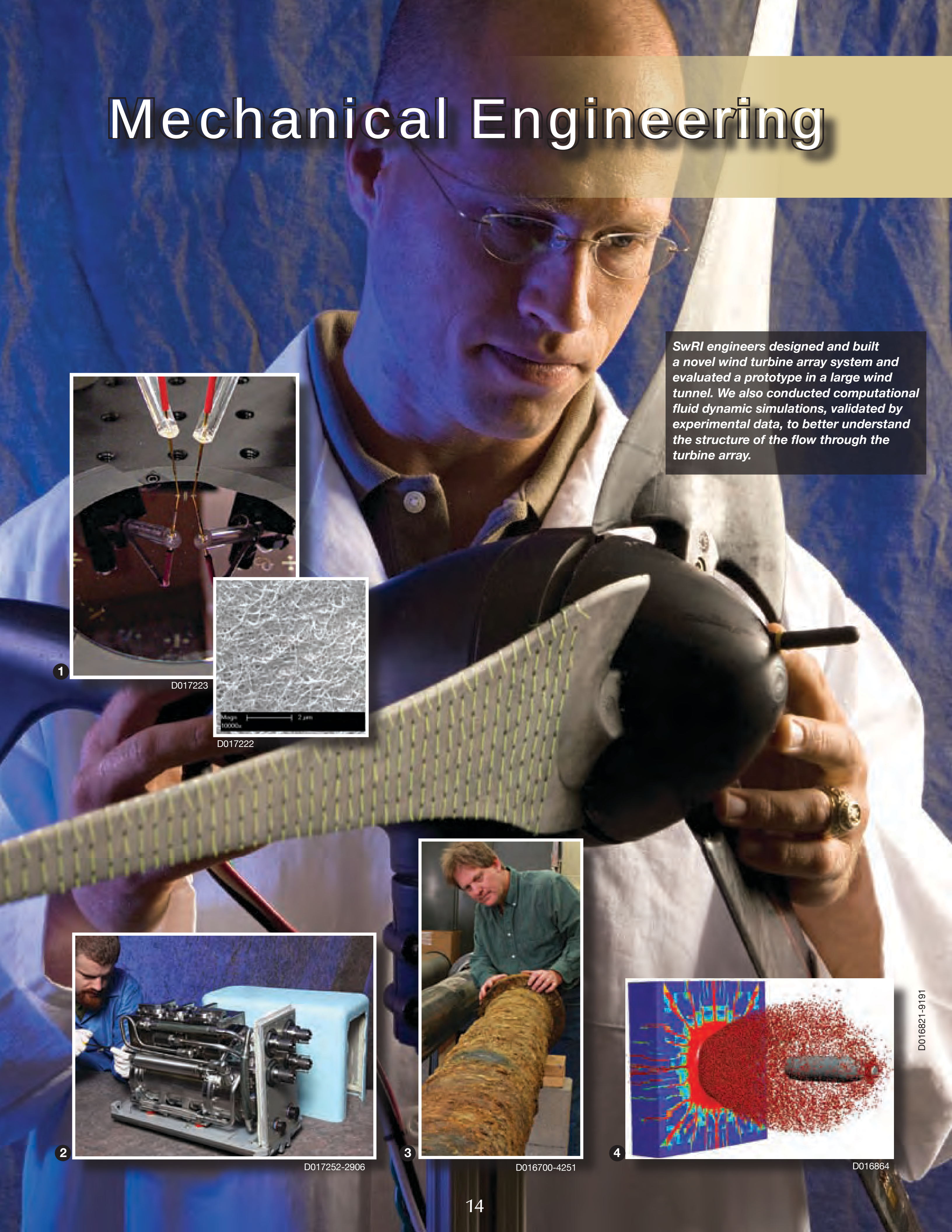
Mechanical Engineering



SwRI engineers designed and built a novel wind turbine array system and evaluated a prototype in a large wind tunnel. We also conducted computational fluid dynamic simulations, validated by experimental data, to better understand the structure of the flow through the turbine array.

