

Decision-Makers

Staff

Effective Risk Communication

Guidelines for Internal Risk Communication

Shared
Understanding



UNITED STATES
NUCLEAR
REGULATORY
COMMISSION

Effective Risk Communication

Guidelines for Internal Risk Communication

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Graphics Key



Things to remember

A summary of the main points in the chapter.



Practice Tip

An NRC-related exercise idea you can use to rehearse the techniques explained in the section before having to use them in an actual risk communication situation.

Preface

This document presents practical, how-to guidelines for management and staff of the U.S. Nuclear Regulatory Commission (NRC) to use in communicating risk-related information to others within the agency. Research and experience show that effective risk communication depends on such key factors as understanding your stakeholders, establishing trust and credibility, clearly presenting your key messages, providing forums for discussion and deliberation, and using listening skills. In addressing these factors, these guidelines demonstrate how NRC management and staff should apply each technique to internal communication about risk-related information and the NRC's risk-informed, performance-based regulatory approach.

This document is a companion to "Effective Risk Communication: The Nuclear Regulatory Commission's Guidelines for External Risk Communication" (NUREG/BR-0308). It is not a primer in risk analysis or the related applications.

Audience

The guidelines are intended for use by NRC management and staff across the agency to improve internal communication about risk-related information. As such, they are generally directed toward risk analysts and others who work with risk-related information. Nonetheless, this document emphasizes the fact that internal risk communication is a two-way process, so other staff may also find the guidelines useful in developing questions and setting expectations. The authors anticipate that, as more NRC staff and management use risk-related information and insights, the audience for this document will grow.

Reader's Guide

Depending on the communication task at hand, different parts of the guidelines will be relevant to the reader. The advice offered in each chapter can stand alone; however, when viewed together, the guidelines provide a comprehensive framework for strategic risk communication.

This document provides several navigation tools that can help readers quickly locate topics that are relevant to their individual needs at any given time. The table of contents includes chapter titles, as well as questions that summarize key chapter topics. Similarly, Chapter 1, "Defining risk communication," ends with a road

map that outlines the communication process and provides references to direct readers to specific chapters and topics. In addition, Chapter 2, “Determining objectives for communicating,” points the reader to relevant chapters based on specific communication objectives.

NRC management and staff should use the principles in these guidelines on a daily basis. Toward that end, Chapters 2-11 conclude with a summary of key points in “Things to Remember,” followed by “Practice Tips” for developing the communication skills addressed in the given chapter.

Frequently Asked Questions

Aren't these concepts merely “good communication,” rather than “risk communication”?

Many principles and practices of effective communication could be applied to address a variety of communication challenges, including risk communication, regardless of whether your interactions are with experts inside the agency or people outside the NRC, such as licensees or the public. Nonetheless, this document applies the guidelines specifically to the communication of risk information to others within the agency.

How do the guidelines in this document differ from the NRC's guidelines for external risk communication?

Risk communication principles remain the same, regardless of whether they are applied within an organization or to an organization's interactions with stakeholders. Thus, these internal guidelines apply risk communication principles to communication within the NRC, and are tailored to suit the needs of NRC management and staff. These applications differ from the NRC's guidelines for external risk communication in that risk communication with external stakeholders has a wider array of audiences and requires significant flexibility to achieve a shared understanding.

Will these guidelines teach me how to interpret risk information?

No. These guidelines are not intended to be a primer on risk analysis. Rather, they focus on communication principles and are designed to help you develop an understanding of your audience's values, concerns, and issues as you work with others within the NRC to find common ground and develop shared understandings of how and where risk information should be used.

Do these guidelines contain specific direction, including definitions of terminology, for me to use in communicating within my area of the NRC?

No. These guidelines are intended to have broad relevance across the NRC and, as such, they do not delve into the details of how risk information is applied in any one area. In addition,

because you can achieve the same goal in multiple ways, these guidelines do not provide specific direction for how to perform a given task. Thus, communicating and brainstorming with a co-worker while performing a task will prove useful in applying these guidelines appropriately.

1 Defining Risk Communication

What is it? Why is it important? How does it relate to external communication?

Within a public context, risk communication is an interactive process used in talking or writing about topics that cause concern about health, safety, security, or the environment. However, NRC management and staff commonly view risk communication more narrowly as discussions about probabilistic risk assessment (PRA), other risk analyses, and related information.

These guidelines are consistent with this latter perspective and, as such, they focus on helping NRC management and staff to improve their internal communication about risk information and policies under the agency's risk-informed, performance-based regulatory approach. The goal of this document is to help create the conditions for successful internal risk communication that will facilitate more effective decision-making and serve as the basis for successful external risk communication.

Because risk analysis is an important element in the NRC's decision-making process, those involved must have a shared understanding of risk-related topics in order to use risk information adequately to reach appropriate decisions.

What is risk?

The public and the NRC have different definitions of risk. The scientific community views risk as the likelihood of an event multiplied by a

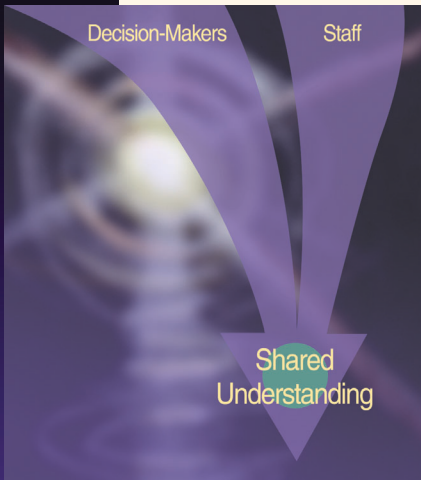
Risk-informed: An approach to decision-making that considers risk insights along with other factors (such as engineering judgment, safety limits, redundancy, and diversity). Decision-makers gather risk insights by asking, "What can go wrong, how likely is it, and what consequences would it have?" A risk assessment is a systematic method for addressing these questions as they relate to understanding likely outcomes, sensitivities, areas of importance, system interactions, and areas of uncertainty.

Performance-based: An approach to regulatory practice that establishes performance and results as the primary bases for decision-making. Performance-based regulations have four common attributes:

- (1) Measurable, calculable, or objectively observable parameters exist or can be developed to monitor performance.
- (2) Objective criteria exist or can be developed to assess performance.
- (3) Licensees have flexibility to determine how to meet the established performance criteria in ways that encourage and reward improved outcomes.
- (4) A framework exists or can be developed in which the failure to meet a performance criterion, while undesirable, will not constitute or result in an immediate safety concern.

NRC's Strategic Plan for FYs 2004-2009

series of consequences ranging from mild to catastrophic (**risk = probability x consequence**). By contrast, the public's view is based on personal perceptions and impacts, while the NRC's perspective is shaped by policy, professional experience, and protocols for risk assessment.



Within the NRC, the most prevalent definition of risk is the **"risk triplet"**:

- What can go wrong?
(accident identification)
- How likely is it? (probability)
- What are the consequences?

Even within the agency, however, management and staff have different definitions and levels of understanding of risk, and use different methods to measure and calculate risk. For example, systems engineering (e.g., equipment failure) and

health (e.g., relative to exposure) are two risk assessment frameworks that have both similarities and differences. The differences have implications for the data required, the metrics used, the form of the outputs of the analyses, and the implications for risk management strategies. In addition, individuals with law enforcement or security backgrounds might have different perspectives and understandings of risk.

We often use the term "risk" when the correct word to use would be "hazard." Hazard is a danger, whereas risk takes into account the danger and the likelihood.

NRC Staff

Clearly, professional expertise and experience play a major role in understanding and defining risk within the agency. As illustrated by the table on page 3, staff and management must reach a nexus in order to bridge the gaps between engineering, security, and health-related fields so that the common ground can provide the basis for a shared understanding. Effective risk communication is one step in building a shared understanding.

Comparison of Engineering and Health Risk Assessments*

	Engineering Risk	Health Risk
Risk assessment process	<ol style="list-style-type: none"> (1) System description (2) Hazard identification (3) Event frequency (4) Event consequences (5) Risk quantification 	<ol style="list-style-type: none"> (1) Hazard identification (2) Exposure assessment (3) Dose response (4) Risk characterization
Treatment of event frequencies or likelihood of occurrence	Looks at the frequency of an event and the probabilities of different failures within the system. Different combinations of failures can lead to releases (or events) of different severity, each with its own probability.	Deals primarily with situations involving chronic releases to the public with a release probability of 1; the assumption is that the release will occur.
Impact on risk management strategies	Focuses on risk management through design, maintenance, and administrative controls (i.e., controlling frequencies, consequences, or both).	Focuses on restricting or eliminating the material's presence, rather than mitigating with engineering controls.
Consequence measures or end points of risk assessment	The end point varies and may include core damage, worker health and safety, loss of a facility or piece of equipment, and immediate or long-term loss of life.	The end point is more specific to radiation exposures and the associated dose response (i.e., cancer fatalities).

* Source: Jones, E. "Risk Assessments: From Reactor Safety to Health Care," Risk Assessment 8: 12-21, 1995.

How does the NRC use risk information?

The NRC has adopted a risk-informed, performance-based regulatory philosophy, which encourages the use of risk information (and risk analysis) and also recognizes that such information is only one input to the decision-making process. The implication is that risk information is valuable, but may be more useful in some cases than in others. The Commission's policy statement on the use of probabilistic risk assessment (PRA) technology includes the following statement:

Use of PRA technology should be increased in all regulatory matters to the extent supported by the state-of-the-art in PRA methods and data and in a manner that complements the NRC's deterministic approach and supports the NRC's traditional defense-in-depth philosophy.

The following table summarizes some of the attributes of this policy and describes their implications for communication.

Communication Implications of the NRC’s Risk-Informed, Performance-Based Policy	
Risk-Informed/ Performance-Based Policy Attributes	Communication Implications
How and where risk information should be used depend on the specific context and decision. Standard procedures and conventions have not yet fully evolved in many areas.	<ul style="list-style-type: none"> • There is a need to clearly discuss and document assumptions and uncertainties that impact how and where risk analyses should be used for decision-making. • As more areas within the NRC become risk-informed, management and staff will need to develop a shared understanding of what is meant by “risk-informed” at the working level. • There needs to be sufficient opportunity for open deliberation and discussion.
Risk analyses are valuable, but are based on a different set of assumptions about safety, uncertainty, and compliance than those used in traditional deterministic approaches.	<ul style="list-style-type: none"> • Miscommunication can occur through lack of familiarity with terminology and the underlying assumptions. • Communication occurs in the context of personal comfort with risk information and concerns about maintaining safety.
Risk analyses require effective integration of multiple areas of expertise.	<ul style="list-style-type: none"> • Integration requires communication and interaction across various disciplines; conflicting technical frameworks and organizational structure issues might interfere with channels of communication.

