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Radioactive Waste, the Last Battlefield of Science, Ethics and Law

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Abstract

Nuclear energy is bound to have a negative impact on the survival of human beings. Although scientists hoped to end all wars, the nuclear arms race resulted in huge amounts of warhead reserves throughout the globe.

When we consider the effects of radiation exposure, a hostile attitude is common worldwide, mostly because there is no threshold in radiation exposure, and even a small degree of exposure would cause diseases. This attitude also resulted from the explosion of the atomic bomb, killing many people. The general public became worried about radiation exposure, which led to many lawsuits worldwide.

In the United States of America, the Atomic Energy Commission (AEC) at that time, reorganized as the Department of Energy (DOE) later, encountered a problem when a military plane carrying hydrogen bombs met an accident and crashed in Spain, resulting in contamination of the immediate area. The AEC had a policy in principle that countermeasures against radiation exposure should be as limited as possible.

The management of man-made radiation varies from one country to another. Countries like the USA try to find rational and universal applications for human activities, while countries like Japan try to keep utilitarianism even after the Fukushima accident.

In this paper, the history of the atomic bomb deployment will be reviewed again in light of its influence on the general public, especially in the context of radiation exposure.

The world is gradually shifting in accepting nuclear energy as a part of Sustainable Development Goals' (SDGs) climate change solutions. However, radioactive waste is still a significant hurdle in transitioning from fossil fuel to nuclear energy.

This study will analyze past events and determine how to proceed with the radiactive waste argument to obtain the general public's reasonable understanding and acceptance.

Keywords: Radiation Protection; Primordial Radioactive Element; Atomic Bomb; High Level Radioactive Waste

Abbreviations: AEC: Atomic Energy Commission; DOE: Department of Energy; SDGs: Sustainable Development Goals; ICRP: International Committee on Radiological Protection.

Introduction

The world has witnessed nuclear power plant accidents as man-made disasters both in Chernobyl and in Fukushima. The media sometimes wrote that they have proved that the last day of nuclear energy utilization has arrived and that some countries already shifted their policy towards nuclear power phase-out.

One of the arguments discussed is high-level radioactive waste management, stating that human beings have not yet achieved the proper way of handling them with safe enough measures [1-3]. However, we may go back to the properties of

the energy sources. As it is known, a nuclear reaction releases about a million times higher than a chemical reaction, which suggests that the waste generated by a nuclear reaction could be a millionth of that generated by a chemical reaction. This is the conclusion of natural science. However, this may not be true in societal meaning.

The German Ethics Commission for a Safe Energy Supply concluded that man could not control radioactive waste in 2011 [4]. However, we released a huge volume of gas in fossil fire plants and ashes in coal fire plants. Since gas, which we could not distinguish as waste, and ashes, which are radioactive, were not categorized as radioactive substances in our society thus, the general public tends to accept fossil fire plants than nuclear power plants. The general public has been insisting on no release of radioactivity, hence, no exposures. In this study, the author tries to determine the cause why people believe that even a cent of radiation is harmful and suggests the way of guiding us towards the acceptance of high-level waste disposal.

Sound Fostering of Radiation Protection

Our scientists discovered radiation, radioactivity, cosmic rays, X-rays, and tried their application to our health and to the industries. Through processes, they found negative effects of radiation exposure on X-ray technicians or radium painters. Radiation protection procedures have been prepared both for external and internal exposures. At that time, the detriment caused by radiation was believed to be only limited to X-ray technicians, radium painters, medical experts, and patients who handled radiation generators or were treated by radium sources for medical treatment.

Robley D Evans first proposed the recommended dose of radium, based on the statistics gathered from radium painters and others in 1933 [5,6]. In 1934, the first International Committee on Radiological Protection (ICRP) recommendations are issued for X-ray and radium sources [7].

Consequently, the general public did not realize the existence of radiation in our environment, nor that of the detriment caused by the excessive radiation exposure to our body.

