

## **EVALUATING INTERNAL STAKEHOLDER PERSPECTIVES ON RISK-INFORMED REGULATORY PRACTICES FOR THE NUCLEAR REGULATORY COMMISSION**

L. K. Peterson

E. H. Wight

WPI, 6 Montgomery Village Ave., Suite 650, Gaithersburg, MD 20879

M. A. Caruso

U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation  
O-10H6, Washington, DC 20555

### **ABSTRACT**

The U.S. Nuclear Regulatory Commission's (NRC) Office of Nuclear Reactor Regulation has begun a program to create a risk-informed environment within the reactor program. The first step of the process is to evaluate the existing environment and internal NRC stakeholder perceptions of risk-informed regulatory practices. This paper reports on the results of the first phase of this evaluation: assessing the current environment, including the level of acceptance of risk-informed approaches throughout the reactor program, the level of integration, areas of success, and areas of difficulty. The other two phases of the evaluation will identify barriers to the integration of risk into NRC activities and gather input on how to move to a risk-informed environment.

### **BACKGROUND**

For the past several years, the U.S. Nuclear Regulatory Commission (NRC) has been moving toward the implementation of risk-informed regulation using probabilistic risk assessment (PRA) and associated analyses in nuclear regulatory activities. Given the dissimilarities in the nature and consequences of the use of nuclear materials in reactors, industrial situations, waste disposal facilities, and medical applications, the commission recognized that a single approach to incorporating risk analyses into the regulatory process would not be appropriate. The transition, therefore, was expected come about in different ways and on different schedules in various parts of the organization.

Also, given the real and necessary emphasis on safety and risk avoidance in the field NRC regulates, a certain amount of resistance to change was to be expected. Reasons for this resistance could include failure to see the need for change; misunderstanding of the purpose, mechanics, or consequences of the change; vested interests in the status quo; and lack of identification or involvement with planning and implementing the changes.

In 2001, the NRC Office of Nuclear Reactor Regulation (NRR) began a program intended to create "an environment in which risk-informed methods are integrated into staff activities, and staff plans and actions are naturally based on the principles of risk-informed regulation." Based on a strategy first to understand the current environment and then to address the weaknesses and build on the strengths, the program has four phases:

- (1) evaluate the current environment,
- (2) design an improved risk-informed environment,

- (3) implement changes to achieve the target environment, and
- (4) assess effectiveness of environmental changes.

## **CURRENT ENVIRONMENT**

The first phase of the program, the evaluation of the current environment, was designed to gain insight into internal NRC staff perceptions of risk-informed regulatory practices in the reactor program. Undertaken in fall 2001, the evaluation included individual interviews and focus groups conducted both at headquarters and in all four regions, reaching a total of nearly 100 NRC employees nationwide. All the respondents volunteered to be a part of the evaluation process, indicating a high level of interest in the topic. Respondents represented all professional levels within the reactor program—senior managers, engineers, PRA branch staff, branch chiefs, inspectors, etc., providing a broad array of perspectives and experience.

The assessment team designed interviews and questions to achieve three goals: assess the current environment, identify barriers to the integration of risk into NRC activities; and gather input on how to move to a risk-informed environment. This paper reports on only the first of these goals. To assess the current environment, the team investigated the level of acceptance of risk-informed approaches throughout the reactor program, the level of integration, areas of success, and areas of difficulty. The following statements briefly characterized the current environment within the reactor program:

- NRC staff demonstrate increasing acceptance of a risk-informed approach in the reactor program.
- Debate appears to have moved beyond whether risk insights should be integrated into activities, to discussion of how and when to implement risk-informed approaches.
- NRC staff and managers vary widely in their understanding of and experience with risk-informed approaches, as well as their acceptance of them. Staff ranged from being experts at conducting PRAs to acknowledging unfamiliarity with risk technology and applications.
- Barriers to implementation span a range of issues, including technical, organizational, communications issues, as well as levels of staff knowledge and experience.