Why is risk communication a priority for the NRC?



Risk communication provides the essential links between risk analysis, risk management (integrated decision-making), and the public (societal values and needs). Successful fulfillment of the NRC’s mission requires integration among each of these areas regarding values and assumptions, technical information, and decisions. You need risk communication to reconcile differing perceptions of risks and gain an appreciation of stakeholders’ points of view.

How to do it

In practice, risk communication is a team effort involving multiple organizational entities of the NRC (project managers, legal and

public affairs, safety inspectors, analysts). It works at two levels—strategic (agencywide) and interpersonal (between and among NRC staff members and stakeholders). Strategic risk communication is an integrated component of risk management and vital to the NRC’s mission.

At the strategic level, risk communication is a process that involves the following:

- long-term planning and coordinated communication efforts
- a shared understanding of risk concepts (among all NRC employees)
- strategic partnerships
- collaborative problem-solving
- common understanding of the strengths and limitations of risk analysis
- an understanding of the difference between risk-informed and deterministic analyses
- consistent messages
- appropriate tools for both internal and external risk communication

At the interpersonal level, risk communication involves applying a variety of skills and tools to communicate and develop a shared understanding. This level of risk communication relies on the following:

- actively listening and demonstrating that you respect and value others’ opinions
- building trust and credibility
- establishing long-term relationships
- sharing expertise and insights
- translating technical information into understandable language
- managing conflict
- effectively delivering relevant messages

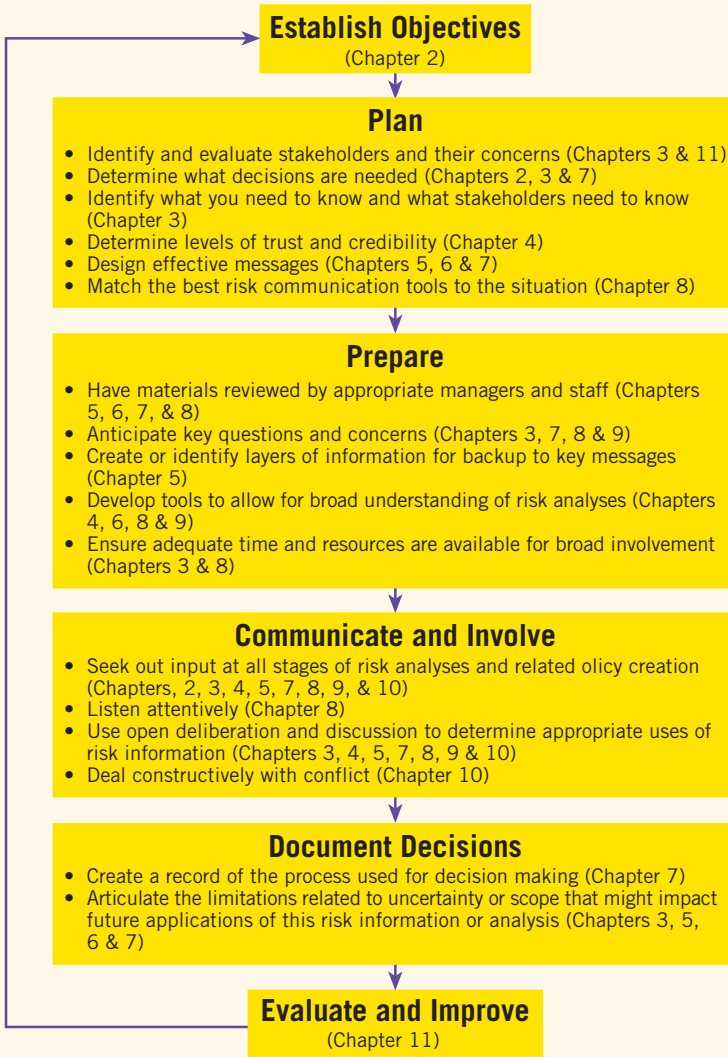
How does internal risk communication relate to external risk communication?

Internal communication about risk information and insights provides the basis for interaction with the NRC's external stakeholders by strengthening decision-making and enhancing the agency's ability to clearly communicate its activities and decisions. As such, it is important to take an early integrated approach to internal and external risk communication, rather than thinking of external risk communication as an afterthought or as the exclusive purview of certain NRC offices, such as the Office of Public Affairs. An integrated approach to internal and external risk communication includes the following activities:

- Identify potentially controversial issues or areas of concern. The earlier you are aware of potential hot spots, the more opportunities the NRC will have to productively fulfill its strategic goal of openness in our regulatory processes.
- Develop tools (including examples) to communicate technical information in plain language, in order to deepen both internal and external understanding.
- Produce technical reports and other documents that are technically accurate, complete, and sensitive to the concerns of internal and external stakeholders.

What steps should I take to implement risk communication?

Much internal risk communication occurs on a daily basis through informal channels, and you need not follow a detailed process for such communication. Nonetheless, whether you are facing a significant communication challenge requiring a formal communication plan or simply looking for suggestions for improving your communication with peers, you can use the following figure as a road map to navigate through this document.



Components of a Strategic Risk Communication Process.

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2 Determining Objectives for Communicating

What is my purpose for communicating?

The first step in effective risk communication is identifying the purpose of the effort. Your objectives may evolve as you refine your understanding of audience needs (more about this in the next chapter), so it's important to think about the people to whom you are talking (your stakeholders), what they already know and need to know about your topic, and what you want to achieve by communicating with them. Skipping this step can lead you to use the wrong risk communication tools and methods, answer the wrong question(s), or communicate an entirely different message than you intended.

You might consider obtaining communication support from the Communication Assistant within your office or elsewhere in the agency to develop objectives and refine your understanding of the internal audience needs. In addition, the Office of Public Affairs can assist you in understanding what risk information would be useful in supporting external risk communication.

Internal risk communication generally focuses on sharing information through briefings, meetings, email messages, memoranda, and phone calls. Consider the following questions when determining your objectives for internal risk communication.

Am I gathering information for a risk determination?

Risk analysts gather operational experience and seek expert judgment for use in PRAs and other risk determinations. To conduct a robust risk analysis, you must draw from a wide variety of sources and disciplines. To do so, you must be able to clearly explain what information you need and how you will use that information in the risk assessment (i.e., the context). (For more, see Chapter 8, "Implementing effective two-way communication.")

Am I eliciting peer feedback or input?

Reviews of reports or analyses contribute greatly to the credibility of the findings and conclusions, particularly when the reviewers include peers within the agency who have relevant expertise. Decision-makers are influenced by specific data, as well as by the credibility of others who agree with the data. Reviews of

risk assessments usually focus on understanding and evaluating the assessments. Thus, it is important to completely and accurately describe key assumptions and their potential effects on the analysis results. It is also important to discuss which scenarios were deemed insignificant risk contributors and why they were not addressed in detail. (For more, see Chapter 4, “Building the credibility of risk information.”)

Am I providing input that will contribute to a decision?

The type of information decision-makers want depends on the resources in their control and the nature of the decision they must make. Even before beginning an analysis, risk analysts can confer with managers to determine how the results will be used and which questions need to be answered. The management team should also be involved in selecting scenarios and discussing assumptions. Similarly, when an analysis is complete, risk analysts must share the findings in a manner that is useful to decision-makers. (For more, see Chapter 3, “Understanding internal stakeholders.”)

Am I providing background information?

Not all briefings are linked to impending decisions. Sometimes, a general briefing or background overview is necessary to keep managers and staff apprised of project progress. In such situations, presentations should focus on the most significant points and avoid becoming too detailed. (For more, see Chapter 5, “Developing key messages.”)

Am I conveying a decision?

Once the NRC has made a decision, it must be conveyed both internally and externally. In such instances, it is usually best to begin with the conclusion, and then provide the appropriate level of detail about what led to that decision. (The “appropriate level” depends on your audience and the nature of the decision.) Your discussion and documentation may include the source(s) of the data, how the analysis was conducted, and key factors that affected the outcome. (For more, see Chapter 7, “Ensuring transparency in decision-making.”)

Am I building consensus or resolving issues?

Because NRC managers and staff have varying roles, work in different offices, and have differing but highly specialized expertise, it is natural to assume that they will have different

views and opinions from those presented. The inherent nature of a risk-informed approach and its recent introduction into regulatory matters also contribute to a need to build consensus. Conflicting views and opinions are not necessarily bad, but they do need to be discussed openly to serve as a catalyst for positive change. (For more, see Chapter 10, “Building consensus and resolving conflict.”)

Am I supporting communication with external stakeholders?

When preparing and presenting information, risk analysts need to appreciate the broader context in which risk managers will need to communicate. Internally, it is appropriate for NRC management and staff to focus on the risk metrics and analyses that are identified by agency policy. Nonetheless, the NRC must also recognize that the concerned public has a different focus. Specifically, members of the public want to know what the information means for them and their families. If the public will be the ultimate receiver of the information you’re presenting, you must keep their interests and perspectives in mind. (For more, see NUREG/BR-0308, “Effective Risk Communication: The Nuclear Regulatory Commission’s Guidelines for External Risk Communication.”)

Am I developing a risk-informed, performance-based approach in a new area?

As NRC management and staff work through the technical issues associated with risk-informing various areas and agency processes, it is important to explicitly address the related communication challenges. Consider early in the process who you’ll need to inform about the project’s status and outcomes. To determine who needs to be involved at a deeper level (such as through participation on a review team), identify who will be impacted or concerned by the new risk-informed approach. Also consider communication processes that allow issues to be raised and concerns to be addressed throughout the project instead of waiting until the end when controversy can derail your work. Set clear expectations regarding why a risk-informed approach is necessary in the new area, and engage in dialogue to establish a shared understanding of what “risk-informed” means at the working level. (For more, see Chapter 3, “Understanding internal stakeholders,” and Chapter 9, “Clarifying common areas of confusion and avoiding miscommunication.”)

Once you have identified your communication objectives, you can make better decisions about what risk communication tools and processes will be most effective.

