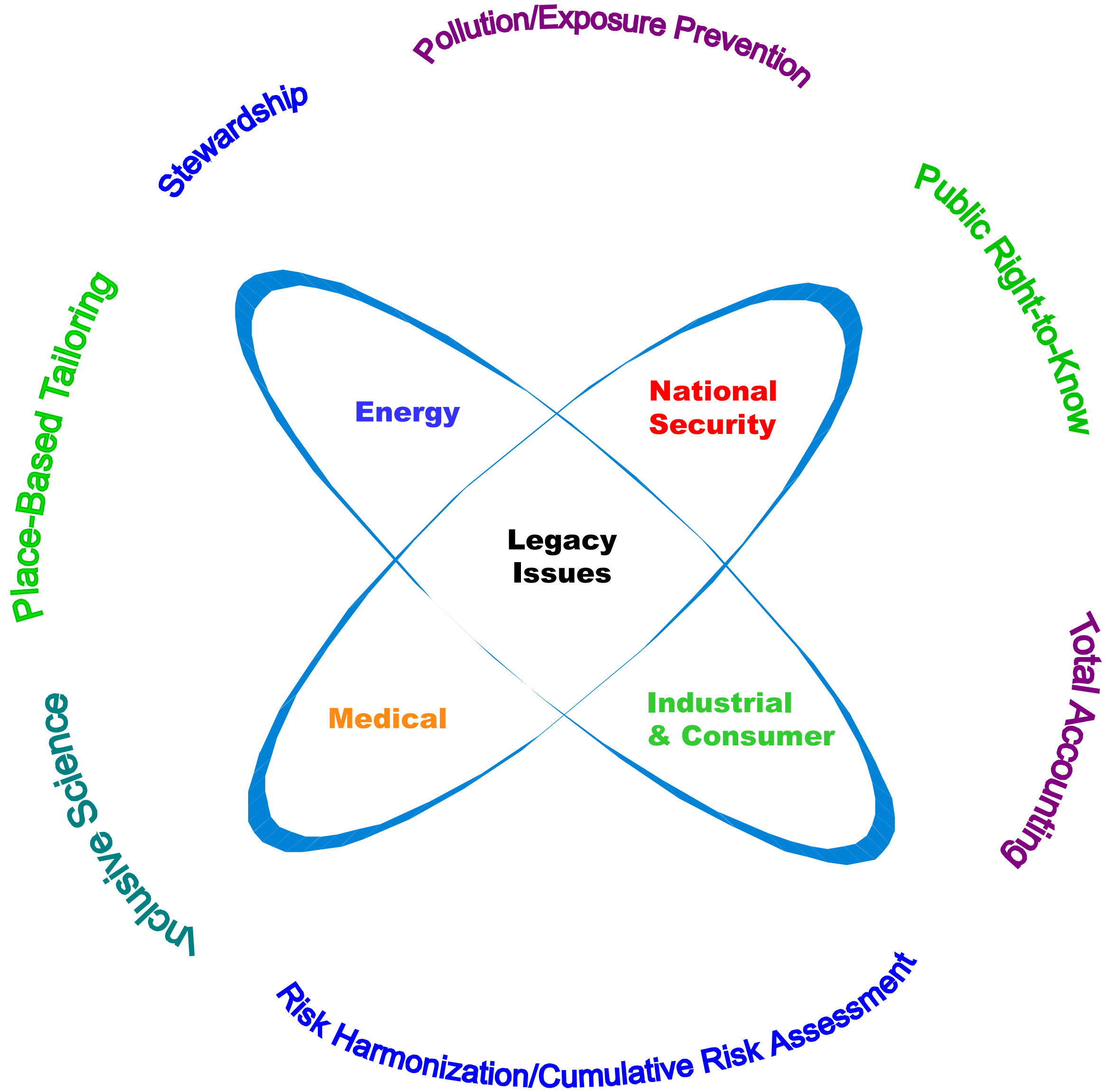
INSTITUTE ALTERNATIVE FUTURES

The Future of Radiation Protection: 2025

A Project of the Institute for Alternative Futures



With Support from the
U.S. Environmental Protection Agency

Phase 1 Project Report

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The Future of Radiation Protection: 2025

OVERVIEW

This is a report on the initial phase of a project on **The Future of Radiation Protection** being carried out by the Institute for Alternative Futures (IAF) with support from the U.S. Environmental Protection Agency. The project is designed to help the radiation protection community by fostering a long-term perspective, identifying important challenges and opportunities ahead that deserve more attention, and providing tools to facilitate long-term strategic planning. Overall, more than 200 participants from Federal, state, local and tribal governments, NGOs, universities, and the private sector provided their views on the next 25 years of radiation protection.

In the project's initial phase, interviews and small group discussions were organized with over 125 thought leaders in the radiation protection community. The key question that all participants were asked was "*What are the most significant radiation-related challenges that will need to be dealt with between now and 2025?"* The question elicited a wide range of views and possibilities for the future, including some ideas that could be considered wildcards (low probability, but high impact events). IAF compiled this information into four scenarios of how issues related to radiation protection might unfold between now and 2025. The scenarios are not predictions of the future, but tools to help people consider a broad range of possibilities. They were crafted to explore the whole range of future conditions that different interviewees saw as plausible. The scenarios were used as a framework for discussion in six scenario discussion sessions with participants from industry, science, environmental groups, and federal agencies concerned with radiation issues.

This report describes the project's methodology and summarizes the findings that emerged from the scenario discussion sessions. While these are only preliminary findings from an ongoing effort, we believe they are sufficiently important to share with people who have been involved in the project and with other interested parties.

Discussions organized around a 2025 time frame shifted participants from a focus on current issues, programs and budgets to a focus on major radiation-related challenges facing society as a whole. In discussing these challenges, participants in each one of these discussion sessions arrived at a common theme: the future is likely to become significantly worse than the present if business-as-usual continues in the radiation protection community. Other important themes emerged about the kind of changes needed to meet the challenges ahead. Examples include:

