

Reliability Analysis of Public Survey in Satisfaction with Nuclear Safety

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1. Introduction

Korea Institute of Nuclear Safety (KINS) carried out a questionnaire survey on public's understanding nuclear safety and regulation in order to grasp public acceptance for nuclear energy [1]. The survey was planned to help to analyze public opinion on nuclear energy and provide basic data for advertising strategy and policy development. In this study, based on results of the survey, the reliability of the survey was evaluated according to each nuclear site.

2. Methods and Results

2.1 Overview

The survey was conducted on eight hundred people lived around 4 sites of nuclear power plants such as Kori, Youngkwang, Ulchin and Wolsong. The detailed design and method for the survey were described in table 1.

Table 1. Survey design and method

Index	Contents
Universe	people above 20 years lived around the 4 nuclear sites
Sample size	800 (200 at each site-Kori, Youngkwang, Ulchin, Wolsong)
Sampling method	purposive sampling
Survey method	face-to-face personal interview
Survey tool	structured questionnaire
Period	2004. 12. 13 ~ 28

Gender, age, education, income, job and residence were considered as the repliers' characteristics. Questions in the survey were satisfaction with nuclear safety, awareness and confidence in nuclear regulation, cognition of radioactive waste and so on. In this study, the satisfaction with nuclear safety was selected as a main concern. The survey results on it were presented in table 2.

For easy comparison with 4 nuclear sites, the nominal scores which were classified into 4 scales such as 'much satisfactory', 'satisfactory', 'unsatisfactory' and 'much unsatisfactory' were given to 100, 75, 25 and 0, respectively. The converted values were shown

at table 3. Its trend was similar to 3 sites except for Youngkwang. Ulchin had a first position among 4 sites.

Table 2. Results on satisfaction (%) with nuclear safety

	KR	YK	UC	WS
Much satisfactory	1.5	1.5	3.0	3.0
Satisfactory	56.5	46.0	58.0	56.0
Unsatisfactory	39.0	39.5	33.5	33.5
Much Unsatisfactory	3.0	13.0	5.5	7.5

Table 3. Converted values on satisfaction with nuclear safety

	KR	YK	UC	WS
Satisfaction	53.63 (2)	45.88 (4)	54.88 (1)	53.38 (3)

2.2 Analysis and Results

For evaluating the deliberation and meditation of the survey repliers (i.e. reliability of the survey), the useful methods were test-retest method, alternative-form method, split-halves method and internal consistency method. First two methods could be applicable through two times surveys and third one could be useful if provided with pre-planned design for analysis. Internal consistency method was used in this study because it was sufficient to evaluate the confidence with only one survey result. The reliability of survey was calculated by the following equation known as Cronbach's α [2].

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k S_i^2}{S_T^2} \right)$$

where, k is number of questions, S_i^2 is variance of i^{th} question and S_T^2 is variance of the measure summing up all questions. Generally, it was considered as excellent at $\alpha > 0.8$, good at $\alpha > 0.7$ and minimum at $\alpha > 0.5$.

At first, twenty-one questions which were related to the satisfaction with nuclear safety were chosen among thirty questions. The final seven questions which have higher scores calculated by independence test known as Pearson's chi-square test were selected. The used computational tool is a Statistical Package for the Social Sciences (SPSS) version 12.0 [3]. The full

sentences of selected questions and chi-square values were presented in table 4.

Table 4. Seven questions selected by Pearson's independence test*

	Questions	χ^{2**}
Q1	There may be some accidents at nuclear power plants which I don't recognize	111.20
Q2	The staffs who work at nuclear power plant located in our region are top-level experts	87.39
Q3	I do not rely on the people related with nuclear energy	134.22
Q4	I trust civil organization more than nuclear organization	63.34
Q5	The nuclear power plant in our region may equip the integrated system to manage all types of accidents	81.66
Q6	The accidents of our nuclear power plant may occur lesser than those of others	80.16
Q7	The workers in our nuclear power plant may be aware of the safety completely	69.19

*h₀: each question is independent on the satisfaction with nuclear safety

**p-value <0.01

Each sentence was made up of 5 scales from 'never agreed' to 'fully agreed'. The variances of the selected seven questions and of aggregated measure were resulted in table 5. Finally, Cronbach' α values representing reliability of the survey were presented in table 6.

Table 5. Variances of the selected questions and aggregated measure

	KR	YK	UC	WS
S_1^2	0.670	1.070	0.840	0.862
S_2^2	1.073	1.230	0.683	1.009
S_3^2	1.173	1.417	0.791	0.806
S_4^2	0.957	1.355	0.703	0.805
S_5^2	1.003	1.012	0.808	0.984
S_6^2	1.515	1.473	0.988	1.044
S_7^2	1.260	1.722	0.833	1.137
S_T^2	18.385	21.197	12.550	15.504

Table 6. Reliability of the survey at each site

	KR	YK	UC	WS
Cronbach's alpha	0.681 (1)	0.656 (3)	0.642 (4)	0.667 (2)
Satisfaction	36.52 (1)	30.10 (4)	35.23 (3)	35.60 (2)

The results of survey conducted at Kori site were considered most reliable and credible while those of Ulchin were worst. Only based on the satisfaction with nuclear safety, the repliers of Kori were more satisfied with the safety of nuclear power plant than other sites.

3. Conclusion

The reliability of public survey in satisfaction with nuclear safety was scrutinized in this study. It was resulted that satisfaction with nuclear safety was changed by considering the reliability of the survey. These analyses could be useful in developing the advertisement strategy and the related policy on nuclear energy.

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