

**TECHNICAL BASIS  
FOR  
U.S. DEPARTMENT OF ENERGY  
NUCLEAR SAFETY POLICY,  
DOE POLICY 420.1**



**U.S. DEPARTMENT OF ENERGY  
OFFICE OF HEALTH, SAFETY AND SECURITY  
OFFICE OF NUCLEAR SAFETY**

**JULY 2011**

## Executive Summary

This document provides the technical basis for the Department of Energy (DOE) Policy (P) 420.1, *Nuclear Safety Policy*, dated 2-8-2011. It includes an analysis of the revised Policy to determine whether it provides the necessary and sufficient high-level expectations that will lead DOE to establish and implement appropriate requirements to assure protection of the public, workers, and the environment from the hazards of DOE's operation of nuclear facilities.

In developing the revised Policy and performing this analysis, DOE reviewed the current Nuclear Safety Policy (Secretary of Energy Notice [SEN] 35-91, *Nuclear Safety Policy*) and safety policies established by other safety organizations, including the Nuclear Regulatory Commission (NRC), the National Aeronautics and Space Administration, and the International Atomic Energy Agency.

DOE P 420.1, *Nuclear Safety Policy* states:

*It is the policy of the Department of Energy to design, construct, operate, and decommission its nuclear facilities in a manner that ensures adequate protection of workers, the public, and the environment.*

The key operative term in this policy is “adequate protection”. This is the same term that is utilized in the 1954 Atomic Energy Act, as amended, and which exists in the NRC's basis for licensing of commercial nuclear power plants. It is intended to encompass the Atomic Energy Act of 1954, as amended, responsibility “to protect health and promote safety” in the conduct of its research and development activities that were transferred to the Department from the Atomic Energy Commission through the Energy Reorganization Act of 1974 and the Department of Energy Organization Act.

Although the Policy is appropriately written at a very high level, it also identifies five critical supplemental “action statements” that define the necessary and sufficient actions that DOE will take to properly implement it (i.e., to ensure adequate protection). In brief, these are:

1. Establish and implement nuclear safety requirements that utilize national consensus (or other government) standards or applicable regulations in accordance with DOE's process for developing and implementing rules, directives and technical standards;
2. Implement core functions and guiding principles of Integrated Safety Management (ISM);
3. Use a safety management approach that includes minimizing use of hazardous material, and establishing controls that provide defense-in-depth;
4. Allow appropriate use of quantitative and probabilistic risk assessments to support nuclear safety decisions; and,
5. Establish safety goals related to worker and public risk from DOE nuclear facility operations.

These actions are consistent with those defined in SEN-35-91, but also reflect DOE's adaptation of the ISM process, which similarly recognizes and incorporates the concepts of technical competency, safety culture and roles and responsibilities that were key elements of SEN-35-91. A review of other agencies' safety policies found that there was no single consistent standard, but that DOE P 420.1 contained the essential elements of the other agencies' policies, and that DOE's Policy is organized in a clear and appropriate manner without being overly prescriptive.

## CONTENTS

1. INTRODUCTION.....	1
2. ANALYSIS OF NUCLEAR SAFETY POLICY STATEMENT .....	1
3. ANALYSIS OF KEY NUCLEAR SAFETY COMMITMENTS FOR IMPLEMENTING THE NUCLEAR SAFETY POLICY .....	2
3.1 High-Level Action 1.....	2
3.2 High-Level Action 2.....	4
3.3 High-Level Action 3.....	6
3.4 High-Level Action 4.....	7
3.5 High-Level Action 5.....	7
3.6 Necessary and Sufficient.....	8
4. SUMMARY AND CONCLUSION .....	9
APPENDIX A.....	10
APPENDIX B.....	15
APPENDIX C.....	20
APPENDIX D.....	22
APPENDIX E.....	24

## Technical Basis for U.S. Department of Energy Nuclear Safety Policy

### 1. INTRODUCTION

This document provides the technical basis for the Department of Energy's (DOE) Policy (P) 420.1, *Nuclear Safety Policy*, dated 2-08-2011, replacing Secretary of Energy Notice, SEN-35-91, *Nuclear Safety Policy*. It includes an analysis of the revised Nuclear Safety Policy to determine whether the revised policy provides the essential high-level expectations to ensure that DOE establishes and implements appropriate requirements to ensure the protection of the public, workers and the environment.

### 2. ANALYSIS OF NUCLEAR SAFETY POLICY STATEMENT

DOE P 420.1 states:

*It is the policy of the Department of Energy (DOE) to design, construct, operate and decommission its nuclear facilities in a manner that ensures adequate protection of workers, the public, and the environment.*

This policy statement is consistent with the intent of the current nuclear safety policy statement in Secretary of Energy Notice (SEN) 35-91, *Nuclear Safety Policy*. (See Appendix A for a crosswalk between SEN-35-91 and DOE P 420.1.) It is also consistent with the high-level safety objective (i.e., adequate protection of the public) for the Nuclear Regulatory Commission's (NRC) licensing of commercial nuclear power plants, the current DOE Federal regulations in 10 Code of Federal Regulations (C.F.R.) Part 830, *Nuclear Safety Management*, Subpart B, and statutory requirements in the 1954 Atomic Energy Act. (See Appendix B for further discussion on "adequate protection") The term, as used in DOE P 420.1, is intended to reflect DOE's commitment to fulfill its responsibilities under the Atomic Energy Act to protect health and promote safety in the conduct of its research, development and production activities and to minimize danger to life and property. Appendix B includes additional discussions with regard to providing for adequate protection.

A review of other safety agencies' safety policies shows that DOE policy is consistent with them in providing high-level agency goals and expectations but that each agency has a unique approach for organizing its policies. Appendices C, D and E provide a brief discussion and excerpts from "policy" statements of National Aeronautics and Space Administration (NASA), the NRC and the International Atomic Energy Agency. For example, NASA has established ten items that make up its safety "policy". (Appendix D provides the text of these ten items from the NASA policy). The first item is a high-level statement to:

*Protect the public, NASA workforce, high-value equipment and property, and the environment from potential harm as a result of NASA activities and operations....*

This first item goes on to state that "protection" will be performed, "by factoring safety as an integral feature of programs, projects, technologies, operations and facilities." The remaining nine items provide "action statements" that further prescribe how this "protection" will be

achieved. This is similar to the approach in the former SEN, except that in DOE P 420.1, DOE has chosen to more clearly separate the high-level policy from the high-level implementation actions. DOE believes its nuclear safety policy organization is appropriate and effective, but also recognizes the efficacy of different approaches taken by other organizations.