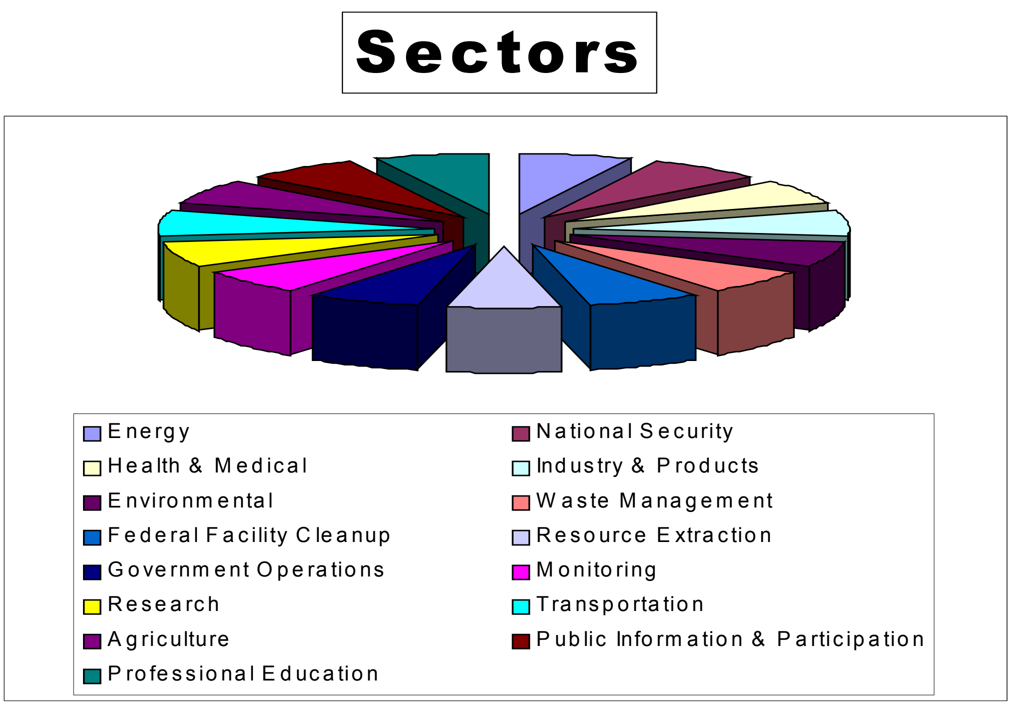
- Focus attention on four "Key Sectors" which are generating the most serious challenges: Energy, National Security, Medical, and Industrial and Consumer
- Develop a more preventive and proactive approach in these four sectors rather than focusing so exclusively on "legacy issues"
- Work to transcend conflicts between entrenched positions by seeking agreement around high-level principles for guiding action
- Give far more emphasis to public access to information
- Integrate radiation and environmental protection through risk harmonization, combined radiation and chemical databases for public access, and shared principles for guiding action.

INTERVIEWS WITH THOUGHT LEADERS

Potential future challenges were explored through a process of personal interviews and small group discussions involving over 125 thought leaders in the field of radiation protection. Discussions were conducted with professionals at the 1999 Conference of Radiation Control Program Directors (CRCPD); an Association of State and Territorial Solid Waste Management Officials (ASTSWMO) Radiation Task Force meeting; a session at EPA's National Air and Radiation Environmental Laboratory in Montgomery, Alabama attended by scientists, NGO, university and state officials; and an International Atomic Energy Agency (IAEA) International Symposium in Arlington, Virginia on the Restoration of Environments With Radioactive Residues. In these discussions, and in personal interviews, the key question that all participants were asked was:

> *What are the most significant radiation-related challenges that will need to be dealt with between now and 2025?*

Hundreds of potential challenges were identified and grouped into the 15 sectors below. The list on the next page presents examples of challenges that participants judged to be both important and highly uncertain in their outcome.



EXAMPLES OF RADIATION PROTECTION CHALLENGES 2000-2025[1]

ENERGY
- Decommissioning nuclear power plants
- Next generation of nuclear power-yes or no
- Alternative energy sources & strategies to limit global warming
- Nuclear accidents
- Radiation issues related to coal, oil and gas, geothermal

HEALTH AND MEDICAL
- Radon
- Changes in technology that increase or reduce medical exposures
- Training & professional certification to reduce inappropriate medical uses
- Better understanding of genetics; understanding of genetically sensitive populations
- Preventive approaches & new modalities for diagnosis & prescription to reduce uses of ionizing radiation
- Non-ionizing radiation issues: e.g., lasers, UV, EMF

ENVIRONMENTAL
- Assessment of ecological risks of radiation
- Synergies between radioactive & chemical toxic wastes

RADIATION FACILITY CLEANUP
- Radiological assessment of DOE, Superfund, & other sites
- Remediation technologies & strategies
- Remediation standards

GOVERNMENT OPERATIONS
- Public/community involvement in radiation protection issues
- Cooperation between federal agencies
- Support for state radiation programs
- Developments in accounting systems (total accounting)
- Setting standards over long periods of time, revising standards as new knowledge and models arise & assumptions change

RESEARCH
- Understanding risks at low doses
- Risk harmonization/ cumulative risk assessment
- Effects of radioactive nuclides that cross the placenta on fetuses – non-cancer effects
- Assuring good science amid controversy & influence of big money from government & industry

AGRICULTURE
- Use of contaminated sewage sludge as fertilizer
- Food irradiation

PROFESSIONAL EDUCATION
- Maintaining the professional/technical infrastructure for radiation protection
- New emphasis on prevention, public health

NATIONAL SECURITY
- Weapons decommissioning
- Preventing radiation-related problems in future weapons development
- Nuclear terrorism – “ loose nukes” & nuclear dispersion devices
- Radioactive materials in former Soviet Union
- Third World nuclear proliferation/testing/use
- Emergency response capability
- What to do with weapons material

INDUSTRY AND PRODUCTS
- Orphan sources (materials that end up in unexpected places)
- Occupational exposures
- Exposures from consumer products
- New industries using radioactive materials
- Proliferation of low level sources – cumulative risks, impact on recycling
- Building construction
- Import of contaminated metals/materials
- Non-ionizing radiation exposures, e.g., rapid growth of wireless communication

WASTE MANAGEMENT
- Finding a good solution for managing the increasing volumes of waste – not “ saving money” or “ blocking nuclear power”
- Lack of system for low-level waste management
- High-level waste management & disposal, U.S. & abroad
- Aligning funding with real risks, avoiding pork barrel waste politics
- Local economic effects of waste sites

RESOURCE EXTRACTION
- Technologically Enhanced Naturally Occurring Radioactive Material (TENORM)
- Source material for nuclear fuel

RADIATION MONITORING
- Cheap, miniature sensor technology
- National monitoring system
- Inexpensive, efficient tracking systems
- Community monitoring
- Monitoring performance of repositories

TRANSPORTATION
- Transportation of spent fuel, high-level wastes, mixed- and low-level wastes

PUBLIC INFORMATION AND EDUCATION
- Public right-to-know - availability of public information about sources & risks
- Education to increase public understanding of radiation protection issues
- Public perception of radiation risks vs. scientific assessment

[1] Data gathered from one-on-one interviews and small group meetings of experts in radiation protection from a variety of perspectives

SCENARIOS OF 2025

The interviews and small group discussions highlighted a wide range of divergent trends, viewpoints, and possibilities for the future. The Institute for Alternative Futures compiled this information into four internally consistent scenarios of how issues related to radiation protection might unfold between now and 2025. The scenarios were crafted to explore the whole range of future conditions that different interviewees saw as plausible, from a future dominated by problems to contrasting images of highly desirable futures. None of the scenarios is likely to come to pass in full, but the future is likely to be somewhere within the broad "possibility space" that they map out.

