

# Regulatory Gap Analysis

Sandia National Laboratories provides regulatory and risk analyses in a comprehensive and efficient manner to close the gap between dated regulations and new technologies being developed in the nuclear energy sector.

## Evolving Regulations for Evolving Technology

As technology evolves, old regulations and frameworks for the nuclear power industry are proving to be inadequate to regulate new technology such as the Department of Energy-supported Next Generation Nuclear Plants (NGNP), including high-temperature gas cooled reactors (HTGR). The absence of appropriate, applicable regulations for NGNPs and other new nuclear energy technology poses serious challenges to the safe and reliable operation of nuclear power plants. In order for the nuclear energy industry to continue operating in a socially and environmentally responsible manner, regulations must be adjusted or established to effectively meet the regulatory needs of evolving technology.

## Sandia Rethinks Regulatory Needs

Working with new and untested designs, Sandia National Laboratories provides regulatory and risk analyses in a comprehensive and efficient manner to close the gap between dated regulations and new technologies. Sandia's regulatory gap analysis is based on the principle that as technologies evolve, the risks associated with those technologies evolve, as well. In the case of NGNPs, this means that current regulations originally formulated in the context of systems designed to prevent or mitigate fuel damage in Light Water Reactors (LWR) - a high consequence event - are not applicable because NGNPs use graphite-based fuel which would not melt or fail in the same manner as LWR fuel.

Sandia's expertise in risk assessment facilitates the Nuclear Regulatory Commission's (NRC) move towards appropriate risk-informed regulations for new technologies. This is because a risk-informed regulatory process requires a rethinking of what regulatory priorities should be based on major contributors to risk rather than hypothetical deterministic criteria. With greater adherence to the changing nature of technology, regulations



HTGR reactor at Forschungszentrum Jülich Germany

can be refined or developed based on the new technology's significant contributors to risk rather than relying on policies that do not apply or cannot effectively provide regulation.

## Uniquely Facilitating Risk-Informed Regulation

Sandia leverages decades-worth of expertise and experience supporting regulatory problems involving risk, safety, and security. Drawing on work extensively developed through its nuclear weapons work, Sandia applies expertise in three major areas to identify and resolve regulatory gaps in order to improve the efficacy of regulations for new power plants.

- Risk and Safety Assessment - Sandia uses risk and safety assessments to systematically evaluate the safety of power plants. With over 35 years of experience supporting the NRC as the lead laboratory in nuclear power severe accident research, these systematic assessments highlight possible points of vulnerability in nuclear power safety designs using combinations of testing, modeling, and simulation. MELCOR, for example, is a Sandia-developed code designed to model accident progression for a broad spectrum of severe accident phenomena, both in boiling water and pressurized water reactors.



Refueling floor at Fort St. Vrain  
Generating Station

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- **Emergency Planning** - Sandia's experience in emergency planning analysis is used to enhance regulations designed to minimize public health and environmental impacts in the event of an accident. Since new plants are designed to be inherently safer, Sandia's expertise in this area is leveraged not only to put effective mitigation measures in place, but to help rethink and identify new areas where regulations can be revised based on a risk-informed perspective of new and evolved technology.
- **Safeguards and Security** - Sandia uses its expertise in safeguards and security to ensure the physical protection of nuclear power plants from activities including sabotage and attacks. As with accident risk and safety, as well as emergency planning, the inherently safer plant designs of new reactors will require a rethinking of where and how regulations should be revised based on a risk-informed perspective. Sandia brings nearly six decades of experience providing physical protection to the Department of Energy's important assets.



An NRC resident inspector and trainee conduct an inspection at Byron Nuclear Plant in Byron, Illinois.

### Determining Priorities and Developing Regulations

A significant challenge for regulatory agencies like the NRC is developing effective regulations when there is a lack of detailed design information or operational data about new nuclear reactors. Sandia helps fill these gaps by using its research and analysis capabilities to better-understand new technology and the risks that are associated with it through an efficient, logical, risk-based approach.

Sandia also uses its regulatory gap analyses to assist regulatory agencies in streamlining their license application process. While old license applications processes were deterministic and generally did not systematically address key contributors to risk, Sandia's analyses help regulatory agencies focus resources on risk-significant aspects of a power plant. Through this approach, license requirements are developed with insights into a new technology's major contributors to risk.

specialists representing more than three dozen organizations to consider SMR-related gaps in regulatory framework and policies. Multiple experts from Sandia joined representatives from government, universities, other national laboratories, reactor designers, industry consultants, technical service providers, law firms, and electric power companies in this effort.

Ultimately, the committee concluded that many U.S. nuclear reactor licensing regulations were focused on the safety and security of large LWRs and recommended a number of approaches to correct these problems for SMRs including seeking exemptions to current rules, revising NRC rule making practices, and making legislative changes. Heeding this governmental and industry initiative, the NRC requested help from Sandia to revise its fundamental guidelines for reviewing reactor licensing applications. These revisions will result in a licensing process to better-serve the public interest in regulating new SMR designs.



A nuclear plant security guard in front of the facility entrance gate

### Sandia's Regulatory Gap Analysis in Action: Adjusting SMR Guidelines

In 2010, the Department of Energy (DOE) raised issues surrounding the applicability of licensing processes for a class of new reactor technology called small modular reactors (SMRs). To address these issues, DOE convened a diverse committee of

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