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Public Perception and Communication Patterns Pertaining to Nuclear Power in Korea: Focusing on the Transition Period from Pro-nuclear to De-nuclear Policy

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ABSTRACT

Background: An effective communication strategy for reducing conflicts in South Korea has been designed through the analysis of public perception and communication variables on nuclear power under the conditions of rapidly changing nuclear power policies.

Materials and Methods: This study conducted both qualitative research through group discussions based on social psychology and quantitative research through surveys.

Results and Discussion: Nuclear power plant (NPP) area residents in favor of nuclear power indicated higher levels of communication, safety perception, and contribution than those against it. NPP area residents trusted the civilian expert groups (18.3%) and local government (17.3%) the most, while metropolitan city residents trusted the Nuclear Safety and Security Commission and the Korea Institute of Nuclear Safety (20.7%) the most. In determining nuclear power policy, both the NPP area residents (18.1%) and metropolitan city residents (17.1%) prioritized safety, health, and the environment. While metropolitan city residents thought that energy security and economic growth (16.4%) were important, NPP area residents thought the current issue of spent fuel rods (14.1%) to be important.

Conclusion: It is necessary for the nuclear power industry to have and actively implement communication and conflict resolution strategies based on the patterns obtained in the study results.

Keywords: Public Perception, Public Communication, Nuclear Energy, Negative Radiation Rumors, Nuclear Policy

Original Research

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Introduction

Nuclear power radiation must be controlled and monitored carefully because it potentially poses special risks to human health and safety, as well as the environment, whereas radiation, nuclear materials, and nuclear power technologies provide considerable benefits in various fields ranging from medicine and agriculture to power generation and manufacturing. The simultaneous coexistence of risks and benefits is perceived as a characteristic of the nuclear power industry [1]. The Chernobyl accident and Fukushima Daiichi Nuclear Power Plant (Tokyo Electric Power) accident, which were Level 7 (the worst level) on the International Nuclear and Radiological Event Scale (INES), form the industrial base of nuclear power technology within this indus-

try. Rapid advances in science and technology within industrial societies have brought upon "neues risiko" in exchange for infinite economic prosperity and progress for the human race. For this reason, modern societies including Korean society must tolerate "erlaubtes risiko" as the ideology which influences slight risks, and society is requested to accept a certain level of potentially harmful results [2]. Perspectives on the relationship between risks and societal influence can vary depending on whether objective risks are increasing or social sensitivity is rising. Given these extreme positions, attempts have been made to overcome the difference between the increase in the actual threats and the increase in social sensitivity. In most cases, the results of studies in this area have concluded and displayed practical compromises in many respects. It is understood that people's attitudes toward cutting-edge technologies vary according to their cultural background and that perception and assessment of risks also change according to their socio-cultural conditions. This implies that a certain society may exercise caution for specific risks, while it does not do so for other specific risks. Furthermore, an increase in discussions on risks depends on the society's unique risk assessment culture system. Numerous potential hazards cannot be perceived by individual humans through their direct experience. They are the results of socially mediated risk choices that structure the personal perception and means of overcoming or experiencing a difficult decision [3]. If science and technology are abused, or a failure occurs in a scientific function, the ripple-effect does not remain confined to a centralized area. Conversely, the impact can have a global effect in terms of a vast spatial perspective. In terms of a time perspective, this same ripple effect may comprehensively and widely restrict not only, the present, but also future generations. It exceeds the scope of an individual problem and may potentially develop into a problem for the entire human race. In addition, nuclear energy or nuclear power is a topic that poses many issues worth debating in various aspects, such as environmental problems according to climate conventions, conflicts among stakeholders, and risk management assessments [4]. Therefore, the balance between the promotion of nuclear energy platforms and the safety of science and technology must be very reasonable and justified. Everyday people, however, tend to react with the emotions of anxiety and fear with regarding uncertainty [5]. Therefore, the general public could exhibit risk as outrage, and emphasize emotional reactions to risks, such as fear, anxiety, outrage, and distrust [6, 7]. In this sense, the importance of risk communication, which minimizes the unnecessary emotional reactions of the general public, delivers information on the topic of the essence of risks, and provides education, which has been attracting social consensus must be presented.