### **3. ANALYSIS OF KEY NUCLEAR SAFETY COMMITMENTS FOR IMPLEMENTING THE NUCLEAR SAFETY POLICY**

DOE P 420.1 includes five high-level “commitments” that define the necessary and sufficient actions that DOE will take to implement its policy (i.e., to assure adequate protection). These actions are briefly summarized as follows:

1. Establish and implement nuclear safety requirements that utilize national consensus (or other government) standards or applicable regulations in accordance with DOE’s process for developing and implementing rules, directives and technical standards.
2. Implement core functions and guiding principles of the Integrated Safety Management (ISM).
3. Use a safety management approach that includes minimizing use of hazardous material, and establishing controls that provide defense-in-depth.
4. Allow appropriate use of quantitative and probabilistic risk assessments (PRA) to support nuclear safety decisions.
5. Establish safety goals related to worker and public risk from DOE nuclear facility operations.

These actions are consistent with those defined in the SEN-35-91, but also reflect DOE’s adoption of ISM, which incorporated the SEN-35-91 high-level actions for technical competency, safety culture, and roles and responsibilities. Each of these commitments is analyzed in the following sections. (Appendix A provides a crosswalk between these action statements and the action statements in SEN-35-91.)

**3.1 High-Level Action 1:** Establish and implement nuclear safety requirements that utilize national consensus (or other government) standards or applicable regulations in accordance with DOE’s process for developing and implementing rules, directives and technical standards.

The full text of High-Level Action 1 is:

*Establishing and implementing nuclear safety requirements that utilize national consensus (or other government) standards or applicable external agency regulations<sup>1</sup> in accordance with DOE's processes for developing and implementing rules, directives, and technical standards. Key nuclear safety elements to be addressed include hazard identification, assessment and control; facility design; quality assurance; and safety management programs to ensure a high level of formality of operations, such as procedures, maintenance, personnel training, conduct of operations, criticality safety, emergency preparedness, fire protection, radioactive waste management, and radiation protection.*

The most essential aspect of this action is that DOE will utilize a standards-based approach. This will ensure consistency, clarity and openness, as well as a sound technical basis for how DOE makes safety decisions. Highlighted in this action are four key nuclear safety elements to be addressed in its safety rules including:

- Hazard identification, assessment and control
- Facility design
- Quality assurance
- Safety management programs, such as:
  - procedures
  - maintenance
  - personnel training
  - conduct of operations
  - criticality safety
  - emergency preparedness
  - fire protection
  - radioactive waste management
  - radiation protection

DOE considers these to be the most essential elements and, therefore, has specifically defined them as part of its Nuclear Safety Policy. Hazard identification, assessment and control ensure that the facility is designed with appropriate controls to prevent and mitigate accidents. Quality assurance is a key element of ensuring that safety-related calculations and analyses are appropriately performed, and that important safety systems and design features are designed, procured and installed with a high degree of assurance that they will meet and perform to their safety specifications. The safety management programs provide for a high-level of formality in operations and are a center piece of DOE defense-in-depth approach for nuclear safety.

---

<sup>1</sup> DOE and the NRC nuclear safety policies, goals and expectations are, in general, consistent. DOE acknowledges that activities licensed by NRC meet the commitments of this policy through compliance with NRC licenses.

It should be noted that, as discussed below, the identification and appropriate application of safety standards is a fundamental part of DOE's approach to nuclear safety and is consistent with the ISM. Thus, DOE chooses to specifically call them out in the *Nuclear Safety Policy* relative to their development within DOE's directives process.

DOE is, in most situations, responsible for regulating its operations to:

1. protect health and promote safety in the conduct of its scientific research, development and production activities<sup>2</sup> and
2. to minimize danger to life and property (provide for adequate protection from these activities).

In some specific cases, the law requires NRC regulation<sup>3</sup> of certain DOE activities. The footnote to this Action in the Policy is intended to recognize that in cases where DOE utilizes NRC requirements, the goals of this policy are met through compliance with NRC regulation. The footnote states:

*DOE and the Nuclear Regulatory Commission (NRC) nuclear safety policies, goals and expectations are, in general, consistent. DOE acknowledges that activities licensed by the NRC meet the commitments of this policy through compliance with NRC licenses.*

### **3.2 High-Level Action 2: Implement core functions and guiding principles of Integrated Safety Management**

The full text of High-Level Action 2 is:

*Implementing the Department's Safety Management System Policy including supporting processes for its core functions and guiding principles, and related activities for performing effective line management, establishing and maintaining strong safety culture, and performing independent oversight.*

---

<sup>2</sup> Includes the responsibility to provide for the safe storage, processing, transportation and disposal of hazardous waste (including radioactive waste).

<sup>3</sup> Examples include:

- The Energy Reorganization Act of 1974 (Sec. 202) which provides the NRC authority to regulate certain demonstration reactors built to demonstrate suitability for commercial application; high-level waste disposal facilities, retrievable surface storage facilities and other facilities for long-term storage of high-level waste not used for research and development.
- The Uranium Mill Tailings Control Act of 1978 provides for the NRC licensing of DOE uranium mill tailings disposal facilities.
- The Strom Thurmond National Defense Authorization Act for Fiscal Year 1999 (sec. 3134) provides the NRC with the regulatory and licensing authority over the MOX fuel fabrication facility at the DOE Savannah River Site.



The core functions and guiding principles of ISM are stated in DOE P 450.4A, *Integrated Safety Management Policy*, (ISM Policy) and are:

#### Core Functions

- Define the Scope of Work
- Analyze the Hazards
- Develop and Implement Hazard Controls
- Perform Work within Controls. Readiness is confirmed and work is performed safely.
- Provide Feedback and Continuous Improvement

#### Guiding Principles

- Line Management Responsibility for Safety
- Clear Roles and Responsibilities
- Competence Commensurate with Responsibilities
- Balanced Priorities
- Identification of Safety Standards and Requirements
- Hazard Controls Tailored to Work Being Performed
- Operations Authorization

DOE P 450.4A, specifically states DOE's expectation that all organizations will embrace a strong safety culture. DOE currently identifies the following safety culture elements in *The Basic Overview of the Integrated Safety Management* found at [http://www.hss.doe.gov/HealthSafety/ism/ISM\\_Brochure\\_41311.pdf](http://www.hss.doe.gov/HealthSafety/ism/ISM_Brochure_41311.pdf). Although not specifically listed in the ISM Policy, these elements remain important in embracing a strong safety culture for nuclear operations.

