A Study of Risk Communication in the Multi-Unit Site Issue in Korea

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1. Introduction

In Korea, since a site has more than 6 units, the two questions, whether or not the multi-unit site is safe and whether or not a new safety goal based on a site should be made although a unit based safety goal is already used, have been issued. Since the issue was first posed by the anti-nuclear group, and the anti-nuclear campaign is still going on under the anti-nuclear government, it is not easy to answer the 2nd question, i.e., site safety goal issue, and the issue should be very careful since whether or not additional nuclear power plants (NPPs) could be easily built depends on the site safety goal.

Also, by the anti-nuclear campaign and the Fukushima accident, the public feel that nuclear NPP is dangerous, and that multi-unit site risk would be high in Korea. In this current risk perception, it is not easy job to persuade the public that the multi-unit NPPs are not dangerous, and furthermore, that a couple of NPPs could be built in the site. Thus, a good risk communication is required to overcome this hard time.

In this paper, we discuss what will be the best risk communication for the nation including the site issue, not for the current government, or not for a specific group.

2. Methods

2.1 Risk Perception

For a good risk communication, we should understand the public's risk perception.

A risk perception experiment and its useful lessen for the risk communication is introduced in detail in [1-3]. Here are summarized results.

		Blue	Red	
Your choice	C	-$1,000	0	50 red 50 blue
	D	- $500 (loss)	- $500 (loss)	
		0.5	0.5	← Probability

Fig. 1. Risk seeking for negative prospects

Fig. 1 is an example of the risk seeking experiment given in Ref. [1]. In the experiment, the assumption is that you have been given $2,000 for joining the experiment at first, and you should choose row C or D, and then, you should take a marble out from a bowl containing 50 red and 50 blue marbles. If a blue marble is taken out, you will lose $1,000 or lose $500 depending on whether you chose row C or D, respectively. If you select row D, you lose $500 regardless of what color marble is drawn from the bowl.

Total 70 people participated, and 69% chose row C and 31% chose row D in the experiment of Fig. 1. Even though the expected utilities of C and D are the same, people's selection was clearly different. People seemed to favor taking a risk to avoid a sure loss of $500 in row D of Fig. 1. Similar experiment was performed [2].

Thus, by using the risk seeking characteristics for negative prospects of the public, the disadvantages of other energy sources should be emphasized [3].

In addition, the lessons from these experiments are;

- Lessen 1: The public do not understand jargon and expected value [4]. Also, while experts obsess about numbers but the public do not.
- Lesson 2: Representation is important for the public acceptance.
- Lesson 3: The public favor taking a risk to avoid a sure loss.

2.2 Prevalence Induced Concept Change

Furthermore, in the recent psychology study [5], a phenomenon called "prevalence induced concept change" is found and the concept can be interpreted with the nuclear risk perception point of view as below;

> *Some people believe that the nuclear NPPs are dangerous since they have problem A, B, etc. With the enhancement efforts, when the problem A is solved, another thing which was not previously issued becomes another problem. Thereby the number of problem in the nuclear NPPs does not decline in their mind.*

2.3 Risk Communication with the Public

According to the lessons of the section 2.1, and the psychological phenomenon of the section 2.2, the following risk communication is recommended to the public.

2.3.1 Risk Representation. By using the data of Ref. [6-7], let's consider the environmental effects of the various electric energy sources. When the value of the nuclear electrical energy source is taken as the reference value 1, then the values of the other energy sources can be expressed as relative ratio scale values to the nuclear ones. By applying a simple visualization for the relative ratio scale values, we can get a simply visualized picture as shown in Fig. 2. In Fig. 2, the relative size of each box indicates the relative environmental adverse effects size compared with the nuclear.