Although the message format and information source, which are the basic elements of communication, are known to be very important for risk perception and public reaction [8], no studies have been conducted on who delivers the message format on nuclear power, and its influence on the risk perception and reaction within Korea. Existing theorists have attempted to identify quick solutions that can resolve conflicts quickly, but the root causes of the conflicts remain unsolved and the conflict situations may recur or deteriorate over time owing to this phenomenon [9]. When addressing public conflicts, the importance of a deliberative democracy conflict management model based on communication and open discussions, with a long-term perspective, has been consistently emphasized [10–12]. Therefore, in this study, an effective communication strategy for reducing conflicts in South Korea has been designed through the analysis of the public perception and communication variables on nuclear power under conditions of rapidly changing nuclear power policies.

Materials and Methods

1. Basic Background of Research Design

Research on risk perception is conducted to understand the manner in which people perceive and judge risks based on the cognitive psychology-based psychological measurement paradigm [13]. In addition, it has been emphasized that risk perception may have a subjective, socio-psychological, and multi-dimensional cognitive structure rather than an objective, technical, and single-dimensional structure [4, 14–18]. This study was conducted utilizing both qualitative research through group discussions based on social psychology and quantitative research through surveys.

2. Characteristics of the Research Target

Through group discussions, information on nuclear power, communication, and conflicts was collected from various groups, such as within the policy-maker group (five former ministers of the Ministry of Science and Technology and five members of the National Assembly), communication-related groups (five communication representatives from nuclear power plant [NPP] areas, five energy-specialized journalists,

five conflict resolution experts, and five psychology experts), expert groups (five nuclear power academic experts, five nuclear power field experts, and five lawyers), NPP area residents (five residents each in favor of and against nuclear power from five areas), educational groups (five teachers, five university students, and five high-school students), and the general public (five office workers and five housewives). Measurement questions related to perceptions and communication avenues, which were appropriate to Korean culture and circumstances and were derived using the collected data (variables selected in Tables 1–5) were utilized in this study. In the course of the qualitative research, only variables with high explanatory power were selected for communication diagnosis to help communication mediation in the face-to-face survey for each group, focusing on the theoretical background.

A survey was conducted among 55 residents each in favor of and against nuclear power generation in each area and with the local NPPs (Weolseong, Yeonggwang, Gori, Uljin, and Ulju), comprising a total of 550 residents. Similarly, another survey was conducted in major metropolitan cities (Seoul, Incheon, Daejeon, Daegu, and Ulsan) with a total of 550 residents participating. In respect to the participants, the data from 50% of respondents who were extremely against nuclear power (265 from NPP areas and 256 from metropolitan cities) as well as data from 50% of respondents who were extremely in favor of nuclear power (255 from NPP areas and 282 from metropolitan cities) were analyzed (a total of 1,058 respondents). In the surveys conducted, the pros and cons on the topic of nuclear energy, according to the respondent's responses were confirmed via the first survey question, and the following survey questions were directed towards respondents who expressed clear opinions on this topic. With regards to gender distribution, 232 respondents from NPP areas were male (47.4%), and 257 were female (52.6%). In the case of metropolitan cities, 234 respondents were male (43.5%), and 304 (56.6%) were female.