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computational fluid dynamics • deep ocean simulations • fracture mechanics • flow measurement acoustics • probabilistic failure analysis • environmental testing • surface engineering & coatings telecommunications evaluations • structural mechanics • failure analysis • eddy current modeling thermal analysis • diagnostic software • corrosion analysis • nondestructive evaluation pipeline compression & measurement • biomechanics & biomaterials • magnetostrictive sensors life prediction • material integrity • terminal ballistics • guided wave inspection • aerodynamics

Energy, aerospace and defense remain core areas of business at Southwest Research Institute, particularly in oil and gas production and transmission, renewable energy, military and commercial aircraft, manned submersibles, space hardware and military ground vehicle armaments. We are applying our expertise in sensors, fluids, materials, structures and mechanical engineering to help clients improve the safety, reliability, efficiency and life of their systems.

In the energy arena, we are continuing compressor system design analysis for the natural gas pipeline industry initiated in the early 1950s. Recent technological breakthroughs at SwRI have resulted in more advanced compressor pulsation control methods, resulting in smoother running, more efficient and more reliable compressors (pulsations.swri.org).

As offshore oil and gas production continues expanding into deeper waters, we continue to expand and improve our capabilities to address extreme temperatures and high pressures associated with these challenging environments. We have added sophisticated new experimental facilities to address corrosion fatigue, multiphase flow assurance and product assurance needs in deep-water environments.

We also develop nondestructive sensor and data analysis techniques to inspect piping, nuclear reactors and other infrastructure for defects that could cause system failures (ndetech.swri.org).

In addition to conventional energy production, we support the emerging wind turbine industry, helping improve the reliability and extend the operating life of gearboxes in large land-based installations (windpower.swri.org). The ability to store energy and match production with demand is key to broader deployment of renewable energy technologies, such as wind turbines and photo-voltaic solar cells. SwRI is developing computational methodologies to support designing materials to advance the power, efficiency and durability of batteries used in hybrid, plug-in hybrid and electric vehicles, as well as stationary power storage.

In the defense arena, we are evaluating SwRI- and client-developed armor concepts using ballistics testing and numerical simulations to help protect personnel from the devastating effects of improvised explosive devices. We also use probabilistic modeling and simulation techniques to evaluate various vehicle and occupant safety enhancements associated with collision, blast, fragment impact and rollover scenarios (compmech.swri.org).

In the aerospace field, we continue working with the Air Force to help maintain the structural health and extend the service life of the T-38 advanced supersonic jet trainer and the A-10 weapons system (structuralintegrity.swri.org). We are helping the Army implement condition-based maintenance for its CH-47 helicopters, and we evaluated the static strength of an aircraft wing structure (verylightjet.swri.org).

In 2009, we transitioned from design to fabrication of the next-generation deep ocean research submersible, successfully forming and joining the titanium hemispheres of the crew enclosure. The new submersible design will withstand depths of 6,500 meters, allowing access to 99 percent of the ocean floor.

The Institute recently built a new crash test facility to perform full-scale vehicle crash testing on our grounds. The 600-foot-long, 100-foot-wide crash pad provides a large, secluded, secure and unobstructed area for highway safety system and other large-scale evaluations.

We developed a plasma enhanced magnetron sputtering process for applying erosion- and wear-resistant, super-hard nanocomposite coatings to components such as turbine blades and petroleum exploration equipment. In 2009, *R&D Magazine* selected the PEMS process as one of the 100 most significant technological advancements of the year (surface engineering.swri.org). ❖

Visit mechmat.swri.org for more information or contact Vice President Danny Deffenbaugh at (210) 522-2384 or danny.deffenbaugh@swri.org.

1. *In 2009, our scientists developed carbon nanotube-based sensors capable of providing reliable, real-time detection of chemical and biological agents as well as physical changes in their surroundings. The sensors utilize high surface area designer biomolecules (inset) and/or chemoselective polymers and are promising candidates for real-world applications ranging from chemical warfare agent detection to* in vitro *medical diagnostics.*

2. *SwRI engineers designed and fabricated the compressor for the International Space Station's Sabatier system, which uses waste streams of carbon dioxide and hydrogen to manufacture water on-orbit.*

3. *Our nondestructive evaluation specialists are developing inspection technologies to detect defects in buried cast iron pipes.*

4. *Our computational specialists continue improving the Elastic-Plastic Impact Computations code used to simulate high-powered ballistic events. Recent advances allow EPIC to generate and characterize behind-armor debris fields produced in the wake of perforated targets, such as this debris field produced when a tungsten projectile perforated a steel target.*