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STUDY OF RISK ASSESSMENT PROGRAMS AT FEDERAL AGENCIES AND COMMERCIAL INDUSTRY RELATED TO THE CONDUCT OR REGULATION OF HIGH HAZARD OPERATIONS

Robert A. Bari, Samuel Rosenbloom & James O'Brien

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STUDY OF RISK ASSESSMENT PROGRAMS AT FEDERAL AGENCIES AND COMMERCIAL INDUSTRY RELATED TO THE CONDUCT OR REGULATION OF HIGH HAZARD OPERATIONS

Robert A. Bari
Brookhaven National Laboratory
Upton, NY 11973-5000
Bari@bnl.gov

Samuel Rosenbloom and James O'Brien
U. S. Department of Energy
Washington, DC 20585
Samuel.Rosenbloom@hq.doe.gov, James.O'Brien@hq.doe.gov

ABSTRACT

In the Department of Energy (DOE) Implementation Plan (IP) for Defense Nuclear Facilities Safety Board's Recommendation 2009-1, the DOE committed to studying the use of quantitative risk assessment methodologies at government agencies and industry. This study consisted of document reviews and interviews of senior management and risk assessment staff at six organizations. Data were collected and analyzed on risk assessment applications, risk assessment tools, and controls and infrastructure supporting the correct usage of risk assessment and risk management tools. The study found that the agencies were in different degrees of maturity in the use of risk assessment to support the analysis of high hazard operations and to support decisions related to these operations. Agencies did not share a simple, "one size fits all" approach to tools, controls, and infrastructure needs. The agencies recognized that flexibility was warranted to allow use of risk assessment tools in a manner that is commensurate with the complexity of the application. The study also found that, even with the lack of some data, agencies' application of the risk analysis structured approach could provide useful insights such as potential system vulnerabilities. This study, in combination with a companion study of risk assessment programs in the DOE Offices involved in high hazard operations, is being used to determine the nature and type of controls and infrastructure needed to support risk assessments at the DOE.

Key Words: risk assessment, safety, high hazard

1 INTRODUCTION

In response to the Defense Nuclear Facilities Safety Board's (Board's or DNFSB's) Recommendation 2009-1, *Risk Assessment Methodologies at Defense Nuclear Facilities* [1], the Department of Energy (DOE) developed an Implementation Plan (IP) [2] to address the Board's recommendation. One item in the IP commits the DOE to studying the use of quantitative risk assessment methodologies at a sample of government agencies and industry in order to identify opportunities to improve the management of nuclear safety through applying such methodologies within the DOE.

This paper describes the results of this study. In parallel, the DOE performed a study of current applications of risk assessment methodologies at the DOE nuclear facilities, the results of which are contained in a separate report [3].

2 METHOD OF STUDY

With the support of DOE's Risk Assessment Working Group Steering Committee, the DOE's Office of Nuclear Safety Policy and Assistance, within the Office of Health Safety and Security, developed a project plan[4] that guided this study. For this study, data on the following three general areas were collected by reviewing agency and industry risk assessment policies, protocols, and procedures and by interviewing agency and industry senior managers and risk assessment staff:

1. Risk assessment applications
2. Risk assessment tools (e.g., qualitative, quantitative, or probabilistic risk assessment)
3. Controls (e.g., procedures, quality-assurance requirements) and infrastructure (e.g., staffing, training, subject-matter expert teams) supporting the correct usage of risk assessment and risk management tools

The following organizations were interviewed:

- U. S. Nuclear Regulatory Commission (NRC)
- Nuclear Energy Institute (NEI)
- National Aeronautics and Space Administration (NASA)
- Food and Drug Administration (FDA)
- Center for Chemical Process Safety (CCPS)
- Federal Aviation Administration (FAA)

The study began in November 2009 and data collection was completed in August 2010.

3 RESULTS

The key findings from examining risk assessment programs in the six external organizations are summarized below.

3.1 Nuclear Regulatory Commission

<u>Background and Overview</u>

The NRC is responsible for regulating the commercial nuclear industry, which includes power reactors and a variety of other less-hazardous operations (e.g. research reactors, fuel cycle facilities, and radioactive sources .The fuel cycle and manufacturing facilities are generally considered similar in hazards to those at some DOE nonreactor facilities.