Table 1. Communication and Perception Levels Pertaining to Nuclear Power

Category	NPPs	Area	Communication level[a]		Safety perception[b]		Contribution[c]		Interest[d]	
			Mean±SD	*F* (*p*-value)	Mean±SD	*F* (*p*-value)	Mean±SD	*F* (*p*-value)	Mean±SD	*F* (*p*-value)
NPP area residents	Pro	Uljin	2.83±1.129	5.014 (0.001)**	3.06±0.870	12.521 (0.000)**	9.14±1.283	5.251 (0.000)**	2.56±0.624	4.358 (0.002)**
		Gori	2.58±1.031		2.80±0.998		9.00±1.225		2.38±0.697	
		Weolseong	3.32±0.551		3.30±0.580		9.41±0.610		2.26±0.444	
		Yeonggwang	3.10±0.863		2.56±0.733		8.45±1.243		2.18±0.388	
		Ulju	2.92±0.805		3.49±0.505		8.96±0.928		2.51±0.541	
	Con	Uljin	1.10±0.735	6.660 (0.000)**	1.12±0.696	8.434 (0.000)**	5.28±2.643	14.876 (0.000)**	2.43±0.677	9.458 (0.000)**
		Gori	1.75±0.779		1.82±0.863		5.29±1.936		2.19±0.617	
		Weolseong	1.08±0.771		1.42±0.535		7.77±1.293		2.43±0.636	
		Yeonggwang	1.50±0.610		1.23±0.425		4.60±2.635		2.69±0.547	
		Ulju	1.31±0.987		1.63±0.896		6.44±2.321		2.00±0.614	
Metropolitan city residents	Pro	Seoul	1.72±1.012	0.843 (0.499)	2.28±1.098	2.581 (0.038)*	6.46±2.642	0.580 (0.678)	2.03±0.674	4.929 (0.001)**
		Incheon	1.77±1.160		2.23±1.236		6.70±2.607		2.05±0.699	
		Daejeon	2.00±0.916		2.73±1.110		7.13±2.893		2.44±0.642	
		Daegu	1.78±1.064		2.56±0.918		6.62±2.708		2.36±0.645	
		Ulsan	1.67±1.275		2.18±1.195		6.57±2.385		2.08±0.659	
	Con	Seoul	1.54±0.927	0.993 (0.412)	1.74±0.835	1.261 (0.286)	6.33±2.223	2.058 (0.087)	1.98±0.668	0.613 (0.654)
		Incheon	1.36±1.034		1.57±0.735		6.54±2.071		1.91±0.668	
		Daejeon	1.25±0.892		1.42±0.981		5.49±2.421		1.82±0.571	
		Daegu	1.24±0.969		1.64±0.783		6.33±2.420		1.91±0.631	
		Ulsan	1.45±0.867		1.49±0.669		6.51±2.127		1.83±0.580	

NPP, nuclear power plant.
[a]Scored on a 5-point scale (a higher score representing better communication).
[b]Scored on a 3-point scale (the degree of accepting nuclear power as a safe energy source). A higher score indicates that nuclear power is accepted as a safer energy source).
[c]Scored on a 10-point scale (the extent to which nuclear power has contributed to the development of South Korea). A higher score indicates a higher perceived contribution or acceptance of nuclear power.
[d]The degree of interest in nuclear power. A higher score indicates more interest in nuclear power.
*$p<0.05$, **$p<0.01$, ***$p<0.000$.

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Table 2. Major Variables Pertaining to Communication about Nuclear Power

	NPP area residents		Metropolitan city residents	
Reliable organization	Civilian expert organizations	108 (18.3)	NSSC/KINS	111 (20.7)
	Local governments	102 (17.3)	None	99 (18.5)
	None	95 (16.1)	Civilian expert organizations	86 (16.0)
	Civilian watchdogs	94 (15.9)	Environmental groups	58 (10.8)
	NSSC/KINS	69 (11.7)	Blue House (Office of the President)	56 (10.4)
	KHNP	61 (10.3)	KHNP	51 (9.5)
	Public research organizations, professors	23 (3.9)	Public research organizations, professors	39 (7.3)
	Not interested	14 (2.4)	Not interested	18 (3.4)
	Others	13 (2.2)	Press	9 (1.7)
	MOTIE	11 (1.9)	Others	5 (0.9)
			MOTIE	4 (0.7)
Conflict reason	Difference in safety perception	203 (30.8)	Difference in safety perception	220 (40.9)
	Interests	105 (15.9)	Interests	143 (26.6)
	Difference in local development perception	93 (14.1)	Difference in local development perception	33 (6.1)
	Subsidy utilization problem	79 (12.0)	Future generation consideration	33 (6.1)
	KHNP attitude	75 (11.4)	Government attitude	31 (5.8)
	Government attitude	75 (11.1)	KHNP attitude	22 (4.1)
	Future generation consideration	27 (4.1)	Unknown	17 (3.2)
	Others	5 (0.8)	Energy security	16 (3.0)
			Others	13 (2.4)
			Subsidy utilization problem	10 (1.9)
Communication method	Briefing sessions required by residents	147 (22.6)	Communication expert utilization	273 (28.8)
	Agreement between KHNP and residents	117 (18.0)	Public-centered discussion	214 (22.6)
	Resident-centered debates	113 (17.4)	Continuous briefing sessions	163 (17.2)
	Communication expert utilization	155 (13.8)	Direct government involvement	110 (11.6)
	Agreement between local governments and residents	42 (6.5)	Agreement between KHNP and the public	72 (7.6)
	Direct government involvement	41 (6.3)	Press utilization	57 (6.0)
	Village conference	29 (4.5)	Agreement between local governments and residents	55 (5.8)
	Others	7 (1.1)	Others	5 (0.5)

Values are presented as number (%).