#### Safety Culture Elements

- Leadership
- Employee/Worker Engagement
- Organizational Learning

The core functions, guiding principles and supplemental safety culture elements encompass four of the five previous high-level management actions in SEN-35-91, including:

- **Management:** Related ISM attributes include roles and responsibilities, balanced priorities and feedback and continuous improvement.
- **Technical Competence:** Related ISM attributes include competence commensurate with responsibilities.

- **Oversight and Self-Assessment:** The primary related ISM attributes are feedback and continuous improvement and oversight for performance assurance, which also includes independent oversight.
- **Safety Culture:** The four supplemental ISM safety culture elements are attributes of safety culture.

DOE has successfully relied on ISM as its fundamental management principle for ensuring safety, and it is therefore appropriate to include ISM as part of its *Nuclear Safety Policy*. DOE considered an approach that would simply identify ISM as the sole high-level action statement in DOE P 420.1, supplemented with a high-level safety goal statement (as ISM addresses most aspects of high-level action statements). However, it was ultimately decided that specifically identifying how the important elements of ISM are to be implemented relative to nuclear safety (such as hazard controls and utilization of defense-in-depth) was more appropriate.

Independent oversight is the one high-level management element from SEN-35-91 that is not specifically highlighted as a core function or guiding principle in ISM. Although independent oversight is an important aspect of the core function for feedback and continuous improvement and is included as a part of the four ISM safety culture elements, DOE felt it was important to specifically call it out separately in the *Nuclear Safety Policy*.

DOE performs oversight in a variety of ways including oversight by staff and organizations supporting the Central Technical Authorities, as well as through independent oversight by DOE's Office of Health, Safety and Security.

**3.3 High-Level Action 3:** Use a safety management approach that includes minimizing use of hazardous material, and establishing controls that provide defense-in-depth.

The full text of High-Level Action 3 is:

*Using a safety management approach that minimizes the use of hazardous materials, establishes appropriate hazard controls based upon a primarily qualitative hazard analysis, and implements a defense-in-depth approach to hazard control.*

A fundamental part of DOE processes for ensuring safety of hazardous operations is the performance of thorough analyses and establishment of appropriate controls. Details of the way this has been accomplished are described in lower-level documents such as DOE-Standard (STD)-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, dated 11-1-08. This is consistent with expectations in High-Level Action 1; which includes reliance on industry standards and good practices. For hazard assessments, this approach involves a qualitative analysis that starts with identification of all hazardous material and the events that could result in a release of this material, followed by a qualitative analysis of the likelihood and consequences of adverse events. For events where the public is potentially impacted, more detailed consequence assessments are performed.

The desired outcome from this process is the identification and implementation of appropriate controls needed to mitigate the potential consequences of events to protect both the worker and

the public. Two fundamental principles are also applied: (1) minimize and mitigate the amount of hazardous materials present and (2) defense-in-depth. DOE's safety management programs are an important part of the defense-in-depth process and exist primarily to prevent an accident from occurring.

**3.4 High-Level Action 4:** Allow appropriate use of quantitative and probabilistic risk assessments to support nuclear safety decisions.

The full text of High-Level Action 4 is:

*Ensuring that quantitative and probabilistic risk assessments, when employed, are used in a manner that:*

- a. Supplements qualitative/deterministic processes for hazard assessments, hazard control development, and safety management programs development,*
- b. Is consistent with DOE directives, and*
- c. Is supported by industry practices and availability of risk data.*

This new addition to the DOE *Nuclear Safety Policy* is, in part, in response to Defense Nuclear Facility Safety Board's Recommendation 2009-1, *Risk Assessment Methodologies at Defense Nuclear Facilities*. DOE has always allowed the use of quantitative and probabilistic risk assessment, but has not defined clear boundaries and conditions for its use. The new policy statement provides definitions of these high-level expectations. In support of High-Level Action 4, DOE has conducted an analysis of the uses and controls associated with quantitative and probabilistic risk assessment, both within DOE and in other government and non-government industries. This analysis is being used along with input from DOE programs to aid in determining whether further direction (e.g., a DOE Guide or Technical Standard) and training is needed to support effective implementation of this action item. DOE has issued a draft Technical Standard, *Development and Use of Probabilistic Risk Assessments in Department of Energy Nuclear Safety Applications* for evaluation.

**3.5 High-Level Action 5:** Establish safety goals related to worker and public risk from DOE nuclear facility operations.

The full text of High-Level Action 5 states:

*Having as its Safety Goal to conduct its operations such that (a) Individual members of the public be provided a level of protection from the consequences of DOE operations such that individuals bear no significant additional risk to life and health to which members of the general population are normally exposed.,<sup>4</sup> and (b) DOE workers' health and safety is protected to levels consistent with or better than that achieved for workers in similar industries.*

*The following two quantitative safety objectives for public protection are established as*

---

<sup>4</sup> This goal and associated objectives are adapted from the U.S. Nuclear Regulatory Commission's Safety Goal for operation of commercial nuclear power plants (51 Federal Register 30028; August 21, 1986).

*“aiming points” (not requirements) in support of the Safety Goal that guides the development of DOE’s nuclear safety requirements and standards:*

- *The risk to an average individual in the vicinity of a DOE nuclear facility for prompt fatalities that might result from accidents should not exceed one-tenth of one percent (0.1%) of the sum of prompt fatality risks resulting from other accidents to which members of the population are generally exposed. For evaluation purposes, individuals are assumed to be located within one mile of the site boundary.*
- *The risk to the population in the area of a DOE nuclear facility for cancer fatalities that might result from operations should not exceed one-tenth of one percent (0.1%) of the sum of all cancer fatality risks resulting from all other causes. For evaluation purposes, individuals are assumed to be located within 10 miles of the site boundary.*

The first safety goal (public) is the same as that of the NRC (see Appendix D), which is similarly supported by the two quantitative risk goals and is intended to support DOE in its development of its nuclear safety requirements. The use of standards, application of safety management programs, and utilization of a defense-in-depth hazard control philosophy are also fundamental elements to achieving these goals. Like NRC, DOE uses the quantitative goals as aiming points in the establishment of specific requirements and guidelines; they are not intended as risk acceptance criteria for risk analyses of specific projects or activities. Appendix B includes additional discussion regarding the use of the quantitative goals in DOE’s system of protection.