Things to Remember



- *In considering your goals and your audience, be sure to identify what needs to be said, to whom, and why.*
- *Different objectives require different information and communication processes.*

Practice Tip



Write down your communication and project objectives, using the questions above as a guideline. Briefly state your objectives in 25 words or less. Once you have concisely stated your objectives, place yourself in the position of various NRC management and staff. What objectives might they have as stakeholders or decision-makers?

3 Understanding Internal Stakeholders

Who are they?

What are their needs and preferences?

Identifying your internal stakeholders and understanding their needs and perspectives are important steps in effective internal risk communication. We can make certain generalizations regarding the different types of information that various internal stakeholders will want based on their roles, responsibilities, and backgrounds; however, we must also consider their individual needs and preferences. Thus, it is helpful to gain an understanding of your audience in order to adjust your approach. For example, you might try to find out the depth and breadth of your audience's current knowledge of the system to be analyzed, their knowledge of relevant risk-related tools and results, and their belief in the value of risk assessment (including the treatment of rare events).

As a basis for these guidelines, we have grouped stakeholders into the three broad categories of decision-makers, technical staff, and nontechnical staff.¹ This chapter offers tips for communicating with stakeholders in each group and summarizes the types of information that they are usually most interested in receiving. The questions posed in the following sections can be used in presenting your risk information, as well as providing your audience with questions they might consider asking during a discussion.

What do decision-makers typically want or need to know?

Risk analysts are responsible for ensuring that risk information meets the needs of decision-makers, and this responsibility requires ongoing and open dialogue. To the extent feasible, decision-makers and risk analysts should engage in dialogue to address the following sample questions (among others):

¹ NRC internal stakeholders can be grouped into many more categories according to areas of expertise, roles and responsibilities, and experience with risk information. However, the three broad categories discussed in this chapter provide a general framework for understanding stakeholders' various perspectives without complicating the discussion.

Problem identification

- What is your understanding of the problem?
- What are the decision criteria?

Key technical issues (results and analysis)

- What assumptions were used?
- Which assumptions had the greatest impact on the final results?
- Which assumptions were based on science, and which were based on policy or procedure?
- What data were used, and what were the sources and limitations of the data?
- Was any relevant data not considered and, if so, why not?
- What are the limitations of the analysis (including data and model)?
- What were the uncertainties in the analysis?
- What contributes to the uncertainties?
- Given the uncertainties and assumptions, what is your confidence in the conclusion?
- Can anything happen in the model that cannot happen in reality (or vice versa)?

Implications

- Is risk analysis appropriate for this situation?
- How do the results compare to a known standard, typical values, or a traditional deterministic analysis?
- What is the impact on safety?
- What is the impact on resources?
- Do you need help and/or resources? How much time is needed to conduct the analysis and why?
- Were specific risk management options ruled out and, if so, why?

- Does this analysis or situation indicate a deficiency or contradiction in policy that needs to be addressed by upper management or the Commission?
- Do the results apply more broadly than just to the facility or system analyzed?

Potential for controversy

- What is the licensee's position on the issue?
- Why is the licensee's analysis different?
- Has this information been shown to other people and, if so, how did they react?
- Which parts of the assessment may be controversial?
- Do other staff members within the agency take a different position on the issue?
- How is the public likely to respond to the decision options under consideration?
- Does this analysis appear to conflict with prior NRC decisions and, if so, how?
- Do the results need to be applied generically to other facilities or systems?
- Has there been a peer review or stakeholder input?

Tips for communicating with decision-makers

Decision-makers lack the time to become deeply involved in the details of a given risk assessment. They are likely to prefer short narrative descriptions of an assessment that give qualitative insight into the causes of risk and the related uncertainties, rather than details of the numerical results, statistical methods, and uncertainty analyses. They need information that clearly states the applicability of the assessment for decision-making. Keep the following tips in mind when preparing reports or presentations for decision-makers:

- Avoid jargon and recognize that decision-makers may not be familiar with risk terminology and methodology.
- Provide the most important information first, and follow with evidence to support your conclusion.

- Acknowledge or emphasize that factors other than risk also contribute to the decision.
- Be brief and to the point (usually about 30 minutes to an hour for a presentation).
- Explain the status of the project or initiative and provide an estimated time frame.
- Explain your recommendation so that they can defend it to the next level of management.
- Explain why the analysis was needed and how it fits into the larger picture.
- Explain the benefits and limitations of the analysis and whether refinement of the analysis is needed.
- Be prepared to provide options based on the risk information and explain the implications of each.

The types of information decision-makers need depend on the nature of the decision to be made. For example, in the reactor oversight process, if they're making a decision on a red or yellow finding, they need a deeper understanding of the background information and more detailed information on issues. If the stakes aren't as high, they don't need as much detailed information.

What do technical staff typically want or need to know?

Technical staff have many of the same interests as decision-makers and they'll likely want much more detail concerning the data and assumptions that were used, especially in their respective areas of expertise. The following additional interests are common among technical staff:

- What are some examples of a risk-informed approach being used to increase, rather than relax, restrictions on licensees?
- What relevant assumptions were made? (For example, why and for what duration was certain equipment considered to be unavailable?)
- What was the thought process?

- How will you use the information that they provide?
- Did you consider the right things, or did you miss something?
- What are the benefits of using a risk-informed approach for this situation?
- What level of PRA was performed?

The following table provides representative examples of information preferences for specific technical stakeholders.

Representative Information Preferences of Technical Stakeholders	
Stakeholders	Sample Information Preferences
Engineers	Specific scenarios that contribute to risk analysis results and assessments of whether they are reasonable, which scenarios dominate risk, and how results of deterministic engineering analysis are used in the analysis and decision-making processes.
Human factors analysts	How the assumptions and analysis reflected human interaction and its impact on the system, and whether realistic human performance data were used.
Inspectors	The risk significance of particular components or activities (to better plan and focus their inspection efforts), and how the analysis uses their input concerning operating practices, observed incidents, and other data.
Health physicists	The risk of worker and public exposure to radiation.
Radiation biologists	What types of devices, sources, and consequences were considered in the analysis.
Security experts	How risk analysis is used to assess a malicious act, what design-basis threat was considered, and whether the analysis considered low-probability, high-consequence events.
Risk analysts	Information that enhances modeling reality to accurately portray the design and operation of complex systems.

Tips for communicating with technical staff

Fulfilling the NRC's mission requires input from individuals with numerous areas of expertise, many of which are highly technical. Moreover, the fact that these individuals work for the same agency does not mean that all NRC employees speak the same language or operate under the same framework for understanding the risks associated with nuclear reactors and nuclear materials. Acronyms and words (such as "risk") that are used in everyday language that have one or more technical definition(s) are just as likely to interfere with communication within the NRC as with external stakeholders. In addition, engineering risk models are based on an understanding of multiple systems, operating environments, and physical phenomena. Thus, risk analysts must be generalists with the ability to draw on the expertise and experience of other disciplines to create appropriate models and use valid assumptions. The following tips will help you communicate more effectively with technical staff who have different backgrounds than your own:

- Describe the value of their input to the broader scope of the analysis and ultimately the decision.
- Recognize the potential effects of differing technical expertise. Avoid or explain jargon and acronyms with which they may be unfamiliar. (This requires careful attention to the questions you are asked and the nonverbal signals you receive from your audience.)
- Involve stakeholders early enough so that their input has meaning and can have a noticeable impact.
- Recognize that many technical staff members do not have a great deal of knowledge, experience, or comfort with probabilities and statistics.
- Invest the time to explore their reservations about the risk-informed, performance-based regulatory approach and concerns about specific risk numbers or assumptions.
- Encourage questions and seek feedback mechanisms that will enable the staff to present differing views or positions to coworkers and management without fear of reprisal.

What do nontechnical staff want or need to know?

Either officially or unofficially, all staff members are spokespeople for the agency and, as such, they need an accurate understanding of how the NRC reaches its decisions. While nontechnical staff want to understand the broad conclusions, they typically want the least background information underlying those conclusions.

Tips for communicating with nontechnical staff

Effective two-way communication between technical and non-technical staff will ensure that the available risk information is technically accurate, understandable, and relevant to stakeholders' concerns. Keep the following tips in mind when communicating with nontechnical staff:

- Explain why a risk-informed approach is beneficial for certain projects.
- Explain how risk will be used in making decisions.
- Explain the impact of the decision on them, the licensee, and the public.
- Use qualitative explanations.
- Use understandable language and familiar examples or comparisons.
- Encourage questions to clarify understanding.

Tips for communicating with mixed audiences

Many situations involve communicating with multiple stakeholder groups at the same time. The key is to provide just enough background information to enable those who are less familiar with your topic to follow the discussion, without losing the attention of those who don't need as much information. Use the following tips to communicate with mixed audiences:

1. Provide a brief overview of the project, process, and purpose.
2. Use a couple of specific examples to illustrate your findings. This might include explaining a couple of parameters.
3. Don't go overboard on the details. If you provide time for questions, your audience will be able to direct you to the information they are most interested in hearing about.
4. Limit your use of jargon and explain the terms you are using (preferably with examples).
5. Engage the members of your audience.
6. Read nonverbal signals to determine whether you are losing the audience.

Things to Remember



- *Internal stakeholders include decision-makers, technical staff, and nontechnical staff.*
- *Tailor the level of detail to the audience's roles and interests.*
- *Be careful not to stereotype even though similar stakeholders generally have similar interests.*
- *Recognize that even staff with technical backgrounds may not be fully conversant in all technical areas (including risk).*
- *Understand that anyone on the NRC staff can be perceived as an agency spokesperson; therefore, all staff should have access to background information concerning the agency's decisions.*

Practice Tips



Think about the perspective of your audience for a report or presentation. If you were in their shoes, what types of information would you want? As you present your information, try to use terminology that is familiar to the audience, and tie the recommendations and conclusions to their interests and needs. Following the presentation, seek out colleagues from different areas or positions within the NRC, and ask for feedback about what they found most useful.

4 Building the Credibility of Risk Information

**How do I gain my audience's trust?
How do I communicate about risk assessment quality?**

Risk analysis is a systematic process for modeling complex systems and relationships to better understand the associated risk(s). Skeptics are concerned that risk analyses can be manipulated to arrive at any outcome, while risk analysts highlight the legitimate uses and benefits of their analyses. As noted in the following quotation, trust in internal risk communication hinges on understanding and trusting the underlying risk assessment.

Incorporating risk information into decision-making will always require some degree of subjectivity. Nonetheless, by understanding and acknowledging both the strengths and the limitations of risk information, the NRC can use such information appropriately and with confidence.