Interferences with Atomic Bomb Emerging

After the discovery of nuclear fission in 1938 by Otto Hahn, Lise Meitner, and Fritz Strassmann, Franklin Roosevelt, the president of the United State of America, decided to invest huge amounts of resources in developing the atomic bomb to release the catastrophically tremendous energy by artificially maintaining the chain reaction of nuclear fission3). By assessing the atomic bomb's effect on the enemy, radiation was defined as a weapon to kill people for the first time in our history. Robert Oppenheimer, the leader of the Manhattan project , reportedly explained how radiation could kill a man effectively to Navy officers [8].

Radiation effects on health are usually discussed in two categories. First is the somatic or deterministic effect like decreased hematopoiesis, skin erythema, hair loss, and others, which correlates to the dose of exposure [9]. The second is the late somatic or stochastic effect which progresses randomly. Carcinogenic effects are not clearly explained by increased doses of exposure in the range of lower dose rate and lower accumulated doses; thus, they are called late somatic effect or stochastic effect [10]. Stochastic effect is proceeding with in the form of random process, which annoys the general public as if radiation sentences the death of cancer in random to the exposed victims by atomic bomb.

Media people came to Hiroshima long after the atomic bomb explosion. They followed the survivors to make report, focusing on the late somatic effect of radiation with the impression that the victims could be affected throughout the rest of their lives. Through these reports, the general public came to have a deep-rooted idea that radiation must have some harmful effect on our body and our health without any exception, even if the exposure is negligible. Hence these people spend every day of their lives fearing late somatic effects caused by radiation [11].

In the society of radiation protection experts, the hypothesis of a Linear Non-Threshold system was adopted following the Mermann J. Muller's Nobel Lecture, mentioning that the mutation rate of any cell is linear to the radiation exposure independent of how small the exposure is [12].

As was predicted at the beginning of radiation protection argument, a nuclear field is equivalent to the frontier for attorneys, where rips are coming in closer for the future benefit [13]. Contrary to it, the AEC tried to minimize the environment restoration efforts as much as they can if any nuclear accident happened. For example, when the US bomber crashed with a load of hydrogen bomb in Spain, scattering plutonium in the surrounding area, the AEC of the USA negotiated with Spanish AEC to agree that highly contaminated soil be sent to USA2). Mid-level contaminated soil was buried in Spain, and low-level contaminated soil was left or mixed with less contaminated soils beneath the surface for dilution [2]. The media constantly criticized that the radioactive substances were left but this event showed that the general public might accept slight contamination of soils.

Natural Environment with Radiation

Primordial radioactive elements, which are mainly the decay chain nuclides of uranium and thorium, are existing around the globe. The radioactivity never been decreased in its intensity since the half-life is remarkably longer than our life span. For example, that of uranium-238 is around 4 billion years. Cosmic rays are falling on us without any breaks. We are handling soils and bricks and receiving exposures, taking foods that surely have radioactive substances. Even artificial radioactive elements are distributed in our environment and exist in our bodies due to the atmospheric atomic bomb testing in the past. We may recall the dawn of radiation application to our life. Excess exposures cause health detriment among X-ray technicians, medical doctors/staffs and workers like radium dial painters. However, the general public never worried about receiving exposures. The detriment is exceptional in our society.

It may be concluded that the fear of radiation started with the mushroom clouds witnessed by citizens of Hiroshima and Nagasaki, Atomic soldiers, and the media replaying it through televisions to the general public. Since nuclear energy development was so fast, human beings needed time to understand its real significance to technological advancement in society. Our society may need hundreds of years to comply with the radiological protection systems discussed in ICRP [14]. It is advisable to remove the obstacles set by radiological regulations and have a societal and natural science approach coupled with ethics and belief, led by radiation protection experts who are sometimes ignored.

Feasible Coexistence with High-Level Radioactive Waste

The media always claims that in the high-level radioactive waste, the radioactivity stands well over one million years, although primordial radioactivity stands well over billions of years. For example, in Fukushima, discussions about releasing slightly titrated water into the environment are going on. Tritium is one of the typical radioactive elements found in the vicinity of the atomic bomb test site. Nowadays, no news media focuses on the tritium adjacent to the test site as long as the quantity is small. People in Fukushima eventually will get used to having very low-level radioactivity and indifferent to the release of tritiated water in the end.