The second safety goal (workers) is one that DOE achieves by requiring adherence to general industry worker safety requirements (as defined in 10 C.F.R. Part 851, *Worker Health and Safety Program* and 10 C.F.R. Part 835, *Occupational Radiation Protection*) as supplemented and enhanced by ISM. DOE strives to highlight this worker safety goal and be considered as “best in class” with regard to protection of its workers.

### **3.6 Necessary and Sufficient**

In formulating DOE P 420.1, DOE’s goal was to be succinct in identifying a high level policy statement that is consistent with its mission, authorities and responsibilities. The five supporting “action items” provide details on “how” to implement this policy effectively.

Each of the five actions is considered important for nuclear safety. These actions are derived from the basic engineering and safety management principles that have successfully served the commercial nuclear, aerospace and chemical industries for many years. It cannot be established whether all are always “necessary”; however, DOE is confident that these actions are sufficient to provide “adequate assurance” of the protection of the workers, the public and the environment. DOE recognizes that there are inherent risks associated with its nuclear operations and that these risks cannot be eliminated entirely if the missions are to be implemented and progress is to be made. However, the fundamental safety measures (effective hazard analysis, application of appropriate controls that utilize defense-in-depth and quality assurance, and other safety management programs) reduce the likelihood and consequence of events to acceptable levels, in which the worker, public and environment are adequately protected.

#### **4. SUMMARY AND CONCLUSION**

In support of revising its nuclear safety policy, DOE has performed a thorough analysis of the existing policy in SEN-35-91 where changes reflect updates in DOE safety management and directives management processes; in particular, the adoption of ISM. Furthermore, DOE reviewed other Federal agencies' safety policies to identify insights in developing its nuclear safety policy.

This review determined that SEN-35-91 contained the appropriate policy statement and identified reasonable high-level critical implementation actions, but that clarification and streamlining would likely enhance effectiveness in implementation. In addition, it was considered appropriate and beneficial to formally integrate key tenets of ISM into DOE's nuclear safety policy as a means of maintaining consistency with DOE's overall safety management approach. This was achieved by highlighting key aspects of ISM fundamental to nuclear safety in DOE P 420.1, as well as establishing nuclear safety goals.

## APPENDIX A

Crosswalk between SEN-35-91 and DOE P 420.1, *Nuclear Safety Policy*

### 1. PURPOSE

The purpose of this crosswalk is to identify, analyze and document rationale for changes between SEN-35-91 and the revised Nuclear Safety Policy.

### 2. CROSSWALK

#### 2.1 Paragraph 1: “Policy”

SEN-35-91:

*It is the policy of the Department of Energy (DOE) that the general public be protected such that no individual bears significant additional risk to health and safety from the operation of a DOE nuclear facility above the risks to which members of the general population are normally exposed.*

*The purpose of this document is to establish the basic nuclear safety policy from which specific safety rules, orders, standards, and other requirements shall follow.*

*DOE facilities will be designed, constructed, operated, and decommissioned to assure the protection of the public, workers, and the environment.*

Paragraph 1 of SEN-35-91 includes three statements. The first is written as a “policy” statement, followed by a “purpose” statement, and lastly an “action” statement.

The new Nuclear Safety Policy simplifies and clarifies the “policy,” as discussed below. First, it provides a broad top-level policy statement:

*It is the policy of the Department of Energy (DOE) to design, construct, operate and decommission its nuclear facilities in a manner that assures adequate protection of workers, the public and the environment.*

This statement is the same as the third sentence in the existing policy paragraph. A key aspect of this policy statement is that DOE will provide “adequate protection” of workers, the public and the environment. The term “adequate protection” is achieved by implementing the key actions that are described under the new Nuclear Safety Policy. These key actions are similar to those provided in SEN-35-91 and encompass the first “policy” statement in SEN-35-91 by inclusion of the safety goal. Furthermore, the term “adequate protection” is the same that is currently utilized in 10 CFR 830 Section 201.

A similar (expanded) term rather than “adequate protection” was also considered. This was “reasonable assurance of adequate protection,” which is a term used as a fundamental nuclear

safety criterion in several documents, including Appendix A of 10 C.F.R. 830, 10 C.F.R. Part 50 (as the basis for licensing of commercial nuclear power plants by the NRC) and also in parts of the Atomic Energy Act of 1954 as amended (but not in a consistent manner, see Appendix B of this report). The two terms are very similar in meaning and the conclusion from this analysis (see Appendix B) is that the term “adequate protection” actually envelops the term “reasonable assurance of adequate protection”, while being shorter and simpler.

## **2.2 Paragraph 2: “Implementation Requirements”**

Paragraph 2 provides five high-level “requirements” for implementing the safety policy, specifically:

*To implement this policy, DOE and its contractors shall: 1) establish and maintain management involvement and accountability to ensure that nuclear safety requirements are met and individual responsibility is articulated and understood by all parties; 2) develop and foster technically competent personnel and the technical standards necessary to achieve nuclear safety; 3) use established nuclear safety goals to serve as aiming points for performance; 4) establish and maintain vigorous oversight to assure adherence to this policy and its implementing directives; and 5) promote a culture that is dedicated to continuously striving to enhance nuclear safety.*

SEN-35-91 expands (includes a paragraph) on each of the five “requirements.” DOE P 420.1 addresses each of these items as discussed in detail below.

### **2.2.1 Management**

Paragraph 2 of SEN-35-91 includes the following elements related to management:

*Establish and maintain management involvement and accountability to ensure that nuclear safety requirements are met and individual responsibility is articulated and understood by all parties.*

This is a fundamental aspect of ISM Guiding Principle 1.

The management “requirement” is expanded upon in Paragraph 3 of SEN-35-91, which includes the following additional details:

- The Secretary of Energy has overall responsibility for the safety of DOE facilities. DOE line managers report to the Secretary and are directly responsible and accountable for the safety of their activities.
- Clear lines of authority and responsibility for ensuring safety will be established and maintained at all levels of DOE and contractor organizations.
- Clear and adequate guidance shall be provided by DOE line managers to their contractors, including the need for management to maintain a proper balance of safety,

production goals and cost considerations, which ensures that safety is fully-integrated into every level of activity.

- DOE line management is responsible for defining appropriate safety objectives for its facilities and contractor management is responsible for meeting those objectives, instilling a philosophy of personal excellence and timely identification and resolution of safety problems. DOE and contractor management are responsible for continuously pursuing enhancements to safety—not just complying with a minimal set of requirements.
- To ensure full responsibility for nuclear safety, DOE will require that all contractors' activities be conducted in accordance with all DOE rules, regulations and orders relating to nuclear safety.
- Contractor responsibility for the safety of its activities does not in any way relieve, diminish or abrogate DOE managers of the responsibility for assuring safety through proper decision-making, planning, direction and oversight.
- Safe operations, environmental protection, and meeting production and research goals are mutually achievable objectives. Assurance of adequate safety will not be compromised to achieve production or research objectives.