After the accident at Three Mile Island, Unit 2, in 1979, various review groups recommended that the NRC should increase its usage of PRA in its safety work. The landmark Reactor Safety Study (known as WASH-1400) that the NRC undertook in the early 1970s was cited as a valuable example of the PRA approach for light-water power reactors because it was able to identify and quantify vulnerabilities to a spectrum of accidents including an event similar to that which led to the accident at Three Mile Island. The NRC's history and experience have led to its role as the lead agency for developing PRA and its uses in safety-related risk management.

Applications

Commercial Nuclear Power Plants

The NRC regulates current operating commercial nuclear power plants according to the detailed, prescriptive requirements in the *Code of Federal Regulations* (Title 10 CFR Part 50) that do not require a licensee to perform a risk assessment to support licensing decisions. However, the NRC had requested licensees of operating commercial reactors to perform PRAs in order to identify potential severe accident vulnerabilities [5], generally known as Individual Plant Examinations (IPEs). New reactors are licensed under new regulations promulgated under 10 CFR 52. The NRC now requires full scope PRAs for new reactor applications licensed under 10 CFR 52. The NRC also issued the maintenance rule requiring an evaluation of the risk of maintenance activities that could make a plant more vulnerable to accidents and affect safety systems. Although PRA is not required for these applications, it is generally used by licensees.

In the arena of commercial power reactors, the NRC now employs PRA to enhance safety decisions by revealing risk insights for a wide range of applications. These include fire protection, inspections, formulation of new regulations, graded quality assurance programs, review of industry requests for relaxing regulation (due to undue burden), and the requirements for new nuclear power plants.

Non-Reactors

For non-power reactor facilities, the PRA methods and data are less mature, the PRA applications are more diverse, more limited in scope and level of detail, and less quantitative. The PRA applications in these areas do not use the tools that are specific to the power reactor regime. For example, fuel-cycle facilities, the NRC currently requires license applicants to perform an integrated safety analysis (ISA) (as described in NUREG-1520). This approach is similar, if not identical, to that used in the documented safety analyses (DSAs) of the DOE's nuclear facilities for identifying safety structures, systems, and components. Limited PRA analyses have been piloted for fuel cycle facilities to show how the PRA technology can be extended to these areas. Generally, the failure data for non-reactor facilities lacks the quality that is available for commercial reactors. Since the data quality is reduced and the applications more diverse, ISAs are not the same as PRAs in regards to the depth of analysis, scope, treatment of dependencies, and uncertainties, but they assess likelihoods and consequences at a more qualitative level than a PRA submitted to the NRC for reactors.

Tools

Over the past 30 years, the NRC developed a full suite of PRA tools, mainly through its Office of Nuclear Regulatory Research, primarily for use in risk assessments for light-water reactors. This suite encompasses tools for predicting core damage (SAPHIRE), characterizing severe accident progression and radioactive releases to the environment including physicalmeltdown and fission-product behavior (MELCOR, CONTAIN), and for evaluating offsite consequences (MACCS).

The NRC also has formulated tools to guide its risk management activities. One notable tool is Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," which offers details on the process for licensee requests for exemptions that are based on PRA results. It covers how to make decisions under the uncertainty in the risk information presented, and how to account for the quality of the analysis. Another important decision-making guide is NUGEG/BR-0058, "Regulatory Analysis Guidelines of the USNRC," concerning the analyses required for rulemakings and back fittings; namely, quantitative and qualitative value-impact assessments.

Controls and Infrastructure

The NRC has a policy statement related to PRA that promotes its use in regulatory applications but also provides limits and controls. It states (in part):

- The use of PRA technology should be increased in all regulatory matters in a manner complementing the NRC's traditional defense-in-depth philosophy.
- PRA and associated analyses should be used to reduce unnecessary conservatism in current regulatory requirements and guides, license commitments, and staff practices.

In addition, the NRC has a safety goal that is risk-based that, in essence, states that the risk to the public from the operation of nuclear plants will be a small fraction of risks the public is normally exposed to. The DOE has essentially adopted this goal in its Nuclear Safety Policy (SEN 35-91), which, although being revised, is expected to retain the current safety goal.