It is important to build trust and credibility within the agency. To do so, you must be comfortable with the information you are presenting. Ask yourself whether you trust your sources, the analysis, and results, and whether the analysis fulfills the following criteria:

- Cover all relevant scenarios.
- Consider human error.
- Use appropriate assumptions.
- Rely on valid data.
- Consider other factors, as discussed in existing standards and review guidance.

So the trust issue in internal risk communications is one of understanding and trusting the PSA (probabilistic safety assessment), not the larger and more difficult problem of trusting the (organization). Therefore, a process to communicate the technical basis for the PSA is needed that places the PSA within the framework of the (audience's) own engineering training and discipline, rather than the public risk communication process that promotes understanding each other's goals and priorities.

**Bley, Kojima, and Wreathall in
"Facilitating Technical Risk Communication among Non-Specialists"**

We need to build trust and credibility from the inside out. As long as there is (comfort) inside, that will propagate outside.

NRC Staff

When presenting risk information, recognize that most audiences don't have time to re-analyze or recreate your results. Consider the following practices to increase the credibility of your results and recommendations:

- Prepare decision-makers in advance by describing what the risk information will look like (so they know what to expect).
- Clarify the nature of the decision to be made, and explain how the risk information is satisfactory for that type of decision.
- Show that different analysts obtained the same results, or explain any differences. (Risk information is more credible when independent analysts reach the same conclusions.)
- If possible, allow interested and affected stakeholders to see, understand, and participate in the analysis. (Make information accessible to people who need or want to participate.)

Communicating about Risk Assessment Quality

How good does a risk assessment have to be?

The NRC encourages the use of PRA technology in regulatory matters, so confidence in the information derived from a risk assessment is an important factor.

Current NRC policy related to the quality of a PRA is that it should be driven by context. That is, the scope, level of detail, and quality of a risk assessment depend on the specific application.

Consequently, it is difficult to set standard guidelines for assessing PRA quality. This problem places a burden on communicators to clearly document and explain why PRA works for one situation but not another. Through open communication, the NRC must also overcome the following misconceptions about risk assessment quality:

- If the risk assessment is good for one situation, it's good for another.
- If the risk assessment has any weaknesses, it's not good for anything.

- Talk about the strengths and limitations of risk information in terms of their potential implications for how the information should be used. (State the limitations up front to avoid problems later in the process.)
- Tell whether the information was staff-reviewed or benchmarked. (Risk managers put a higher value on staff-reviewed materials. Knowing who agrees or disagrees is helpful when making decisions.)
- Explain how you concluded that something is not a concern.
- Explain what the risk information does and doesn't tell you. (Good risk

information is still imperfect because it tries to predict the future, often with respect to the occurrence of rare events.)

Why must I be careful of the words I use?

When a risk analysis determines that a system or component is not “risk-significant,” this information can be useful in prioritizing resources and the attention of staff, inspectors, and licensees. However, NRC management and staff must bear in mind that risk-significance does not, in and of itself, equate to safety-significance. Moreover, the NRC and its regulatory activities are risk-informed, not risk-based. Thus, it is misleading to use the words “not important” synonymously with “not risk-significant,” and doing so undermines the credibility of the information and reinforces concerns about the way risk information is applied in the NRC’s decision-making process.

Things to Remember

- *Most audiences don’t have time to re-analyze or recreate your results, so be ready to explain the risk information.*
- *Recognize that risk managers place a higher value on staff-reviewed materials.*
- *Communicate that the scope, level of detail, and quality that are required of a risk assessment depend on the application for which the assessment is used.*
- *Pay attention to the words you are using.*
- *Involve relevant staff and management early and often.*



Practice Tip

The next time you are asked to review a technical document that you weren’t involved with creating, take notes as you read on your own mental steps for assessing the quality of the work. Do this for a document that involves a subject you know a great deal about and then for one that is outside your area of expertise. How do the factors you use to assess the quality of the information differ in these instances?



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5 Developing Key Messages

What should I say to achieve my objectives with this audience?

After you have determined your communication objectives, accounted for the interests and preferences of your internal stakeholders, and considered the context as it relates to trust and credibility, you're ready to develop your key messages. To be most effective, those messages should be brief, accurate, straightforward, easy to understand, consistent, and tailored to the needs of your internal stakeholders. Stick to just a few key messages—using more will weaken the overall message of your communication.

While numerical values of risk may *support* your messages, they should not stand alone. Focus the messages on your interpretation of what the numbers mean, their context, and their implications for a specific decision or policy with respect to safety. Put your messages into the context of answering questions that are relevant to your audience. (See Chapter 3.)

Use the following principles as a guide when preparing and delivering a briefing; writing a memo, report, or email; and engaging in conversations:

- Explain the important conclusions and summarize the impacts first. Save technical details as backup information. Your audience may want to hear the details after you have provided the summary statement.

The implicit contract between speakers and (those) spoken-to requires the former to use the time of the latter well. Listeners will not like a communication that repeats well-known facts or introduces irrelevant ones, while ignoring topics that they want to understand better. Nor will listeners appreciate information that conflicts with their existing beliefs, with other experts' claims, or with everyday experience—unless those discrepancies are explained.

Baruch Fischhoff, "Communicate unto others..." *Reliability Engineering and System Safety*, Volume 59, pages 63-72, 1998

Key messages should be a mixture of what the audience wants to explore and what you want to convey:

- *What decisions do people face?*
- *What information is most critical to those decisions?*
- *What do people already know?*
- *What are the critical gaps in their current knowledge?*

- Provide qualitative assumptions underlying the analysis and reasons for the results. Do not get bogged down in the details of the numerical results and statistical methods used in the analysis.
- When you do discuss risk values, provide context. Your key messages might answer the following questions: “Is the number generally considered to be good or bad?” “Is the number higher or lower than expected?” “Has it decreased or increased?” “Is it a change for the better or the worse?”
- Be up-front about any uncertainties, weaknesses, or data gaps in the assessment. External stakeholders are likely to bring these up, so you should be proactive in preparing management to respond. Indicate whether any ongoing research or other opportunities might yield new data that could reduce the uncertainties or alter opinions of the risk.
- Use diagrams or other visual tools to illustrate your key messages (e.g., a graphical representation of a particular event sequence that contributed significantly to risk).

Things to Remember



- *Understand your specific communication objective, and tailor your messages to your specific audience.*
- *Develop several messages in support of your objective.*
- *Do not use numerical risk information as a standalone message. When such information is needed to support another message, provide adequate explanation of how the numbers will be used in making a decision.*

Practice Tip



Ask colleagues to review your reports or presentations and summarize your main points. Did they understand the messages you were trying to convey? If not, discuss ideas for how you could present your messages differently to ensure that they are understood.

6 Communicating Risk Information to NRC Audiences

How do I select the best information, language, level of detail, and approach?

While most NRC staff have technical and scientific backgrounds, they differ in their knowledge of and experience in using and interpreting risk assessments. Part of the NRC's challenge in communicating effectively about risk to internal audiences is finding ways to enhance their understanding and acceptance of "risk-informed" approaches. While the NRC makes its transition from the traditional deterministic approach to those that are risk-informed, communication is critical to build an understanding about how risk assessments and insights appropriately fit into the decisions facing the NRC.

Provide thorough risk characterizations

The NRC intends risk information to be used in a thoughtful and appropriate way. Risk information is but one tool for use in reaching decisions and, as such, it must be supplemented with operational experience, engineering insights, and qualitative information. Consider the following tips for presenting risk information to audiences within the NRC who may not have day-to-day experience with risk:

- Be prepared for skepticism. People have a natural discomfort with any new approach to safety evaluation. In fact, informed skepticism should be considered necessary to ensure that assumptions are valid and that risk information is applied appropriately in decision-making.
- Provide a frame of reference. Relate the results to some established standard or typical result.
- Decide on the appropriate level of detail to present. Your audience may benefit from an examination of the initiating events, accident sequences, equipment failures, and human errors.
- Explain key assumptions behind the model and how those assumptions affect results in both directions. (Why isn't the risk higher or lower?)

- Explain how the data from different disciplines fits into the risk assessment, and how the audience’s expertise is used as input to the final result.
- Ask your audience to examine the model to test whether it accurately reflects their knowledge and experience. (“Did we leave out anything that should be included?”)

While PRAs have applicability to reactor safety issues, other techniques are used in other areas, such as the High-Level Waste Program, where the staff is using Performance Assessment and Preclosure Safety Assessment models. However, relevant methods have not yet been fully developed to handle many of the other issues outside of the reactor arena, such as security and emergency preparedness. In assessing risks in these areas, expert judgments are often relied on to make decisions. Make sure your audience understands this situation and has an opportunity to ask questions, as needed, about different applications and models.

Communicate information about uncertainty

According to interviews with NRC management and staff, uncertainty is a primary area of miscommunication and lack of understanding. Therefore, effective risk communication about uncertainty must achieve the following objectives:

- Recognize that policy and practices related to uncertainty aren’t well established in many areas. Make time for discussion of the issues and the implications related to different decisions.
- Be precise about the type of uncertainty that is under discussion, which uncertainties are most relevant for the specific decision, and how those uncertainties should affect the decision.
- Distinguish between uncertainty and variability. Their importance depends on the types of decisions to be made.

Three types of uncertainties² that are addressed and affect the results of risk assessments relate to parameters, models, and completeness:

² Uncertainty is also commonly categorized as aleatory and epistemic. Aleatory uncertainty deals with the randomness or predictability of an event. By contrast, epistemic uncertainty deals with the state of knowledge in risk assessment (e.g., parameter and model uncertainty are examples of epistemic uncertainty).

- **Parameter uncertainty** stems from imprecise values for parameters used in the PRA model, such as equipment failure rates, initiating event frequencies, and human error probabilities. The probabilities that the PRA generates for these parameters are used to quantify probabilities for accident sequences.
- **Model uncertainty** is the risk analyst's degree of confidence in the model's capability to capture reality. Model uncertainty answers the question of how closely the model represents the actual system being modeled.
- **Completeness uncertainty** refers to the limitations in the PRA scope (what is or is not included). It is addressed by limiting the scope of the application, or by demonstrating the impact of the unanalyzed portion of the risk. This type of uncertainty cannot be quantified, but is arguably the most important to discuss.