Each of these bullets is also encompassed by ISM Guiding Principles 1) *Line Management Responsibility for Safety*, 2) *Clear Roles and Responsibilities*, and 3) *Balanced Priorities*, which have been adopted in the new Nuclear Safety Policy. The level of detail associated with the above bullets could, therefore, be left out of the new Nuclear Safety Policy since these concepts are already documented in ISM policy and implementation guidance. This approach serves to streamline the nuclear safety policy and maintain consistency under the DOE Directives process for policies.

### **2.2.2 Technical Competence**

- The scientific, engineering and technical knowledge and ability of DOE and its contractor personnel directly determines the Department's ability to achieve its safety policy. Potential hazards associated with nuclear operations dictate that DOE and contractor personnel possess technical competence, commitment, discipline and high standards of professional and personal excellence. Organizations responsible for DOE nuclear activities shall have the ability to recruit, train and qualify personnel who possess these attributes for job-specific positions.

This aspect is addressed in ISM Guiding Principle 3, *Competence Commensurate with Responsibilities*, which has been adopted as part of the new Nuclear Safety Policy.

- Adherence to appropriate national and international standards in the design, construction, operation and decommissioning of DOE's nuclear facilities and activities is necessary for the successful implementation of the Department's nuclear safety policy. Standards proven through years of experience and accepted by professional and technical societies shall be used wherever applicable. Yet, no matter how carefully conceived and properly developed, technical standards cannot address all eventualities.



- Therefore, DOE contractors must critically assess the standards in use at DOE facilities to assure that they remain consistent with the latest information arising from operational experience and developments in science and engineering. Where standards do not exist, or where existing standards do not suffice, appropriate DOE nuclear safety standards shall be developed and adopted.

These elements are addressed in ISM Guiding Principle 5, *Identification of Safety Standards and Requirements*, and in ISM Core Function 5, *Feedback and Improvement*. It is also specifically called out in the new Nuclear Safety Policy High-Level Action 1 which identifies the need for DOE to develop nuclear safety rules and guides. These are implemented via DOE directives and standards process requirements.

### **2.2.3 Safety Goals**

The SEN identifies two quantitative safety goals to limit the risks of fatalities associated with its nuclear operations. The new Nuclear Safety Policy includes these same goals.

The SEN also includes the “requirement” that:

*In striving to reach these goals, DOE nuclear facilities and activities shall be designed, constructed, operated, and decommissioned with: a) appropriate barriers to prevent or minimize potential radioactive releases; b) engineered safety features to minimize potential releases; and c) procedural controls to mitigate the effects of potential releases.*

This requirement is essentially included as High-Level Action 3 in the new Nuclear Safety Policy, which addresses performance of hazard assessments to identify appropriate hazard controls (that will include hazard barriers, engineering safety features and procedure controls).

The new policy includes a new worker safety goal, i.e., “DOE workers’ health and safety is protected to levels consistent with or better than that achieved for workers in similar industries.”

### **2.2.4 Oversight and Self Assessment**

The SEN identifies the need for independent oversight and self assessment. These are both identified in the ISM Guiding Principle 1, *Line Management Responsibility for Safety* and Core Function 5, *Provide Feedback and Continuous Improvement*. The new Nuclear Safety Policy adopts the ISM policy, and specifically calls out independent oversight as a key element for ensuring nuclear safety.

### **2.2.5 Safety Culture**

The SEN identifies the need for a “safety culture” and describes why it is important for achieving continuous improvement. This is addressed in the ISM Supplemental Safety Culture Elements. The new Nuclear Safety Policy adopts the ISM policy, and specifically calls out safety culture as a key element for ensuring nuclear safety.

### 3.0 Changes to Address Quantitative Risk Assessment Use

The most significant change is the highlighting of the means in which DOE manages its risks of nuclear operations, i.e.:

*Uses a safety management approach that minimizes the use of hazardous materials, establishes appropriate hazard controls based upon a primarily qualitative hazard analysis (which is a part of the documented safety analysis of the nuclear facility), and implements a defense-in-depth approach to hazard control.*

*Recognizes that quantitative and probabilistic risk assessments may be used to supplement qualitative hazard assessment and hazard control development processes to the extent that standard industry practices and data allow.*

It provides the essence of how DOE currently manages risk and provides high-level expectations for when quantitative risk assessments can be utilized. Details of how quantitative risk assessment may be utilized in this regard will most likely be provided in a DOE guide or standard which will be developed if DOE's internal and external risk study indicates that one is warranted.

## APPENDIX B

### Adequate Protection

The Department of Energy (DOE) Safety Policy is to “conduct its nuclear activities in a manner that provides for **adequate protection** of workers, the public and the environment.” [emphasis added] The term adequate protection is key to this safety policy and is the same term that is utilized in the 1954 Atomic Energy Act, as amended, and is used as the NRC’s basis for licensing of commercial nuclear power plants. As used in the policy, it is intended to encompass those DOE responsibilities assigned in the 1954 Atomic Energy Act as amended “to protect health and promote safety” in the conduct of its research and development activities and “to minimize danger to life and property.” These Atomic Energy Act responsibilities were transferred to DOE from the Atomic Energy Commission through the Energy Reorganization Act of 1974 and the Department of Energy Organization Act (see Table B1 for relevant excerpts from the laws).

The five commitments/actions in the policy establish the means by which DOE provides adequate protection of the workers, public and environment. As discussed in the main body of this new policy each of the five actions is considered important for nuclear safety. These actions are derived from the basic engineering and safety management principles that have successfully served the commercial nuclear, aerospace and chemical industries for many years. DOE is confident that these actions are sufficient to provide “adequate assurance” of the protection of the workers, the public and the environment. DOE recognizes that there are inherent risks associated with its nuclear operations and that these risks cannot be eliminated entirely without cessation of operations. However, the fundamental safety measures (effective hazard analysis, application of appropriate controls that utilize defense-in-depth and quality assurance, and other safety management programs) reduce the likelihood and consequence of events to acceptable levels, in which the worker, public and environment are adequately protected.

DOE also believes the implementation of its hazard-based approach to nuclear safety will ensure the quantitative risk goals are achieved and implementation of the associated safety basis will provide reasonable assurance of adequate protection, which achieves the policies primary commitment to conduct its operations in a manner that ensures adequate protection of the workers, public and environment.