The purpose of the scenarios was not to predict the future, but to serve as a framework for discussion in a series of discussion sessions with different stakeholders in the radiation protection community. Participants were asked not to "argue" with the scenarios, but rather to use the scenarios to:

- Reflect on the range of possibilities for 2025 that appear plausible today,
- Clarify views about what they want the future to be like, and
- Consider what principles are appropriate for resolving disagreements, finding common ground, and guiding action.

The four scenarios are summarized in the box below and described in more detail on the following pages.

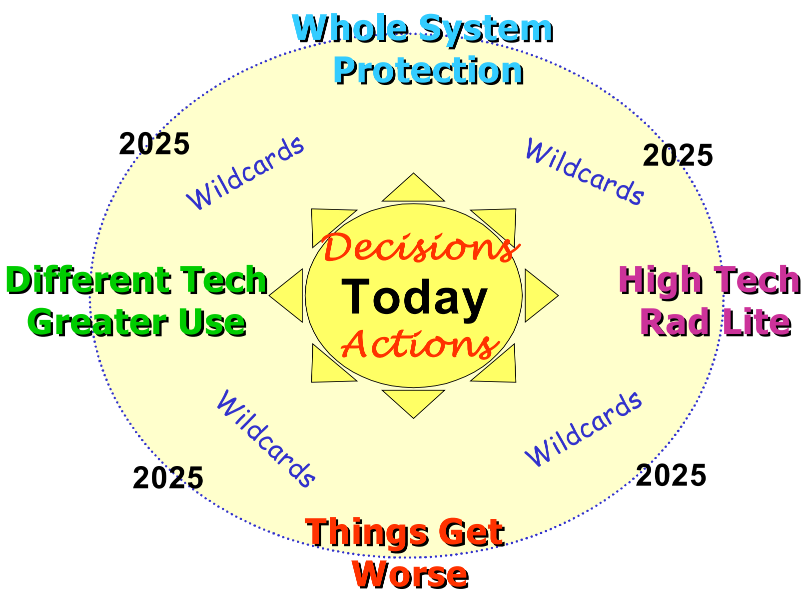
Things Get Worse – Today's major controversies remain unresolved. Without decisive action, limited problems evolve into much bigger messes.

Different Technology, Greater Use – Problems in the Things Get Worse scenario are mitigated by improvements in technology and management. A second generation of nuclear power is initiated. Expanding uses of radiation in industry and health care provide benefits that clearly outweigh risks.

High Tech Rad Lite – The market favors energy efficiency, natural gas, wind, and other renewable sources over nuclear energy. Advanced technologies increasingly substitute for conventional uses of radioactive materials in industry and health care. Economics and health concerns drive change.

Whole System Protection – Concepts like *pollution prevention*, *public right-to-know, total accounting*, and *risk harmonization* reshape radiation protection.

Scenarios of Radiation Protection in 2025



Things Get Worse

This scenario was designed to test participant's views about how problem-plagued the future (2025) could plausibly become. Each aspect of the scenario was mentioned as an important future challenge in the original round of interviews and small group discussions, but putting many negative developments together in a single image of the future makes the scenario as a whole less likely than its individual elements. This is not a "worst case" scenario – a nuclear war, for example, would be far worse – but it portrays a decidedly negative image of future possibilities.

It should be noted that different stakeholders held differing views about what "getting worse" means. For example, the commercialization of a new generation of smaller, standardized nuclear power plants was viewed as an extremely negative development by some participants, while others viewed it as critical for limiting global warming. The partial listing of the scenario's elements below contains only developments that were viewed as "getting worse" by nearly all parties involved in the project.

- Global warming is accelerating rapidly because no substitutes for fossil fuels have been developed.

- Accidents related to nuclear energy generation have occurred in the U.S., Japan, France, the former Soviet Union, and the Third World.
- Environmental and public health scandals have occurred in the U.S. involving improper handling, transportation and storage of radioactive wastes.
- Huge expenditures for DOE and Superfund cleanups have often been boondoggles.
- Lawsuits are underway across the country for damages caused by medical and occupational exposures.
- Concentrations of Radon in residential structures have never been systematically addressed and remain an under-appreciated health danger.
- Large-scale proliferation of nuclear weapons and weapons material has made nuclear terrorism the primary national security threat.
- Naturally occurring radioactive materials (NORM) and technologically enhanced NORM (TENORM) are major public concerns.
- The waste management problem is still not solved: YUCCA never opened; people adjacent to potential waste sites fear a decline in property values and tourism revenue; resistance to opening new low-level waste sites has continued; it has become politically unacceptable to ship waste overseas.
- Critical ‘watchdog programs’ and other radiation protection programs have been cut.
- Many personnel with appropriate training as well rounded generalists in radiation protection have retired; the number of people entering the field has declined sharply.

Different Technology, Greater Use

This scenario portrays a highly positive future from the point of view of many people who participated in the project. The problems that dominate the *Things Get Worse* scenario are avoided or significantly reduced in this scenario. Future research findings support a growing consensus that there is a relatively high threshold for health effects of radiation and that risks of commercial activities involving radiation have been greatly exaggerated. Progress accelerates in the nuclear power industry, nuclear medicine, and other areas. Care is taken to avoid needless risks by developing inherently safer technologies and assuring that users are properly trained. Examples of changes that occur between 2000 and 2025 include:

- Total cost accounting, including costs related to climate change and other environmental impacts, has demonstrated the superiority of nuclear energy to coal and most solar electric technologies; nuclear energy is widely recognized as an essential technology for limiting global warming.
- A new generation of smaller, standardized, inherently safer reactors has been initiated; older nuclear power plants have been safely decommissioned.
- Uranium mining has been shut down; power plants use materials from dismantled nuclear weapons.
- Large-scale DOE and Superfund cleanup projects have been carried out efficiently; technical innovations have sharply reduced project costs, and costs of meeting unnecessarily high levels of protectiveness have been avoided.
- The U.S. defense arsenal has been shifting to a next generation of nuclear weapons.
- Important new uses of radioactive materials have been developed for medical diagnosis and treatment; the health benefits greatly exceed the risks.