Promote discussion about the uncertainties. Risk assessments use the best available data on what is occurring or could occur at the site, and they evaluate the likelihood of different kinds of system or equipment failures, as well as the likely consequences of such failures. The results are probabilities, not certainties. When explaining risk analyses, discuss the uncertainties in the inputs to and outputs from the risk model, as well as those associated with the model itself. Invite examination of the results, and discuss the following questions:

- What are the weaknesses of the available data?
- On what assumptions are the estimates based?
- How sensitive are the estimates to changes in assumptions?
- How sensitive is the decision to changes in the estimates?
- How complete is the logic model, and what is the justification for a limited scope?

Present risk tradeoffs to assist with decision-making

A risk analysis might be the first step in deciding on the best option from among a range of options. As such, risk analysis can be used to calculate the positive impacts (or benefits), negative impacts (such as costs or decreases in efficiency or effectiveness), and risks of each option under consideration. Using risk assessment results as a point of departure for staff discussions highlights the value judgments that contribute to the final decision. Along with clearly and simply presenting the numerical data, encourage discussions

concerning the significance of each positive and negative factor and risk calculation. Sharing risk tradeoff information helps the staff focus not only on the numbers, but also on the numbers that they feel are most significant when deciding which option to pursue. All should have an opportunity to use the numbers to explain their viewpoints:

- Present the numerical data on options in a clear and straight-forward manner.
- Portray the differences among positive and negative factors and risks either numerically or qualitatively.
- Solicit audience feedback by asking questions that compare negatives to risks and positives:
 - "How important is the increase (or decrease) in risk, (negative or positive) between Option A and Option B?"
 - "How acceptable is a slight increase in risk to provide an efficiency of X?"
 - "Does the decrease in risk for Option A warrant the increased costs?"
 - "How important is it that the risk is lowered from 10^{-5} to 10^{-6} ?"
 - "Do the positives outweigh the negatives?"

Create effective graphs and charts

Visual depictions of information (such as graphs and charts) are critical to an audience's understanding of complex data. Images help our brains make comparisons and quickly understand complex relationships. Graphical representation is a powerful tool for portraying data because images tend to make deeper and more lasting impressions than text alone. The following suggestions can help you create effective and accurate visuals:

- Consider which type of visual representation will be most effective in conveying your intended message. (For example, "Will the audience better understand the results if a risk assessment includes event trees or some other means of depicting initiating events and consequences?")
- Engineers may appreciate your use of an event tree if you use it as a tool to demonstrate how the model reflects their expertise

and if you solicited their participation in critiquing the accuracy of the model.

- Provide yardsticks for understanding where the risk numbers fall in relation to performance measures and safety standards. Allow the audience to see (visually) where the value (mean) or distribution falls in relation to regulatory standards or the NRC's safety goals or quantitative health objectives.
- Risk information is often most appropriately portrayed using a logarithmic scale. However, it is common for our minds to subconsciously interpret visual images in a linear manner. Therefore, some analysts have found it effective to also provide the linear scale perspective, even if this must be achieved through a verbal example.

Do's & Don'ts for Using Color

Do...

- Use color to layer and separate data.
- Keep color significance consistent throughout a presentation. It is confusing if orange indicates one variable on one chart and a different variable on the next.
- Highlight data using strong hues in small amounts against a muted field.

Don't...

- Develop color systems that will be confused or conflict with those of the Reactor Oversight Process (green, white, yellow, and red) or Homeland security levels (green, blue, yellow, orange, red).
- Place strong colors in large, adjacent areas as this will be distracting for the viewer.
- Use green/red combinations, especially in small areas.

Graphical excellence begins with telling the truth about data

- Ensure that a graphic does not distort the actual quantities. The picture of the numbers, as physically represented by a graph, should be directly proportional to the quantities represented.
- Label important parts of each graphic, including important events that the data represent. Write explanations of the data on the graphic itself.

Help your audience focus on the most important information

- Ensure that the amount of ink you are using is proportionate to the importance of the data you are portraying. For example, avoid or mute grid lines, and don't include unnecessary decoration.

- Organize and sequence information to highlight changes in the key variables. For example, don't list a series of variables by date, if the main point is the impact of temperature on a component. In this case, the series should be ordered by temperature so that it is easier to see any correlation between temperature and other variables.

There are many ways to communicate risk information using graphs and charts. However, there is no definitive answer for which is most effective for the public, and there is even less research about which approach is best for internal stakeholders. Nonetheless, it is clear that consistency in colors, format, style, and content significantly increases the effectiveness of graphics to portray similar types of risk information for use in decision-making.

Don't stop with the numbers

NRC audiences will appreciate some form of qualitative information to supplement and provide a more complete understanding of how the numbers were derived and how they were influenced by the assumptions. In fact, qualitative risk insights can often be more useful than a risk number. Consider the following hints for alternative ways to present risk information:

- Tell the story of the risk assessment. Include background information, reasons for conducting the risk assessment, and how the results compare to results from other sites.
- Share key assumptions, and show how using different assumptions would have influenced the results.
- Use verbal descriptions of a risk value, such as "frequently," "sometimes," or "rarely." However, wherever possible, tie qualitative terms to quantitative data.
- Group risks into categories, such as "high," "moderate," and "low."
- Present key messages in executive summaries to state assumptions, uncertainties, and results.

Recognize the value of qualitative risk information

In some areas, the amount or quality of the data is not sufficient to generate a number. In addition, even when they can be generated, numbers often convey a sense of precision and accuracy even if the measurements that yielded the numbers are relatively unreliable. In the materials arena, analysts use the Integrated

Safety Analysis (ISA) method to systematically explore process hazards at chemical facilities. An ISA explores what can happen, as well as the likelihood, impacts, and controls needed for safety. Instead of quantifying the likelihoods and consequences of specific events, however, an ISA generally uses qualitative classes to rank the relative importance of risks.

Despite the value of purely qualitative risk information, some people are simply not comfortable with such information. In fact, within both the technical and nontechnical communities, use of qualitative information can be quite controversial. As a result, a credible qualitative analysis will need to clearly communicate the following issues:

- What techniques and methods were used to ensure the integrity, validity, and accuracy of the findings?
- What does the analyst bring to the study in terms of qualifications, experience, and perspective?
- What theoretical frameworks and assumptions undergird the study?
- What is the risk classification scheme, and how is it applied to provide a value judgment?

In addition, it can be challenging to standardize qualitative information, especially if that information is not tied to a quantitative framework. Consequently, when communicating qualitative risk information, be aware that when you fail to provide a number, audiences tend to latch onto any number, even one that is tucked away in an appendix as an example. Thus, a number that you merely intended to illustrate a single acceptable answer can become the *de facto threshold*.

Risk metrics

Metrics are surrogates for the NRC's safety goals and quantitative health objectives and, as such, they reflect the agency's focus on avoiding accidents and preventing or mitigating their negative consequences. Toward that end, the staff chooses metrics to quantify risks and reflect the agency's values. Consequently, each metric has its own strengths and limitations. In the reactor arena, for example, "core damage frequency" (CDF) and "large early release frequency" (LERF) are familiar terms. Nonetheless, despite the familiarity of the terms, CDF and LERF are not well understood by many, especially as they relate to the NRC's safety goals and the differences between the various related parameters, such as

core damage probability (CDP), conditional core damage probability (CCDP), and change in CDF (Δ CDF). Moreover, as the staff establishes metrics in the materials, waste, and security arenas, additional challenges will arise in communicating the interrelationships among the metrics that are used throughout the agency, as well as the questions that the public ultimately wants answered about safety.

Consider the following tips:

- Especially when members of your audience have less direct experience with risk information, provide examples that illustrate the basis of your metrics, what they omit (e.g., land contamination), and how they are calculated.
- Different metrics have their own yardsticks for defining what is acceptable, and those who use risk metrics on a daily basis tend to internalize the framework for interpreting the numbers so that they no longer need to refer to it directly. It is important to recognize that many people with whom you communicate—even within the NRC—do not have frequent experience with risk information. Consequently, they will need you to explain the framework for interpreting the numbers associated with the various metrics and their acceptability.
- As the NRC develops metrics for use in risk assessments, the agency should develop a comprehensive reference tool that includes units, specifics for the situations in which each metric should be used, guidelines or criteria against which each metric should be evaluated, and the bases for all of these factors.

Consider the level of technical detail to present

The level of technical detail you should present depends on your audience and the purpose of your communication. Audiences have different tolerances for technical presentations, different perceptions of risk, and different interests in receiving risk information. (See Chapter 3.)

- Be ready with handouts to fill requests for additional technical detail.
- Use a range of tools—diagrams, outlines, and analogies—to explain complex phenomena and promote shared understanding.

- Use props to illustrate your technical information. (For example, a geologist might provide rock samples to augment a discussion of how water might flow through different layers of a rock formation.)
- Have informal discussions with staff who are interested in learning more about the risk assessment process or interpreting the risk assessment results.

Things to Remember

- *Be open about the inherent uncertainties in risk analysis.*
- *Use visuals to help your audience quickly understand complicated relationships and data.*
- *Present risk tradeoffs.*
- *Discuss qualitative aspects of risk assessment.*
- *Be aware of the jargon and terms used in different NRC offices.*
- *Explain all new terms to your audience.*
- *Match the level of technical detail you present to the technical background of your audience.*



Practice Tip

At the next meeting you attend where you do not have a major role, write down all of the questions asked of the presenter. Does the audience want more information about where the data came from? Do they want clarification about a certain assumption or policy? Were graphics or tables used to explain the data and, if so, how effective were they? Try to address these types of questions in your next presentation.



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7 Ensuring Transparency in Decision-making

How can communication enhance the legitimacy of the decision-making process and outcome?

Some critics of the NRC complain that the agency makes decisions on the basis of information that is generated in a “black box.” Not being able to see, hear about, or participate in the process leads to misunderstandings and breeds distrust. Consequently, open communication within the NRC—both during an analysis and throughout the decision-making process—sets the stage for better understanding within the agency. It also enables the staff to share information with greater confidence. The three basic stages for ensuring transparency in decision-making are (1) defining the process, (2) communicating the decision and how input was used in making that decision, and (3) documenting for the future.

Openness... in communications and decision-making

The NRC views nuclear regulation as the public’s business and, as such, it must be transacted openly and candidly in order to maintain the public’s confidence. The goal to ensure openness explicitly recognizes that the public must be informed about, and have a reasonable opportunity to participate meaningfully in, the NRC’s regulatory processes.

