

An Empirical Comparative Study on Recognition of Nuclear Safety and Recognition of the Cause of Nuclear Accident in Korea and Japan

- Focusing on the post-Fukushima nuclear accident -

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1. Introduction

The Fukushima nuclear accident caused many changes in nuclear safety management, such as the world's nuclear power plant operating countries set up strict safety regulatory measures. After the Fukushima accident, Korea and Japan established safety checks and measures and quickly implemented them. At the same time, the two countries carried out activities to improve nuclear safety related laws and administrative systems, strengthen the independence and expertise of nuclear safety regulators, and promote nuclear safety culture, safety research, and international cooperation, focusing on strengthening nuclear safety regulations.

Therefore, contrary to public concerns, the governments of Korea and Japan and the nuclear industry argued that after the Fukushima accident, the risk of accidents was significantly lowered by sufficient safety measures such as safety inspection of nuclear power plants and strengthening safety regulations of nuclear power plants. According to a survey conducted by the Institute for Science and Technology Policy (STEPI, 2011), after the Fukushima nuclear power plant accident in Japan, 75.6% of the Korean nuclear expert group recognized that Korean nuclear power plants are "safe". On the other hand, 49.6% of the general public perceived it as "safe," but 27.5% of the general public perceived it as "anxious" (Hong Sa-gyun et al., 2011).

However, despite various policy changes and safety measures since the Fukushima accident, safety incidents¹ at nuclear power plants continue to occur as shown in <Table 1>.

<Table 1> Nuclear power plant incidents by year in Korea (as of the end of 2019)

Year / scale	0	1	2	More than 3	total
2010	13	0	1	0	14
2011	10	2	0	0	12
2012	14	1	1	0	16
2013	5	3	0	0	8
2014	8	4	0	0	12
2015	4	1	0	0	5
2016	14	2	0	0	16
2017	4	1	0	0	5
2018	9	1	0	0	10
2019	3	1	1	0	5
total	84	16	3	0	103

(Source: Nuclear Power Plant Safety Operation Information System Homepage, <https://opis.kins.re.kr/opis>)

Looking at these cases, even after the Fukushima nuclear accident, we are compelled to raise questions about the safety of nuclear power plants. To clarify these issues, I conducted an empirical comparative study (survey and in-depth interview) with nuclear experts in Korea and Japan in this study. Through this study, I would like to clarify the reality of nuclear safety and to suggest the direction of a relevant nuclear safety policy. The comparative study with Japan is because Japan has experienced the Fukushima nuclear accident in person and understands what needs to be corrected realistically. I thought these might have implications for us.

2. Empirical research

2.1 Survey

2.1.1. Subject and method of investigation

The total questionnaire was distributed 200 copies to

¹ In the International Nuclear Event Class (INES), classes are classified from 1 to 7 according to the safety importance of events in nuclear power, and 1 to 3 are defined as incidents, and 4 or more are defined as accidents.

Events that are not critical to safety are classified as minor Deviation as below grade (0 grade/below scale). (source : OPIS, <https://opis.kins.re.kr/opis?act=KROCA1100R>)

nuclear experts in Korea and 200 copies to nuclear experts in Japan. Among them, 134 copies were collected, 51 copies from Korea and 83 copies from Japan. Distribution and collection took place over two months from November to December 2017. All of the collected 134 questionnaires were used for analysis.

The method of survey was conducted online and in-person survey using List. The questionnaire was extracted two questions from previous studies and the preceding survey.

2.1.2. Analysis result

The survey on the perception of nuclear experts in Korea and Japan was measured on a 5-point scale, and the average analysis results for each influencing factor are shown in <Table 2-3>. As a result of the reliability analysis of the measurement tools in this study, it was found that Cronback's α coefficients for all scales were 0.8 or higher, indicating high reliability.

(1) Nuclear safety

The results of the survey on the perception of nuclear experts in Korea and Japan are shown in <Table 2>

<Table 2> Comparison of perceptions on nuclear safety

Question	Items	Korean (%)	Japanese (%)	Total (%)
How safe do you think your country's nuclear power plants are?	Not safe at all	1(2.0)	5(6.0)	6(4.5)
	Not safe	1(2.0)	1(1.2)	2(1.5)
	it's average	7(13.7)	11(13.3)	18(13.4)
	safe	24(47.1)	51(61.4)	75(56.0)
	It is very safe	18(35.2)	15(18.1)	33(24.6)
Total		51(100)	83(100)	134(100)
Average		3.84	4.12	
Standard Deviation		.943	.864	

The analysis results showed no difference in perception of nuclear safety. This is because 82.3% of Korean experts answered 'yes' and 'very yes', whereas 79.5% of Japanese experts answered 'yes' and 'very yes'. However, Japan had somewhat more negative opinions on nuclear safety than Korea. It seems that there is still a lot of distrust in nuclear power because Japan experienced the Fukushima accident.

