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Safety of Nuclear power

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Abstract: - Nuclear safety governance should move towards a more robust regime including elements of international monitoring and verification. This is needed because nuclear energy production is likely to grow and new reactors will have different global dispersal, veering towards less experienced countries. In addition, there is growing interest in international and multilateral collaboration on disposal of mounting nuclear waste. Unlike existing improvements that came in response to nuclear disasters (*by accident)*, it makes sense to implement all these elements at once (*by design)*. While a comprehensive global governance regime must include elements of verification and enforcement, more transparent international oversight would also improve global nuclear safety through public pressure. The monitoring and enforcement of such a globally organized regime could be introduced at regional or otherwise supranational level. In this paper, we argue that a robust global nuclear safety regime is not only necessary but also feasible provided it manages to address the following potential hurdles: i) the tensions in international security politics, ii) the stickiness of national sovereignty and iii) industry resistance to additional restrictions and to issues of proprietary commercial information. These objections will be elaborately reviewed in the paper.

Key Words: - Nuclear energy, Nuclear power, Nuclear safety, Nuclear accidents, Global governance of safety.

I. INTRODUCTION

It has been more than four years since an earthquake and tsunami caused an accident at the Fukushima Daiichi nuclear power plant in Japan resulting in repeated fires and three reported core meltdowns. At the latest count, the accident had caused $166 billion in damages1 [1] and at least 573 immediate deaths from the evacuation, along with hundreds of future deaths related to cancer anticipated to occur [2]. Somewhat sweeping industry reforms were called for, and public acceptance of the technology plummeted [3]. Supporters of nuclear power were quick to point out that a complete phase out would complicate efforts at mitigating greenhouse gas emissions from the electricity sector [4] and could lead to cumulative global losses in global gross domestic product [5]. The March 2011 Fukushima nuclear accident is a poignant reminder that disasters of enormous consequences can occur in the nuclear industry. But how often and with what severity? These two questions constitute the core of sound risk management, which requires identifying and quantifying such potential losses and their frequencies. For most natural and human-made catastrophes such as earthquakes, meteorites, avalanches, mountain collapses, forest fires, hurricanes, epidemics, health care costs, war sizes, terrorist intensities, cyber risks, dam failures, industrial disasters, and so on, plentiful historical data has allowed scientists and engineers to determine the distributions of losses.

II. METHODS

There are many ways to quantify the risk of accidents in nuclear energy systems. The Farmer curve is one of the standard tools of nuclear risk assessment, with the risk defined as "probability × consequences" [20]. Typical Farmer plots display the annual frequency of fatalities or of property damage from human made sources of risk. Remarkably, the nuclear risks reported in Farmer plots are fundamentally different from all previously mentioned risks, in that the distributions for nuclear event losses are always thin-tailed and Gaussian-like, presenting a downward concave shape in the standard log–log representation.

The appearance of the Soviet Union's Chernobyl accident in 1986 and of Japan's Fukushima Daiichi nuclear power plant accident, after the tsunami on 11 March, 2011, seem at odds with the statistics implied by the Farmer curves. Actually, following the Chernobyl accident, Hsu [17] and Sengor [18], [19] suggested a different approach, based on the reasoning that the number of fatalities is an incomplete, if not misleading, metric for measuring nuclear losses given the difficulties in assessing long term real mortality in addition to early morbidity and mortality. Indeed, this metric misses many other dimensions and also prevents quantitative comparisons. Hsu in particular made the point that the statistical analysis of earthquake risks, for instance, would have missed the fundamental Gutenberg–Richter magnitude–

frequency law [21] if seismologists had focused on only the few large earthquakes. By considering a range of event sizes above which the data is known to be sufficiently complete, or at least representative, one can identify possible statistical regularities that are relevant to the largest events.

III. Development of nuclear safety goals

The General Nuclear Safety Objective is to establish and maintain an effective radiation protection measures in nuclear power plant, in order to protect staff, the public and the environment from radioactive hazards [1]. This general nuclear safety objective is supported by two complementary safety objectives: radiation protection and technical aspects. Radiation Protection Objective is to ensure that the radiation exposure within the nuclear power plant when it is in the operation or the radiation exposure from any planned release of the nuclear power plant radioactive material maintain below prescribed limits and as low as reasonably achievable, and to ensure that mitigate any radiological consequences of the accident. This objective is based on the protection of staff, public health and environmental safety. Technical Safety Objective is to take all reasonably practicable measures to prevent accidents in nuclear installations and in the event of an accident to mitigate its consequences. When design the nuclear power plant, all possible accidents should have considered. It includes a low probability of accidents. It should make sure with the high credibility that any radiological consequences are as minor as possible and below the prescribed limits. There is extremely low probability occurrence of serious radiological consequences of the accident. The purpose of establishing a safety goal could not eliminate risk, but it could help control the risk. In order to promote nuclear power plant operation achieves high safety standards in effective way and make the risk from operational states to levels as low as reasonably achievable.

IV. Public acceptance

Public acceptance research is a cross research theme of technology and public administration. It is an interaction subject between public and technical. The aim is to alleviate the potential conflict between technological development and social development ultimately by studying the characteristics of public risk awareness [5]. At present, the approach of spreading public opinion has been very different from that previous in China. More and more public can access the variety of anti-nuclear opinion through the Internet, television broadcast and other media. Implementation of a series of the system such as hearings and open legislation makes the public participate in social affairs frequently, and the government will widely have consulted and adopt the public opinion during the decision-making process. As the public acceptance would have a more direct impact on the development of Chinese nuclear power, two aspects “the main factors affecting public acceptance” and “the impact of public acceptance on the development of nuclear power” will be studied in the following.

V. Conclusions

Through the discussion with public acceptance of nuclear energy and the nuclear power safety goals, it can be found that the public acceptance effects the development and the safety goals establishment of the nuclear power. Meanwhile the nuclear power safety goals directly influence the public attitude towards the nuclear power. Relative to the safety goals, the public prefers the defence-in-depth safety principles [9]. Therefore, the defence-in-depth safety principles should be considered in the safety goal establishment. The answer to the question “How safe is safe enough” should be contained in the safety goal establishment. In this way, the safety goals could be easily acceptable by the public. According to the study of the Chernobyl accident, the public concern about environmental impacts of nuclear power plants, the public wants nuclear power not to affect the living environment. It could be better to contain the land pollution in the nuclear safety goals. Due to the complexity of the nuclear power technology, it is difficult for the public to recognize the mechanism of the nuclear power risk. Thus the establishment of the safety goals should be easier to understand for the public. The public could involve in the assessment of the safety goals and help improve it. In the nuclear power technology development, the safety goals should be adjusted timely according to the actual circumstances. It could help to improve the safety of the nuclear power. The nuclear power could be accepted and supported.

References

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