

# A Comparison of QRA Methods used by DOD for Explosives and Range Safety with Methods used by NRC and EPA

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## Abstract

This paper compares the quantitative risk analysis (QRA) methods in current use by the government for regulating potentially hazardous technologies. These are: 1) nuclear power plants, regulated by the Nuclear Regulatory Commission (NRC), 2) chemical facilities, regulated by Environmental Protection Agency (EPA), 3) Department of Defense (DoD) explosives facilities, regulated by the DoD, and 4) launch ranges, administered by DoD. A description of these QRA methods will be provided highlighting the unique features of each, followed by a comparison of the methods on these fundamental issues of risk: How safe is safe enough? How is risk calculated? How are risk decisions made?

## Introduction

Many methods used today for conducting quantitative risk assessments originated in the early 1960s in the United States (US) aerospace industry as a means to compare and improve the reliability of aeronautic system designs. This comparison required the development of quantitative methods of assessment based on probabilistic and statistical mathematics. These same assessment methods were employed during the 1960s and 70s in the commercial nuclear industry to quantify the risk of reactor plant designs. With continued use, the assessment methods were refined and tended to be more logical, explainable and repeatable. Over time these quantitative techniques have become more formal and scientific.

Since that time there has been growing use of QRA methods to assess risks in other areas of technology. Use of these methods is routine in many engineering fields concerned with the design and operation of potentially-hazardous technological systems, and in managing the risk to the public of hazardous materials. These hazards, stemming from modern technology, include large engineered systems such as nuclear power plants, large buildings and civic structures, public transportation systems, and defense-related manufacturing and storage facilities, as well as the ~140 substances currently designated by the EPA as “extremely hazardous substances.” Many QRA methods in use today developed in parallel with these potentially-hazardous technologies. The analytical method used to assess their risk to the public was by necessity, tailored to the particular type of hazard being analyzed.

Today, by employing these tools of QRA, safety professionals are succeeding in minimizing these risks, and are continuously improving the overall safety and cost-effectiveness of these potentially-hazardous technologies. And due to these demonstrated successes, the *craft of assessing risk* has gradually become *the discipline of QRA*.

As part of the trend toward using quantitative methods to assess risk there has been a related trend among agencies of government to use risk-based standards and regulations for ensuring the safe deployment and use of these potentially-hazardous systems and substances. Increasingly, the regulations and standards governing these areas of technology call for use of QRA methods as a basis for rational, informed decision-making regarding risk to the public.

Risk-related regulatory guidance can be divided into three general categories: 1) Standards for “How safe is safe enough?” 2) Guidance for analyzing “How safe is this action?” and 3) Guidance for deciding “Is this action acceptable?” Risk-related regulations focus primarily on the second category, the analysis method, as a means to make reliable, repeatable and verifiable decisions. In this context, ease and consistency of use are important considerations affecting the choice of analysis methods. To best serve these aims, assessments of risk should be made on the basis of consistent assumptions and modeling techniques, with consistent standards for analytical data and documentation of results. Where QRA results are used to make real-time operational decisions involving public risk, this is especially important because differences in assessment methods can be confusing even to well-informed decision makers. In the worst case, these differences in assessment methods can lead to bad decisions and/or unnecessary loss. At best, unnecessary differences in methods will merely complicate the decision-making process and the regulatory process.



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