To support appropriate use of PRA by its licensees, the NRC developed several documents. A key document for determining the technical adequacy of the PRA is Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities." Regulatory Guide 1.200 defines graded PRA requirements consistent with the intended regulatory applications. It provides criteria and guidance for determining whether the PRA is sufficient to ensure confidence in the findings from a PRA, such that the PRA is suitable for its intended specific regulatory decision-making action for light-water reactors

In the non-reactor area, the NRC uses the following documents that can provide controls (e.g., procedures, quality assurance requirements) to support the proper use of the tools:

- Risk-Informed Decision-Making for Nuclear Materials and Waste Applications, Revision 1, February 2008, ADAMS accession number: ML080720238.
- NUREG-1520, Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility
- NUREG -1513, ISA Guidance Document
- NUREG/CR-6410, Fuel Cycle Facility Accident Analysis Handbook

The NRC has an extensive infrastructure supporting PRA activities. For example, it has several offices supporting PRA studies or development, application to development of requirements or review of licensee submittals. It has an office for the regulation of current reactors and a new office for licensing of reactor applications that are in the process of being submitted. Another office supports non-reactor application and another regulates materials usage. A research office, described below, develops tools for the agency, including those used in risk assessment.

The NRC's Office of Regulatory Research issues risk assessment tools to the other offices in response to users' requests. PRA staffing is not centralized in NRC and it is dispersed across the whole organization. Each major NRC office employs a senior risk expert with the pertinent special skills in risk assessment. The NRC is an active participant in several standards-development projects sponsored by professional societies. The NRC offers training courses at various levels, from a basic course on "risk for managers" to more detailed training on risk methods and applications for technical staff.

3.2 Nuclear Energy Institute

Background and Overview

The Nuclear Energy Institute is an organization sponsored by the commercial nuclear industry to develop products that benefit the entire industry and to be an industry advocate. NEI provided DOE with a commercial industry perspective on the use of PRA.

Applications

The commercial industry uses PRA technology to provide a basis for some operational criteria that are reviewed by the NRC (e.g., technical specifications for allowable outage time) and the control of maintenance activities. Commercial nuclear power licensees have taken several actions related to risk assessments, including:

- All licensees have quantitative risk assessments for at-power internal events.
- Qualitative assessment generally is used for initiators (e.g., fire, seismic) for which no methods and data exist for completing a detailed quantitative assessment or for operating modes (such as low power) wherein it is known that a quantitative assessment would little improve the development of risk insights.
- In the non-reactor areas, the NEI approach is less quantitative, and supports the fuel-cycle licensees in their integrated safety assessments (ISAs).

Although NEI itself does not develop or use PRA, it does provide guidance to the nuclear industry. While NRC gives licensees the option of using or not using PRA in connection with fire protection regulation, NEI recommends not using PRA for fire analysis. Another area of policy-related support involves review of NRC requirements related to PRA. An important outcome of that effort was a letter NEI provided to the NRC on the use of risk assessment that brought out the following issues:

- Industry PRA resources are finite and their focus on standards development and PRA model maintenance must be considered in light of other plant priorities.
- The continuing expansion of Regulatory Guide 1.200 Rev 2 with regard to meeting newly-developed and relatively untested PRA standards creates regulatory instability and has detracted from the pursuit of regulatory applications as evidenced by the relatively small number of submittals over the past few years.
- A stable and predictable regulatory environment for PRA using a measured approach would be most beneficial for encouraging applications and ultimately lead to better PRA technical adequacy and more complete scope.

Tools

The NEI's members (reactor owners) developed their own probabilistic risk assessment and supporting decision tools. Generally, members use quantitative risk assessments for decision making to make requests for risk-informed license amendments. The NRC Regulatory Guide 1.200 gives guidance on acceptable changes to a plant's calculated risk profile. NEI has developed a peer review protocol that was approved for use by the NRC. In the non-reactor areas, NEI members undertake ISAs following the methodologies of the chemical industry, such as process-hazard analysis. The NEI noted that the database for hardware and human failure is not good enough for quantitative PRAs for the fuel-cycle facilities.

Controls and Infrastructure

Licensees evaluate the scope and technical adequacy of the PRA needed to support a given decision. For license amendment requests, per the NRC's Regulatory Guide 1.200, the licensee includes information about the PRA's scope and technical adequacy that is relevant to the decision making involved in assessing the request for amendment. There is no approval of the risk assessment per se; rather, an industry-run peer-review process evaluates the scope and technical adequacy of a licensee's PRA to assist the utilities in improving their PRAs to support risk-informed decision making in general. For several years, the reactor owners' groups have been formulating and applying a PRA peer review program and have issued several peer-review guidance documents. NEI has a small staff that is focused on supporting the nuclear industry in the area of PRA. In conjunction with the Electric Power Research Institute, NEI sponsors a risk professionals' education program that involves six one-week courses; more than 50 industry personnel have completed it since its inception three years ago.