(2) Factors causing accidents at nuclear power plants

The results of the survey on the perceptions of experts in

Korea and Japan are shown in <Table 3>

<Table 3> Comparison of perceptions on factors causing accidents in Korea and Japan

Items	Korean (%)	Japanese (%)	Total (%)
1. Serious accidents caused by natural disasters such as earthquakes and tsunamis	22(43.1)	24(28.9)	46(34.3)
2. Severe accidents caused by external attacks such as war and terrorism	4(7.8)	43(51.8)	47(35.1)
3. Accidents caused by human factors such as neglect of safety rules	20(39.2)	9(10.8)	29(21.6)
4. Secondary pollution accident by radioactive waste	2(3.9)	3(3.6)	5(3.7)
5. Other	3(5.9)	4(4.8)	7(5.3)
Total	51(100)	83(100)	134(100)

There was a difference in perception of the possibility of causing an accident. Korean experts were thinking about the possibility of accidents due to natural disasters such as earthquakes and tsunamis (43.1%). However, Korean experts thought that there was little (7.8%) the possibility of accidents caused by external factors such as war and terrorism.

However Japanese experts thought the most about the possibility of accidents caused by external attacks such as war and terror (51.8%). But artificial factors such as neglect of safety rules were considered low. This was accepted as a very strange result, as many nuclear accidents, including the Fukushima accident, have been found to have occurred due to complex factors including human error.

2.2 In-depth interview

2.2.1. Subject and method of interview

For in-depth interviews, nuclear experts selected 15 from four expert groups in Korea and Japan.

The government agency officials group conducted interviews with researchers affiliated with the Nuclear Safety Technology Institute under the Nuclear Safety Commission in Korea and the executives of the Nuclear Foundation (formerly high-ranking officials from the Ministry of Economy, Trade and Industry) in Japan. The group of government officials was limited to two

interviewees because the population was not large.

The nuclear power plant workers group conducted interviews with executives of Korea Hydro & Nuclear Power in Korea and executives of Central Electric Power in Japan. The power generation business group was limited to two interviewees because the population was not large.

The public sector workers group, interviews were conducted with researchers at the Korea Atomic Energy Research Institute and the Korea Atomic Energy Cooperation Foundation in Korea, and researchers at JANE and Japan Electric Power Research Center in Japan. The public sector group was limited to two. In addition, the interview contents were structured in consideration of the characteristics of the public sector.

In general expert group, a total of 4 interviews were conducted In Korea: 2 university professors, 1 nuclear power plant citizen monitoring center, and 1 reporter. In addition, a total of 3 people were interviewed in Japan: 1 university professor, 1 Atomic Energy Society, and 1 civic movement representative. In particular, it included two people oppose nuclear experts. In Korea, one is a professor at a Japanese university and a professional member of the Korea Nuclear Safety Commission, and in Japan, one is a citizen representative who has been promoting the dangers of nuclear energy for 30 years. This is because we tried to find out the perception of nuclear safety from various perspectives. Since they have expertise in a variety of fields, the interview content was composed in consideration of these characteristics.

The interviews was conducted in Korea and Japan for about two and a half months from mid-January to the end of March 2018. The survey method was conducted as an individual interview with a semi-structured questionnaire to reflect the characteristics of the interviewees. The analysis method used constant comparison analysis. The question content of the in-depth interview was composed of variables that differed in the survey.

The results of the in-depth interview showed differences in perceptions by expert group and country according to the type of accident. The causes of accidents were classified into three types: human factors, natural disasters, war and terrorism.

2.2.2. Summary of interview contents

(1) Safety awareness

There was no difference in perception of nuclear power plant safety by country and by expert group. It is generally safe, but it cannot be said that there is no possibility of an accident. These results were not different from the survey results of this study. According to a survey conducted by the Korea Institute of Science

and Technology Policy (2011), 75.6% of the expert group recognized that nuclear power plants are “safe” (Hong Sa-gyun et al., 2011). It was confirmed that these results were similar to those of this study. This confirmed that experts are generally convinced of the safety of nuclear power plants. However, an anti-nuclear power plant expert said that nuclear power plants are very dangerous and not safe.

(2) Recognition of factors causing accidents

There were differences in perceptions by country and by expert group, and there were various opinions. These results were not different from the survey results of this study. These results appear to have been due to concerns about natural disasters after the 2016 earthquake in Gyeongju in Korea. In addition, in Japan, since sufficient safety measures were established after the Fukushima nuclear accident, the possibility of war or terrorism appeared higher than human and natural factors.