“Communicating Results of a Decision,” NRC’s Strategic Plan for FYs 2004-2009

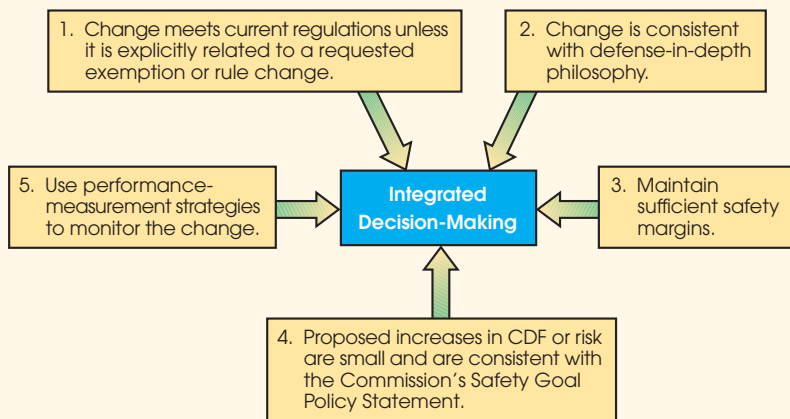
Stage 1: Defining the process

The NRC’s stakeholders use guidance documents to understand the factors that will be considered in decision-making, who will be included, and what the process will be. Remember that it is always important to be clear about when and how input will be used. (See Figure on the following page.)

Stage 2: Communicating the decision

Once a decision has been made, it must be communicated to interested parties, and any deviations from expected outcomes or processes must be clearly explained. Use the following tips when communicating about risk-informed decisions:

- Provide examples of how decision-makers used the inputs from various offices and levels of the NRC and how those inputs impacted the decision.



Principles of Risk-Informed Integrated Decision-Making. An example of a chart used to communicate a decision-making process, from Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis."

- Explain the relationship between defense-in-depth and the risk information and how these concepts influenced the decision.
- Discuss the implications of the decision for other offices or the NRC as a whole.
- Explain what has changed and why. Pay more attention to communication when the final results differ from what was expected. This process includes allowing more time for questions about data, assumptions, and the impetus for the additional analysis.
- Be careful not to rely too heavily on slide presentations to support decision-making, and choose words carefully when developing slides. Make sure the key points are prominent when condensing the information to fit on a slide, and place critical information in the most visible location. (See box on the right).

Stage 3: Documenting for the future

Throughout the risk assessment process, it is important to maintain accurate, complete, and understandable records of the thought process that contributed to a decision and the underlying analyses. Thorough documentation of the decision-making process is an internal risk communication tool that can help prevent others from

using data, analyses, and conclusions in a manner that is inconsistent with the intent. People may have an inherent tendency to view published information with undue authority or definitiveness. Explanation and caveats can help to put the information into the proper perspective.

Even if an assumption is used because “it’s standard practice,” it’s important to *document every assumption*. Readers of a report or analysis who are unfamiliar with risk assessment practices may not know the “standards.” Thus, you can help them understand the risk information by providing a complete explanation of why the analysis was conducted a certain way and how the conclusions can be used appropriately.

During the decision-making process, document information such as the following:

- What were the initial scenarios?
- What assumptions were made and why?

Risk Management by PowerPoint

On February 1, 2003, Shuttle Columbia was destroyed in its return to Earth, and all crew members were lost. The Columbia Accident Investigation Board identified a complex system of technical, organizational, and cultural failures that led to the tragedy. Among the things that the board reviewed were the viewgraphs used in technical briefings at NASA before the accident. At many points during the investigation, the board was “surprised” to receive confusing and misleading presentation slides from NASA officials instead of technical reports. The board pointed out that, “As information gets passed up an organization hierarchy, from people who do analysis to mid-level managers to high-level leadership, key explanations and supporting information is filtered out. In this context, it is easy to understand how a senior manager might... not realize that (information on a slide) addresses a life-threatening situation.”

Edward R. Tufte, Visual Explanations: Images and Quantities, Evidence and Narrative

Avoid Isolation in Decision-Making

Risk analyses and decision-making cannot happen in isolation. Rather, these processes require strong communication about the variables on which the risk assessment is based. For example, one analyst might conclude that a pump “need not be that robust” because the valves are robust and will limit failure. Another analyst might say it is acceptable to reduce the redundancy of the valves because the pumps are robust. If the dependency between these relationships is not clearly communicated to all involved parties, a decision-maker might decide to reduce the robustness of both the valves and the pump, without realizing the potentially dangerous overall impact on the system.

- In what other circumstances could the assumptions be used, and when would they not be applicable?
- Where did the data come from?
- In what other circumstances could the results be used appropriately, and when would it be inappropriate to use them?

Taking these steps will not guarantee that risk information and results will not be taken out of context. It is everyone’s responsibility to prevent risk numbers from being stripped of relevant discussions on uncertainties and assumptions.

Things to Remember

- *Share information throughout the analysis and decision-making processes to increase trust in the outcome.*
- *Clearly define how stakeholders' input will be used in making a decision. After the decision is made, reinforce how the input was used.*
- *When a final decision differs from what was expected, explain what changed and why.*
- *Ensure that all analysis reports include explanations of the factors considered in reaching a decision.*
- *Prepare clear documentation to help prevent the information from being used inappropriately in a future analysis.*



Practice Tip

Review a report from the past that you've used in a subsequent analysis. How well are the assumptions and caveats explained? What background information was omitted that would have made your analysis more complete? Keep these things in mind as you prepare your own reports so that you can provide the documentation that an analyst will find useful in the future.



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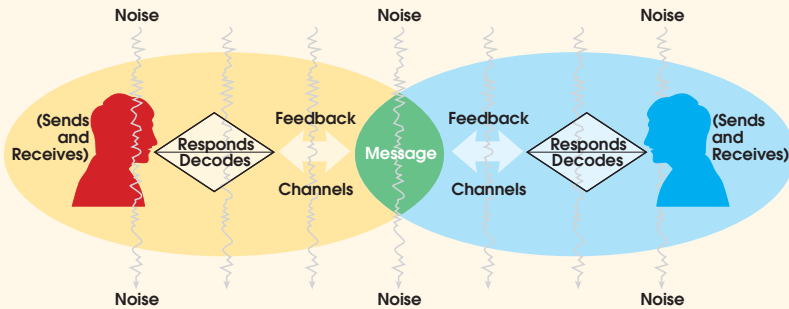
8 Implementing Effective Two-Way Communication

How can I achieve a productive dialogue with my stakeholders?

Two-way communication is essential for effective internal risk communication. Two-way communication is a continuous cycle of exchanges between sender and receiver, and ongoing interaction is crucial to successful communication. By openly communicating with coworkers and encouraging participation, you can use input and feedback to generate more useful risk information.

The communication process

All communications involve a message delivered through one or more channels, a sender who encodes the message, and a receiver who decodes the message and may provide feedback. All interactions occur in an environment of competing messages, differing levels of knowledge and experience, and distractions, all of which constitute noise that affects whether and how the receiver interprets the message.



The Two-Way Communication Process

To be a successful communicator, you must understand your audience's perspectives, use various techniques to deliver effective messages, listen actively, and make adjustments based on feedback or evaluation.




Encourage participation!

Effective two-way communication requires thinking strategically about who needs to be involved and at what point. Before conducting a risk analysis, work with decision-makers to determine the level of detail they need to make a decision. Find out what

assumptions or scenarios need to be considered so you can include them in your analysis. As you gather data for your analysis, describe how the information will be used so your coworkers can provide input that best meets your needs.

As always, remember to listen. As an issue emerges or a plan comes together, input is critical, and your coworkers can provide important insights. Be flexible and open to new ideas and different perspectives. While it is natural to place a higher value on ideas that are similar or complementary to your own, it is important to seriously consider other points of view. If you disagree with others' ideas, try to understand their points of view. Considering different perspectives can help you identify new solutions and may help you (and others) avoid future problems. The table above illustrates two-way communication among different NRC stakeholders, identifies what each can hope to learn from the interaction, and provides examples of what might interfere with understanding among the

Examples of Two-Way Internal Risk Communication

<p>Decision-Makers <i>will gain a better understanding of...</i></p> <ul style="list-style-type: none"> • The information that is available and its quality • What form it will be in • What it means 	<p style="text-align: center;"> Noise</p> <ul style="list-style-type: none"> • Time pressures • Lack of familiarity with risk terminology and decision-making • Lack of openness due to organizational culture issues 	<p>Risk Analysts <i>will gain a better understanding of...</i></p> <ul style="list-style-type: none"> • The decision • The non-risk-based factors that are present • Individual communication preferences
<p>Risk Analysts <i>will gain a better understanding of...</i></p> <ul style="list-style-type: none"> • Key design or operational factors • Failure rates/sources of data • Accidents to consider • Review of assumptions about a specific technical area, such as fire protection 	<p style="text-align: center;"> Noise</p> <ul style="list-style-type: none"> • Technical jargon from area of specialty • Different conceptual frameworks about safety • Lack of familiarity with risk models • Varying understandings of what "risk informed" means 	<p>Technical Staff <i>will gain a better understanding of...</i></p> <ul style="list-style-type: none"> • Where information/expertise is included in a risk analysis • What might be missing from the model • The problems risk information can help address
<p>Risk Analysts <i>will gain a better understanding of...</i></p> <ul style="list-style-type: none"> • Concerns and values of external stakeholders • Local conditions that might influence assumptions or models • Risk perceptions 	<p style="text-align: center;"> Noise</p> <ul style="list-style-type: none"> • Time pressures • Lack of familiarity with risk terminology and decision-making • Lack of understanding of public perceptions and acceptance of risk 	<p>Public Affairs <i>will gain a better understanding of...</i></p> <ul style="list-style-type: none"> • What information is available • The processes used to arrive at a decision • The risks

parties. Use these examples to gain perspective on what you can learn from others and what you can do to minimize “noise.”

Ensure that adequate time and resources are available

For a risk-informed regulatory approach to be accepted and integrated throughout the NRC, attention must be paid to the time and resources made available for learning, discussing, building consensus, and resolving conflicts. The amount of time needed for such activities is often significantly underestimated, or the activities don't take place early enough in the process. Management has a responsibility to make this a priority. Schedule and budget constraints are facts of life; however, an upfront investment in learning and integration can often prevent controversy from derailing an initiative later on. Even a well-informed, receptive audience may take a while to absorb and respond to complex concepts (like risk), and it may take several exchanges over time. It is important to have realistic expectations about what can be accomplished in a single interaction.