In adopting the quantitative goals, DOE in no way regards a death as a routine or permissible event. The quantitative goals deal with acceptable risk not acceptable deaths. As the NRC stated<sup>5</sup>:

*“In any fatal accident, a course of conduct posing an acceptable risk at one moment results in an unacceptable death a moment later. This is true whether one speaks of driving, swimming, flying or generating electricity from coal. Each of these activities poses a calculable risk to society and to individuals. Some of those who accept the risk*

---

<sup>5</sup> 51 FR 30028, 8/21/86, *Safety Goals for the Operation of Nuclear Power Plants: Policy Statement: Republication.*

*(or are part of society that accepts the risk) do not survive it. We intend no such accidents will occur, but the possibility cannot be entirely eliminated.”*

DOE similarly will take every reasonable measure to ensure that fatal accidents will be avoided and has adopted the quantitative goals as an aiming point to help ensure the risks of such accidents are very low.

Adequate protection is not synonymous with absolute protection. As noted above in the discussion of the risk goals, every activity has some associated risks. This was clearly recognized in the Atomic Energy Act in its charge to DOE. DOE was directed to “minimize danger to life and property.” The charge is not to eliminate danger, but to minimize it. DOE uses various means and combinations of controls to achieve this and to ensure a reasonable expectation of adequate protection.

For example, if the risk from an operation is a release of hazardous material, the only way to ensure no risk of a consequence, other than not conducting the activity, would be to establish a consequence limitation which can only be ensured by limiting the amount of hazardous material. Without such limits, there will always be some risk or “lack of assurance” that the consequence threshold will be exceeded.

However, controlling off-site consequence by limiting the potential source term (amount of hazardous material) is not always feasible or consistent with mission needs. A combination of controls, applied in layers of defense-in-depth, may provide an assurance of adequate protection by making it highly unlikely that there would be an accident, while at the same time minimizing the consequences of an accident, even when the potential consequences cannot be demonstrated to be in the desired dose range. A key concept is to identify and implement controls where ever feasible, to reduce both likelihood and consequence, while at the same time not accepting undue risk without there being a commensurate and compelling national security benefit.

Application of defense-in-depth controls provides for high levels of assurance that the consequence levels will not be exceeded and that “adequate protection” is being maintained, even when hazardous material levels cannot be kept below certain (very small) levels.

As noted in Table B1, various phrases are employed in DOE’s enabling legislation to describe safety-related activities and responsibilities including: protect health and promote safety; provide reasonable assurance of adequate protection; protect health and minimize danger to life and property; and provide adequate protection. As such, DOE has decided to simplify and use the term “adequate protection,” which is consistent with the term utilized in the Atomic Energy Act for the duty of the Defense Nuclear Facilities Safety Board.

**Table B1. Selected Legal Citations Related to DOE Authorities and Responsibilities for Protection of the Workers, Public and Environment**

Source	Citation
<b>Atomic Energy Act of 1954 as amended</b>	
<p><b>Title IV-Research</b> Research Assistance. <b>SEC. 31.</b></p>	<p>a. The Commission is directed to exercise its powers in such manner as to insure the continued conduct of research and development and training activities in the fields specified below, by private or public institutions or persons, and to assist in the acquisition of an ever-expanding fund of theoretical and practical knowledge in such fields. To this end the Commission is authorized and directed to make arrangements (including contracts, agreements, and loans) for the conduct of research and development activities relating to—</p> <ul style="list-style-type: none"> <li>(1) nuclear processes;</li> <li>(2) the theory and production of atomic energy, including Processes ----</li> <li>(5) the <b>protection of health and the promotion of safety</b> during research and production activities.</li> </ul> <p>d. The arrangements made pursuant to this section shall contain such provisions <b>(1) to protect health, (2) to minimize danger to life or property,</b> and (3) to require the reporting and to permit the inspection of work performed thereunder, as the Commission may determine.</p>
<p><b>Title V-Production of Special Nuclear Material</b> Ownership and Operation of Production facilities. <b>SEC. 41</b></p>	<p><b>(b) Operation of the Commissions Production Facilities.</b> The Commission is authorized and directed to produce or provide for the production of special nuclear material ... Any contract entered into under this section shall contain provision ... (2)obligating the contractor ... (C) <b>comply with all safety and security regulations prescribed by the Commission</b> [Department]</p>
<p><b>Title IX-Military Application of Atomic Energy</b> Authority. <b>SEC. 91</b></p>	<p>(a) Research and Development; production of atomic weapons. The Commission is authorized to-...</p> <p>(3) <b>Provide for the safe storage, processing, transportation and disposal of hazardous waste (including radioactive waste)</b> resulting from nuclear materials production, weapons production and surveillance programs and naval propulsion programs.</p>
<p><b>Title XIV-General Authority of Commission</b> General Provisions <b>SEC. 161</b></p>	<p>In performance of its functions the Commission is authorized to-</p> <p>(b) Standards and instructions. establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission may deem necessary or desirable ... <b>to protect health or to minimize danger to life or property; ...</b></p> <p>(i) Regulations or orders. prescribe such regulations or orders as it may deem necessary ... (3) to govern any activity authorized pursuant to this Act, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, <b>in order to protect health and to minimize danger to life or property.</b></p> <p>(p) Rules and regulations. make, promulgate, issue, rescind, and amend such rules and regulations as may be necessary to carry out the purposes of this Act.</p>