## **PROGRESS IN IMPLEMENTING RISK-INFORMED REGULATION**

The evaluation found that acceptance of risk-informed regulatory approaches in the reactor program is generally increasing. Though there are pockets of disagreement, the majority of respondents felt that PRA technology can make significant contributions to NRC regulatory practices. Respondents consistently agree on the issues NRC faces in the use of PRA technology and risk insights, but thoughts varied on how to address those issues.

### **Growing Acceptance Correlates with Experience**

The evaluation showed both increasing acceptance of PRA across the reactor program and an apparent positive correlation between acceptance and experience. A number of indicators of increasing acceptance appeared consistently during the focus groups and interviews. The PRA experts reported positive movement, demonstrated by more requests for help and less perceived defensiveness and hostility. Staff took care to avoid appearing anti-PRA when discussing the

technology and its use, and concerns raised were about implementation, not about whether PRA technology would or should play an important role in NRC activities.

NRC staff varied widely in their understanding of and experience with risk-informed approaches. The experience range paralleled those for trust and acceptance. Staff with more PRA experience had a more realistic understanding of what can be expected of the technology and also tended to have a higher degree of trust in and acceptance of it. Conversely, those with limited experience using PRA techniques trusted and accepted them less.

### **Some Activities Invite Risk-Informed Initiatives**

As NRC seeks to expand risk applications within the reactor program, staff and decision makers can gain important insights into the time and effort needed by identifying characteristics that facilitate integration of risk insights, as well as the barriers to a risk-informed environment. The focus groups revealed certain conditions where risk insights are easy to integrate into reactor program activities. These are shown in Table I, along with examples of specific activities or programs with successful application of risk-informed approaches. For example, risk insights are more easily integrated in cases where clear guidelines are established, as was the case with the Reactor Oversight Process (ROP) and the Maintenance Rule. Staff are also more comfortable using risk insights to expand requirements for the licensee than to remove them or fill in areas where there is a demonstrated deficiency in identifying and addressing safety concerns under the design-basis framework.

**Table I. Conditions Facilitating Integration of Risk Insights**

<b>Condition</b>	<b>Applicable Activities/Programs</b>
There are no design-basis regulations	Non-safety-related components that are risk-significant
There is a demonstrated deficiency under the design-basis framework	In-service inspection
Function is identification and appropriate prioritization of high-safety-significant issues	Reactor Oversight Process (ROP); Structures, systems, or components classification
Function deals with day-to-day operations	Testing, Allowed Outage Times, oversight
Implementation guidance is provided; an approach is codified	ROP and Maintenance Rule
PRA insights lead to safety improvements	Maintenance Rule

### **Benefits of NRC Using PRA**

Respondents indicated a general recognition that PRA and risk insights have a significant and potentially positive role to play in the reactor program. They recognized that leadership has mandated its use, but also identified clear benefits in NRC's use of risk. Even those who had significant reservations or limited experience with PRA identified positive impacts from the use of risk technology. The most successful impacts of PRA most frequently mentioned were providing a common language, focusing people and resources on the same important issues, identifying issues that might not have been observed under a strict design-basis evaluation,

providing a holistic view of system impacts and safety concerns, and reducing unnecessary regulatory burden.

## **CHALLENGES**

Though preferred paths forward differed, staff and managers were remarkably consistent in identifying specific challenges that the reactor program faces in moving to a risk-informed environment.

### **Clear and Common Understanding of Risk-Informed Practices**

Every focus group and many individual interviews revealed concern over the lack of a common understanding of what “risk-informed” means. Respondents felt that a clear, consistently agreed-upon definition either did not yet exist or had not been adequately communicated. Respondents believed that risk-informed approaches are intended to draw from the strengths of both deterministic and PRA techniques, but didn’t know what this ideal means in a practical sense for individual jobs and tasks. Both staff and lower-level managers indicated they were looking for increased leadership in this area, asking questions like, “How do we do it? What are the objectives? What is the proper balance between risk and deterministic approaches? How do we retain the concept of defense-in-depth?” These kinds of questions were raised many respondents with both minimal and extensive experience with and acceptance of PRA technology.