3. Investigation Procedure and Analysis Method

A total of 27 group discussions were held from January to November 2017, and the surveys were conducted in August and September 2017. For statistical analysis, frequency and percentage, mean and standard deviation, correlation analysis, ANOVA, and factor analysis were performed.

Results and Discussion

1. Communication-Related Perception Level of Nuclear Power

Nuclear power in South Korea is a living history of highly advanced science and technology, which was developed for technical independence and energy security. Due to sudden changes in nuclear polices after the launch of a new political platform in 2017, communication with the general public regarding nuclear power and public acceptance of nuclear power has become more important than the technical independence of nuclear power and national energy security. Various studies have been conducted on public communication levels or perception levels with either the local or general public, however, there are limitations in applying results in these studies realistically. In this study, a communication target was set for all citizens. Metropolitan cities, in which administrative actions can be actively facilitated when a communication strategy is involved, and NPP areas regarding concerned residents, were considered. For NPP area residents, communication-related perception levels were surveyed with two groups at the extremes of conflict on the topic of nuclear power generation, a group in favor of nuclear power, and the other against it. It was anticipated that communication for the latter group would be difficult and much more time consuming. Safety perceptions which concern many citizens, the contribution of nuclear power which has to be chosen if necessary, interest in nuclear power, and communication levels were surveyed. Results from NPP area resi-

Table 3. Major Variables Related to Nuclear Power Policy Decision

	NPP area residents	Metropolitan city residents
Reasons for public anxiety		
Facility unsafety	195 (19.7)	228 (19.4)
Distrust in the society and government	160 (16.2)	171 (14.6)
Insufficient communication and promotion	122 (12.3)	156 (13.3)
Low expectations from nuclear power	110 (11.1)	58 (4.9)
Insufficient information	88 (8.9)	129 (11.0)
Corruption	78 (7.9)	146 (12.4)
Ignorance	63 (6.4)	116 (9.9)
Anti-nuclear protests	57 (5.8)	52 (4.4)
Distrust in experts	43 (4.4)	32 (2.7)
Negative attitude	42 (4.3)	65 (5.5)
Distrust in technology	25 (2.5)	13 (1.1)
Others	5 (0.5)	7 (0.6)
Nuclear power policy considerations		
Safety, health, and environment	247 (18.1)	219 (17.1)
Spent fuel rods	193 (14.1)	169 (13.2)
Nuclear power technology	161 (11.8)	180 (14.1)
Natural and cultural heritages	159 (11.6)	127 (9.9)
Energy security/economic growth	156 (11.4)	210 (16.4)
Securing public acceptability	128 (9.4)	158 (12.3)
Anti-nuclear	94 (6.9)	71 (5.5)
Operation of nuclear power environment corporation	74 (5.4)	63 (4.9)
Additional construction of nuclear power plants	58 (4.2)	21 (1.6)
Drive of the government	53 (3.9)	28 (2.2)
International status	31 (2.3)	11 (0.9)
International conventions	10 (0.7)	18 (1.4)
Etc.	4 (0.3)	5 (0.4)

Values are presented as number (%).
The variables for the reasons of public anxiety were selected based on the priority in social cognitive theory and were quoted from the study of the Korea Academy of Nuclear Safety [43]. All the human factors (distrust in experts, anti-nuclear protests, and ignorance), risk factor (distrust in technology), physical environment (facility unsafety), and social factors (distrust in the society and government, insufficient communication and promotion of nuclear energy, low expectations on nuclear power, insufficient information, corruption, and negative attitude) were included.

