



NUCLEAR ENERGY AND WORKER SAFETY

A UniStar Issue Brief



“Safety first” is a fundamental commitment of the U.S. nuclear energy industry. Nowhere is this reflected more clearly than in the efforts undertaken to protect the health and safety of the nuclear energy workforce. The overseers of this effort are government regulators such as the U.S. Nuclear Regulatory Commission (NRC) and Occupational Safety and Health Administration (OSHA), who regulate the radiological and non-radiological occupational health components of safety respectively. Other participants in this effort include third-party industry groups and standard setting bodies—such as the Institute of Nuclear Power Operations (INPO) and American Nuclear Society (ANS), the utilities who are the owner/operators of nuclear energy facilities—and the workers themselves. Everyone cooperates in the effort to maintain the safety culture of nuclear energy to keep it the safest industry in which one can work.

Radiation Protection

The protection of radiological workers is at the core of NRC’s mission to ensure that the use of radioactive materials for civilian purposes is safe and protective of both people and the environment. One of the keys to accomplishing this mission is the maintenance of a strong safety culture throughout the industry, one that focuses on safety first in all activities.

The NRC divides its regulatory process into five principal areas: developing regulations and guidance, licensing applicants to use nuclear materials or operate nuclear facilities, overseeing licensee operations and facilities, evaluating operational experience, and obtaining research, hearings and independent reviews to support regulatory decisions.

Throughout this Issue Brief, the term “dose” is used in place of the technically-correct “dose equivalent” as the unit of exposure.

Essential to a strong safety culture:

“...personal dedication and accountability of all individuals engaged in any activity which has a bearing on the safety of nuclear power plants.”

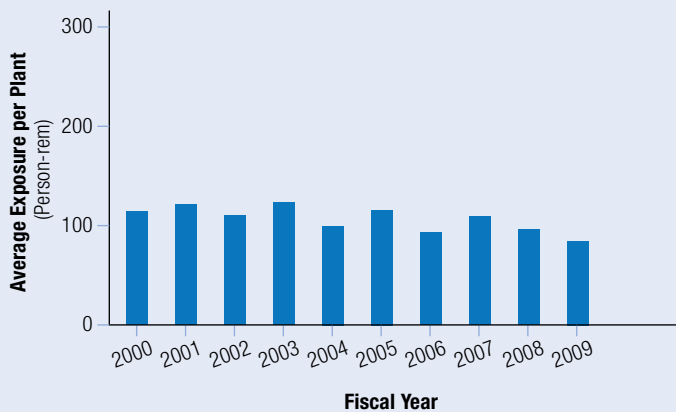
*Policy Statement on the Conduct of Nuclear Power Plant Operations,
USNRC*

With regard to protection of workers, the NRC sets an annual limit of 5 rems (5,000 millirems) as an individual’s permissible dose.¹ Furthermore, the NRC also requires that occupational doses be kept “as low as reasonably achievable” regardless of whether an individual has met their individual dose limit. The concept of “as low as reasonably achievable” (often referred to as ALARA) stems from the assumption that there is no 100 percent safe exposure to radiation and therefore any exposure

to radiation in an occupational setting should be the absolute minimum required to perform the job. The ALARA programs instituted at U.S. nuclear energy facilities are designed to make every effort reasonable to maintain worker doses as far below the regulatory limits as is practical consistent with the utilization of nuclear energy in the public interest, taking into account the state of technology and the economics of improvements to that technology in relation to benefits to the public health and safety and other societal and socioeconomic considerations. In other words, every activity at a commercial nuclear facility is analyzed to ensure that worker exposures are as low as they can be made allowing the job to still be performed in a cost-effective manner. The ALARA programs are very effective: In 2009 individual doses in the U.S. nuclear energy industry averaged only 100 millirems per worker, about 2 percent of the occupational limit.²

**Industry Performance Indicators:
Annual Industry Averages FY 2000–2009—for 104 Plants**

Collective Radiation Exposure



This indicator monitors the total radiation dose accumulated by plant personnel.

Further Explanation:

In 2009, those workers receiving a measurable dose of radiation received an average of about 0.1 rem. For comparison purposes, the average U.S. citizen receives 0.3 rem of radiation each year from natural sources (e.g., the everyday environment). See "Exposure" section on the Glossary.

Note: Data represent annual industry averages, with plants in extended shutdown excluded. Data are rounded for display purposes. These data may differ slightly from previously published data as a result of refinements in data quality.