### **Paradigm Shift**

In *The Structure of Scientific Revolutions*, Thomas Kuhn says a paradigm provides both model problems and model solutions and discusses the problems this fact can cause when a group is shifting to a new paradigm. Although PRA is often referred to as a tool or a technology, some respondents perceived that its use requires a different set of underlying assumptions than the deterministic design-basis approach. As NRC shifts from using risk insights to adjust the amount of testing required for different components to applying the technology more rigorously, the organization faces a set of challenges broader than simply encouraging the use of a new tool.

The profundity of this shift may account, in part, for the widely shared lack of clarity about the term “risk-informed.” Some respondents recognized that PRA is being applied more as a change in philosophy than simply as a new tool. For example, in the case of the South Texas request for exemptions regarding treatment of structures, systems, and components (SSCs), underlying changes in assumptions were not clarified to staff in the presentation of the project. It was not clear what the current regulations allowed or who bore the responsibility for ensuring that functionality of SSCs was being maintained. Many respondents thought this example made it clear that PRA is not simply another tool, but a change in philosophy requiring careful attention to the way new tasks are framed and how risk-informed approaches might conflict with current regulations. Thus, use of PRA introduces not just a new tool for finding an answer, but also a new type of answer.

## **Practical Experience in a Risk-Informed Environment**

A significant portion of respondents from headquarters said they didn't see how risk assessment or application of risk insights directly relates to their jobs. Respondents reported little contact with PRA and in some cases felt it does not relate to their work. Similarly, some respondents who supported the use of risk assessment in general were reluctant to apply it to their own areas due to lack of knowledge of job-related applicability, lack of guidance, or a sense of security in the old way of doing things.

An overriding issue that emerged during the focus groups and interviews relates to trust in the PRA technology itself. Respondents asked questions such as, "Where does the data come from? How good is this number?" Respondents indicated that many NRR staff and managers outside the PRA branch are not well versed in the calculations, data, or assumptions that feed PRA results. One barrier to acceptance of risk-informed approaches, therefore, is the lack of knowledge and experience with the technology.

Although, as noted earlier, increased experience correlates with positive attitudes toward PRA and its potential usefulness, direct experience also makes staff more discerning about the broad application of PRA technology and the strengths and weaknesses of current implementation of risk-informed regulation. Many respondents among the risk analysts raised issues related to the quality and availability of data needed for PRAs in certain areas. They were also looking for increased awareness about the impact of limited or outdated data on the PRA process and the applicability of PRA insights.

Judging from the focus group and interview respondents, NRC staff need the following to reduce mistrust in PRA technology:

- more experience with and understanding of the data and technical rigor that go into PRA calculations;
- increased understanding of the appropriate and intended use, applications, and implications of PRA calculations;
- increased understanding that PRA numbers don't have to be perfect to be useful;
- candid, open discussion and acknowledgment of where PRA is not useful; and
- demonstration that concerns resulting from current implementation practices are being recognized and addressed.

Questions to consider in this area include the following: Are there enough opportunities for staff to gain practical experience in using risk-informed approaches? In areas where utilities are given the choice of the old or the new way, will they be interested in using the opportunities available through risk-informed approaches? Does the promise of the benefits of using risk analysis outweigh the risk of entering into a process that is untested and the outcomes are uncertain?

## **Reactor Program Organizational Structure and Process**

Respondents across the spectrum of management and staff noted several organizational issues that are exacerbating the challenges of moving to a risk-informed environment. The consolidation of PRA expertise in a small number of organizations, in particular, has affected the

ability to create a risk-informed environment that promotes integrated decision making. While respondents believed that increasing the use of PRA within the reactor program is a priority, they observed that there is not always a match of resources and incentives to help make a risk-informed environment a reality. For example, industry is not required to use PRA, risk experts are not sufficiently represented in management, and NRR and the regional offices do not have enough risk analysts on staff.