Be creative

Remember that there are many ways to communicate with co-workers. While formal methods (such as staff reviews, surveys, and planned meetings) may be necessary when developing official documents and plans, remember to employ informal techniques as well. Casual one-on-one conversations, phone calls, or informal group sessions are great ways to gather information. It may also be helpful to talk to people outside of your office to gain additional perspectives.

Tips for Effective Listening

- (1) Pay attention to nonverbal communication. People give clues as to whether they understand or are overwhelmed by information, as well as whether they agree or disagree. Also pay attention to the nonverbal messages you are sending.
- (2) Summarize to clarify what has been said and to demonstrate that you listened.
- (3) Ask questions:
 - Use open-ended questions to—
 - gather information about opinions and preferences
 - help elicit the reasoning behind a decision
 - Use direct questions to—
 - give the other person a clear idea of what you want to know
 - guide discussion toward a specific problem or solution

Things to Remember



- *Listen actively; active listening is an essential component of two-way communication.*
- *Remain open to new ideas and different perspectives.*
- *Informal conversations and phone calls are great ways to gather information.*
- *Involve everyone in the decision-making process.*
- *Leave your desk and talk to your colleagues from other parts of the agency.*

Practice Tip



Identify an internal stakeholder (either a person or a group) with whom you would like to improve your communication. List the various types of “noise” that might be interfering with your communication. (See table on page 44 for examples.) Brainstorm ways to minimize the interference. After your next communication with that stakeholder, evaluate the experience.

9 Clarifying Common Areas of Confusion and Avoiding Miscommunication

How can I provide accurate information without silencing other viewpoints?

The NRC has a difficult task in addressing public concerns about the agency's mission and role. However, it can be equally difficult to communicate with internal audiences to correct misinformation, clarify positions, and broaden understanding about risk information. Internal risk communication is important in implementing agencywide changes and building and maintaining a strong, united, and efficient agency.

Be aware of the power of jargon to interfere with communication

Everyone knows that NRC jargon and acronyms are obstacles to understanding when agency spokespersons try to communicate with the public. A similar problem arises when staff from different areas within the agency try to communicate and realize that they have different jargon or use common terms (like "risk") in different ways. Consider the following tips when communicating across the NRC:

- Don't assume that everyone knows what you know and uses risk terms in the same way.
- Be aware of the special meanings of commonly used words, and take time to explain your use of such words within the context of your discussion.
- When using terms that are not universally understood outside your group, give examples to illustrate what the term does and does not mean to you.

You Know Not What I Say...

In a speech to the Society for Risk Analysts, Stan Kaplan described two theorems of miscommunication:

Theorem 1: 50% of the problems in the world result from people using the same words with different meanings.

Theorem 2: The other 50% result from people using different words with the same meaning.

Kaplan hung those theorems on his office wall, and he routinely used them to point out to colleagues how their arguments exemplified either Theorem 1 or Theorem 2. "It's amazing how that drains the emotion from an argument."

- Develop common understandings and uses of major concepts and terms to facilitate communication with other NRC staff. It may be helpful to write agreed-upon definitions and list acronyms that aid communication between groups.
- Don't be afraid to question how someone else is using a term to ensure that you are clear on their interpretations.

Learning in organizations means the continuous testing of experience, and the transformation of that experience into knowledge -accessible to the whole organization, and relevant to its core purpose.

The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization

Don't confuse different perspectives with incorrect information

In several areas, internal stakeholders have a tendency to confuse different perspectives with incorrect information or a lack of understanding. For example, the reactor program has been using risk information longer than the materials, waste,

and security programs. Decision-makers and staff should not assume that tools, metrics, and types of analyses can be directly transferred from the reactor program for use in all areas.

In addition, some internal stakeholders have a tendency to assume that those who raise concerns are opposed to the risk-informed approach, rather than recognizing that they may simply have specific—and valid—concerns about implementation issues.

Develop tools to communicate and involve staff and decision-makers in risk analyses

The NRC should consider investing in tools that enable non-risk analysts to interact directly with risk information and analyses. Risk analysts from both the NRC and other agencies anecdotally report that they see a visual and physical display of understanding from their audience when their colleagues see firsthand how changing an assumption, for example, influences the result. In the Reactor Oversight Program, this type of tool has been developed for use by inspectors.

Sample responses to counter misperceptions about a risk-informed approach

One of the NRC's internal risk communication challenges is building understanding and support for integrated, risk-informed approaches in reaching safety decisions. Using risk-informed

approaches (rather than relying exclusively on traditional deterministic engineering analyses) is an issue that polarizes many NRC employees. The following representative statements and responses should be viewed not as ways to silence opposing viewpoints, but as efforts to shed some light on an issue that divides the agency.

“Our risk-informed approach makes it easier for licensees to make changes that are compromising safety.”

Suggestions for addressing this concern:

- Acknowledge the legitimacy of the concern. Not all licensees have the same level of commitment to safety and understanding of risk information.
- Explain the systems and processes that are in place to counter-balance the use of risk assessment.
- Communicate examples of how risk information was used to address problems in a more effective way, as well as cases where such information was used to identify safety issues that had previously been overlooked.

“PRAs can be effectively applied across the NRC for any issue or decision.”

Suggestions for addressing this overstatement:

Issues Commonly Requiring Clarification

The following issues are drawn from interviews with NRC staff. Interviewees were asked what they believe are key areas requiring additional clarification or discussion:

- Several definitions of risk exist within the NRC. How is risk defined? What is the difference between risk to the individual and collective risk?
- Uncertainty is not always understood. What are the uncertainties? What is contributing to the uncertainties?
- Numbers can be misleading and confusing. What do the numbers mean? What is the context for this number?
- There is a need to understand what is and isn't included in risk models. What is the relationship between the model and reality?
- Some assumptions are controversial, and there is a need to describe assumptions. How do these assumptions impact the analysis? Which assumptions are based on accepted values? Which assumptions are the most influential?
- “Defense-in-depth” and “risk-informed” are often portrayed as two distinct concepts. How are these terms defined? How do these principles relate? How can they work together?

- Provide specific examples to illustrate the strengths and weaknesses of PRAs and risk information.
- Discuss the steps taken to decide the appropriate risk-informed approach in a specific area or NRC process and the factors that were considered.
- Explore how other areas are using risk assessment and how that approach is applicable to a specific technical issue.

Things to Remember



- *Avoid misunderstandings by explaining your terms and language to people outside of your office or group.*
- *Don't be afraid to ask how other people are using certain terms.*
- *Be willing to understand different perspectives.*
- *Develop tools to communicate internally.*

Practice Tip



Spend about half an hour researching how various NRC documents use a risk-related term (such as risk, risk-informed, integrated decision-making, defense-in-depth, risk-significant, or safety-significant). How do the definitions and usages of the term vary among different sources? Next, for a couple of days, pay special attention to how the selected term is used during presentations, discussions, and other oral communications. What different meanings do you hear, and how do they compare with those spelled out in NRC documents? Use what you learned to help clarify what the term does and does not mean in a particular context.

10 Building Consensus and Resolving Conflict

What role does conflict play inside an organization? How do I deal with disagreements? When should I use a facilitator?

Because risk decisions are inherently complex, differences of opinion often arise. It is important to remember that conflict is not necessarily bad. Conflict can be a catalyst for positive change and can lead to meaningful relationships between coworkers.

The key is to encourage, draw out, and compile all the misperceptions and challenges. Get them out in the open. Get the staff to tell you what they don't like. Put it all on the table, pull all the negatives out. Then address them with answers.

NRC Manager

Conflict is a natural part of workplace dynamics, and it can serve to balance power relationships, promote flexibility and adaptability, guard against giving in to the consensus of the group without considering alternatives, and facilitate effective decision-making by challenging complacency and illusions of invincibility. If left unresolved, conflict can interfere with communication, foster "winning at the expense of others," and polarize groups.

To minimize destructive conflict and prevent workplace disruptions, initiate or increase personal contact and communication with coworkers. Listen to the concerns of others, and acknowledge their perspectives. Remember that the workplace comprises individuals with diverse interests, experiences, and backgrounds. Try to view conflict from the perspective of others.

Tips for managing conflict

- Admit the problem. It's difficult to reach a resolution if people ignore the problem or deny that there's a conflict.
- Arrange a time and place to discuss the issue. This can be an informal conversation or a group meeting. In most situations, do not rely on

Sources of Conflict

- Data
- Resources
- Interests
- Expectations
- Power structure
- Relationships

electronic communication to resolve the conflict. Face-to-face interaction works best to address concerns:

- Select a neutral location.
- Allow adequate time to talk through the issue.
- Include everyone who is involved, interested, or likely to be affected. Leaving a person or group “out of the loop” may create additional conflict.
- Adopt a strategy of achieving resolution and consensus. Abandon the concept of winning or losing.
- Avoid negative or confrontational language.
- Listen. Uncovering the concerns and feelings of others can be instrumental in creating solutions that are acceptable to everyone involved.
- Be flexible and open to new ideas.
- Be ready to suggest possible solutions.
- Always treat others with dignity and respect.

Consider taking a team approach to handle significant internal risk communication

In some cases, it might be useful to form a team of three to five NRC employees to address internal communication about issues that are potentially controversial or have broad impacts. Conflicts can often be prevented by involving people in solving problems and generating solutions. Team members should be personally affected by the issues, have credibility within the NRC, represent or understand conflicting views, and have good communication skills.

Using a facilitator

If meetings about an issue are repeatedly unproductive, a stalemate exists, or the situation has the potential to escalate, consider using a facilitator. An uninvolved third party can sometimes help to provide objective solutions. A facilitator can improve internal communication in the following ways:

- Keep meetings focused and on track.
- Clarify questions and comments.

- Acknowledge conflict and underlying issues.
- State problems in constructive ways.
- Sense agreement.

Building consensus to resolve conflicts

Consensus building is a decision-making process that works creatively to include all persons involved in a decision. It equalizes power over a group of people by allowing everyone an opportunity to express his or her opinions. Consensus building is a powerful decision-making process because it takes into account and validates each participant. People have a chance to be heard, feel they have been heard, and can agree to a final decision even if it wasn't their first choice.

We need a shared mental model for safety that combines all of the metrics and defense-in-depth safety margins. We need a bigger picture of safety.

