned over the shimmering desert as the ground crew squinted up intently, silently watching every wing tilt. It seemed to pick up speed as it approached the cracked and weed-encroached runway but perhaps it was just the perspective from a breathless bystander. No landing gear lowered from its belly as it neared, and no warning cries came from the crew. It landed hard into the wind, skidding across the tarmac before coming to rest quietly just at the edge of the sand and sagebrush. No pilot emerged from the cockpit. One crew member approached the plane, picked it up and carried it back to the command center, already crowded with computers and crew.

This flight was just one of hundreds that INEEL's unmanned aerial vehicle team flies during operations of its several research and development projects.

Unmanned aerial vehicles, or UAVs in the parlance of the experts, look somewhat like the hobby planes flown by aviation aficionados worldwide. But these UAVs, explained project manager Scott Bauer, have a special purpose.

"It's the mission that makes the difference," said Bauer, sounding like the National Security Division employee that he is. "We're working with DARPA (Defense Advanced Research Projects Agency, see sidebar) Future Combat Systems Communications program to prove that small, low-cost UAVs can carry the payload and perform a potential future application."

The UAVs used by Bauer and his team are not quite off-the-shelf systems. They include sophisticated avionics that unleash the birds from constraining RF controls to roam the skies for hours, on predetermined flight paths. But before the military risks soldiers and battles on the reliability of the relatively tiny planes, Bauer and team members Mark McKay, Matt Anderson and Jodie Boyce are out on the Idaho National Guard Orchard Training Area, launching, flying and landing plane after plane.

INEEL Specialty

Many groups are involved in the UAV arena, from cutting-edge airframe and avionics designers to various branches of the military. So why is the INEEL not only conducting R&D projects for DARPA but also beginning construction activities to build its own UAV airfield?

"We are focused on small, low-cost, disposable planes, the under-50-pound class," said Bauer. "We think that's where the greatest cost to benefit will be for UAVs in the future. We take the airframes and payloads that industry has developed, integrate the components, and independently and objectively prove if they can perform the missions of our customers. That's specifically what we are doing for DARPA in the FCS Communications project."

The recent conflicts in Iraq and Afghanistan saw a surge in specialized UAV missions, using larger, advanced and more expensive models such as the Predator and Global Hawk. As avionics and fabrication methods become less expensive, a new role is emerging for small, low-cost UAVs that brings new possibilities for communications, sensory and intelligence gathering to the ground warfighter.

And that's where INEEL expertise comes in. Autonomous flight – where the UAV is flown though computer programs and sensors rather than pilot-operated line-of-sight RF signals – is comparatively new, particularly using the sophisticated yet low-cost avionics such as Piccolo (Cloud Cap Technologies) that Bauer and the team have installed. In what is believed to be a first-ever event, in early July the team autonomously flew five UAVs from a single ground station and operator within the same two-kilometer airspace. This feat speaks to the level of autonomy that the new low-cost systems are providing.

"If we can do five, why not ten?" said Bauer. Their goal is not setting a Guinness World Record, but increasing the ability of the small planes – which can carry only small payloads and are vulnerable to mishap – to complete their assigned missions.

Bauer describes the potential for complex assignments with multiple UAVs carrying out a collaborative task. He said this would require self-adjusting among the fleet. If one fails, is reassigned or crashes, the remainder must still carry on.

Planes do crash. Everyone on the team had his favorite phrase. *Takeoff is optional; landing is mandatory. It's not a matter of if, but when.* But the UAV team minimizes the risk by running each operation as thoroughly as if the small planes were manned. Their Flight Ops Checklist is followed every flight. Their procedures are "clear, concise and consistent."

Bauer knows that the more experimental the airframe, avionics or payload, the greater the risk. But he also knows that if you don't fly, and don't do the missions, the technology won't mature. The team gets its greatest insight by putting the research to practice.

The UAV team is conducting some experimental research of its own. According to Bauer, communications, power and propulsion are the three limiting issues confronting future abilities of UAVs. Funded through INEEL's Laboratory Directed Research and Development program, the INEEL team is targeting commercial wireless communications for research and civilian efforts. They are using cell phones to fly a highly autonomous "bird" or to augment cellular coverage.

In a test earlier this year, they used a cellular CDMA 1x connection through the Internet, to an intranet, and controlled a UAV flying in Idaho from a remote location.

“Everyone has talked about using cellular, but we put it into practice,” said Bauer. “Throughput and reliability will only get better as cellular infrastructure improves.”

The INEEL knows the significance of cellular infrastructure, having just this year – in partnership with Bechtel Telecommunications – established the Wireless Testbed. For more information, see the April 2003 edition of *Need to Know* at http://www.inel.gov/nationalsecurity/newsletter/apr2003.pdf Bechtel selected the INEEL’s 890-square-mile site, in part, for its relatively free RF space. Yet its National Telecommunications Information and Administration test station status allows the INEEL to transmit at all but a few frequencies. These same attributes make it an ideal location for a UAV airfield. Add to that extremes in temperatures, winds, miles of rough terrain and a concentration of experts and applications, and you have all the necessary ingredients to field test robust systems for the military.

Mobile, Scientific Platforms

While Jerry Harbour recognizes the importance the military plays in UAV technology development, he also sees enormous potential for myriad peacetime scientific applications. Harbour is the acting manager for the Human, Robotic and Remote Systems organization, home to UAV team members McKay and Anderson and hotbed for much of the INEEL’s robotics work.

“So much in science research is gathering of data, and collecting good data has been expensive,” said Harbour. “UAVs today are smaller, cheaper and can be loaded with powerful sensors. When you add a long loiter time, you have a mobile scientific platform, perfect for hundreds of scientific applications.”

Loiter time is the ability to stay aloft in an area. Some UAVs, even small, inexpensive ones, can circle a site for hours. Studies conducted in remote or dangerous locales – such as when assessing pollutant effects on delicate coral reefs, elephant migrations across the African veldt or awakening volcanoes on Pacific atolls – are all ideal applications for UAVs.

“You can’t do these things with satellites,” said Harbour. “They flash by and are gone. Manned aircraft is very expensive and sometimes dangerous. UAVs are perfect.”

According to Harbour, surveillance by UAV could help monitor those environments that are subject to slow onset or creeping disasters that are not easily discernable to the naked eye. Harbour envisions combining UAV platforms with the INEEL’s award winning Change Detection System (see *Need to Know*,

August 2003) to create a powerful tool to detect almost imperceptible changes in a landscape.

Closer to home, Harbour and his robotics experts are working to apply UAV technology at the INEEL on such applications as remote environmental monitoring to range fire observations.

“It’s not the UAV that’s so great,” said Harbour. “It’s what it can do.”

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