We have many arguments on the detriment of lowest exposure of radiation, in Hiroshima, in Nagasaki, about the so called atomic soldiers, in the TMI accident, in the Chernobyl accident, and in the Fukushima accident. Laws and regulation are trying to demand the same reference, in this case, dose of exposure, while they know that it cannot be applied to natural environment. The author believes that the worry on radiation exposure cannot be relieved by natural science alone. Natural science releases nuclear energy in a form of atomic bomb in such a short period of time. However, human beings cannot understand the meaning of radiation exposure in such a short period of time. We witnessed many arguments on acceptable dose rates. Laws in nature try to use mutually agreeable dose rate among stakeholders and results in dose levels with a note as low as reasonably achievable. Only ethical ties bond those stakeholders.

As is in ordinary experiences, our activities always accompany facing malfunctions and trouble shootings. However, specific terms are ready for nuclear energy like “reactor trip” for stop safely, “decommission” for dismantling, etc. Our negative image of nuclear energy comes from the atomic bomb using the energy for a weapon. Seventy five years have passed since Hiroshima and Nagasaki, but nothing has changed in its negative impressions. We witness replay of mushroom cloud on our televisions. Discussions on probability risk analysis, epidemic surveys, risk communications, etc., have been made. However, the tendency of our society to hate nuclear energy never been lowered. Then we come to the simple conclusion that our development in nuclear energy release is too fast to be cached out by our society. Current approaches to calm down the general public seem to be not good enough. Why? Because they are not touching the fundamental aspects of natural science to our travel in the space of spirit. Currently dignity and natural science are being discussed globally and are sometimes called by interdisciplinary area of academies. The atoms for peace in 1954 might be our first approach to that. The author proposes that all the radiation protection experts start with ethical aspects of radiation protection in understanding the meaning of life both in matters and in spirit. To be a lecturer, persuading with truth in human life, he/she should be able to communicate with the general public to achieve mutual understandings in the true meaning of their beliefs in the value of our lives.

Currently few hundreds of years are needed to understand the real figure of radiation effect on our body and in health damage. The author wishes to shorten the time frame for our society to achieve the proper understanding in radiation exposure risk from currently expected to a few hundred years down to 100 years owing to our sincere interpretation of radiation protection as wisdom given to human beings.

Conclusions

Nowadays, technical discussions on high-level waste disposal mainly focus on whether the repository stands well, keeping geological stability over one million years, or whether the possible or anticipated migration of radioactive

nuclides could transport the man-made radionuclides up to our biosphere and give any radiation exposure increase in our environment. By simulation with parameter surveys, natural science may give the numbers of risk levels or expected additional exposures to the general public. However, decisions on whether human beings may dispose of the high-level radioactive waste in their repository cannot be made by natural science alone. Ethical values or philosophy are needed to go further [15]. We may easily recall the contradiction if we have to evacuate in case a man-made exposure increase of a few mSv/year. What will happen to the residents living in an area of natural exposure of 20 mSv/year [16]. Natural science repeats "as low as reasonably achievable" as a principle. Only ethical values and philosophical considerations could reach the solutions.

We may easily see the example in medical diagnosis and treatment. Today, the average dose exposed to the general public is becoming similar to that of the natural environment. Regulations do not limit exposures for medical purposes. Only the medical physician's ethical values fulfill the practice of as low as reasonably achievable.

The author showed the roots of fears on radiation exposure in the general public's mind in this paper. As long as those fears are as they were, the media will continue bashing nuclear power by expressions such as however small, radiation is dangerous, or however tiny amounts, artificial radioactive substances are found.

The author believes that the age of nuclear energy will rise without any doubt in the end. When proper understanding of the history of atomic energy development, including atomic bomb deployment, is acquired together with ethical consideration, the last obstacle of high-level radioactive waste disposal, i.e., the last fort of warriors who do not like nuclear energy, would be resolved by itself, accepted by the general public when the geological stability of repository is anticipated commonly by geological experts.

Proper understanding and ethical considerations of the history of atomic bomb deployment are the keys to recognize the value of human beings in our globe.

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