Table 4. Correlations among Major Communication Variables

	Communication	Safety	Contribution	Interest
NPP area residents				
Pro				
Communication	1			
Safety	0.382**	1		
Contribution	0.345**	0.376**	1	
Interest	0.091	0.295**	0.399**	1
Con				
Communication	1			
Safety	0.178**	1		
Contribution	-0.053	0.239**	1	
Interest	0.069	-0.072	-0.131*	1
Total				
Communication	1			
Safety	0.032**	1		
Contribution	0.455**	0.588**	1	
Interest	0.077	0.077	0.013	1
Metropolitan city residents				
Pro				
Communication	1			
Safety	0.425**	1		
Contribution	0.061	0.081	1	
Interest	0.347**	0.519**	0.135*	1
Con				
Communication	1			
Safety	0.329**	1		
Contribution	-0.076	0.024	1	
Interest	0.098	0.069	0.029	1
Total				
Communication	1			
Safety	0.428**	1		
Contribution	0.025	0.092*	1	
Interest	0.276**	0.399**	0.110*	1

NPP, nuclear power plant.
*$p<0.05$, **$p<0.01$, ***$p<0.000$.

dents in favor of nuclear power indicated and identified the importance of higher levels in communication, safety perception, and contribution than those against it. Interest in nuclear power was similar for both resident groups. In addition, there was no significant difference for metropolitan city residents. Korean society faces a communication crisis in every area with respect to this topic (Table 1). Many studies have raised communication issues, but the concept and aspect of effective communication have been unclear and difficult to understand [19].

In this study, different results to the question of a nuclear power related communication variables were also derived even in the same area, which was similar to the study results of Lim and Kim [4]. It is believed that the fact that residents in the same area had different perceptions can be attributed to perception patterns based on individual emotions rather than facts. As different areas exhibited altered perceptions on the topic of nuclear energy, it was determined that a communication strategy must be designed considering regional characteristics to help NPP area residents change their perceptions, and communication processes to resolve general conflicts. Compared to the clear differences among the perceptions of NPP area residents, metropolitan city residents did not exhibit regional differences in communication and contribution between both the group in favor of nuclear power generation and those against it. Therefore, it is necessary

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Table 5. Variables Affecting Nuclear Power Communication

	Pro				Con				Total			
	B	SE	β	*t*	B	SE	β	*t*	B	SE	β	*t*
NPP area residents												
(Constant)	0.500	0.497		1.006	0.853	0.342		2.490	0.012	0.259		0.047
Residence period	0.003	0.091	0.003	0.036	0.054	0.079	0.045	0.680	0.082	0.064	0.048	1.273
Briefing session attendances	-0.004	0.012	-0.022	-0.314	-0.004	0.009	-0.030	-0.447	-0.016	0.007	-0.084	-2.182*
Safety	0.268	0.081	0.237	3.324**	0.245	0.073	0.222	3.361**	0.569	0.048	0.542	11.875**
Contribution	0.215	0.058	0.277	3.737**	-0.033	0.024	-0.095	-1.389	0.062	0.022	0.128	2.814**
Interest	-0.120	0.123	-0.072	-0.973	0.102	0.085	0.080	1.199	0.105	0.075	0.054	1.407
	$F=0.749^{**}$, $R^2=0.158$				$F=2.790^{*}$, $R^2=0.057$				$F=59.663^{**}$, $R^2=0.406$			
Metropolitan city residents												
(Constant)	0.386	0.264		1.461	0.740	0.278		2.661**	0.503	0.185		2.721**
Residence period	0.008	0.082	0.005	0.101	0.034	0.084	0.024	0.399	0.015	0.059	0.010	0.249
Safety	0.319	0.060	0.334	5.316**	0.374	0.069	0.324	5.453**	0.364	0.041	0.379	8.939**
Contribution	0.004	0.022	0.011	0.194	-0.036	0.025	-0.087	-1.469	-0.010	0.016	-0.024	-0.624
Interest	0.273	0.100	0.172	2.726**	0.114	0.090	0.076	1.270	0.196	0.066	0.127	2.986**
	$F=17.601^{**}$, $R^2=0.203$				$F=8.718^{**}$, $R^2=0.122$				$F=32.732^{**}$, $R^2=0.197$			

NPP, nuclear power plant; SE, standard error.
*$p<0.05$, **$p<0.01$, ***$p<0.000$.

to separate and also consider the opinions and viewpoints of NPP area residents and metropolitan city residents, when a public communication strategy on nuclear power is designed.