Source	Citation
<p><b>Title XVI-Judicial Review and Administrative Procedure</b> License Applications <b>SEC. 182</b></p>	<p>Each application for a license hereunder shall be in writing and shall specifically state such information as the Commission, by rule or regulation, may determine to be necessary to decide such of the technical and financial qualifications of the applicant, the character of the applicant, the citizenship of the applicant, or any other qualifications of the applicant as the Commission may deem appropriate for the license. In connection with applications for licenses to operate production or utilization facilities, the applicant shall state such technical specifications, including information of the amount, kind and source of special nuclear material required, the place of the use, the specific characteristics of the facility and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization or production of special nuclear material will be in accord with the common defense and security and will provide <u>adequate protection to the health and safety of the public.</u></p>
<p>Hearings and Judicial Review <b>SEC. 189</b></p>	<p>a.(1)(a) In any proceeding under this Act, for the granting, suspending, revoking, or amending of any license or construction permit, or application to transfer control, and in any proceeding for the issuance or modification of rules and regulations dealing with the activities of licenses, and in any proceeding for the payment of compensation, an award or royalties under sections 153, 157, 186 c., or 188, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding...</p> <p>(1)(b)(ii) A request for hearing under clause (i) shall show, prima facie, that one or more of the acceptance criteria in the combined license have not been, or will not be met, and the specific operational consequences of nonconformance that would be contrary to providing <u>reasonable assurance of adequate protection of the public health and safety.</u></p> <p>(iii) After receiving a request for a hearing under clause (i), the Commission expeditiously shall either deny or grant the request. If the request is granted, the Commission shall determine, after considering petitioners' prima facie showing and any answers thereto, whether during a period of interim operation, there will be <u>reasonable assurance of adequate protection of the public health and safety.</u> If the Commission determines that there is such reasonable assurance, it shall allow operation during an interim period under the combined license.</p>
<p><b>Title XXI-Defense Nuclear Facilities Safety Board</b> Functions of the Board <b>SEC. 312</b></p>	<p>(a) IN GENERAL - The Board shall perform the following functions:</p> <p>(1) Review And Evaluation Of Standards.—The Board shall review and evaluate the content and implementation of the standards relating to the design, construction, operation, and decommissioning of defense nuclear facilities of the Department of Energy (including all applicable Department of Energy orders, regulations, and requirements) at each Department of Energy defense nuclear facility. The Board shall recommend to the Secretary of Energy those specific measures that should be adopted to ensure <u>that public health and safety are adequately protected...</u></p> <p>(4) Review Of Facility Design And Construction.—The Board shall review the design of a new Department of Energy defense nuclear facility before construction of such facility begins and shall recommend to the Secretary, within a reasonable time, such modifications of the design as the Board considers necessary to <u>ensure adequate protection of public health and</u></p>

Source	Citation
	<p><b>safety.</b> During the construction of any such facility, the Board shall periodically review and monitor the construction and shall submit to the Secretary, within a reasonable time, such recommendations relating to the construction of that facility as the Board considers necessary to ensure <b>adequate protection of public health and safety.</b> An action of the Board, or a failure to act, under this paragraph may not delay or prevent the Secretary of Energy from carrying out the construction of such a facility.</p> <p>(5) Recommendations.—The Board shall make such recommendations to the Secretary of Energy with respect to Department of Energy defense nuclear facilities, including operations of such facilities, standards, and research needs, as the Board determines are necessary to ensure <b>adequate protection of public health and safety.</b></p>
<b>Energy Reorganization Act of 1974</b>	
<p><b>Title I-Energy Research and Development Administration</b> Abolition and Transfers <b>SEC. 104</b></p>	<p>(c) There are hereby transferred to and vested in the Administrator all functions of the Atomic Energy Commission, the Chairman and members of the Commission, and the officers and components of the Commission, except as otherwise provided in this Act.</p>
<p>Administrative Provisions <b>SEC. 105</b></p>	<p>(a) Rules and regulations. The Administrator is authorized to prescribe such policies, standards, criteria, procedures, rules and regulations as he may deem to be necessary or appropriate to perform functions now or hereafter vested in him.</p>
<b>Department of Energy Organization Act</b>	
<p><b>Title I-Declaration of Findings and Purposes</b> Congressional Declaration of Purpose <b>SEC 102</b></p>	<p>The Congress therefore declares that the establishment of the Department of Energy is in the public interest and will promote general welfare by assuring coordination and effective administration of Federal energy policy and programs. It is the purpose of this Act:</p> <p>(1) To establish a Department of Energy...</p> <p>(13) To assure incorporation of National environmental protection goals in the formulation of energy programs and to <b>advance the goals of restoring, protecting and enhancing environmental quality and assuring public health and safety...</b></p>
<p><b>Title II-Establishment of the Department</b> Assistant Secretaries <b>SEC. 203</b></p>	<p>(a) The functions which the Secretary shall assign to the Assistant Secretaries include...</p> <p>(8) Nuclear waste management responsibilities, including-...</p> <p>(G) The promulgation of such rules and regulations to implement the authority described in this paragraph...</p>
<p><b>Title III-Transfers of Functions</b> General Transfers <b>SEC. 301</b></p>	<p>Except as otherwise provided in this Act, there are hereby transferred to and vested in, the Secretary all of the functions vested by law in...the Administrator of the Energy Research and Development Administration...</p>

## APPENDIX C

### NRC Safety Policy

The NRC has not issued a single high-level Nuclear Safety Policy but rather has issued many Policy Statements that provide high-level expectations for both the NRC and licensee regulatory actions. These are listed in Table C-1

The regulatory authority of the NRC in many respects provides a policy statement. It provides the authority for the:

*NRC to establish by rule or order, and to enforce, such standards to govern these uses as "the Commission may deem necessary or desirable in order to protect health and safety and minimize danger to life or property."*

High-level Policies NRC has issued that relate to DOE Nuclear Safety Policy include:

- Safety Goals for the Operation of Nuclear Power Plants
- PRA Policy Statement
- Safety Culture (Draft Policy)



**Table C-1: List of NRC Policy Statements**

<b>NRC Policy Statements</b>
<ul style="list-style-type: none"> <li>• Program for Resolution of Generic Issues Related to Nuclear Power</li> <li>• Nuclear Power Plant Standardization</li> <li>• Recommendations for Improving Nuclear Power Plant Licensing Generic Rulemaking to Improve Nuclear Power Plant Licensing</li> <li>• Planning Basis for Emergency Responses to Nuclear Power Reactor Accidents; EPA Policy Statement</li> <li>• Nuclear Power Plant Accident Considerations Under the National Environmental Policy Act of 1969</li> <li>• Further Commission Guidance for Power Reactor Operating Licenses</li> <li>• Nuclear Power Plant Staff Working Hours</li> <li>• Environmental Qualification of Electric Equipment</li> <li>• Systematic Safety Evaluation of Operating Nuclear Power Reactors</li> <li>• Environmental Qualification of Electrical Equipment; Status of June 30, 1982, Deadline</li> <li>• Emergency Planning</li> <li>• Severe Reactor Accidents Regarding Future Designs and Existing Plants</li> <li>• Engineering Expertise on Shift</li> <li>• Safety Goals for the Operation of Nuclear Power Plants</li> <li>• Emergency Planning-Medical Services</li> <li>• Production and Utilization Facilities; Request for Comments on Development of Policy for Nuclear Power Plant License Renewal</li> <li>• Request for Comments on Development of Policy for Nuclear Power Plant License Renewal</li> <li>• Deferred Plants</li> <li>• Conduct of Nuclear Power Plant Operations</li> <li>• Litigation of TMI-Related Issues in Power Reactor Operating License Proceedings; Revocation of Superseded Policy Statement Concerning TMI-Related Procedures</li> <li>• Additional Applications of Leak-Before-Break Technology</li> <li>• Program for Resolution of Generic Issues Related to Nuclear Power Plants, Withdrawal</li> <li>• Education for Senior Reactor Operators and Shift Supervisors at Nuclear Power Plants</li> <li>• Cooperation with States at Commercial Nuclear Power Plants and Other Nuclear Production or Utilization Facilities</li> <li>• Availability and Adequacy of Design Bases Information at Nuclear Power Plants</li> <li>• Integrated Schedules</li> <li>• Technical Specifications Improvements for Nuclear Power Reactors</li> <li>• Use of Decommissioning Trust Funds Before Decommissioning Plan Approval; Draft Policy statement</li> <li>• Regulation of Advanced Nuclear Power Plants</li> <li>• Restructuring and Economic Deregulation of the Electric Utility Industry</li> <li>• Policy Statement on the Regulation of Advanced Reactors</li> </ul>