3.3 National Aeronautics and Space Administration

Background and Overview

NASA, like the DOE, has responsibility for establishing safety programs to protect its workers and the public from hazards associated with its operations. Over the past decade, NASA developed a formal, elaborate program incorporating the use of probabilistic risk assessment (PRA) for applications to public and worker safety and to mission success. This program was developed in response to reviews of the Challenger and Columbia shuttle accidents, which recommended an increased use of PRA.

During the previous 10 years, NASA generated an impressive set of documents that offer valuable information on how and where to use PRA, how to have it reviewed, and how to use this information in making decisions related to the safety of the mission, crew, and the public. NASA's PRA organization continues to develop new tools and related information, indicating that NASA views this as a worthwhile effort.

Applications

The applications are focused on astronaut safety. However, NASA also performs PRAs to evaluate public safety from the launch of power-generating devices that utilize radioactive material (i.e., plutonium). Applications include:

- Evaluating priorities for resource allocations
- Evaluating the benefit of inspections, surveillance, and maintenance,
- Evaluating tradeoffs between improvements in the level of safety and impacts on capability to meet scientific mission objectives utilizing physical reliability models to predict the probability of specific hardware failures.

Tools

NASA uses a wide range of tools for performing PRAs. Some were adapted from the nuclear industry, such as the software tool, SAPHIRE, that is used to evaluate fault trees. Others, such as reliability analysis models, are developed by NASA. NASA also relies on a variety of methods and techniques and generates specific guidelines of how they should be implemented. In this regard, NASA generated its own version of a fault tree handbook. For identifying and quantifying failure events, NASA relies on well-established tools, such as failure modes and effects analysis, master logic diagrams, faults trees, and events trees. Detailed analyses of physical phenomena are geared to specific aerospace applications.

Controls and Infrastructure

NASA has established a rigorous process for developing and reviewing PRAs. It has produced many documents to support the development and review of risk assessment and to support risk management. NASA's approach to risk assessment and management is well-documented and articulated via documents posted on its website and elsewhere. NASA issued the following Policy Statement on risk assessments (in NPD 8700.1E, *NASA Policy for Safety and Mission Success*):

> Use qualitative and quantitative risk assessment techniques to develop information for making informed decisions regarding safety and mission success within a structured and formal decision process.

NASA's Office of Safety and Mission Assurance reviews and approves all of the PRAs required by NASA. This review concentrates on the appropriateness of methods, information, sources, judgments, and assumptions, and their application to the program/project/system being evaluated.

The Office of Safety and Mission Assurance at NASA headquarters is the central point for developing and promulgating PRA information and practices. The Office has about six PRA experts on staff. Its broad mission is to assure the safety and enhance the success of all NASA activities through developing, implementing, and overseeing Agency-wide safety, reliability, maintainability, and quality assurance policies and procedures.

3.4 Food and Drug Administration

Background and Overview

The FDA is responsible for regulating the safety of commercial food and drug industries. The focus of DOE's study of the FDA was on their application of risk assessments to food inspections.

The primary mission of the U.S. Food and Drug Administration's Center for Food Safety and Applied Nutrition (FDA CFSAN) is to safeguard public health by ensuring the safety of food products in the United States. To accomplish this goal, they increasingly rely on approaches to risk analysis that enhance the scientific basis of regulatory decisions, evaluate risk management options, and implement food-safety programs.

Applications

The FDA uses risk assessment daily in the inspection process. Their approach is qualitative, particularly for uncertainties. The FDA also undertakes large-scale risk assessments of health issues (e.g., the relative risks of mercury in fish vs. benefits of Omega 3 oils). Their focus is on public risk. The FDA also utilizes cost/benefit analysis to justify regulations.

Tools

The FDA investigators do not have a formal toolbox for risk assessment and, therefore, such tools are not directly available to them. They rely on informal expert judgment (not a formal expert elicitation process) and on data, when possible. The FDA uses decision-support tools, (e.g., PREDICT) to aid multi-attribute decision-making. Investigators have discretion in how information from risk assessments actually is employed in inspections.

