U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Fact Sheet

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Nuclear Reactor Risk

Background

The risk of a nuclear power plant accident with a significant amount of radioactivity released offsite to the public is very small. This risk is small due to diverse and redundant barriers and numerous safety systems in the plant, the training and skills of the reactor operators, testing and maintenance activities, and the regulatory requirements and oversight of the Nuclear Regulatory Commission.

Nuclear power plants are designed to be safe and are operated without significant effect on public heath and safety and the environment. No industrial activity, however, is risk-free. To prevent the release of radioactive material to the environment, nuclear power plants are constructed with several barriers between the radioactive material and the environment surrounding the plant. The first barrier is the fuel cladding, sealed metal tubes in which ceramic pellets of uranium fuel are encased. 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 be released from the reactor system in the unlikely event of a serious accident.

To maintain the integrity of the reactor fuel and avoid damage, an adequate supply of water is provided for cooling the fuel at all times. There are diverse and multiple safety systems at each plant that can provide the necessary cooling water. These safety systems frequently require electric power to perform their safety function. Hence, plants are also 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

In 1986 the NRC issued a policy statement that established safety goals that specify the Commission's expectations with respect to an acceptable level of risk to public health and safety from the operation of nuclear power plants. According to the policy statement,

(1) the risk of an immediate fatality to an average individual in the vicinity of a nuclear power plant that might result from reactor accidents should not exceed 0.1% of the sum of the immediate fatality risks that result from other accidents to which the U.S. population is generally exposed and

(2) 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 regulations contain criteria and requirements for a nuclear power plant license which ensure an acceptable level of plant safety, i.e., an acceptably low level of risk to public health and safety. The regulations are based on sound engineering precepts that are judged to be acceptable for safe plant design and operation. To assist with license application and review, the NRC has developed 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, that address potential safety concerns.

In August 1995, the Commission issued a policy statement on the use of probabilistic risk assessment (PRA) methods in nuclear regulatory activities. PRA is a methodology that can be used to provide a structured analytical process to assess the likelihood and consequences of severe reactor accidents.

The policy consists of four basic elements:

(1) The use of PRA technology 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 for additional regulatory requirements in accordance with the NRC's backfit rule, 10 CFR 50.109, which describes the process necessary to support imposition of 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) The Commission's safety goals and subsidiary numerical objectives are to be used with consideration of uncertainties in making regulatory judgements 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 that would promote 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). To implement the Commission's policy on the use of PRA, the NRC staff developed a PRA Implementation Plan which is updated semi-annually.

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 Decisionmaking

The NRC has made use of PRA methods to address complex safety issues and make risk-informed decisions, such as those involved in rules on Station Blackout, Anticipated Transients Without Scram, and Pressurized Thermal Shock; to formulate the backfit rule; to set the priorities for addressing generic safety issues; and to prepare, and evaluate responses to generic letters.

In July 1998, the NRC issued the standard review plan (SRP) section and associated regulatory guide (RG) documenting general guidance on risk-informed decisionmaking for changes to the plant-specific licensing basis, SRP Section 19.0 and RG 1.174, respectively. Since then, application-specific, risk-informed guidance documents have been issued for:

	SRP Section	RG
-- inservice testing	3.9.7	1.175
-- inservice inspection	3.9.8	1.178
-- technical specifications	16.1	1.177
-- graded quality assurance	-	1.176

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

The NRC has also expanded risk-informed decisionmaking 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 decisionmaking 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.

In March 2003, the Commission approved publishing a proposed rule (10 CFR Part 50.69) that would 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.

In an effort to improve plant safety and reduce unnecessary burden through risk-informed decisionmaking, interactions are continuing among the NRC, licensees, industry organizations and public interest groups. The expected results from these activities are a better focus by the NRC and by licensees on those licensing actions and regulatory practices that have a significant impact on plant risk and less emphasis on those that have less impact on plant risk. Paramount to these expectations is the quality of the PRSs relied upon to make these decisions. In November 2002, the NRC issued draft Regulatory Guide DG-1122 and companion SRP Section 19.1 to provide an acceptable approach for determining that the quality of the licensee’s PRA is sufficient for regulatory decisionmaking. Interactions with the public and industry will continue to gain the full potential for risk-informed decisionmaking at the NRC.

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