2. Major Variables Pertaining to Nuclear-Power-Related Communication

In the absence of a neutral mediator for communication, conflicts among the corresponding participants have the potential to be maximized. In order to enable communication about nuclear power in South Korea, reliable organizations which act as information communication sources, reasons for conflicts and central elements of solutions, as well as communication methods desired by conflicting parties, were examined. NPP area residents trusted the civilian expert groups (18.3%) and local government (17.3%) the most, while metropolitan city residents trusted the Nuclear Safety and Security Commission (NSSC), and the Korea Institute of Nuclear Safety (KINS, 20.7%), the most. Both NPP area residents (third rank, 16.1%) and metropolitan city residents (second rank, 18.5%) exhibited an overall social distrust in current systems and indicated that no one individual organization can really be trusted. However, both resident groups highly trusted civilian expert groups. Groups, organizations, and individuals producing information can be information sources [20]. Information sources delivering information play an important role in communication processes [21], and the reliability of information sources is an important influential factor in risk communication process because it indicates the recipient's trust in the information sources [22]. In other words, it may be significantly effective for local governments to play the role of information sources in NPP areas, and NSSC, as well as the KINS can do the same in metropolitan cities. In addition, utilizing civilian expert groups in both metropolitan cities and NPP areas is an option. This is because the reliability of nuclear-power-related organizations affects nuclear power risk perception or acceptability variable [23]. Higher reliability on such organizations leads to a potential lower risk perception, and risk perception and acceptability vary according to the reliability of information sources [24].

In South Korea so far, the Korea Hydro and Nuclear Power Co. Ltd. (KHNP), which is the major business stakeholder, has been responsible for communication with NPP area residents. The Ministry of Trade, Industry and Energy (MOTIE) has been in charge of policy decisions. As the reliability of these two groups is considered low as indicated in Table 2, an in-depth analysis and reflection of communication agents are required because it appears that the incapability of effective communication is at the essence of communication issue. As the Organisation for Economic Co-operation and Development (OECD) survey indicates, South Korea is a low post-trust society. It may have been impossible to engage in risk communication appropriately in such a situation, in which a high level of distrust among classes exist due to social polarization and general trust in the government is significantly low [25]. It is necessary even now to realize strategic communication policies with the public through the ef-

fective selection of information sources and communication agents. In addition, to addressing nuclear power problems, the trend of addressing other public conflicts displays that those conflicts have also been on the rise continuously for the past 20 years since 1990 [26]. Many studies have measured differences in the perception of specific projects or conflicts not related to nuclear power in South Korea. These studies have indicated that there are significant differences in the perceptions of the same project between the government and residents and that the conflict frameworks are different [27, 28]. The first reason for conflicts about nuclear power was the difference in safety perceptions between NPP area residents and metropolitan city residents, and the second reason was personal interests. One notable aspect is that metropolitan city residents exhibited a higher conflict level due to the difference in safety perception than NPP area residents. The safety perception of NPP area residents is considered to be lower than that of metropolitan city residents because NPP area residents live in the vicinity of NPPs and feel closer to the risks of nuclear power in their everyday lives. Regarding major and conflict issues which may affect conflict resolution [29, 30], it is necessary to actively perform conflict resolution processes in a manner that is suitable for South Korea considering the reasons of the conflicts, i.e., the safety of nuclear power and personal interests or concerns. In this case, it must be considered that conflicts will change over time depending on issues (stakeholders and profits due to political, economic, and social dynamics).

NPP area residents preferred the briefing sessions mandated for residents (22.6%) for communication, while metropolitan city residents preferred utilizing communication experts (28.8%). This indicates that different approaches between local residents and metropolitan cities are necessary when a nuclear power communication method is devised. It must be noted that, it is not easy to find cases in which different types of communication are used for metropolitan cities and NPP residents. In conclusion, for NPP area residents, the most effective form of communication may be civilian expert organizations, communicating in the form of briefing sessions, which meet the needs of local residents on the subjects of nuclear power safety and personal interests or concerns. For metropolitan city residents, the most effective form of communication might be communicating using experts from specialized organizations such as NSSC and KINS on the subjects of nuclear power safety and interests. It appears that these methods can also be applied based on the theoretical background in which conflicting parties, conflicting issues, conflicting environments, and conflicting management methods were presented as the main factors affecting the results of public conflicts [29, 31–35].