Controls and Infrastructure

Quality assurance in the risk area is informal. The Agency relies on input and peer reviews from academia and sometimes from other agencies. The FDA coordinates with the USDA, CDC, and EPA in risk-related areas. The FDA does not have a formal policy on using risk assessment. Between 20 and 30 of the approximately 800 individuals in the CFSAN are involved directly in risk assessment work. The current risk-management program in the Office of Regulatory Affairs is about two years old; the CFSAN program has existed for at least a decade. An on-line course is under development to train CFSAN investigators in risk assessment and risk management. The CFSAN collaborates with the Joint Institute for Food Safety and Applied Nutrition, based at the University of Maryland and offers some risk training.

3.5 Center for Chemical Process Safety

Background and Overview

CCPS was formed 25 years ago after two significant accidents in the chemical industry that resulted in worker and public fatalities (i.e., the Bhopal and PEMEX accidents). Seventeen companies asked for the creation of the center to help them manage risk. Currently, CCPS includes 125 companies worldwide. DOE collected data from CCPS to obtain the chemical industry perspective on the applications and controls of risk assessments to support safety operations.

Applications

Companies in the chemical industry utilize risk assessment for evaluating the safety of their operations. The chemical industry is required by OSHA regulations (29 CFR 1910) to perform process hazards analysis (PHA) and by EPA regulations (40 CFR) to perform accident analysis (with an evaluation of potential public consequences) in addition to PHAs. Each company sets its own risk criteria for internal risk management via quantitative risk assessment (QRAs); OSHA and EPA are not involved in companies' QRAs. No regulations require performing a QRA.

Tools

Chemical companies use standard hazard and accident analysis tools such as process hazard assessments and "what-if" checklists. CCPS also advocates a "layers of protection" approach, which is similar to defense-in-depth in the nuclear field. The industry has a variety of computer tools for performing QRAs. Some are internally developed, while some are developed and marketed by consultants. Failure mode and effects analysis, (FMEAs), fault trees, event trees, and consequence models typically are part of the evaluation toolbox.

Controls and Infrastructure

The chemical industry is much more diverse than the nuclear industry, and one size, in methodological approach, does not fit all. Larger chemical companies tend to use QRA. Chemical companies perform quality assurance in the risk area internally. Industry users' groups provide controls on evaluating the products; in this regard, the industry oversees itself. Training typically takes the form of one-week courses offered by consultant firms and by CCPS; the other mode is the usual on-the-job training.

The CCPS Director noted that CCPS schedules regular bi-monthly technical Web conferences with its members. DOE was invited to participate in an upcoming conference to give a status report on its study of risk assessment by other organizations. CCPS holds the global Conference for Process Safety, a gathering of approximately 600 attendees, once a year. The chemical industry has an ongoing dialogue with INPO, the nuclear operators' organization.

3.5 Federal Aviation Administration

Background and Overview

The Federal Aviation Administration (FAA) is responsible for regulating the safety of the commercial air industry. For this study, DOE reviewed the FAA's Air Traffic Safety Oversight Office (AOV), and its Air Traffic Organization (ATO). The AOV's primary function is safety assurance. In its safety assurance capacity, the AOV has oversight authority for the ATO. The International Civil Aviation Organization (ICAO), an organization operated by the United Nations, was the driver for a safety-management system in the mid-1990s and spirited the increased use of risk assessment by the commercial aviation industry. The ATO took 5 years to implement its own system. The work on risk started in 2005-2006 and the FAA is still building its capability. It has a comprehensive website with information on safety and risk.

Applications

The FAA employs risk assessments to assess changes in the National Airspace System (NAS), such as the separation of airplanes in the sky and during landing. The number of risk analyses performed throughout the ATO runs to hundreds per year; most are qualitative. Examples include assessments supporting seeking a waiver for a control tower, runway incursions, and considerations of factors causing a pilot's loss of awareness.

AOV is beginning to formulate a risk-based auditing capability, developing lists of hazards to determine the biggest risks for the National Airspace System and the ATO. The latter's safety risk management (SRM) process has adapted and institutionalized the safety risk assessment methodology from MIL-STD-882C that involves developing a risk matrix based on a semi-quantitative categorization of the likelihood and severity of hazards. A guide on using the semi-quantitative risk categorization using an existing flight risk assessment tool is described in InFO 07015, 7/3/2007. Presently, the criteria for judging the significance of changes in risk are case-specific. The ATO is trying to establish more uniform risk-based criteria for acceptable levels of safety performance; this will take some time. Their risk policy statement will be available at the end of this year.

