

# **Radiological Protection System in the Era of Nuclear Renaissance**

## ***Expectation for Development of Radiological Protection System***

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**Abstract.** The current radiological protection system, which was established mainly by the ICRP and UNSCEAR, has contributed to the prevention of potential radiological health hazards, and has been a fundamental concept during the development of nuclear energy. Through a detailed discussion regarding the new ICRP recommendations, the world nuclear industry has reached a consensus that the current radiological protection system keeps its integrity in principle although it involves some remaining issues, such as the disposal of radioactive waste. In order to maximize the advantages of nuclear energy while keeping the integrity of radiological protection system, it is essential to address the characteristics of radiation, which is specific to nuclear energy, so that nuclear energy can coexist with other energy sources. The three basic principles of radiological protection (i.e., justification, optimization and dose limits), which were completed in the 1990 recommendations of ICRP, should be retained as the basic concepts for the future radiological protection system in order to maintain the continuity and consistency of the radiological protection system. The radiological protection system can be furthermore developed only by combining the above three principles with best practices extracted from utilities' field experience. The significant reduction of radiation exposures received by members of the public and radiation workers in the field has resulted from the efforts by the world utilities to achieve the optimization. In order to correctly apply the theory to the work practices, it is essential to see how the theory is practically used in the field. Such a process should be also emphasized in the revision work of the IAEA Basic Safety Standards (BSS), which is currently under progress. Integrating the theory in the work practices is the key to the true development of nuclear renaissance, which could lead to the establishment of the nuclear safety regime.

**KEYWORDS:** *Nuclear renaissance, environment problem, energy security, radiological protection system, ICRP new recommendations, optimization, Linear non-threshold (LNT), IAEA Basic Safety Standards, Nuclear safety regime*

### **1. Accelerated movement toward nuclear renaissance**

With a string of major disasters recently occurring worldwide, including Hurricane Katrina that hit the southern coast of the United States with devastating effect in 2005, global environmental problems, such as the prevention of global warming (i.e., reduction of CO<sub>2</sub> emissions) have emerged as an urgent issue. The existence of nuclear power generation is drawing more and more attention as the concern about the possibility that no corrective action taken at this point of time would lead to an irreversible consequence is growing. In addition, given the future economic development and oil demand peak of Asian countries, such as China and India, the issue of energy security has become a serious concern for the international community. As such, the environment and energy problems can no longer be considered separately, and the fact that the only one measure to resolve the both problems at the same time is nuclear power generation has been widely recognized.

Under such circumstances, in many occasions, the plans established by emerging countries to introduce nuclear energy and the aggressive programs prepared by the proactive nuclear nations, such as China, India and Russia, to build new reactors are highlighted. The world largest nuclear nation, the U.S. has recently announced many projects to build new nuclear power plants while the U.K., which had been unwilling to promote the nuclear power generation, shifted its energy policy and announced its nuclear policy (i.e., White Paper) incorporating a plan to develop the environment suitable to the promotion of nuclear energy. All these trends clearly show the movement toward the nuclear renaissance.

### **2. Importance of assuring the radiological safety in the era of nuclear renaissance**

The establishment of nuclear safety regime is a precondition for the promotion of nuclear energy. In establishing the nuclear safety regime, the assurance of radiological safety is a major concern, which is specific to nuclear energy. The radiological protection system has been developed to assure the radiological safety. Various international organizations, such as United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and IAEA, are working on the activities to develop the radiological protection system under the leadership by International Commission on Radiological Protection (ICRP). In addition, such activities are supported by the other international organizations, such as OECD Nuclear Energy Agency (NEA) and World Health Organization (WHO) while the radiation standards to assure safety of members of the public and radiation workers being established. The radiation standards and the regulatory system of each nation based on the standards help support the promotion of nuclear energy and assure the radiological safety. In this regard, it is important to pursue the development of radiological protection system in conjunction with the development of nuclear safety regime by collecting and incorporating latest scientific knowledge and field experience while the interested international organizations are playing the well-defined roles individually.

