BACKGROUNDER
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Nuclear Reactor Risk

Background

The risk of a nuclear power plant accident releasing a significant amount of radioactivity affecting the public is very small. The NRC minimizes that risk in several ways. The agency's requirements for U.S. nuclear power plants include: diverse and redundant barriers and numerous safety systems; properly trained reactor operators; and ongoing testing and maintenance activities. NRC inspectors provide oversight in all these areas.

Nuclear power plants are designed to operate safely, without significant effect on public health and safety and the environment. Any industrial activity, however, involves some risk. To keep any accident's radioactive material out of the environment, nuclear power plants are constructed with several barriers. The first barrier is the sealed metal tubes, or "cladding," which encase the ceramic uranium fuel pellets. The second barrier is the heavy steel reactor vessel, in the range of nine inches to a foot thick, and the primary cooling water system piping. The third barrier is the containment building, a heavily reinforced structure of concrete and steel up to several feet thick that surrounds the reactor and is designed to contain radioactivity that might get past the first two barriers in the unlikely event of a serious accident.

A nuclear power plant uses large quantities of water to cool its fuel at all times, maintaining the fuel's integrity and avoiding damage. Diverse and multiple safety systems at each plant provide the necessary cooling water. These safety systems frequently require electric power to perform their safety function. Plants are therefore equipped with emergency diesel generators to provide electrical power in the event that the primary power source is lost. In addition, plant operators are required to operate the plant within safe operating limits and under safe conditions as part of their license. These limits and conditions cover such things as operability of plant equipment, plant operating procedures, periodic equipment testing and maintenance.

Policy, Regulations, and Regulatory Framework

A 1986 NRC policy statement established safety goals that specify the Commission's expectations regarding an acceptable level of risk to public health and safety from nuclear power plant operation. The policy statement concludes the risk of cancer fatalities to the population near a nuclear power plant should not exceed 0.1% of the sum of cancer fatality risks from all other causes.

NRC-issued nuclear power plant licenses include criteria and requirements that ensure an acceptable level of plant safety, i.e., an acceptably low level of risk to public health and safety. The agency's regulations are based on sound engineering precepts that are judged to be acceptable for safe plant design and operation. The NRC's license application and review processes are supported by a

detailed set of regulatory guides and a standard review plan to clarify license requirements and describe practices that satisfy these requirements. In addition, the NRC issues various generic communications to all appropriate nuclear power plants to address potential safety concerns.

A 1995 Commission policy statement covers the use of probabilistic risk assessment methods in nuclear regulatory activities. PRA's structured analytical process examines the likelihood and consequences of system failures or other events that could lead to reactor accidents.

The policy consists of four basic elements:

1. PRA technology use should be increased in all regulatory matters in a manner that complements the NRC's traditional defense-in-depth philosophy.
2. PRA and associated analyses should be used to reduce unnecessary conservatism associated with current regulatory requirements and guides, license commitments, and staff practices. Where appropriate, PRA should be used to support proposals under the NRC's backfit rule, 10 CFR 50.109, the process necessary for imposing additional regulatory requirements. Appropriate procedures for including PRA in the process for changing regulatory requirements should be developed and followed. The existing rules and regulations shall be complied with unless subsequently revised.
3. PRA evaluations in support of regulatory decisions should be as realistic as practicable and appropriate supporting data should be publicly available for review.
4. Uncertainties will be considered when using the Commission's safety goals and subsidiary numerical objectives in making regulatory judgments on the need for proposing and backfitting new generic requirements on nuclear power plant licensees. The Commission's policy is intended to allow the many applications of PRA to be implemented in a consistent and predictable manner. This promotes regulatory stability, efficiency, and predictability of regulatory decisions, making the regulatory process risk-informed (the use of risk insights to focus on those items most important to protecting public health and safety).

These safety goals and policies are used as the basis for establishing the regulatory framework for making risk-informed decisions at the NRC.

Risk-Informed Decision-making

The NRC has used PRA to address complex safety issues and make risk-informed decisions, such as those involved in rules on Anticipated Transients Without Scram and Pressurized Thermal Shock; to formulate the backfit rule; to prioritize generic safety issues; and to prepare, and evaluate responses to generic letters.

Since July 1998, the NRC has issued standard review plan sections and associated regulatory guides on risk-informed decision making, including:

	SRP Section	RG
• Plant-specific changes to the licensing basis	19.2	1.174
• inservice testing	3.9.7	1.175
• inservice piping inspection	3.9.8	1.178
• technical specifications	16.1	1.177

The NRC is developing additional guidance on the use of PRA in the power reactor inspection program.

The NRC has also expanded risk-informed decision making approaches to its processes. It is now part of the reactor oversight process, which includes inspection, enforcement, and assessment. These improvements are intended to better focus inspection resources on the most safety-significant aspects of plant design and operations and to make the process more objective.

Risk-informed decision making approaches are also being used in the modification of NRC's basic reactor regulations contained in 10 CFR Part 50, Domestic Licensing of Production and Utilization Facilities. The intent of this work is to add, modify, or delete regulations so that the regulatory burden imposed by individual regulations is commensurate with the importance of that regulation to protecting public health and safety.

The NRC's rules under 10 CFR Part 50.69 allow licensees to risk-inform various special treatment requirements within 10 CFR Part 50. Special treatment requirements are those requirements that provide increased assurance (i.e., beyond normal industrial practices) that selected structures, systems, and components in a nuclear power plant will perform their functions under specific conditions (e.g., earthquakes or harsh environments) with high quality and reliability.

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