- New industrial uses of radioactive materials have emerged, including a major new industry of radioactive molecular biology.
- A safe, acceptable waste storage and disposal program has been put into place for all forms of waste; the economic benefits generated by waste repositories overcame NIMBY resistances.
- Education programs for nuclear engineering and health physics are expanding rapidly to strengthen the technical infrastructure for dealing with radiation issues.

High Tech Rad Lite

This scenario also portrays an image of the world in 2025 that was viewed as highly positive by many project participants. The problems that dominated the *Things Get Worse* scenario are avoided in this scenario by significantly reducing the use of radioactive materials over time. Future research findings support the linear no-threshold hypothesis and demonstrate that over 15% of the population is genetically sensitive to ionizing radiation. Research also reveals how radiation and chemical toxic wastes can have synergetic or mutually amplifying impacts on both human health and the natural environment. Examples of developments that occur between 2000 and 2025 in this scenario include:

- Total cost accounting, including the capital costs of building nuclear plants and costs for major reactor repairs, waste disposal, and decommissioning, has reinforced a global shift away from nuclear energy toward energy efficiency, natural gas, wind, geothermal, and a variety of renewable energy sources.
- Fuel cells using natural gas are widely utilized for onsite generation in buildings, industry and vehicles, allowing gas to be utilized without producing CO_2.
- Commercial and government reactors have been decommissioned on an accelerated schedule, and no new reactors have been built.
- All radiation standards have been set to protect the most vulnerable, genetically sensitive part of the population.
- Global treaties have banned all further testing and production of nuclear weapons; by 2025, nearly 90% of the nuclear weapons in existence in 2000 have been dismantled.
- All materials from decommissioned nuclear weapons and all spent nuclear fuel have been put in secure high-level waste disposal facilities.
- Advanced modalities for diagnosis and treatment have eliminated many uses of ionizing radiation in health care; improved training and professional certification have reduced inappropriate uses.
- Technological advances have provided substitutions for many uses of radioactive materials in industry and for all uses in consumer products.
- Low cost, miniaturized sensor technologies for detecting both radiation and chemicals are used on everything from garbage trucks to water treatment systems; genetically sensitive individuals can wear personal sensors.
- Community Monitoring Programs around the country are integrated into a comprehensive National Monitoring System that operates across media (air, land, and water) and monitors both chemicals and radiation.
- Professional training in radiation protection emphasizes prevention and public health.

Whole System Protection

In this scenario, U.S. society as a whole goes through a period of rapid technical and social innovation. Every field, including radiation protection, is influenced by the society-wide goals of constant innovation and improvement, rapid personal and organizational learning, flexibility to adapt to change, and movement beyond old conflicts that get in the way of progress.

Unlike the other scenarios, this one does not focus on describing end states, such as whether medical uses of radiation will increase or decrease by 2025. Instead it specifies a number of changes in ways of doing things such as "Cooperation between Federal agencies in radiation protection improves dramatically." Most importantly, the scenario sets out three *principles for guiding action* that emerged in the initial interviews and discussions. Readers of the scenario were always invited to evaluate these principles and suggest other equally important principles for guiding action. The scenario was essentially a tool for helping people reach agreement on high-level principles that, when applied, could help transcend old conflicts. The three principles are:

- *Public Right-to-Know* – Assure easy public (and public manager) access to complete and up-to-date information on the state of chemicals and radiation in the environment
- *Total Accounting* – Assess the full cradle to grave costs and benefits of decisions, including impacts on human health and natural systems
- *Risk Harmonization* – Harmonize radiation and chemical regulatory programs… Focus on understanding risks posed by cumulative exposures and interactions between hazardous agents

SCENARIO DISCUSSION SESSIONS

The four IAF scenarios were used as a framework for discussion in sessions of approximately twelve to fifteen people each. The discussion session format was designed to reach a cross-section of the vast US radiation protection community. The first discussion session, held at the EPA's Radiation and Indoor Environments National Laboratory (R&IENL) in Las Vegas, included state, tribal, university, and Federal laboratory officials. These participants tested the scenarios and a set of exercise/discussions based on them.

After the Las Vegas discussion session, the scenarios and exercises were revised and used in a series of five discussion sessions in Washington, DC, with different stakeholder groups. The sessions used both high-tech (a computer-based "groupware" tool) and high-touch (small group face-to-face discussions and exercises). The small group discussions created an initial set of reactions and comments that formed the input to the computer-based part of the session. The computer groupware allowed everyone in the sessions to comment simultaneously, react to each other's views, and participate in various kinds of ranking and voting exercises. The groupware also allowed discussion session facilitators to rapidly pull up graphs and charts to show areas of group consensus and disagreement, and to focus face-to-face discussions on topics the group as a whole assessed as important.

Each of the five scenario discussion sessions was organized around a broadly defined stakeholder group:

1. **Federal agencies** – Department of Energy, Nuclear Regulatory Commission, Department of Defense, Department of State, Food and Drug Administration, Centers for Disease Control, National Institute for Science and Technology, Occupational Safety & Health Administration, and other agencies involved in radiation protection

2. **Industry and Science** – Nuclear Energy Institute, National Council on Radiation Protection and Measurements, American College of Radiology, Lawrence Livermore National Laboratory, Chevron Research and Technology, and other industry groups

3. **Environmentalists** – Environmental Law Institute, Public Citizen, Sierra Club, Institute for Energy and Environmental Research, National Safety Council, Nuclear Information Resource Service, Arlingtonians For a Clean Environment, and other non-governmental organizations

4. **EPA Radiation Professionals** – Staff and Managers from EPA's radiation programs

5. **Other Environmental Professionals within EPA** – Senior staff from many different parts of EPA beyond the radiation program

Input was also sought from state and local government officials at a December 1999 Conference of Radiation Control Protection Directors (CRCPD) board meeting and at CRCPD's annual meeting in May 2000.

