Geosciences & Engineering

For more than 25 years, Southwest Research Institute has conducted field studies, laboratory experiments, and computer simulations to advance the state of the art in Earth sciences and engineering, with a focus on energy, water resources, and planetary geology. We continue operating the Center for Nuclear Waste Regulatory Analyses (CNWRA®), supporting the Nuclear Regulatory Commission (NRC) in its regulatory responsibilities related to radioactive waste storage, transportation, and disposal, as well as other aspects of commercial uses of radioactive materials.

In 2015, we completed safety evaluation reports and conducted advanced modeling studies associated with a range of waste storage systems. The CNWRA also assisted the NRC in evaluating risks, hazards, and emergency and control systems for nuclear facility operations. Our engineers and scientists are collaborating with the NRC to develop a generic performance assessment model called SOAR, for Scoping of Options and Analyzing Risk. The model will provide timely risk and performance insights on a wide variety of potential geologic disposal options.

Through licensing and license renewals, nuclear power plants are permitted to operate for up to 60 years. As technology advances over decades of operation, modifying equipment and processes is essential to safely generating clean energy. SwRI analysts assist the NRC, reviewing plant license amendment and license renewal requests, to safely improve nuclear power production, reduce power generation interruptions and reactor shutdowns, and extend the operational life of these base-load sources of electricity.

We continue to export our expertise, completing probabilistic flow, transport modeling, and sensitivity analyses for a proposed nuclear waste repository in France. We are also supporting repository investigations for various entities in Canada, Finland, and Sweden. We performed

DM021586_4902

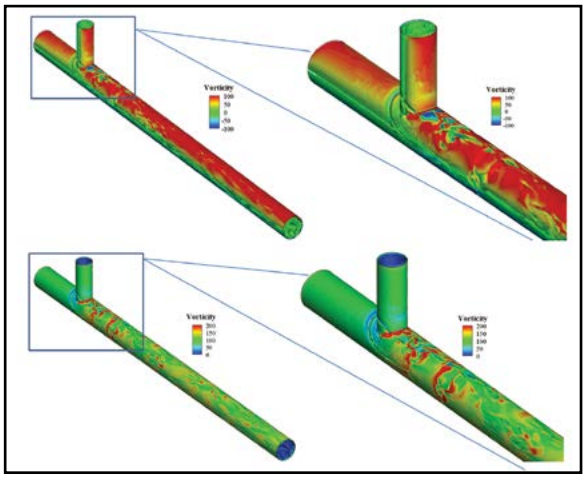
The U.S. Department of Energy is physically and chemically stabilizing residual radioactive waste inside underground tanks by filling them with grout. To address performance issues, SwRI scientists investigate grout characteristics using bench-scale and larger experiments.

- Geophysical & Geological Investigations
- Groundwater Resource Evaluations
- Geological Structure Analyses
- Energy Exploration
- Chemical & Radiological Contaminant Transport
- Laboratory, Field & Numerical Analyses
- Corrosion & Materials Life Prediction
- Risk & Performance Assessments
- Environmental Impact Assessments
- Geoscience Processes
- Cold Region Investigations
- Climate Change Impact Assessment
- Remote Sensing
- Structural Integrity Analyses
- Computational Fluid Dynamics
- Reliability & Operational Safety Analyses
- Planetary Science
- Regulatory Analysis & Guidance
- Fire Protection & Forensic Analyses
- Material Aging & Degradation
- Natural & Human-Induced Hazard Assessments
- Pipeline Failure Analysis
- Probabilistic Risk Assessment

With funding from the National Science Foundation, SwRI used satellite-based remote-sensing studies to measure rock glacier movement. Field measurements confirmed movement of these permafrost formations, providing key information about changing climate conditions.

D021667

SwRI geologists study faulting in the foothills of the Guadalupe Mountains to better understand the terrain in and around Texas' Permian Basin and how it affects petroleum production.



D021668

When hot and cold flows mix, temperature fluctuations in piping systems can cause thermal fatigue, a serious safety concern in nuclear power plants. SwRI scientists used high-fidelity numerical simulations to understand the swirling mixtures, identifying the vorticity magnitude and dominant temperature oscillation frequencies near a piping T-junction. This image illustrates the results from numerical simulations.

D021669 / Courtesy Florina Ardelean/West University of Timisoara

full-scale fire tests and developed advanced computer-based fire modeling technology to help the Japanese nuclear industry meet new fire safety requirements.

SwRI's petroleum exploration and development program continues to provide in-depth structural geology and geomechanical analyses and training for the petroleum industry. A new high-performance computer cluster allows large, three-dimensional geomechanical simulations of induced hydraulic fracturing.

We continue to improve our award-winning 3DStress® software, most recently adding an ability to simulate 3-D pore-fluid pressure changes associated with well injection or production activities. Of particular interest is induced seismicity, the minor earthquakes associated with wastewater injection, geothermal reservoir exploitation, and fracking. Using 3DStress, we analyze pore-pressure-related changes in the slip tendency of faults and fractures to assess and mitigate the potential for induced seismicity.

As SwRI began the second phase of the Eagle Ford Joint Industry Project, geologists focused on subsurface reservoir properties, studying seismic, well, and core data. Understanding the correlation between surface and subsurface geology is critical to successful production of fuels from unconventional reservoirs, such as Eagle Ford.

As global and local concerns about groundwater availability and quality grow, we continue to expand our expertise to meet the needs of government agencies, as well as municipal and commercial organizations. In 2015, we completed a major project, developing and applying a detailed groundwater model for the Edwards Aquifer. Our hydrologists support groundwater districts in South Central and West Texas, providing modeling, analysis, and field expertise.

For NASA, we apply expertise in Earth science to other planetary bodies, studying debris flows formed in subfreezing environments on Earth as terrestrial analogs to those formed on polar sand dunes on Mars. In cold-climate dune fields, relatively dark sand lying on bright snow can produce highly localized warm spots, melting the snowpack. Despite subfreezing air temperatures, we have concluded that this meltwater can cause alluvial processes and debris flows on Martian dune slopes.

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