Geosciences and Engineering

This year, we developed two new structural geology training courses for the oil industry, using the natural laboratory provided by exposed geologic features at the Canyon Lake Spillway, just north of San Antonio.

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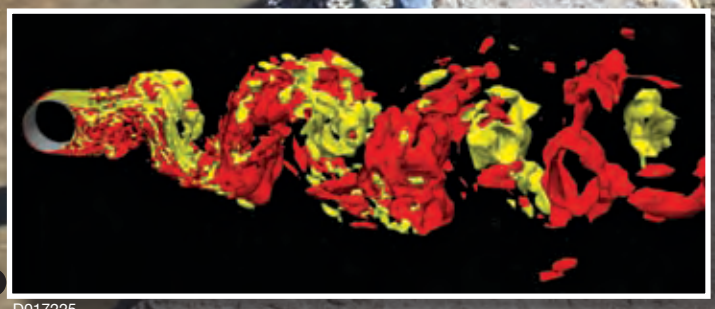

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Courtesy U.S. Army Corps of Engineers

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geophysical & geological investigations • groundwater resource evaluations • geological structure analysis energy exploration • chemical & radiological contaminant transport • laboratory, field & numerical analyses corrosion & materials life prediction • risk & performance assessments • environmental impact assessments geoscience processes • structural integrity analysis • reliability & operational safety analyses planetary science • regulatory analysis & guidance

For more than two decades, Southwest Research Institute has been building a center of excellence in geosciences and engineering, initially applying this expertise to long-term radioactive waste storage and disposal before transferring this expertise to oil and gas, water resource and planetary research programs. Fluctuating energy costs and policies are affecting the directions of some of our core energy-based activities, particularly in nuclear energy and waste management; however, we continue to be a technical resource for the Nuclear Regulatory Commission as well as other government agencies and commercial endeavors, here and abroad.

We continue operating the Center for Nuclear Waste Regulatory Analyses, providing technical support associated with considerations relating to the possible licensing of a potential geologic repository for high-level radioactive waste (cnwraweb.swri.org). In this connection, the year's activities focused on assisting the NRC with its review of the Department of Energy's license application and associated environmental impact statement. In support of these activities, CNWRA developed secure shared information management systems to provide configuration control and joint workspace for thousands of pages of electronic documentation. CNWRA technical expertise is available to support possible changes in the U.S. waste management program, other parts of the nuclear fuel cycle and nuclear energy programs worldwide.

For example, we developed a computer model to analyze the performance of nuclear waste disposal systems in Japan, and we continue developing and applying the MARFA tool to model and analyze radionuclide transport for a geological repository for spent nuclear fuel in Sweden.

We continue to participate in advancing the understanding of long-term risks associated with storing and disposing radioactive waste, ranging from evaluating general and localized corrosion of nuclear waste packages to conducting probabilistic assessments of facility vulnerabilities from natural phenomena such as earthquakes, volcano eruptions and tsunamis, as well as impacts from aircraft crashes and other accidents.

Our services to the worldwide oil and gas industry continue to expand, particularly in structural geology and geomechanics. Projects include geomechanical and stress modeling of petroleum reservoirs in Colorado, Wyoming, the North Sea, Indonesia and Colombia (geoscience.swri.org).

The second year of a multiyear joint industry project made major advances in understanding the role of faults in carbonate strata, important for characterizing and producing oil from major reservoirs around the world. The research site is instrumental in training global oil industry geologists, and information dissemination is aided by our local collaborator, the Guadalupe-Blanco River Authority (carbonatefaultproject.swri.org).

Our technical support to water resource management this year included studies of the Carrizo-Wilcox aquifer system, surface and ground water in Mexico, and water-related environmental issues in Wyoming. We continued to investigate the karst aquifer systems of south-central Texas and developed an updated groundwater availability model for the Barton Springs segment of the Edwards Aquifer (karst.swri.org).

In a multidivisional hydrogen research effort, we continued investigating the creation of alternative vehicle fuels from hydrogen-deficient feed stocks, such as coal.

Our expertise in terrestrial sciences is being applied to planetary programs, including developing and testing the MarsFlo code, a three-phase, two-component computer code to simulate hydrological processes in the subsurface of Mars. Other planetary programs include studying permafrost features on Earth to better understand Martian ice beds as well as investigating volcanic-tectonic interactions and analyzing and modeling landslides on Mars (planetarygeosciences.swri.org). ❖

Visit geosciences-engineering.swri.org for more information or contact Vice President Dr. Wesley Patrick at (210) 522-5158 or wesley.patrick@swri.org.

1. *Using internal funding, we developed techniques to produce three-dimensional simulations for high-speed flow over a circular cylinder to validate multiscale hybrid turbulence models of fluid flow and heat transfer simulations in nuclear power reactor components.*

2. *Using laboratory experiments as well as numerical models, our scientists are investigating fluid movement through fissures and conduits that form in grouts used to isolate the radioactive waste contents of subsurface vaults and tanks from the environment.*

3. *We updated our physical analog laboratory, now outfitted with an SwRI-developed dynamic structured light measurement system, to investigate tectonic resurfacing processes on Jupiter's moon, Ganymede, and pit chain formation on Mars and the asteroid Eros as well as to support oil and gas geomechanical modeling activities.*

4. *Using wireless sensor networking developed through internal funding, SwRI scientists are mapping the limestone karst system surrounding Center Hill Dam near Cookeville, Tennessee. The karst system could affect the structural reliability of the dam, which provides hydroelectric power and flood control in central Tennessee.*