Communication-related major variables differ between NPP area residents and metropolitan city residents. This was also derived by the qualitative survey through debates. Priority items were derived by the preliminary survey. As nuclear power communication for the public through systematic approach has never been deployed in South Korea, differences in the perception about related variables between NPP areas and metropolitan cities are inevitable. Until now, in many cases, the management and resolution of public conflicts in South Korea were not ideal already from the policy establishment stage, and official efforts to analyze the effects of conflicts were absent. Planning was conducted by the unilateral decision of the government or the leader of a local government, and many projects were performed without considering the needs of residents or their positions [35]. Communication and conflict-resolving strategies capable of reducing this gap are required.

3. Major Variables Related to Nuclear Power Policy Decision

As shown in Table 3, people are worried about nuclear power because both NPP area residents and metropolitan city residents are concerned about facility insecurity (19.7% and 19.4%) after the Fukushima accident. The second reason is the distrust of society and government (16.2% and 14.6%), which indicates that the distrust of society leads to distrust in nuclear power. The third reason is insufficient communication and promotion of nuclear energy (12.3% and 13.3% respectively). Therefore, in the future, it is necessary for governments to communicate with the public by providing safety information regarding facilities of nuclear power plants to the extent desired by the public.

When determining nuclear power policy, both NPP area residents (18.1%) and metropolitan city residents (17.1%) have prioritized safety, health, and environmental concerns. Secondly, regarding metropolitan city residents' thoughts that energy security and economic growth (16.4%) are important, NPP area residents thought the current issue of the spent nuclear fuel (14.1%) was important. These considerations indicate that the future of nuclear power policy must be prioritized considering information on safety, health, and the environment. Communicating about energy security and eco-

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nomic growth for metropolitan city residents, and about policy decisions related to spent nuclear fuel for NPP area residents can be effective. Nuclear power is a public value, and the public value is multi-dimensional [36, 37]. Additionally, public value creation is assessed using various criteria [38–41]. Koreans' perception of public values is affected by various factors, such as political and ideological tendencies, regional orientations, interpersonal trust, interagency cooperation, and communication between the public and the central government. To improve the perception of the public values on nuclear power, it is necessary to construct a co-operative governance and to prepare capabilities and expertise capable for preventing and alleviating conflicts. As communication is important in activating the perception of public values, plans to establish effective communication systems must be considered [41]. In this sense, if the nuclear power industry is a valued for nuclear power regarding national growth through energy security and independent technology development, it needs to receive valued public acceptability improvement through effective communication processes and conflict resolution in the future.

The root cause of communication problems in nuclear power issues is not the concept of communication. Communication is needed to solve realistic social problems that surface as a conflict between profit and loss. It is necessary to clarify the communication process and the responsibilities of communication. In other words, it should be dealt with as a matter of responsibility [42].

4. Relationships among Major Communication Variables

For the NPP area residents, there was a positive correlation between communication, safety, and contribution in the nuclear energy support group, and there was also a positive correlation between safety, contribution, and interest. Contribution and interest also showed a positive correlation. In the NPP area, the opposition group showed a positive correlation between communication and safety, safety and contribution, and contribution and interest, and the remaining variables were not related. In the NPP area, communication, safety, and contribution showed positive correlations, and safety and contribution also showed positive correlations. For the metropolitan or city residents, there was a positive correlation between communication, safety, and interest in the nuclear energy support group, and there was a positive correlation between safety and interest, as well as contribution and interest. In the opposite group, only communication and safety showed a positive correlation. For the metropolitan or city residents, there was a positive correlation between communication and safety, communication and interest, and safety and contribution, safety and interest, and contribution and personal interest. Safety perception was related to the communication level for both NPP area residents and metropolitan city residents regardless of whether the residents were in favor of or against nuclear power as shown in Table 4. This means that the perception structure in which better communication leads to the perception of something being safe is a serious consideration. If more aggressive safety-oriented public communication is performed, it is likely that vague anxiety will reduce. In other words, providing information on safety can be perceived as good communication. As the contribution of nuclear power emphasized by the nuclear power industry represents a negative correlation for those against nuclear power, the emphasis on contribution in communication may result in an adverse effect. All variables on communication, safety, contribution, and interest were not completely correlated between each other. Therefore, it is desirable to use relevant correlation results between variables depending on the group. The most explicit issue in debates on communication problems is the conflict between the values of mutuality and rationality. Different communication diagnoses can be presented by specifically emphasizing one of the two criteria for the same communication situation [19]. As these results are based on surveys using the two criteria, they can be directly used for communication variables.