NRC manager

Consensus-building process

The following steps describe one method of developing consensus:

- (1) **Presentation.** Present an issue or plan to the group.
- (2) **Questions.** Give group members an opportunity to ask clarifying questions to ensure that they understand the issue or plan.
- (3) **Discussion.** Discuss and debate the issue or plan, and allow group members to make recommendations.
- (4) **Assessment.** Take the group's pulse. Are their feelings generally positive? Are there major objections or strong concerns about the issue or plan?
- (5) **Resolution.** Consensus does not mean that everyone agrees on every detail, but rather that they have a shared understanding of the issue or plan and a basic level of widespread acceptability of the outcomes.

You may not always have time to conduct a formal meeting, but you can apply the same steps informally. For example, you can send a proposed plan to your colleagues and give them a certain period of time to reply with comments and concerns. Let them know they can call, send an email message, or drop by your office to give you feedback.

Additional tips for building consensus

- Present your position as clearly, simply, and logically as possible. Listen to other people's reactions and consider them carefully. Avoid arguing solely for your own ideas or cutting others off before they have had an opportunity to complete their point.
- Avoid the attitude that someone must win and someone must lose. Instead, look for alternatives that are acceptable for all parties.
- Do not change your mind simply to avoid conflict and to reach agreement. When agreement seems to come too quickly, explore the reasons and be sure everyone accepts the solution for similar reasons.

Things to Remember

- *Recognize that conflict is natural and can be a positive catalyst for change.*
- *Minimize conflict by increasing interaction and communication with coworkers.*
- *Resolve issues by providing unbiased recommendations. (A facilitator can help.)*
- *Use the consensus process to help a group reach a solution that is acceptable to everyone involved.*

Practice Tip

Developing strong listening skills can help improve your ability to prevent and resolve conflicts. A key part of listening is asking questions to learn more about the perceptions, interests, and concerns of others. Think of a disagreement or confrontational situation in which you have been involved. Using the tips for effective listening, draft some open- and closed-ended questions to help you learn more about the other party's perspective. (Skimming Chapter 3, "Understanding internal stakeholders," might also assist you with this exercise.)



11 Evaluating the Effectiveness of Internal Risk Communication

Am I being effective? How can I improve?

When determining whether your internal risk communication efforts are working, it is important to have a realistic impression of what success looks and feels like. Because decision-makers, risk analysts, and other technical staff at the NRC have different roles and responsibilities, they will not always see eye to eye. Being in perfect agreement 100% of the time is not a realistic goal. It is reasonable to expect, however, that more effective internal risk communication can improve relationships and professional respect for differing points of view. In an atmosphere of successful internal risk communication, the staff can build a common understanding of the key issues even if they disagree about how to address those issues.

Consider the following criteria when evaluating your internal risk communication:

- Are risk analysts interacting with decision-makers and other technical staff before, during, and after the analysis to discuss how the results will be used, which scenarios to consider, and which assumptions are acceptable?
- When risk analysts present analysis results, are they putting that information into the larger context of the NRC's mission and the specific interests of the audience?
- Do internal stakeholders understand the uncertainties that are linked to a specific risk analysis result?
- Do staff members know where to go for clarification of specific risk analysis results?

Simple, readily available methods for gathering feedback

Evaluation efforts do not need to be formalized and complex. There are quick and easy ways to evaluate your efforts:

- **Just ask.** Asking is the simplest way to find out if your internal risk communication efforts are working. When you complete a briefing, ask the audience for constructive feedback. ("What

did you think?” “Is there additional information you would like to have?” “How did this meeting compare to others you have attended?” “What would have made it better?”)

- **Have a designated observer at a meeting.** Ask colleagues to observe you at a meeting. They can provide you with specific feedback about what you said and how people responded. (What questions are people asking? What nonverbal signals were participants sending at various points in the meeting?)

Things to Remember



- *Agreement is not a fair or accurate measure of success in internal risk communication.*
- *A primary goal of internal risk communication should be to achieve a common understanding of the key issues, even if there is disagreement about how to address those issues.*
- *A simple and readily available method for getting feedback on your reports and presentations is to ask the audience or a colleague for a critique.*

Practice Tip



Based on feedback from your audience or a colleague in response to a report or presentation, think about how you would implement those ideas to improve the report or presentation. Write down those ideas and refer to them the next time you develop a report or presentation.

References and Resources

References

- Bier, V.M. "Challenges to the Acceptance of Probabilistic Risk Analysis," *Risk Analysis* 19: 703-710. 1999.
- Bier, V.M. "On the State of the Art: Risk Communication to the Public," *Reliability Engineering and System Safety* 71: 139-150. 2001.
- Bier, V.M. "On the State of the Art: Risk Communication to the DecisionMaker," *Reliability Engineering and System Safety* 71: 151-157. 2001.
- Bley, D.C., S. Kojima, and J. Wreathall. "Facilitating Technical Risk Communication among Non-Specialists," PSA '99, International Topical Meeting on Probabilistic Safety Assessment, August 22-26, 1999, Willard Intercontinental Hotel, Washington, DC. 1999.
- Columbia Accident Investigation Board. *The CAIB Report*, Vol. 1. 2003. Accessed on the Internet at www.caib.us/news/report/volume1/default.html.
- Dusenbury, R., and M.G. Fennema. "Linguistic-Numeric Presentation Mode Effects on Risky Option Preferences," *Organizational Behavior and Human Decision Processes* 68(2): 109-122. 1996.
- Fischhoff, B. "Communicate unto others...," *Reliability Engineering and System Safety* 59: 63-72. 1998.
- Fox, C.R., and J.R. Irwin. "The Role of Context in the Communication of Uncertain Beliefs," *Basic and Applied Social Psychology* 20(1): 57-70. 1998.
- Jones, E. "Risk Assessments: From Reactor Safety to Health Care," *Risk Assessment* 8: 12-21. 1995.
- Kaplan, S. "The Words of Risk Analysis," *Risk Analysis* 17(4): 407-417. 1997.
- Koehler, J.J. "The Influence of Prior Beliefs on Scientific Judgments of Evidence Quality," *Organizational Behavior and Human Decision Processes* 56(1): 28-55. 1993.
- Kuhn, K.M., and D.V. Budescu. "The Relative Importance of Probabilities, Outcomes, and Vagueness in Hazard Risk Decisions," *Organizational Behavior and Human Decision Processes* 68(3): 301-317. 1996.

Patton, M. *Qualitative Evaluation and Research Methods*, 2nd ed. Sage Publications. 1990.

Thompson, K.M., and D.L. Bloom. "Communication of Risk Assessment Information to Risk Managers," *Journal of Risk Research* 3(4): 333-352. 2000.

Additional Resources

NRC Resources

USNRC. "Effective Risk Communication: The Nuclear Regulatory Commission's Guidelines for External Risk Communication," NUREG/BR-0308. 2004.

USNRC. "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Regulatory Guide 1.174, Revision 1. November 2002.

USNRC. "White Paper on Risk-Informed and Performance-Based Regulation" (SRM to SECY 98-144, Attachment, "Risk-Informed and Performance-Based Regulation"). 1998.

USNRC. "Guidance for Performance-Based Regulation," NUREG/BR-0303, N.P. Kadmbi. 2002.

USNRC. "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities: Final Policy Statement," *Federal Register*, Vol. 60, p. 42622 (60 FR 42622). August 16, 1995.

USNRC. "An Approach for Plan-Specific, Risk-Informed Decisionmaking: Inservice Testing," Regulatory Guide 1.175. August 1998.

USNRC. "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Regulatory Guide 1.200 for Trial Use. February 2004.

USNRC. "Use of Probabilistic Risk Assessment in Plant-Specific, Risk-Informed Decisionmaking: General Guidance," Chapter 19 of the Standard Review Plan, NUREG-0800, Rev. 1. November 2002.

USNRC. "Yucca Mountain Review Plan," NUREG-1804, Rev. 2. July 2003.

USNRC. "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," Chapter 3 of the Standard Review Plan, NUREG-1520 (and Appendix A).

USNRC. "Strategic Plan for FYs 2004-2009," NUREG-1614, Vol. 3. August 2004.

Presentation Resources

www.presentations.com

Tufte, E.R. (1997). *Visual Explanations: Images and Quantities, Evidence and Narrative*. Cheshire, CT: Graphics Press.

Rutledge, P., Dyck, T., Fuller, R., Gilgen, R., Ulrich, L., and Mucciolo, T. (2001). *Special Edition Using Microsoft PowerPoint 2000*. Indianapolis, IN: Macmillan Computer Publishing.

Web Sites

Consortium for Risk Evaluation with Stakeholder Participation (CRESP) II (internet). Piscataway (NJ): CRESP Headquarters; 2004 August 12 (cited 2004 December 9). Available from: <http://www.cresp.org>

Health Risk Communication (CBM 2000-7) (internet). Bethesda (MD): National Library of Medicine; 2003 December 15 (cited 2004 December 9). Available from: http://www.nlm.nih.gov/pubs/cbm/health_risk_communication.html

Institute for Risk Analysis and Risk Communication (internet). Seattle (WA): University of Washington; 2003 (cited 2004 December 9). Available from: <http://www.depts.washington.edu/irarc/index.html>

Integrated Risk Information System (IRIS) (internet). Washington (DC): U.S. Environmental Protection Agency; 2004 December 2 (cited 2004 December 9). Available from: <http://www.epa.gov/iriswebp/iris/index.html>

Peter Sandman Risk Communication Web Site (internet). Princeton (NJ): Peter M. Sandman; 2004 December 4 (cited 2004 December 9). Available from: <http://www.psandman.com>

Publications (internet). Washington (DC): U.S. Environmental Protection Agency; 2004 November 4 (cited 2004 December 9). Available from: <http://www.epa.gov/opei/pubsinfo.htm>

Rand Environmental Science Policy Center (internet). Santa Monica (CA): Rand Environmental Science Policy Center Corporate Headquarters; 2004 November 18 (cited 2004 December 9). Available from: <http://www.rand.org>

Recent Publications (internet). Washington (DC): National Academy of Public Administration; 2003 (cited 2004 December 9). Available from: http://www.napawash.org/pc_economy_environment/recent_publications.html

Risk Abstracts Library (internet). Knoxville (TN): Tec-Com; 2004 October 26 (cited 2004 December 9). Available from: <http://www.riskworld.com/Abstract/AB5ME001.htm>

Risk Communication Web Sites (internet). Knoxville (TN): Tec-Com; 2004 October 26 (cited 2004 December 9). Available from: <http://www.riskworld.com/websites/webfiles/ws5aa014.htm>

Society for Risk Analysis (internet). McLean (VA): Tec-Com; 2004 November 1 (cited 2004 December 9). Available from: <http://www.sra.org>

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