

SANDIA NATIONAL LABORATORIES  
*Nuclear Energy Program*  
 REPOSITORY SCIENCE



### *Yucca Mountain Project (YMP)*

The Yucca Mountain Site in southern Nevada is proposed for the permanent disposal of spent nuclear fuel and higher-level radioactive waste. In 2006 the DOE's Office of Civilian Radioactive Waste Management designated Sandia as its Lead Laboratory to integrate repository science work for the YMP. Sandia has been a key participant in the YMP since its inception, contributing 18 of 71 chapters of the License Application submitted to the NRC on June 3, 2008. These chapters, prepared by Sandia and its Lead Laboratory staff, represent expertise in performance assessment, numerical modeling, geosciences, field and laboratory testing, and quality assurance. These attributes will remain critical to successful Lead Laboratory support of YMP during the coming years, as the repository moves into licensing, design, operations, engineering and regulatory compliance.

### *Waste Isolation Pilot Plant (WIPP)*

WIPP is the world's only operating deep geologic repository for nuclear waste. Sandia's scientific, engineering, and project management leadership enabled WIPP's Environmental Protection Agency certification in 1999 and recertification in 2006. Sandia serves DOE as primary scientific advisor for WIPP, and led activities in site selection and characterization, experimental studies to understand the interaction of transuranic waste and the disposal environment, transport of radioactive actinides in the subsurface, and performance assessment modeling of the repository for the 10,000-year regulatory time frame.



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NUCLEAR ENERGY SAFETY AND SECURITY TECHNOLOGIES

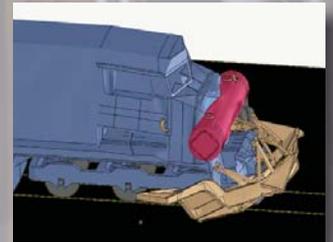


*Probabilistic Risk Assessment (PRA) & Human Reliability Assessment (HRA)*

Sandia led the development and application of probabilistic risk assessment to nuclear power regulation for the Nuclear Regulatory Commission. Our analyses and tools are key components of NRC's risk-informed regulatory approach for both existing and new reactors. Sandia also develops human reliability assessment methods and applications for the NRC and other federal agencies. Human response during both normal operation and in accident scenarios provides critical insights for maintaining and improving nuclear power plant safety.

*Transportation*

Sandia develops innovative technologies and methodologies to solve problems involving transportation and packaging of civilian radioactive materials, for DOE and other federal agencies. Solutions range from new package design and analysis to package testing, and from technical information for regulatory standard development to assessment of transportation safety and risk.



*Severe Accident Modeling - MELCOR & MACCS2*

Sandia developed the MELCOR computer code for the NRC to provide a fully integrated, engineering-level capability for modeling severe accident progression in nuclear power plants. The combination of MELCOR and its companion consequence analysis code, MACCS2, provides the capability to model an accident from its inception through potential radiological release, including atmospheric dispersion, economic, and health consequences.



*Fire Research*

Sandia has been the lead laboratory for NRC-sponsored fire safety research since 1975. Sandia develops fire simulation and analysis codes, plans and executes fire tests at multiple scales, and provides technical data for regulatory decisions. Experiments are conducted at Sandia's state-of-the-art Thermal Test Complex and an extensive outdoor fire-test facility.

*Containment Integrity/Structural Analysis*

Sandia performs complex systems analysis, structural/mechanical analysis, design, and experiments in support of safety and security assessments of commercial nuclear power generation plants and fuel cycle facilities. A combination of analyses using both commercial and Sandia-developed structural codes and large-scale experiments provide insight and technical data to support regulatory decisions by the NRC.



*Mars Science Laboratory (MSL)*

Sandia has been tasked by DOE to perform the safety analysis for the launch of radioisotope power systems into space. The MSL is the next such launch and includes a rover that is powered by a newly developed radioisotope power system. Sandia is performing the launch safety analysis for this mission and is developing a Safety Analysis Report.

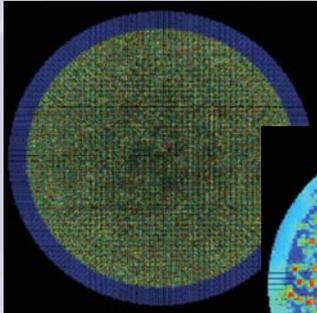
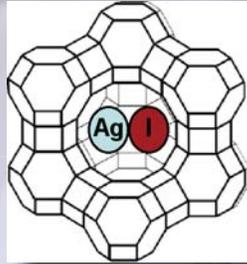
*New Reactor Licensee Application Reviews*

In a new role with NRC, Sandia is part of an extended team of national labs and private-sector contractors directly involved with NRC's Office of New Reactors certifying new nuclear power plant designs and reviewing license applications for construction and operation.

