Sandia National Laboratories

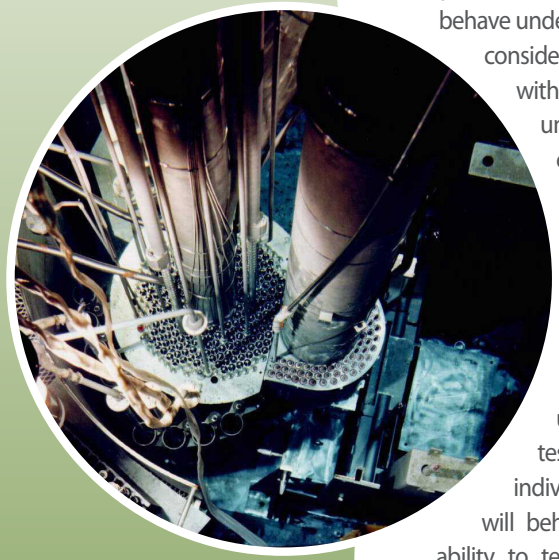
Energy, Climate & Infrastructure Security

Multi-Scale, Multi-Process Testing

Sandia National Laboratories uses multi-scale and multi-process testing to explore and understand how individual components and subsystems will behave in different environments.

Understanding the Parts that Make a Whole

When using a particular package to transport radioactive or hazardous material, designers and regulators must know whether the package will be able to effectively contain the material and prevent material releases into the atmosphere. They must be able to predict how parts of the package--the seal, for example--will behave under a variety of circumstances. Whether considering the seal of a package or wiring within a nuclear reactor, it is important to understand the behavior of individual components and subsystems, and how that behavior will affect the system as a whole.



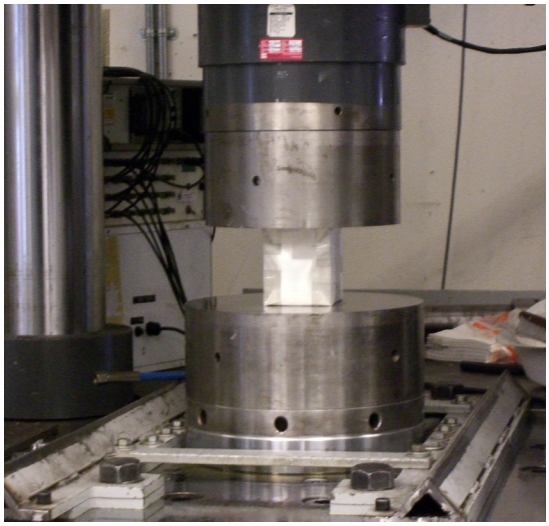
Sandia's Annual Core Research Reactor

As a measure to inform risk and safety assessments and performance certification processes, Sandia National Laboratories uses multi-scale and multi-process testing to explore and understand how individual components and subsystems will behave in different environments. The ability to test these individual parts serves as an important element of total system integrity and performance assurance.

Sandia's Testing Combines Applied and Pure Science

Since the performance of a single component or subsystem within a larger system can mean the difference between proper system function and total system failure, Sandia uses testing to determine how individual parts behave. Often combining principles of both applied and pure science, Sandia's testing is designed to generate detailed, increasingly useful data for both designers and regulators, alike.

Many of Sandia's tests examine behavior and performance from a function-based point of view. Will this package seal survive a high temperature fire? Does a medium velocity impact cause wiring within a unit to short out? Can a particular material be used as an energy absorber during an electrical fire? These questions of performance are answered through testing behavioral responses in one of Sandia's many controlled environments.



Materials testing at Sandia

However, Sandia also leverages pure science in its testing to better-understand and more accurately characterize the physics of events. Sandia looks beyond the simple question of whether or not a component or subsystem performed successfully in order to understand the phenomenology of the environmental conditions. For example, extra instrumentation is sometimes used during package fire tests not to gather data about what's happening to the package, but to gather information about the fire itself. By better-understanding the fire's behavior, researchers can better-understand component and subsystem tests that involve fire. This results in a more complete, thorough examination of subject and phenomena of interest.

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U.S. DEPARTMENT OF ENERGY

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A Legacy of Testing Leadership

Leveraging over six decades of extensive experience in weapons component testing, Sandia serves as a hub of testing expertise. When needed, Sandia applies a multi-physics approach to testing achieved through its vast expertise base including important areas such as fire science, instrumentation, explosives, and mechanics. With a wide variety of fielded expertise, Sandia's testing experts are capable of performing all steps of the experimentation process. Whether custom experiment design, preparation, execution, or a unique combination is needed to achieve particular goals, Sandia's researchers have the experience and procedural know-how to produce the best data possible.

Sandia is also home to a number of notable testing facilities. With high profile facilities like the Thermal Test Complex, which is used to demonstrate the performance of components and assemblies under a variety of abnormal thermal environments, and the Water Impact Facility, which provides a controlled environment for high-velocity water impact and underwater testing, Sandia is capable of simulating nearly any environment required by a test.

Leveraging Testing to Fill Gaps

In order to understand the function and performance of a system, it is important to understand the components and subsystems that comprise it. This is of particular importance in high consequence situations such as those in the area of nuclear energy involving radioactive and hazardous materials.

Generally, component manufacturers provide limited information about their products. They may provide performance assurances under general use, but when components are used in high consequence systems such as nuclear reactors, general use assurances are not enough. Industry and regulatory agencies must know that the component can withstand a number of environments that may pose serious risks to the system.

When needed, Sandia serves as an intermediary between component manufacturers, industry, and regulatory agencies, using component and subsystem testing to help fill the gaps. By testing components at varied temperatures, strain rates, and damage states, for example, users will have the behavior and performance information they need to know whether or not a component or subsystem is suitable for use in a high consequence system.

Testing of this nature is also used to inform risk and safety assessments. By better-understanding a component or subsystem's performance in high consequence situations, potential risks and limitations can be identified and mitigated either through adjusted design or regulatory action. This leads to safer, more reliable complete systems.

Component Testing in Action: Liquefied Natural Gas Vessel

When uncertainty arose regarding how the steel of a Liquefied Natural Gas vessel would behave when subjected to very low temperatures, Sandia was called upon to perform testing. To examine the behavior of the steel and the ship structure when exposed to cryogenic temperatures, Sandia designed a series of tests to produce the extreme environment by applying cryogenic liquid to ship steel plates and representative ship wall sections.

These tests provided researchers with mechanical and thermal information which was used to generate benchmarks for code validation.

Molten core/concrete interaction experiment

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