In the in-depth interview, there were differences in perceptions by expert group and country according to the type of accident. There were three types of accidents, human factors, natural disasters, war, and terrorism.

First, the differences in perceptions by country are as follows.

-Korea mentioned natural disasters and human factors as the possibility of causing an accident, but war and terror were not considered. This was thought to be due to the increase in natural disaster factors after the 2016 earthquake in Gyeongju.

-Japan said war, terrorism and human factors could be caused by accidents, but it did not consider natural disasters. This was because safety measures were sufficiently established after the Fukushima nuclear accident, so human and natural factors were evaluated low.

In particular, Japanese experts were very much thinking of war and terrorism as causes of accidents. This is because the government agency officials group sufficiently supplemented safety measures and systems, the nuclear power plant workers group had a perception of concern that police officers would reside before Fukushima in the power plant, and the public sector workers group was thinking about the possibility of a North Korean missile attack.

Second, differences in perceptions by type and by expert group are as follows.

-As a human factor, the Korean government agency officials groups considered the possibility of an employee's mistake as a factor that caused the accident because they prepared for natural disasters sufficiently. The Korean public sector workers groups thought that there was no possibility of a natural disaster, as it had

taken sufficient safety measures unlike Fukushima by installing emergency generators on the ground. In the general expert groups, Korean experts considered the possibility of corruption or mistakes of employees rather than technical factors, and Japanese experts thought that it was a person's carelessness or mistakes.

-As a factor of natural disasters, the Korean nuclear power plant workers groups said that it was due to an extreme disaster that we did not expect, while the general expert groups said that it was due to the change in public perception after the Pohang and Gyeongju earthquakes.

-As for the factors of war and terror, it was said that the Japanese Government agency officials groups had sufficient safety preparations and system enhancements, and the Japanese nuclear power plant workers group had a perception of concern that police officers would reside in the power plant before the Fukushima accident. In addition, Japanese public sector workers groups were thinking about North Korean missile attacks.

3. Conclusion

Nuclear power plants should be managed safety with the possibility of an accident in mind. Policy decisions and enforcement exclusively by nuclear experts are likely to involve many elements of accident risk. In other words, "Generally, nuclear risk has a very high level of unknown risk and fear" (Cha Yong-jin, 2012). In addition, since the general public has low knowledge or expertise in nuclear risk, they often have risk perception due to personal prejudice, and in some cases, they are affected by cultural and situational factors that experts have not considered (Cha Yong-jin 2012).

In this empirical study, experts said that nuclear power plants are generally safe. However, they also said that it cannot be said that there is absolutely no possibility of an accident. However, an anti-nuclear power plant expert said that nuclear power plants are very dangerous and not safe.

There were various opinions on the possibility of causing an accident. There were three types of accidents, human factors, natural disasters, and war and terrorism. According to the survey in this study, 43.1% of Korean experts considered the possibility of accidents as natural disasters such as earthquakes and tsunamis, and 51.8% of Japanese experts considered the possibility of accidents as external attacks such as war and terrorism.

In the in-depth interview, Korea considered natural disasters and human factors, and Japan recognized war, terrorism and human factors as factors of accident. In particular, most experts in Japan, unlike Korea, considered war and terrorism as causes of accidents. This is because they have sufficiently prepared for accidents

caused by natural disasters and human factors through institutional supplementation.

The difference in perception between the two countries is due to the following reasons. First, Korean experts were not aware of the possibility and danger of war and terrorism. In the in-depth interview, they vaguely perceived war and terrorism as a national risk, not just nuclear power plants. Second, since Japan has sufficiently established safety measures after the Fukushima nuclear accident, they are more concerned with the possibility of war or terrorism than natural disasters and human factors. Third, In the general expert group, Korean experts were thinking about the possibility of employee corruption or mistakes. However, Japanese experts thought that humans were vigilant or making mistakes. This is because Japan has prepared for the possibility of extreme natural disasters such as installing emergency generators on the ground.

In this way, I was able to confirm that there is a big difference in the perception of experts in Korea and Japan regarding the factors that cause nuclear accidents. This means that the evaluation of the safety of nuclear power plants is high, so we should not be really relieved or overconfident. The Fukushima nuclear power plant accident was also caused by policy decisions and enforcement only by nuclear experts. This problem can be considered to be related to the "monopoly of intellectual resources by a small number of professional groups" and the closed policy process (Sung-Don Joo, 2011).

Therefore, I generally think that the safety awareness of experts is quite high, but I think that sufficient review and countermeasures should be prepared for factors that may cause accidents even a little.

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