Tools

The FAA uses models for simulating the risks of collisions. The Oversight Office does not undertake quantitative risk assessment, but its oversight reviews address such capabilities and activities. An example is the recent assessment of the ATO organization, which made observations in this area. Data for QRA are limited in the Oversight Office. The FAA's Atlantic City facility researches human-factors influence.

The ATO focuses on safety risk management (SRM). Defense-in-depth is an essential aspect of their safety philosophy. Using SRM, the ATO is promoting quantitative risk assessments and performs some detailed risk assessments using fault trees and event trees (called "bow-tie" models). The ATO also relies on simulations.

Data in numerous operating-experience databases are available for risk assessments, encompassing equipment failures, events, system issues, and lessons learned. Major sources for this data are the Air Traffic Safety Assessment Program (ATSAP) and the Aviation Safety Information Analysis and Sharing System (ASIAS).

Software tools are not standardized within the FAA, but risk assessment methods are standardized. The FAA uses a risk matrix of consequence vs. likelihood to facilitate risk-management. The ATO requires quantification of uncertainties, especially for new applications; it turns to industry for analyses of specific areas (e.g., Boeing Corporation for turbulence studies).

Controls and Infrastructure

The FAA assures the quality of its analyses by having subject matter experts review their results. Its safety manual prescribes the risk tools. The SRM process always requires a "monitoring plan" when a change (e.g., to a rule) is proposed that may involve a supporting risk assessment. Monitoring is intended to verify the effectiveness of the change and, thereby, to validate the results of the risk assessment.

In terms of infrastructure, several safeguards are place: certification for safety competency, classes on safety assessment, lessons on bow-tie modeling, and a required SMS overview course for every ATO employee. The University of Southern California provides safety training for the FAA; on-the-job training also is important. The ATO also has contracts with several vendors, such as MITRE and SAIC. Engineers at the FAA have qualifications in many of the standard engineering disciplines.

4 SUMMARY AND OBSERVATIONS

The study found that the agencies reviewed were in various degrees of maturity in the use of risk assessment to support the analysis of high risk operations and to support decisions related to these operations.

All six organizations reviewed considered risk assessment an integral part of their safety-management programs. The commercial nuclear power industry, the NRC, and NASA have the most mature programs in place to support the effective utilization of risk assessments (including quantitative risk assessments) and have well-defined procedures and processes in place and extensive supporting organizations. The risk assessment programs have been beneficial in providing greater safety assurance and better safety decisions by providing a structured approach for evaluating hazards and quantifying the likelihood and consequences of accidents.

Both the FAA and FDA utilize risk assessment but mostly in a qualitative matter to support safety decisions. These organizations are looking to continue expanding on their capabilities for using quantitative risk assessment to better inform their decision-making . The commercial chemical industry has long had effective guidelines in place for supporting risk assessments. However, these risk assessments are primarily qualitative in nature.

Both EPA and OSHA do not get involved with the quantitative risk assessments performed by the chemical process industry; rather, the regulation of the latter is done by directing the industry to have a management system with certain characteristics in order to meet a purpose, consistent with the respective federal regulations (29 CFR 1910.119 and 40 CFR 68).Similarly, FDA does not have an overarching quantitative risk assessment approach to the regulation of the food industry.

Organizations did not share a simple, "one size fits all" approach to tools, controls, and infrastructure needs. This was most obvious from review of the NRC and commercial nuclear industry where significant differences exist in risk assessment capabilities between the power reactor and non-reactor communities. However, there were many similar program attributes in place for some of the mature programs including:

- A high-level policy statement regarding the use of risk assessments
- Specific procedures controlling the development, use, and review of risk assessments
- The identification of available tools (and development of the application specific tools to support) in performing risk assessment
- An organization tasked with the generation and maintenance of risk assessment procedures, support of risk assessment reviews, and training of the developers and users of risk assessment

Furthermore, the organizations recognized that flexibility was warranted to allow use of risk assessment tools in a manner that is commensurate with the complexity of the application. The study also found that, even with the lack of some data, agencies' application of the risk analysis structured approach could provide useful insights such as potential system vulnerabilities.

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