Respondents also noted that the organization needs to become flexible enough to adjust to new processes as unanticipated issues emerge. In the review of the South Texas exemption request, for example, staff spent many months trying to integrate new expectations about functionality of SSCs with existing ones. Once management provided needed guidance, the team was able to make rapid progress. The organization needs to move faster to respond to projects that are applying PRA technology for the first time and facilitate open discussion of issues raised during implementation. Regional focus groups emphasized that good two-way communication and feedback mechanisms are critical to an effective implementation of a risk-informed environment. Respondents also expressed concern about general area of personnel issues and accountability, mentioning personal job satisfaction, job security, and promotion potential for PRA experts versus other staff members. One concern was there are very few PRA experts within management.

The need for better guidance also emerged as an important issue. There was a shared concern about the existing guidance and policy statements' lack of detail and specificity with regard to PRA/risk-informed approaches. Respondents noted the current format of the guidance reinforces the dichotomy between risk and deterministic approaches. With two separate documents (i.e., Standard Review Plan sections for risk-informed and non-risk-informed reviews), even the guidance is not integrated. Due either to lack of time or a sense that it is not relevant for them, non-PRA staff have limited knowledge of existing guidance, which is regarded as complex.

### **Technical Concerns: Standard and Limitations**

As mentioned earlier, respondents were very concerned about the standards and quality issues for PRAs, repeatedly asking for PRA standards and for the opportunity to review industry-created PRAs. While lack of standards contributed to lack of trust in the technology, from a practical standpoint, PRAs coming to the NRC from industry are of mixed quality. Some respondents insisted that standards are essential, while others felt a better understanding of PRA concepts would remedy the perceived need for standards.

Respondents also listed areas where they felt risk insights are harder to apply, including fire, human performance, security, and seismic events. NRC staff shared a concern that evolving practices do not reflect the point that some areas are less suited to the direct application of risk insights under the current state of the technology.

### **Stakeholder Issues**

This project focused on stakeholders internal to the NRC reactor program, but respondents raised issues related to the influence of industry stakeholders and the impact of public confidence on

NRC activities. Respondents noted strong economic motivations from industry supporting the use of risk-informed approaches. Some respondents viewed this situation as a simple reality; others viewed economic influences with suspicion and questioned the motivations for using risk-informed approaches. Respondents also noted that stakeholders' perception of risk may have an impact on NRC's implementation of risk-informed approaches, particularly in light of the events of September 11, 2001.

Respondents were asked to assess how industry is helping and/or hindering the development of a risk-informed environment. The majority generally believed that industry has been an important driver of this change. Some viewed this role as positive, some as negative. In some cases, staff members felt PRA has been emphasized to the detriment of safety concerns; in other cases they felt safety is enhanced because both the NRC and licensees can focus on high-risk issues. Many staff members believed that burden reduction is the primary driving force behind the use of PRA. While there are specific examples of real successes in burden reduction, some implementation issues have increased burden on both NRC and licensees. For example, areas of the ROP have proven to be cumbersome, and the review of the South Texas Project request for exemptions took two years.

In the area of public confidence, respondents discussed the concerns that, in general, the term "risk" has negative connotations with stakeholders and that these perceptions may be even more problematic due to the 9/11 tragedy. NRC's move to a greater reliance on risk insights and technology may affect public confidence, which in turn could influence a risk-informed environment.

## **CONCLUSION**

This project addresses one of NRR's Operating Plan goals and was conceived by the NRR Leadership Team to foster the use of risk-informed approaches in the reactor program. The program includes four phases: (1) evaluate the current environment; (2) design an improved risk-informed environment; (3) implement changes to achieve the target environment; and (4) assess effectiveness of environmental changes. The basic strategy is first to understand the current environment and then to address the weaknesses and build on the strengths.

The assessment team implemented the first phase using qualitative research methods to explore staff attitudes and feelings. The results reported here provide insights into multifaceted motivation and behavior that can be used to design and effectively implement an improved risk-informed environment throughout the NRC Office of Nuclear Reactor Regulation program.

## **Acknowledgements**

This work was performed under subcontract to ISL, Inc on Contract NRC-03-00-003.