Source: Licensee data as compiled by the U.S. Nuclear Regulatory Commission

The NRC monitors the ALARA and general safety programs as part of its rigorous inspection program at nuclear energy facilities. There are at least two resident NRC inspectors assigned to each site. Their full-time, on-site oversight is supplemented with targeted inspections by engineers and specialists from regional offices and NRC headquarters staff. In 2009, each nuclear energy facility received over 6,000 hours of inspection.³

Industry Support for Safety

After the Three Mile Island accident in 1978, the nuclear electric industry redoubled its efforts to improve safety. In 1979, it created the Institute of Nuclear Power Operations (INPO), with the mission of promoting the highest levels of safety and reliability in nuclear electric generation. Every U.S. organization that operates a commercial nuclear energy facility is an INPO member. INPO achieves its goals by providing independent evaluation of plant performance, identifying and communicating lessons learned to all members, facilitating electronic exchange of information among members, and continuously evolving assistance programs to share strategies for safe operation with all of its members.



Through the National Academy for Nuclear Training, formed by INPO in 1985, member training programs for key positions at respective nuclear facilities are reviewed and accredited.

The effectiveness of industry efforts is reflected in the long-term continuous improvement in all performance indicators for the U.S. nuclear fleet. The average nuclear worker today receives only about 11 percent of the 900 millirems annual dose received from cosmic radiation by airline crews regularly flying the New York to Tokyo route.⁴

After more than 50 years of radiological monitoring and medical research, there is no evidence demonstrating negative health effects to workers at U.S. nuclear energy plants from their occupational radiation exposures.

Safe Energy

The safety culture at modern nuclear energy facilities extends beyond the reduction of radiation exposure, emphasizing safe performance of all activities conducted by nuclear workers. U.S. nuclear energy facilities all have programs to foster a Safety Conscious Work Environment—an environment where all employees can feel free to raise safety concerns to management or the NRC without fear of retaliation.

OECD Countries – 1969 to 2000 (NEA 2010)⁵

	Accidents	Fatalities	Fatalities/ GWey
Coal	75	2259	0.157
Oil	165	3713	0.132
Natural Gas	90	1043	0.085
LPG	59	1905	1.957
Nuclear	0	0	-
Total	390	8934	

Summary of severe (>5 fatalities) accidents that occurred in fossil and nuclear energy chains

This emphasis on safety in the nuclear industry has made nuclear energy clearly the safest of the major sources of energy; workers in other energy sectors undergo far greater risks.

The dangers of the coal mining industry are well-known and fatal accidents are common throughout the world. On April 5, 2010, an explosion at a Massey Energy Co. mine in West Virginia killed 29 miners.⁶

Explosions in a mine at Rospodskaya, Russia killed 90 miners and rescuers in May 2010.⁷

In China, there were ten accidents from March through June 2010. At least 199 miners were killed in the various accidents that included explosions, fires, and floods.⁸ By official government statistics, more than 2,600 miners were killed in accidents in 2009 alone.



In the U.S., 18 miners were killed in 2009 and at least 39 have died on the job in 2010.⁹ Although less frequent than mining accidents, fatalities also occur at coal generating plants and in transportation, contributing to coal's toll.



Natural gas explosions occur frequently and at times turn deadly. On February 7, 2010, six people were killed and a dozen injured by a gas explosion at the Kleen Energy Systems site in Middletown, Connecticut.¹⁰ The accident occurred during a gas line cleanout using natural gas. Plant safety practices were criticized for allowing procedures that use ignition sources to go on at the same time.

Even hydropower contributes to the death toll. In August 2009, a major accident occurred at Sayano-Shushenskaya hydroelectric dam in Russia. Excessive vibration caused one of the turbines to break apart, flooding the turbine hall and engine room and collapsing the ceiling. The accident killed 75 people.¹¹



When it comes to worker safety, not even renewable sources of electricity can keep pace with nuclear energy's record of safety. The Caithness Windfarm Information Forum tracks wind turbine accident data starting in approximately 1995. While the data compilation is believed to be a conservative, comprehensive cross-section, it is probably not complete due to a reliance on confirmed press reports and official information releases.¹² Nevertheless, 71 wind turbine-related fatalities and



945 accidents were reported through September 30, 2010. Typical accidents include falls, inadequate safety precautions, and equipment failure.

Safety-Conscious Work Environment

The poor safety record in other energy sectors compares to zero fatalities from commercial nuclear energy generation in the U.S. This contrast is across the board for all types of worker injury.¹³

The nuclear energy industry is one of the safest places to work in the U.S. In 2009 nuclear facilities had a lost-time accident rate of 0.1 accidents per 200,000 worker hours, compared to 1.1 for fossil-fueled and 0.5 for hydroelectric generation. Statistics compiled by the Bureau of Labor Statistics show that it is safer to work at a nuclear power plant than in the manufacturing sector, or even the real estate and financial sectors.¹⁴



If you would like to look closer at the research behind the information in this publication, please visit our website at www.unistarnuclear.com. You will find there an annotated version of this Issue Brief with links to the original research and other data behind this publication, as well as all of the other publications in the Issue Briefs series.

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