## APPENDIX D

### **NASA Policy for Safety and Mission Success from NASA Policy Directive (NPD) 8700.1E)**

It is NASA policy to:

- a. Protect the public, NASA workforce, high-value equipment and property, and the environment from potential harm as a result of NASA activities and operations by factoring safety as an integral feature of programs, projects, technologies, operations, and facilities.
- b. Establish and maintain independent lines of communications for unrestricted flow of information and adjudication of dissenting opinions concerning any matters affecting the ability to meet the safety and mission success requirements and criteria.
- c. Hold NASA leaders, managers, supervisors, and employees accountable for safety and mission success within their assigned areas of responsibility.
- d. Define and document both safety and mission success requirements and criteria in NASA programs and projects as a foundation for the design and development of safe and reliable program hardware and software.
- e. Require all acquisition instruments as specified by the NASA Federal Acquisition Regulation Supplement to appropriately address SMA processes so that the responses to these instruments describe the approach to be used to implement SMA and to manage the associated safety and mission success risk factors.
- f. Verify and validate life-cycle implementation of the SMA processes and any related safety and mission success requirements through ongoing surveillance of program, project, and contractor processes.
- g. Certify the safety and operational readiness of hazardous or mission-critical hardware and software (including flight systems, support equipment, facilities/operations, ground-based systems) through a process of formal review of the compilation of validation and verification information.
- h. Address safety and mission success concerns, requirements, noncompliance, risks and risk acceptance, and appropriate lessons learned at all major management reviews, other major milestone review activities, and operational readiness reviews.
- i. Use qualitative and quantitative risk assessment techniques to develop information for making informed decisions regarding safety and mission success within a structured and formal decision process.
- j. Process all technical decisions that result in residual safety and/or mission success risk by obtaining:

- (1) The approval/concurrence of the cognizant Technical Authority (Engineering, SMA, or Health/Medical) with the acceptance of risk.

NOTE: The approval or concurrence is based on the technical merit of the case and independent assessment of the risk. If the technical decision relates to requirements owned by the Technical Authority, then the Technical Authority approves the decision. If the technical decision does not relate to requirements owned by the Technical Authority, then the Technical Authority concurs with the decision. Refer to NPR 7120.5D, NASA Space Flight Program and Project Management Requirements, for definitions of approval and concurrence.

- (2) Formal approval by the cognizant SMA authority that the risk is acceptable.

NOTE: The cognizant SMA authority should not be confused with Technical Authority. SMA authority is the authority assigned by NPD 1000.3, the NASA Organization, to the Chief, Safety and Mission Assurance to determine if the risk of a hazard exceeds the limits where it can be accepted. This authority is not limited solely to hazards related to SMA requirements but to any hazard. Application of this authority is intended to be applied at a level consistent with the application of Technical Authority (that is to the cognizant SMA authority).

- (3) Formal consent to take any human safety risk by the actual risk-taker and an appropriate member of his/her supervisory chain.

NOTE: There are two elements to the consent to take risk. The first element is that the risk takers themselves volunteer to take the risk. The second element is that the appropriate member of the supervisory chain also consents to the risk-taking. The first element focuses on the willingness of the risk-taker to volunteer while the second element provides for a check and balance on the risk-taker to alleviate situations in which a risk taker might be reluctant to decline taking inappropriate risk.

- (4) Formal acceptance of the risk by the applicable program, project, or operations and facilities manager.

NOTE: Residual risk is the remaining risk that exists after all mitigation actions have been implemented or exhausted in accordance with the risk management process.

- k. Report and track to resolution all corrective actions resulting from investigations of mishaps, incidents, nonconformances, anomalies, and safety and mission assurance audits; distribute and use lessons learned to improve activities and operations.

## APPENDIX E

### International Atomic Energy Agency Fundamental Safety Principles

**Principle 1 -Responsibility for safety:** The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks.

**Principle 2-Role of government:** An effective legal and governmental framework for safety, including an independent regulatory body, must be established and sustained.

**Principle 3-Leadership and management for safety:** Effective leadership and management for safety must be established and sustained in organizations concerned with, and facilities and activities that give rise to, radiation risks. *Safety has to be achieved and maintained by means of an effective management system. This system has to integrate all elements of management so that requirements for safety are established and applied coherently with other requirements, including those for human performance, quality and security, and so that safety is not compromised by other requirements or demands. The management system also has to ensure the promotion of a safety culture, the regular assessment of safety performance and the application of lessons learned from experience.*

**Principle 4-Justification of facilities and activities:** Facilities and activities that give rise to radiation risks must yield an overall benefit.

**Principle 5-Optimization of protection:** Protection must be optimized to provide the highest level of safety that can reasonably be achieved.

**Principle 6-Limitation of risks to individuals:** Measures for controlling radiation risks must ensure that no individual bears an unacceptable risk of harm.

**Principle 7-Protection of present and future generations:** People and the environment, present and future, must be protected against radiation risks.

**Principle 8-Prevention of accidents:** All practical efforts must be made to prevent and mitigate nuclear or radiation accidents. *The primary means of preventing and mitigating the consequences of accidents is 'defense in depth'.*

**Principle 9-Emergency preparedness and response:** Arrangements must be made for emergency preparedness and response for nuclear or radiation incidents.

**Principle 10-Protective actions to reduce existing or unregulated radiation risks:** Protective actions to reduce existing or unregulated radiation risks must be justified and optimized.