Since the visualized picture of Fig. 2 is based on the relative ratio scale value per MW, it does not represent the benefit of the multi-unit site. Thus, to express the benefit of the multi-unit site, the total generated amount of CO_2, find dust, or the saved land loss is calculated during the lifetime operation of the multi-unit in the site, and then the amount is expressed by the typical symbolic words which are well known to the public. For example, for the land saving, "*the saved land is 200 times as large as Yeouido*", and for the fine dust case, *"the multi-unit NPPs have changed 100 dusty days to 100 clear days in the vicinity of the site during 10 years"*, and for CO_2 emission, *"$1,000,000 was saved by emission trade caused by the multi-unit during 10 years"*

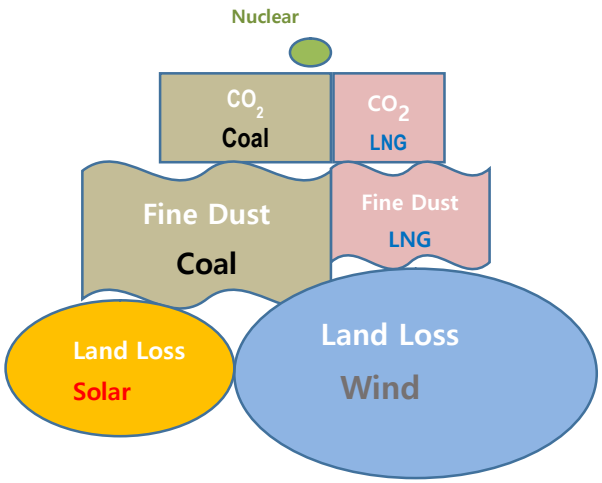

Fig. 2. Simple Visualization of Environmental Adverse Effects of Various Electrical Power Sources Compared with Nuclear NPP

2.3.2 New Expression for Nuclear Risk. Due to Fukushima accident and a series of anti-nuclear campaign, many people have preconception that the nuclear is unsafe. However, as discussed in section 2.2, it is difficult to make the public believe that nuclear is safe. Thus, instead of saying 'safety' only, the usefulness of nuclear energy should be also emphasized to the public.

Thus, the risk expression of nuclear energy should be changed to the following;

$$Risk_{nuclear} = N_{fatalities} / N_{Gwh.yrs} \quad (1)$$

The existing risk expression such as core damage frequency (CDF) is just considering the danger. However, Eq. (1) implies the usefulness of nuclear energy as well as the danger. Of course, CDF may be used in the inside of nuclear energy industry, or among experts. However, for the public risk perception, Eq. (1) should be used. This risk representation can be easily compared among the electric power generation sources, and in addition, would be useful in the public acceptance point of view for the multi-unit site risk since multi-unit multiply generates electricity.

The transportation industry including railway industry uses the risk expression similarly as below [8];

$$Risk_{railway} = N_{fatalities} / N_{passgr.km.\ travel}$$

2.4 Risk Communication with the Regulator

To the regulator, it is necessary to use number, probability, risk, etc. Even though the multi-unit site risk studies [9-11] have not yet been completed, the risk does not increase largely. It seems that it does not lose the linearity between risk and the number of NPPs in the site.

Also, the site safety goal in Korea is being studied [12-14], from which a decision about site safety goal would be made by the Korean regulatory body. However, it would be difficult to decide the site safety goal because it is a delicate problem in the situation that anti-nuclear and pro-nuclear group are struggling against each other.

Thus, one of easy things is to benchmark the case of other countries including USA. As discussed in Ref. [14], the site safety goal in US would be applied to only newly built NPPs.

Also, the site safety goal might be determined in the risk cooperation [15] with the issue of reconstruction of Shin Hanul 3, 4 units, together.

For a better public acceptance or as a risk cooperation, the newly built NPP might have a very small risk like a zero release risk or equivalent to the risk of the Chinese NPPs affecting on the site in Korea.

3. Results and Conclusions

Since the public's risk perception is risk seeking for negative prospects, the disadvantages of the other

energy sources should be emphasized to the public. The effective representation is suggested by a simple visualization. Also, for the multi-unit NPPs, another expression using typical symbolic words is suggested. Also, a psychology phenomenon called 'prevalence induced concept change' is introduced, and thus a different risk measure containing usefulness as well as dangerous factor is suggested for a new nuclear risk measure, and which can be well used for multi-unit site. The new nuclear risk is similar to that of the transportation industry.

A method to setup a site safety goal is suggested. Risk cooperation between anti-nuclear and pro-nuclear group is suggested for the determination of the site safety goal.

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