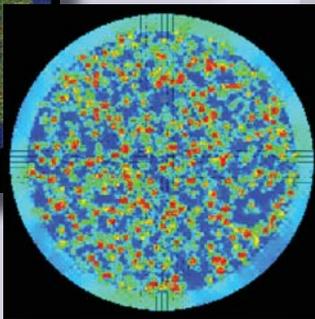


SANDIA NATIONAL LABORATORIES  
*Nuclear Energy Program*  
ADVANCED NUCLEAR ENERGY TECHNOLOGIES

Ag-I-Zeolite for  
I291 capture



Modeling gas bubble  
growth in  
nuclear fuel pins

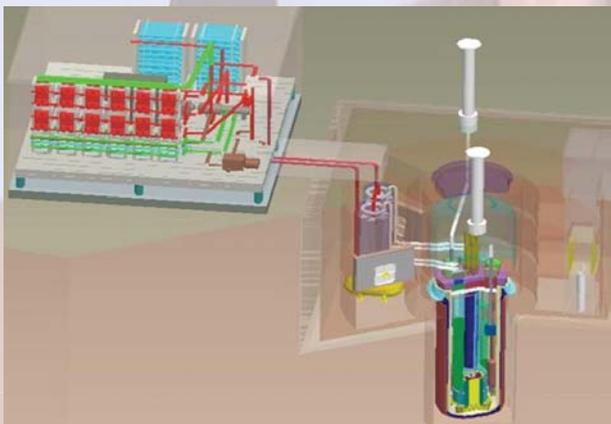


### *GNEP (Global Nuclear Energy Partnership)*

Nuclear Fuel Cycle Science Solutions are developed at Sandia under the GNEP. Two examples of Sandia's work include: In Advanced Waste Form development we are pursuing research for the sequestration and storage of radioactive iodine and in Fuels Performance Modeling and Simulation, we are supporting technology development of fuels modeling that will be used in conjunction with testing to qualify a new generation of fuels for the nuclear industry. This work is critical to the development of new reactors as a way to streamline the fuels qualification process while maintaining the high level of safety that is required.

### *Nuclear Hydrogen Initiative - MELCOR Hydrogen*

A hydrogen economy will require new methods of hydrogen generation; nuclear is an attractive option. MELCOR-H2 is the world's first fully-dynamic, fully-coupled nuclear reactor/hydrogen production simulation tool. It is the only tool capable of successfully modeling the transient chemistry required to produce large-scale quantities of hydrogen with no CO2 emissions. MELCOR-H2 brings the US one step closer to achieving the goal of energy independence for the impending hydrogen economy.



Schematic of Underground RSR

### *Right-Sized Reactor (RSR)*

RSR is a marketable nuclear system that can meet societal needs of the 21st century. Over the last 15 years, increasing demand in the U.S. has been met by 290 GWe of right-sized gas systems (100-300 MWe). Eighty percent of the countries can only absorb 100-300 MWe power plants. Sandia's RSR concept include the following features: will be factory made and can be placed in service within 2 years, can operate twenty years without refueling, could be deployed anywhere in the world, and is completely sustainable.

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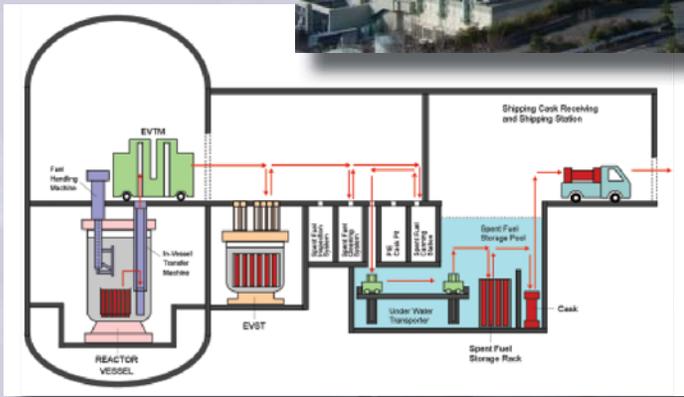
INTERNATIONAL - IN PARTNERSHIP WITH THE GLOBAL SECURITY PROGRAM

Monju Nuclear Power Plant



*Transparency*

Transparency in the nuclear fuel cycle is the cooperative process of providing outside parties with access to information so they can independently evaluate the safety, security, and legitimate management of nuclear materials. Sandia is a facilitator in the transparency process by offering comprehensive services in the usage, storage, and disposal of nuclear materials that enables countries to implement monitoring activities during all stages of the nuclear fuel cycle.



*Technical Challenges of International Spent Fuel Management Approaches*

Discouraging the spread of used nuclear fuel reprocessing technology is a critical nonproliferation and security goal. Realizing this goal will require overcoming a variety of challenges that currently inhibit international used fuel management approaches. Sandia's work is directed at identifying key areas in which technical solutions can facilitate such a system. Currently, conflicting international standards for safety and security, as well as disparate approaches to meeting those standards, make spent fuel "return" efforts prohibitively expensive or unacceptable to stakeholders.

First East Asia Forum on Radioactive Waste Management in Taipei, Taiwan