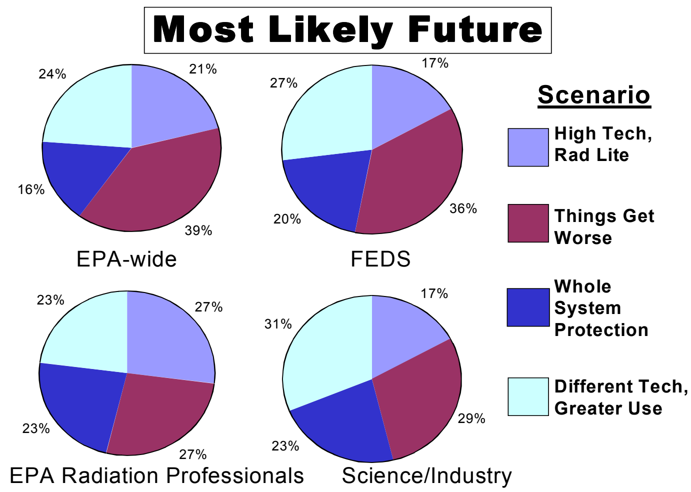
PHASE 1 FINDINGS

IAF reviewed the results of the scenario discussion sessions, and analyzed the areas of agreement that emerged across all the sessions. The ten most important findings from this analysis are set out below.

Finding 1: Value of a Long-Term Perspective

In evaluations of each discussion session, one of the most common comments was about the value of adopting a 2025 time frame. It shifted the focus of participants' attention away from current issues, programs, and budgets and led to a focus on major radiation-related challenges facing society as a whole. It did not eliminate disagreements and conflicts, but it made it easier to see shared aspirations for a better future.

Finding 2: Pessimism About the Future of Radiation Protection



One of the most surprising insights to emerge from the discussion sessions was the degree of pessimism about the future of radiation protection. In four of the five sessions, the "Things Get Worse" scenario was voted the "most likely" future for 2025.*

In every discussion session, participants were surprised that so many of their peers held such sobering views. In discussions about the votes, participants often said that thinking in a 2025 time frame heightened their sense of the magnitude of the challenges ahead. Some felt that the anonymous voting using the groupware allowed people to be more frank than they might normally be in discussions with their colleagues.

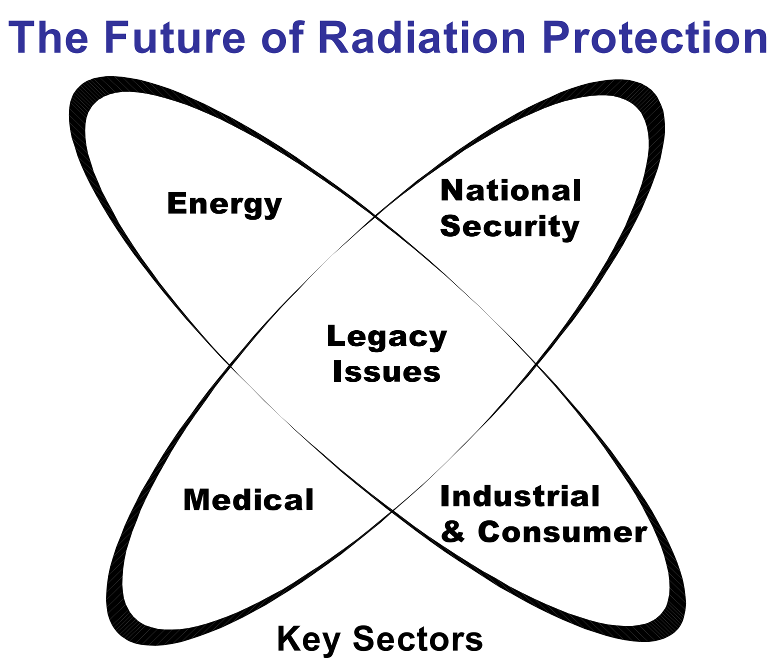
Once the voting was displayed for participants to see, it frequently triggered additional sobering comments. Many participants said the "Things Get Worse" scenario represents the way things are going right now. Some said the future could be significantly worse than what the scenario portrays. Others said that even if the future does not go this way in the long run, it will in the short run: "Things will get worse before they can get better."

* The pie charts display votes on the probability of the four IAF scenarios done using groupware at four of the discussion sessions. The initial R&IENL Las Vegas discussion session did not use the groupware, but in a show of hands nearly half the participants voted the "Things Get Worse" scenario as "most likely." In the discussion session with environmentalists, participants developed their own even more pessimistic "Things Get Worse" scenario and did not vote on the IAF version.

The collective discovery in each discussion session that “we’re all more worried than I thought we were” led many participants to question current priorities. There was a widespread sense among participants that business-as-usual will lead to worsening problems.

Finding 3: Most Challenges Come from Four “Key Sectors”

Another insight that stands out from the analysis of the discussions is that participants believe most of the challenges that the radiation protection community will confront between now and 2025 will come from four “Key Sectors”: Energy, National Security, Medical, and Industrial and Consumer.



The Key Sectors image above represents these sectors as four lobes within an image of an atom. In the center, where the lobes intersect, is a fifth key sector: Legacy Issues. Wastes and other risks from the Energy, National Security, Medical, and Industrial and Consumer sectors eventually become the responsibility of people working in the “Legacy Sector.”

Finding 4: Radiation Protection Currently Deals Primarily with Legacy Issues

One of the most important realizations that occurred in analyzing the session discussions is that the participants from the radiation protection community defined its role primarily as working within the Legacy Sector. In the larger community of environmental protection, the emphasis has been shifting for many years from *pollution control* to deal with wastes toward *pollution prevention* to prevent wastes from being generated in the first place. In the radiation protection community, however, this shift has occurred much more slowly and efforts remain focused on dealing with the legacy of wastes and risks.

Finding 5: "Legacy" Challenges Will Decline, Future Needs Will Center on Prevention in the Four Key Sectors

Many participants believe that institutions which have defined their roles as dealing with legacy issues will experience shrinking missions and budgets well before 2025. For example, work on DOE and Superfund sites may reach a peak and then begin to decline because new sites will not be created on anything like the scale they were in the past. Many CRCPD participants in the project foresee shrinking resources in traditional areas, but are concerned about new emerging issues such as lasers, non-ionizing radiation, and new digital technologies.

On the other hand, participants believe that many problems are likely to grow worse, as the votes on the probability of the "Things Get Worse" scenario show. Participants' perceptions of the future intersect in a paradox: they see a future of declining radiation-related institutions amid a world of worsening radiation-related problems.

While the focus of business-as-usual is on legacy issues, many of which will decline in importance, future needs center primarily around developing a more preventive approach in the four key sectors that generate most of the radiation-related problems.

Finding 6: Widespread Agreement on Principles for Guiding Action

One of the project's most important findings is that people across a wide range of organizations, disciplines and policy positions are able to reach substantial if not unanimous agreement on a number of *principles for guiding action*.

The “Whole System Protection” scenario initially set out three principles for consideration: public right-to-know, total accounting, and risk harmonization. In the scenario discussion sessions, participants were asked to comment on these principles, suggest how they should be defined, and discuss their appropriateness for decision making in radiation protection. They were also asked to suggest additional principles that might be just as appropriate and important for guiding action. At the end of the series of discussion sessions, the seven principles below emerged as the ones viewed as both most important and most acceptable to all parties.