### **3. Necessity of developing furthermore the radiological protection system**

#### **1) Risks inherent to radiological safety**

The current radiological protection system, which was established mainly by the UNSCEAR, ICRP and IAEA, has helped much prevent potential radiological health hazards, and has been a fundamental concept during the development of nuclear energy. In addition, the established radiological protection system has significantly contributed to the reduction of radiation exposures to a large extent. On the other hand, the “Linear Non-Threshold” (LNT) model is used in this radiological protection system. The concept of LNT was originally established as “the convenient assumption that was made for the sake of the radiological protection”, which deals with risks from low dose radiation exposure conservatively in order to maintain the safety margin of radiological protection system. However, the interpretation of LNT has been changed to “the belief that even minor radiation exposure may cause health effects”. This change in the interpretation of the LNT has contributed to the public’s radiophobia, and has turned even negligible radiation exposures into a pervasive problem for nuclear energy. As exemplified by the use of collective doses for estimating human health risks following the Chernobyl accident, the inappropriate use of the LNT concept to determine numbers of cancer deaths due to low-dose radiation has unnecessarily aggravated people’s fear and led to misunderstanding. In order to position nuclear energy as one of the useful energy sources which can be utilized for the development of human beings, the new ICRP recommendations and IAEA’s BSSs should play a significant role in keeping the current radiological protection system which can prevent adverse health effects due to radiation exposure. At the same time, the fact should be made completely clear to the public that the health risks of radiation exposures less than 100mSv are small enough to be inseparable from many other risks that are inherent to modern life.

#### **2) Rationality in the radiological protection system**

Through a detailed discussion regarding the new ICRP recommendations, we have reached a consensus that the current radiological protection system keeps its integrity in principle although it involves some remaining issues, such as the disposal of radioactive waste. In order to maximize the advantages of nuclear energy while keeping the integrity of radiological protection system, it is essential to address the characteristics of radiation, which is specific to nuclear energy, so that nuclear energy can coexist with other energy sources. In other words, it is necessary to achieve the rationality in the radiological protection system. In this context, nuclear energy must be rational from the socio-economic viewpoint. In some cases, risks from nuclear energy have not been clearly contrasted with other industrial risks. In the future, it is necessary to promote a better understanding of nuclear energy while comparing the risks from nuclear power generation with those from exposure to chemical substances and from other methods of energy production.

### **4. Future radiological protection system**

The three basic principles of radiological protection (i.e., justification, optimization and dose limits), which were completed in the 1990 recommendations of ICRP, are widely recognized as the basic concepts for the radiological protection system. Radiation management activities, including ALARA efforts and management of radiation sources, have been successfully implemented worldwide and significant results have been achieved in these fields. Therefore, the basic concept of the current radiological protection system needs to be maintained as the basis for the future radiological protection system since top priority should be put on maintaining the continuity and consistency of the radiological protection system.

#### Establishment of Nuclear Safety Regime and Industry's Responsibilities

The industry's efforts involving the international organizations, such as World Association of Nuclear Operators (WANO) and OECD/NEA's Information System on Occupational Exposure (ISOE) to promote the reduction of radiation exposure by disclosing information about field experience and sharing the best practices worldwide (i.e., benchmarking) have contributed to today's achievements .

It is widely recognized that nuclear power generation and the use of radiation are currently playing an important role worldwide and their necessity and importance are expected to grow furthermore. In order to establish the nuclear safety regime and assure the radiological safety, it is important to develop the concept of radiological protection contemplated by ICRP and IAEA by incorporating the knowledge and experience that the industry has accumulated so that the concept of radiological protection can be put into practical use. The industry is required to provide support and services for the introduction of nuclear power generation and the use of radiation in a safe manner not only to the countries that have been actively utilizing nuclear energy but also to the others that have not been familiar with the use of nuclear energy. It is industry's mission to steadily pursue its own responsibility while working closely with ICRP, IAEA and other international organizations.