5. Factors Affecting Nuclear Power Communication

Multiple linear regression analysis was performed to find out the factors affecting nuclear communication among residents within the NPP area. Communication was used as the dependent variable, and the period of residence in the region, number of briefing sessions attended, safety, contribution, and interest were used as independent variables. In the support group, the contribution of nuclear energy had the greatest impact, followed by safety. For the opposition group, safety had the greatest impact. The period of residence in the region did not affect communication for the total groups.

Multiple linear regression analysis was conducted to find out the factors affecting nuclear power communication by metropolitan or city residents. Communication was used as the dependent variable, and the period of residence in the

region, number of briefing sessions attended, safety, contribution, and interest were used as independent variables. In the support group, safety had the greatest influence, followed by personal interest. The opposite group also had the greatest impact regarding safety. Among metropolitan or city residents, safety had the most impact, followed by interest.

Safety had the greatest impact on all groups, including NPP area residents as well as metropolitan city residents both in favor of and against nuclear power as shown in Table 5. This indicates that it is necessary to perform eye-level customized communication using safety as a key word.

Conclusion

In South Korea, although nuclear power is an energy source with important public values in energy security, establishing the basis for industrial development, strengthening international capabilities, and responding to climate changes, political influence and public acceptability have led to public conflicts, resulting in a rapidly changing energy transition policy. As public values are assessed and valued by the public through various criteria [36–45], it is more important to improve public acceptability by building capabilities for transition than to identify permanent solutions to specific conflicts such as nuclear power [46]. Therefore, while both the structure and process of interaction between the conflicting parties aims to resolve conflicts, more holistic approaches to conflicts are required to deal with the root causes of violent conflicts in the long term [47]. The proposals of this study based on holistic approaches are as follows. Firstly, NPP area residents and metropolitan city residents have different reliable communication agents regarding nuclear power and safety. As viewed by NPP area residents, preferred civilian expert organizations, metropolitan city residents, the NSSC and KINS, it is necessary for these organizations to become communication agents and information providers respectively. This is because the intervention of the third party chosen by the conflicting parties can affect the possibility or degree of conflict resolution [48]. The survey on the public conflict perception of Korean people also indicates that attempts for alleviation or reconciliation through conflict experts or third parties (65.1%) were the best method [35]. Second, the causes of conflicts pertaining to nuclear power were the same (safety problem and interests) for both NPP area residents and metropolitan city residents. In particular, the perception of safety of metropolitan city residents was higher than that of NPP area residents. As public conflicts in South Korea involve many people as stakeholders and tend to be prolonged, it is necessary to reveal them via discussions [49]. Third, NPP area residents and metropolitan city residents have different communication method requirements for nuclear power. While the former preferred the briefing sessions required by residents, the latter preferred utilizing communication experts. Among various factors affecting public conflict resolution, conflicts between the conflicting parties, authority, and trust can affect the relationship between them [31, 48]. As for the environmental factors of conflicts, conflicts can be affected by social, economic, and political factors [30, 50]. Therefore, it is necessary to design and apply action strategies using the agents, contents, and methods required by each group. Until now, South Korea has had a social environment where conflicts could not be completely resolved because there has been no strategic intervention in the public's acceptability and perception of nuclear power on a national level, and the root causes of conflicts have not been dealt with. It is considered that the fundamental resolution of conflicts as well as the positive orientation and constructive changes on conflicts are possible only if there is a will to intervene in the conflicts. Therefore, it is necessary for the nuclear power industry to have a focus and actively implement communication strategies and conflict resolution based on the patterns obtained in the study results [51]. Diagnosis on nuclear power communication can practically help find solutions to communication problems and may provide clues to identifying the causes of communication problems or finding solutions. Quality communication, in particular, can resolve or reduce social conflicts or opposition [52–54]. It is not easy to predict social communication structures with precision because they vary dynamically. The fundamental solutions for correcting the communication structures, however, must be strengthened by the nuclear power industry itself [55]. In the future, it is necessary to continuously implement the results of this study as well as multidimensional diagnosis including rationality, communication etiquette, and freedom of expression, which have been identified as important by existing studies on communication problems.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Author Contributions

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