Summary of Principles for Guiding Action

(for full descriptions see Appendix A)

1. *Pollution/Exposure Prevention* – Adopt practices which reduce at the source the amount of any hazardous substance or pollutant being released into the environment. Adopt practices that reduce exposures to existing pollutants.

2. *Public Right-to-Know* – Assure easy public (and public manager) access to complete and up-to-date information on the state of chemicals and radiation in the environment.

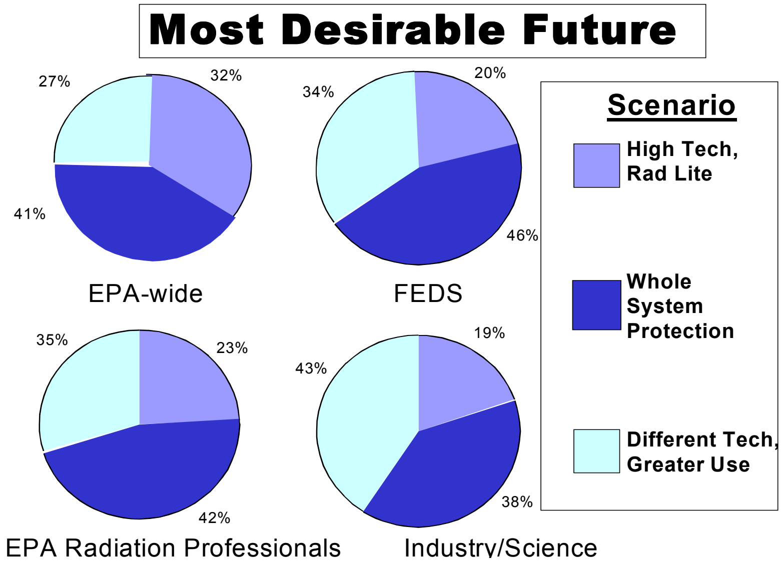
3. *Total Accounting* – Assess the full cradle-to-grave costs and benefits of decisions, including impacts on human health and natural systems.

4. *Risk Harmonization/Cumulative Risk Assessment* – Harmonize radiation and chemical regulatory programs, based on a careful crosswalk between chemical and radiation models, parameters, risk calculations, and measurement techniques. Focus on understanding risks posed by cumulative exposures and interactions between hazardous agents.

5. *Inclusive Science* – Assure sound, rigorous research methods. Bring the full range of relevant disciplines and viewpoints to bear in research related to important issues of public policy. Where appropriate, employ alternative dispute resolution techniques to foster agreement on questions and methods for research.

6. *Place-Based Tailoring* – Where uniform policies are not necessary, avoid “one size fits all” approaches, tailor policies to local or regional circumstances, and encourage experimentation.

7. *Stewardship* –Take responsibility for providing the expertise and resources to maintain an adequate level of protection to human health and the environment across generations.



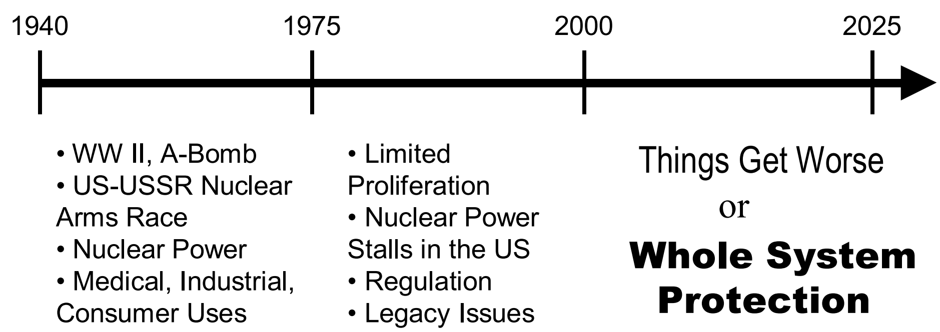
Finding 7: "Whole System Protection" is the Preferred Future

Discussion session participants were asked to rate the scenarios on their desirability as well as their likelihood. Across the six scenario discussion sessions, the "Whole System Protection" scenario emerged just as strongly as the "most desirable" future as the "Things Get Worse" scenario had emerged as the "most likely" future.

Participants in four of the discussion sessions voted for "Whole System Protection" as the most desirable future. No formal vote was taken in the discussion session with environmentalists, but the "High Tech, Rad Lite" scenario was clearly the favorite. The discussion session with the most participants from industry favored the "Different Tech, Greater Use" scenario. But both the environmental and industry groups, even with widely differing perspectives, favored the "Whole System Protection" scenario as a close second choice.

Two main reasons for the popularity of the Whole System Protection scenario emerged in the discussions. First, it was less specific than the other scenarios about what the "end state" in 2025 would be like, which gave people more leeway to read into it whatever they wanted. Second, participants found it attractive because of its emphasis on *principles* for guiding action that seemed meaningful and appropriate. Many participants felt that the application of the principles highlighted in the scenario offered at least a possibility of transcending some of the entrenched conflicts between positions associated with the “Different Tech, Greater Use” and “High Tech, Rad Lite” scenarios. Because of these conflicts, neither of these two approaches is likely to be fully adopted as the preferred future by the public and political decision-makers. As a result, many participants believed that the nation will either move toward the conditions described in the “Things Get Worse” scenario or toward the approach characterized by the “Whole System Protection” scenario. Pursuing the latter scenario requires:

1. Agreement on high-level principles for guiding action,
2. Good science, and
3. Openness to forming new views based on where the principles and scientific findings lead.



Finding 8: The Primacy of Public Right-to-Know

Public right-to-know emerged in the discussion sessions as the most discussed and most widely agreed upon principle. Participants emphasized the lack of public trust in information about radiation provided by both the private and public sectors, the importance of presenting information in understandable formats, and the need for education to help the public understand and interpret information. Providing balanced, credible, usable information is seen as one of the major roles that government is best positioned to fill. Some participants said that a special emphasis on openness is necessary to counter the habits of secrecy developed during the Cold War era.

Finding 9: The Principles Integrate Radiation and Environmental Protection

Historically, radiation protection developed as a field before the emergence of the modern environmental movement in the late 1960s and early 1970s. It has remained, to a considerable extent, a community onto itself. In discussing the principles, some participants observed that risk harmonization, integration of chemical and radiation databases for easy public access, and a systematic application of all the other principles would act over time to integrate radiation protection and environmental protection into a single community.

Some of the principles, like "stewardship," arose primarily within the radiation protection community. But the concept of stewardship applies equally well to other areas of environmental protection and is closely related to the concept of "sustainability" in its emphasis on taking responsibility for protecting future generations. Other principles, like "public right-to-know" or "pollution prevention" emerged first as important themes in the broader environmental community since the 1970s, but apply equally well to radiation protection. Most of the principles are familiar and widely accepted, but some, like "Inclusive Science," need to be better developed.

Finding 10: Sectors and Principles as Tools for Rethinking Radiation Protection

At the Council of Radiation Control Program Director's (CRCPD) May 2000 annual meeting, the Institute for Alternative Futures tested the use of the Key Sectors and Principles with 25 state radiation protection officials in the Saturday Members Forum and with a plenary audience of 200 at the Sunday Opening Session. The Sector and Principles Framework received positive feedback. For example, the executives in the Sunday Forum identified the Right-to-Know Principle as an approach where all levels of government could collaborate. Executives concerned about medical issues thought the Inclusive Science principle showed great promise for working with the public in identifying questions that need to be addressed in future research efforts.

A SHIFT IN PERSPECTIVE

The expert interviews and discussion session findings, taken as a whole, suggest that looking systematically at challenges and alternative futures out to 2025 leads to a significant shift in perspective.

FROM CURRENT APPROACH	TO NEW APPROACH
Focus on current issues, programs, budgets	Focus on major radiation-related challenges facing society as a whole, which leads to rethinking current priorities
Tacit assumption that the future will be much like the present	Common theme that the future is likely to become significantly worse than the present if business-as-usual continues
Radiation protection defined by a focus on " Legacy Issues"	Assessment that legacy issues will decline in importance & that future needs center primarily around developing more preventive approaches to four Key Sectors: Energy, National Security, Health, and Industrial & Consumer
Continuous conflicts between parties with entrenched positions	Focus on shared principles and good science for working toward better positions
Limited emphasis on public information due to habits of secrecy from the Cold War era	Primacy of public right-to-know – strong emphasis on public education and open access to credible, usable information
Radiation protection as a community onto itself	Integration of radiation, public health and environmental protection through risk harmonization, combined databases, and shared principles for guiding action

APPENDIX A - PRINCIPLES FOR GUIDING ACTION

1. Pollution/Exposure Prevention

Pollution Prevention involves adopting practices that reduce at the source the amount of any hazardous substances or pollutants being released into the environment. It includes processes that eliminate the use of hazardous materials or increase the efficiency of their use. Exposure prevention involves adopting practices that reduce exposures to any hazardous substances that are released.

Pollution prevention approaches include substitution of materials, technology innovations, process modifications, redesign of products, improvements in training, and mass balance measurement to assess progress in reducing emissions. Exposure prevention includes inventory control, isolation and storage, and improvements in maintenance and housekeeping. Pollution/exposure prevention often saves money by reducing waste and health-related costs. Even where costs are substantial, it is justifiable to eliminate or reduce the use of hazardous materials and reduce exposures to them if the risks of damage to human health or the environment are high.

2. Public Right-to-Know

Right-to-Know involves assuring easy public (and public manager) access to complete and up-to-date information on the state of chemicals and radiation in the environment.

Actions to foster this principle include:

- Providing high quality, credible information;
- Filling in important information gaps with monitoring and research;
- Providing information in understandable, usable forms;
- Integrating information on chemical and radiation exposures into community-specific formats;
- Providing guidance to the public in interpreting data;
- Eliminating unnecessary secrecy;
- Integrating information on radiation into environmental databases;
- Integrating information from different Federal agencies.

3. Total Accounting

Total Accounting involves assessing the full cradle-to-grave costs and benefits of decisions, including impacts on human health and natural systems.

Challenges that arise in applying this principle include:

- Building agreement on methods;
- Doing life cycle analyses (cradle-to-grave, and cross-generational where appropriate);
- Valuing environmental resources and ecosystem services in doing environmental accounting;
- Assessing social costs to individuals and society as well as costs to the bottom line;
- Dealing with uncertainties and lack of data.

4. Risk Harmonization/ Cumulative Risk Assessment

This principle involves harmonizing approaches to radiation and chemicals based on a careful crosswalk between chemical and radiation models, parameters, risk calculations, and measurement techniques. It also requires a focus on understanding risks posed by cumulative exposures and interactions between hazardous agents.

Many of the major environmental risks we face require the simultaneous evaluation and control of both radiological and chemical risks, yet separation of the two persists along legal, regulatory, programmatic, training and operational lines. An additional complexity is the possible interaction between hazardous agents. Risk harmonization is necessary to allow us to evaluate cumulative risk and evolve beyond today's inadequate carcinogen-by-carcinogen approach to public health.

5. Inclusive Science

Inclusive Science involves bringing a wide range of disciplines and viewpoints to bear in research related to important issues of public policy.

Sound, rigorous scientific methods that can stand up to public and peer scrutiny are essential in all areas of research dealing with health and environmental risks. In many research areas related to public policy debates it is also essential to take an inclusive approach, drawing as appropriate on disciplines within the social sciences as well as the physical and biological sciences. Parties with views that are currently non-mainstream in character should have a role in the formulation of research agendas if their views are an important aspect of particular policy debates and their overall approach is evidence-oriented rather than ideological. Where apropos, an inclusive approach may employ alternative dispute resolution techniques to foster agreement on questions and methods for research.

6. Place-Based Tailoring

Place-based tailoring involves deliberate efforts to adapt policies to fit local or regional circumstances, and to encourage experimentation.

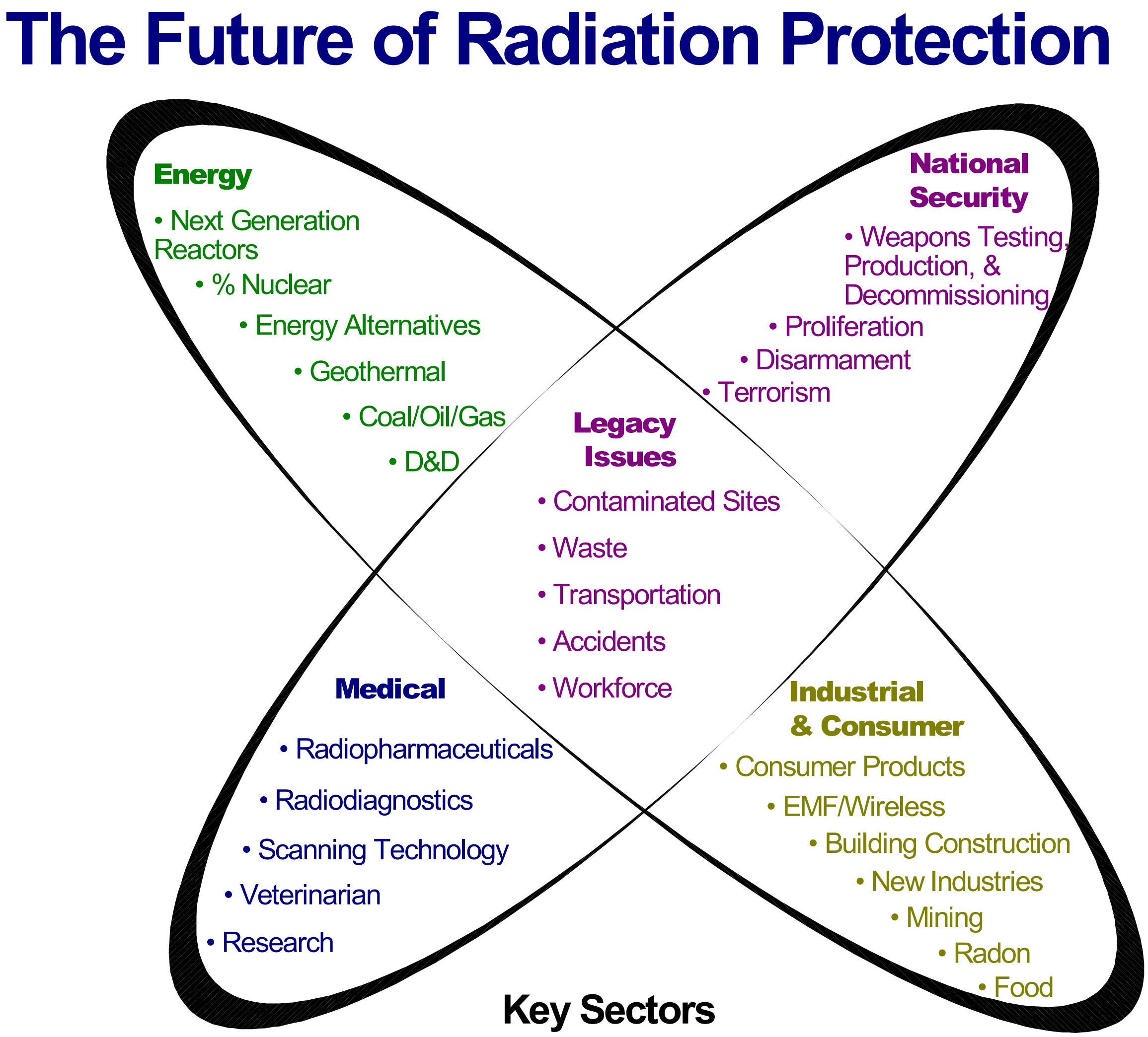
While uniform national policies and regulations are justified in many circumstances, they are sometimes adopted merely for bureaucratic convenience. As a result, "one size fits all" approaches sometimes fit no one. Place-based tailoring requires adopting a grass roots perspective as well as a national perspective. It also requires encouraging local and regional participation in the formulation of policies and regulations. Where appropriate, research can be tailored to address local questions, and information should be organized so that communities can look at local end exposures across media and disciplines.

7. Stewardship

Stewardship involves taking responsibility for providing the expertise and resources to maintain across generations an adequate level of protection to human well being, health and the environment. S*tewardship can be viewed as a "master principle" that encompasses all the others.*

Stewardship is to hold something in trust for another. Historically, it was a means to protect a kingdom while the king was away or to govern for the sake of an underage king. Stewardship in today's context is willingness to choose service to the next generation over immediate self-interest. It is accepting accountability and providing leadership to assure the success of future generations. Stewardship is closely related to the concept of *sustainability*. Sustainable development is development that meets current needs without compromising the ability of future generations to meet their own needs.

APPENDIX B - KEY SECTORS WITH EXAMPLES OF CHALLENGES



APPENDIX C - PRIMARY EXPERT INTERVIEW, FOCUS GROUP QUESTIONAIRE

Key Questions for the Future of Radiation Protection: 2025

What are the most significant radiation-related issues that will need to be dealt with between now and 2025? *1.* *2.* *3.* *Other:*	***What are the least appreciated, neglected challenges?*** *1.* *2.* *3.* *Other:*
What are the most important prevention opportunities? *1.* *2.* *3.* *Other:*	***What "wild cards" – low probability but high impact developments – could create new challenges and opportunities that are not being seriously considered today?*** *1.* *2.* *3.* *Other:*

Submitted by (optional): ______________________Phone:_______________E-mail:______________

APPENDIX D - SCENARIO DISCUSSION SESSION AGENDA

High Touch (Face to Face Meetings of Small Groups)

9:00-9:30 Opening (Carson Room)
- Welcome
- Introductions
- Project Overview
- Brief presentation/review on the 4 Scenarios

9:30-10:15 Discussion of Scenarios (Carson Room)
- Self-select into scenario groups
- Review scenario descriptions
- Discuss "Most Preferred" aspects of each scenario and the "Positive Alternatives" to bad aspects
- Scenario groups report on their discussions

10:15-10:30 Break
- Enter list generated by participants into the Group System

High Tech (Individuals Work at Group System Terminals)

10:30-11:15 Group System Exercise on Strongest Areas of Agreement About the Preferred Future (Muir Room)
- Introduction to the use of the Group System
- Warm Up Exercise: Votes on the "Most Likely" and "Most Desirable" scenarios
- Opportunity to add to the Preferred Future List
- Consolidate the List
- Rating vote
- Discuss vote results

11:15-12:15 Group System Exercise on Principles and Roles
- Brief presentation on principles for guiding action suggested to date
- Opportunity to enter additional principles into the list of principles
- Enter comments on principles – how they apply to/ what they mean for radiation protection
- Enter comments on key roles for implementing principles (government, private sector, public interest, partnerships)

12:15-12:30 Closing
- Invite comments on insights from the last exercise or the entire morning
- Evaluation form
- Thanks to participants, what they will receive

APPENDIX E - SCENARIO DISCUSSION SESSION WORKSHEET

Scenario Name:

Recorder:

1. Most Strongly Preferred Developments in the Scenario:

2. Other Strongly Preferred Developments That Would “Fit With” the Character of the Scenario:

3. Positive Alternatives to Negative Developments in the Scenario:

4. “Top 3-5” Headlines of the Most Preferred Aspects of the Future of Radiation Protection: