ANALYSIS OF THE SITING PROCEDURE FOR RADIOACTIVE WASTE MANAGEMENT FACILITY IN KOREA

By

Sun-Mi Wee

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
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Committee in charge:

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ABSTRACT

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Sun-Mi Wee

With the world struggling due to a lack of sufficient energy, nuclear power has become an indispensable power source. The need for safe management of nuclear related facilities has increased in unison with an increased use of nuclear energy. The effective management of radioactive waste has become a significant national issue in Korea. Korea had struggled to select an appropriate site for its radioactive waste management facility and ever since 1986, there have been many conflicts and concerns regarding safety and reliability of the facility. After much deliberation, the Korean government finally selected the Gyeongju repository site by way of referendum in November, 2005. This study analyzes the key factors and procedures which resulted in the selection of Gyeongju as the waste management site as well as major differences between this location and the other unsuccessful options.

This study examines whether or not the referendum is useful with regards to radioactive waste site selection and in which ways it can be differentiated from other procedures pertaining to the site's selection. This study will cover many issues, including 1) the way that Korea selected the radioactive waste facility in Gyeongju – how the path of selection process has changed 2) the history of and common factors dictating site selection processes in other countries, 3) lessons learned from the Gyeongju case and how these

lessons can be developed for future implementation.

The Gyeongju case is analyzed by the point of periodical changes, and changes in approach. There are a certain characteristic aspects of approach – change of compensation, diversification of deliberation structure, and enlargement of local people participation. Despite a great deal of effort on their part, Korea failed on several occasions to select a suitable site, but reached a turning point following the introduction of the referendum, with public receptivity changing dramatically.

In addition to analyzing the Korean case, this study also analyzes the experiences of countries like Canada, United Kingdom, and France, who have also encountered similar obstacles when attempting to settle on a site location for radioactive waste management facilities. Indeed, thorough periodic research demonstrates the approach taken by these countries and assesses the success of these approaches.

In conclusion, policy acceptance level is determined on the base of trust between residents and policy executors, whilst decision a making process should have openness and transparency. With this in mind, the policy makers should attempt to enhance community participation in all phases of the siting process by showing their support for independent consultants, community review of facility design and safety systems, monitoring of facility performance and property value protection.

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I. INTRODUCTION

A. Background

With the world struggling due to a lack of sufficient energy, nuclear power has become an indispensable power source. A total of 436 nuclear power plants are currently in operation with a total net installed capacity of 370,128 MWe.[1]

As the use of nuclear energy increases, the need for safe management of nuclear related facilities has also increased. In fact, the safety and energy efficiency of nuclear power has been at the center of worldwide debate since the 1950s. People have been worried about the long-term effects of nuclear power plants and their waste products. Of particular note is the radioactive waste treatment issue which has emerged as a serious matter in terms of sustainable development, not only in South Korea but also in other countries which use a vast amount of nuclear energy.

In the case of the United States, the Yucca Mountain Nuclear Waste Repository was designated as the deep geological repository storage facility for the country's spent nuclear reactor fuel and other high level radioactive waste. Although the appropriateness of the location had been rigorously opposed by environmentalists, this waste site was deemed effective with the passing of the federal budget by Congress on April 14, 2011 following pressure from the Obama Administration. Indeed, this freed up funding for the development of Yucca Mountain. The US GAO stated that the closure was due to political reasons rather than technical or safety reasons.[2]

With regards to Belgium, this country has seven nuclear reactors in operation with a net MWe of 5,761. Nuclear energy provides 54% of the country's energy, and it

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[1] Power Reactor Information System (PRIS), *IAEA*, http://pris.iaea.org/Wedas/WEDAS.asp

[2] Hannah Northey, "Gao: Death of Yucca Mountain Caused by Political Maneuvering,"(2011), http://www.nytimes.com/gwire/2011/05/10/10greenwire-gao-death-of-yucca-mountain-caused-by-politica-36298.html?pagewanted=allzz

was only in 2006 that the government decided low-level and short-lived intermediate-level wastes should be disposed of in a surface repository at Desseli. Before the site selection of Desseli, ONDRAF/NIRAS, the Belgian agency for radioactive waste and enriched fissile materials attempted to select 98 candidate sites based on scientific and industrial factors, however all of the candidate sites refused to participate in this feasibility study. Moreover, countries such as Canada, United Kingdom, and France have also gone through similar experiences with regards to settling on a site for radioactive waste management facilities.

A total of 21 nuclear reactors are currently in operation in Korea, with this number set to rise to 28 by 2015. With this in mind, the effective management of radioactive waste has become a significant national issue. In 1986, Korea was struggling to select a site which could house the radioactive waste management facility. Indeed, since this date, there have been many conflicts and concerns regarding the safety and reliability of the facility. After much deliberation, the Korean government finally chose the Gyeongju repository site by way of referendum in November, 2005. This study analyzes the key factors and procedures which resulted in the selection of Gyeongju as a waste disposal site as well as the major differences between this site and other failed candidates.

B. Purpose of the Study and Research Method

This study analyzes whether or not a referendum is useful with regards to radioactive waste site selection and how it can be differentiated from the other procedures of site selection.

My research question pertains to the Gyeongju case, and more specifically whether or not the use of referendum to select a radioactive waste management site was

the most effective and efficient method by which to solve the public dispute. The hypothesis of this study states that use of referendum in the siting procedure could be an effective democratic option and a way of forming a consensus with local people. This study is of a comparative nature, and analyzes the procedures of previously failed site candidates whilst also conducting periodical research into other countries' cases. In conclusion, this study will cover a number of issues, including 1) the way in which Korea selected the radioactive waste facility in Gyeongju – how the path of selection process has changed 2) the history and common factors of siting processes in the case of other countries, 3) lesson learned from the Gyeongju case and how these lessons can be developed for future implementation.

This thesis covers Korea's experience from 1986 to 2005 at the domestic level, and analyzes characteristic aspects of the referendum and consensus building process of 2005. I found that in Korea there were many diverse studies regarding this issue, the majority of which were analyzing this siting procedure as a point of governance, social trust and risk communication.

This study will go one step further than previous studies by conducting a comparative analysis of other countries' cases. Many countries – almost all of which are developed countries – have experienced trials and errors when attempting to establish radioactive waste management facilities. A number of these countries have succeeded, whilst others are still in the process of selection, and many have failed. The siting procedure has changed with the passing of time, and it can now be evaluated and categorized as a point of public perception and success rate. With this in mind, the present study attempts to analyze the periodic characteristics of other countries' cases in order to improve policy adaptability. In addition, this study will also analyze the potential conflicts which remain following the site's selection and will attempt to provide a policy

suggestion in order to contribute to the developing process of consensus for the siting of radioactive waste management facilities. The review of this site selection process could well provide a valuable insight for countries which use a vast amount of nuclear energy or countries which plan to introduce nuclear energy in the near future.

Following the Fukushima crisis (in Japan, 2011 March) and recent explosions at a French nuclear waste treatment site (2011 September),[3] nuclear industries have begun to encounter a huge amount of criticism and opposing movements. One of the main reasons for criticism stems from the way in which the government deals with this crisis. In the case of Japan, events in its history, along with a lack of transparency, have led to a great deal of public skepticism. Indeed, the public are opposed to the siting of radioactive waste treatment facilities and feel that these situations should be reviewed using the mechanism of risk communication and decision making process in order to formulate more productive solutions.

II. THEORETICAL BACKGROUND AND LITERATURE REVIEW

A. Theoretical Background

Risk Perception

Ever since the psychometric studies carried out by Slovic & Fischhoff in the 1970s, risk research has been influenced by a wide range of theoretical perspectives and has developed various related subjects. Taylor-Gooby & Zinn constructed a two dimensional model intended to exemplify certain features of recent research regarding risk as shown in Fig. 1.[4] They asserted that "recent developments reflect a general move

[3] "Action Plan after Nuclear Blast Kills One in France," (2011), http://tvnz.co.nz/world-news/action-plan-after-nuclear-blast-kills-one-in-france-4398133.
[4] Peter Taylor-Gooby & Jens O. Zinn, "Current Directions in Risk Research: New Developments in Psychology and Sociology," *Risk Analysis*, Vol. 26, No. 2 (2006) : 407.

to acknowledge the significance of social and cultural factors more seriously in understanding risk." They then concluded that these two trends bring "developments in psychology and sociology closer together and opens up opportunities for cross-disciplinary research."[5] The two dimensions shown in Fig. 1 are concerned with ontology and particularity. At an ontological level, two extremes are constructionist and realist views. From the perspective of a realist, risks are to be understood as real, as having an independent existence, external to the individuals or social groups who perceive and respond to them.

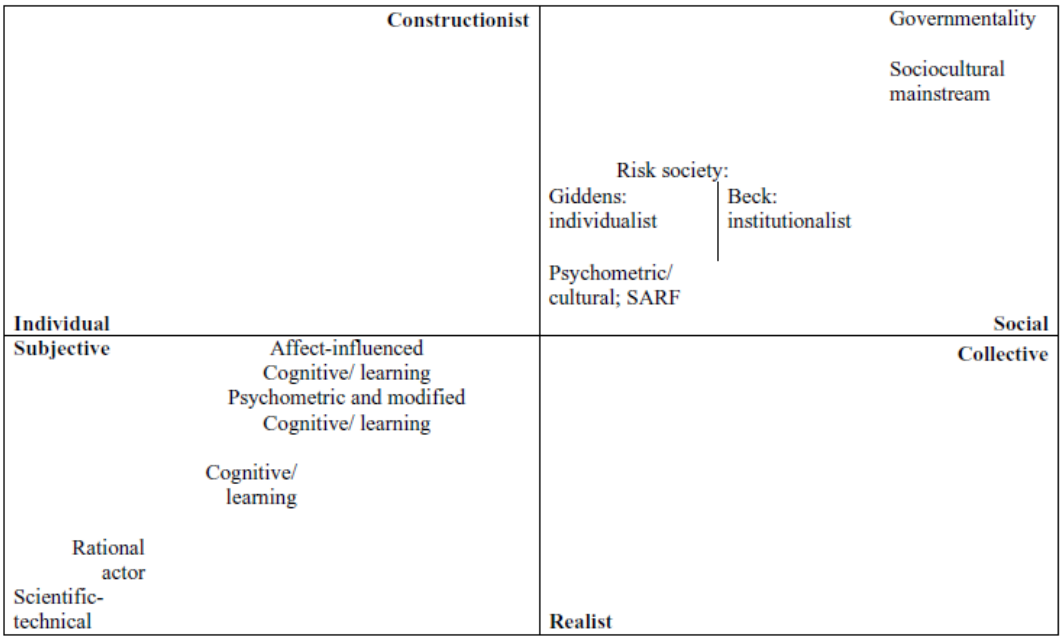

Figure. 1 *Psychological and sociological approaches to risk (**S**ource*: Taylor & Zinn, 2006, p.407)

As developments were made regarding the psychometric approach, it began to include constructionism. Taylor-Gooby & Zinn stated that "constructionism enters to the extent that social factors may, for example, influence the mental modeling that generates a particular prioritizing of risk."[6] They concluded that new research directions for the interdisciplinary approach between sociology and psychology were necessary. Indeed, they stated that "opportunities for closer linkages between the two disciplines are

[5] Ibid., 397.
[6] Ibid., 408

emerging, which may enable development of psychological ideas in the context of the broader and more holistic conceptualizations of sociology, and more rigorous testing of the theories of sociologists, drawing on the methods and conceptual distinctions developed by psychologists."[7]

Up until the 1980s, the risks of nuclear energy had been perceived as qualitatively different from those of other activities. These risks were regarded as highly involuntary, unknown, delayed, new, uncontrollable, fatal, dread and catastrophic as shown in Fig. 2. Indeed, with this in mind it is no surprise that nuclear related risks ranked very highly in comparison to other risks. Indeed, we can easily observe the field of nuclear energy due to the remarkable isolated position of nuclear power.[8] Fischhoff et al. stated that people "viewed the risks from nuclear power as qualitatively different from those of the other activities."[9]

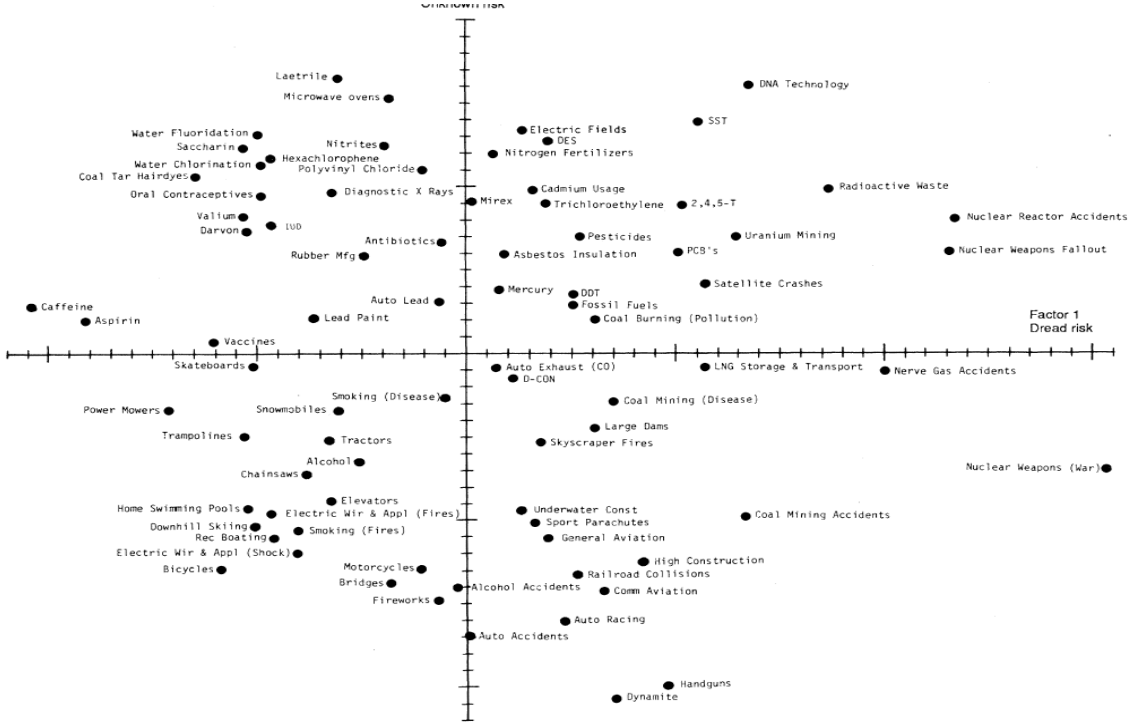

Figure.2 *Location of 81 hazards on factors derived from the relationship among 18 risk characteristics (Source*: Slovic, 1987, p.236)

[7] Ibid., 409
[8] Paul Slovic, "Perception of Risk", *Science*, New Series, Vol. 236, No. 4799. (Apr. 17, 1987) : 282
[9] Baruch Fischhoff, Paul Slovic, Sarah Lichtenstein, "How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits", *Policy Sciences 9* (1978) : 147

The overall worldwide attitude regarding the nuclear industry remains negative. Indeed, Slovic et al. conducted a survey of American citizens using images related to a nuclear waste repository. In this survey, "respondents were asked to indicate the first thoughts or images that come to mind when they think of underground nuclear waste repository."[10] The results were divided into two sizeable categories, namely "negative consequences" and "negative concepts" such as "dangerous", "unsafe", "toxic", "disaster", and so on. These "negative concepts" accounted for more than 56% of the total number of images, with positive imagery proving rare. Taylor summarized the survey results of the European Union and concluded that the average European is worried about radioactive waste and the nuclear industry is trusted by very few people.[11] In reference to a Korean case, Lee & Lee conducted a survey of Gyeongju citizens regarding the image of radioactive waste facilities, and concluded that the waste facility was closely related to negative imagery which had clearly emerged from opposition to the facility.[12]

Environmental Conflict

The word 'conflict' finds its origins in the Latin word 'confligere', which consists of 'con' (with) and 'fligere' (crash). Conflict is generally defined as a serious disagreement or argument between two or more beliefs, ideas, or interests. Conflicts between certain groups over the use of the environment and natural resources are now common occurrences and are growing both in number and importance as the human

[10] Paul Slovic and others, "Perceived Risk, Trust, and the politics of Nuclear Waste" *Sciences* 254 (1991): 1605.

[11] Derek M. Taylor, "The Management of Radioactive Waste in the European Union — Opinions, Situation and Proposal for Changes.", *Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management*, 9(1), (2005) : 19.

[12] Nakeung Lee and Yong-Ai Lee, "Factors affecting decision making concerning the location of a nuclear waste repository. ", *2005 PMORP WORKSHOP : Pyschological Mechanism of Risk Perception* (2005) : 32.

population grows, technology changes, and as pressures to use the environment increase.[13]

Environmental conflicts are rooted in the different values which people place on natural resources and environmental quality. Environmental conflicts are also incited by different stakes in the outcome of environmental and natural resource management decisions.[14] According to Emerson, environmental conflicts are characterized by certain key elements, including whether or not they: (1) involve the environment, natural resources, public lands, or all three; (2) involve multiple parties engaged in a decision making process who disagree about the endpoint or impacts of choices or outcomes; and (3) are general public disputes.[15]

B. Literature Review

Since the 1990s, many studies have been conducted regarding the issue of site selection procedures for radioactive waste management facilities in Korea. Initial studies primarily focused on analyzing the reasons behind opposition to Locally Unwanted Land Uses, whilst later studies, in contrast, approached this matter from the perspective of policy failure.

Jeon emphasized the importance of understanding the differences of a discourse which is a base of pros and cons, to solve nuclear related disputes.[16] The basic discourse of pro-radioactive waste management facility is neutral, and involves the prioritization of

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[13] Thomas Gladwin, "Trends in Industrial Environmental Conflict." *Environmental Consensus 3* (September 1979): 1

[14] James E. Crowfoot and Julia M. Wondolleck, *Environmental Disputes : Community Involvement in Conflict Resolution* (Washington D.C: Island Press, 1990) : 6-7

[15] Kirk Emerson et al., *The Challenges of Environmental Conflict Resolution*, in THE PROMISE AND PERFORMANCE OF ENVIRONMENTAL CONFLICT RESOLUTION 3 (Rosemary O'Leary & Lisa B. Bingham eds., 2003) : 4

[16] Jin Seok Jeon, "The study on Policy Change for Building the Nuclear Waste Dump through Advocacy Coalition Framework", *Study of Local Government,* Korean Local Government Society, Vol.7, No.4 (2003) : 183

science and technology. From this perspective, radioactive wastes are indispensable by-products of nuclear energy, and siting matters can be resolved through the development of science and technology. On the other hand, the basic discourse of anti-nuclear site is ecology. They regard the crisis of civilized society as stemming from an excessive development of science, which can and should be solved using an ecological approach and prioritizing the environment. For them, the fundamental issue with regards to siting radioactive waste management facilities is the use of nuclear energy. Indeed, they prioritize making 'social consensus on energy without nuclear', and also seek the establishment of a safety control system which uses existing nuclear power plant sites efficientlyd.[17] Similarly, Lee viewed the conflict on siting as the debate between techno-centeredness and ecology following his analysis of the Ulchin case.[18]

The characteristic aspect of radioactive waste management facilities as environmental goods which are shown under the collision among basic discourses should be considered. Slovic found behavioral mechanisms whereby development of the radioactive waste management facility may have serious impacts on tourism, migration, and economic development. These mechanisms of perceived risk, signal, social amplification, and stigma are so powerful that well publicized problems associated with the repository have the potential to result in substantial losses for each of the various economic sectors at risk. Therefore, the possibility of these impacts should no longer be ignored in repository-planning decisions.[19]

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[17] Sohee Kim, " Remained task and significance of demonstration against the radioactive waste disposal site in Gulup Island", *Environment and Life* (1995)

[18] Jong Youl Lee, "The anti nuclear wastes disposal sites: The case of Ulchin", *Korean Association for Public Administration*, Vol.29, No.2 (1995) : 379~396

[19] Paul Slovic, "Perceived Risk, Stigma, and Potential Economic Impacts of a High-Level Nuclear Waste Repository in Nevada", *Economic Impacts of a Repository in Nevada* (1991) : 141.

III. ANALYSIS OF SITING PROCEDURE OF RADIOACTIVE WASTE MANAGEMENT FACILITY IN KOREA

A. Status of Nuclear Energy and the Necessity of Radioactive Waste management in Korea

From the early 1960s to the late 1990s, Korea had one of the world's fastest growing economies, and it has continued to represent one of the fastest growing countries in the 2000s. In 2010, Korea was the sixth largest exporter and the tenth largest importer in the world. Korea's nominal GDP per capita grew from $103 in 1962 to $7,276 in 1991, reaching $20,759 in 2011.[20] With few fossil fuel resources, South Korea has sought to harness nuclear energy as a means by which to secure the country's rapid economic development. Over the last three decades, South Korea has averaged 8.6% annual GDP growth, with a corresponding leap in electricity consumption. In 1980, the country consumed some 40,078 Giga Watt hours (GWh), which had risen by 2010 to around 495,745 GWh. Today, 23 reactors account for 22% of South Korea's total capacity but actually provide 30% of the country's electricity.[21] A further 9 plants are in the construction or planning phases. Indeed, this will further increase the nuclear share in the country's electricity consumption, which is projected to reach 56% of electricity supply by 2020.

Nuclear activities were initiated when South Korea became a member of the International Atomic Energy Agency in 1957. In 1958, the Atomic Energy Law was passed and the Office of Atomic Energy was established by the government in 1959. The first nuclear reactor to achieve criticality in South Korea was a small research unit in 1962. Ten years later construction began of the first nuclear power plant - Kori-1, a Westinghouse unit built on turnkey contract. It started up in 1977 and achieved commercial operation in 1978.

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[20] "Economic Statistics System," Bank of Korea, http://ecos.bok.or.kr/. last modified August 3 2011.

[21] "Electric Power Statistics Information System," Korea Power Exchange, http://epsis.kpx.or.kr/.

Table 1. *Power reactors operation in South Korea*

Reactor	Type	Net capacity	Commercial Operation	Planned Close
Kori 1	PWR - Westinghouse	576 MWe	4/’78	2017
Kori 2	PWR - Westinghouse	637 MWe	7/’83	
Wolsong 1	PHWR - Candu 6	666 MWe	4/’83	2036
Kori 3	PWR - Westinghouse	1007 MWe	9/’85	
Kori 4	PWR - Westinghouse	1007 MWe	4/’86	
Yonggwang 1	PWR - Westinghouse	953 MWe	8/’86	
Yonggwang 2	PWR - Westinghouse	947 MWe	6/’87	
Ulchin 1	PWR - Framatome	945 MWe	9/’88	
Ulchin 2	PWR - Framatome	942 MWe	9/’89	
Yonggwang 3	PWR (Syst 80)	997 MWe	12/’95	
Yonggwang 4	PWR (Syst 80)	994 MWe	3/’96	
Wolsong 2	PHWR - Candu	710 MWe	7/’97	
Wolsong 3	PHWR - Candu	707 MWe	7/’98	
Wolsong 4	PHWR - Candu	708 MWe	10/’99	
Ulchin 3	OPR-1000	994 MWe	8/’98	
Ulchin 4	OPR-1000	998 MWe	12/’99	
Yonggwang 5	OPR-1000	988 MWe	5/’02	
Yonggwang 6	OPR-1000	996 MWe	12/’02	
Ulchin 5	OPR-1000	1001 MWe	7/’04	
Ulchin 6	OPR-1000	1001 MWe	4/’05	
Shin Kori 1	OPR-1000	1001 MWe	2/’11	
Shin Kori 2	OPR-1000	1001 MWe	6/’12	
Shin Wolsong 1	OPR-1000	1001 MWe	6/’12	
Total: 21		20,787 MWe		

(*Source:* World Nuclear Association, 2012.)

The South Korean energy policy has been driven by considerations of energy security and the need to minimize dependence on current imports. The policy recommends that nuclear power be maintained as a major element of electricity production. The Ministry of Education, Science & Technology's third comprehensive nuclear energy development plan, for 2007-11, projected that South Korea should develop

its nuclear industry into one of the top five in the world, with approximately 60% of its electricity coming from nuclear sources by 2035.[22]

Table 2. *South Korean reactors under construction, on order or planned*

Reactor	Type	Gross capacity	Start construction	Commercial operation
Shin Wolsong 2	OPR-1000	1000 MWe	September 2008	1/2013
Shin Kori 3	APR-1400	1350 MWe	October 2008	9/2013
Shin Kori 4	APR-1400	1350 MWe	August 2009	9/2014
Shin Ulchin 1	APR-1400	1350 MWe	Sept 2012	4/2017
Shin Ulchin 2	APR-1400	1350 MWe	Sept 2013	4/2018
Shin Kori 5	APR-1400	1350 MWe	8/2014	12/2018
Shin Kori 6	APR-1400	1350 MWe	8/2015	12/2019
Shin Wolsong 3	APR-1400	1350 MWe		6/2020
Shin Wolsong 4	APR-1400	1350 MWe		6/2021
Total 9		12,200 MWe		

(Source: World Nuclear Association, 2012.)

Korea is currently attempting to export its own nuclear power plant technology to other countries which have a plan to introduce nuclear energy. As of January 2010, Korean companies reached the agreement to build a research reactor in Jordan, and four APR-1400 reactors in the United Arab Emirates. [23]

These nuclear reactors are ingenerating radioactive wastes - high-level waste (spent nuclear fuel) and low levels of waste. Low-level waste (LLW) comprises paper, rags, tools, clothing, filters, and so on. Indeed, these items contain only small amounts of mostly short-lived radioactivity. Materials which originate from any region of an Active Area are commonly designated as LLW as a precautionary measure even if there is only a remote possibility of radioactive contamination. Such LLW typically exhibits radioactivity no higher than one would expect from the same material disposed of in a

[22] "Nuclear Power in South Korea", World Nuclear Association, (22 February 2012), http://world-nuclear.org/info/inf81.html.

[23] David Adam Stott, "South Korea's Global Nuclear Ambitions," *The Asia-Pacific Journal: Japan Focus* (March 22, 2010), http://japanfocus.org/-David_Adam-Stott/3322.

non-active area, such as a normal office block.

Low level waste has been stored in temporary storehouses at various nuclear power plant sites, and it will be saturated in 2014. With this in mind, the government has been attempting to select radioactive waste disposal site since 1986.

B. Procedures of Radioactive Waste Management Facility Siting: 1986-2004

The radioactive waste management facility issue has been at the top of the governmental agenda since 1984. The Korean government set up a 'fundamental principle for management of radioactive waste material' at the 211th Atomic Energy Committee. The content of the principle is to build a permanent inland facility for managing medium-low levels of radioactive waste outside of nuclear power sites. In 1986, the Korean government revised the 'Atomic Energy Act' and established the 'Atomic Energy Commission' whilst also designating KAERI (Korea Atomic Energy Research Institute) as the organization to manage radioactive waste disposal site selection. As a result of field investigations, Ulchin, Yeongdeok, and Yeongwol were selected although these selections were dismissed due to resistance from local people.

With the passing of time, the nuclear power plant issue has become a social matter, with the anti movement becoming more organized. The anti-nuclear movement started in 1987, as a claim for compensation in the fishing industry. However, at that time, the government did not recognize the social change which occurs alongside policy implementation. Indeed, as a result of this, the first impression citizens had of 'Radioactive waste' was that 'Nuclear waste' is synonymous with negative words such as opposition, resistance, and demonstration.[24]

In 1990, KAERI initiated the '2nd Atomic Energy Research Institute' on Anmyon

[24] Seong Kyong Cho, *The Reverse Side of the Radioactive Waste Management Facility - the Danger on Doma (Defend Only My Area)* (Seoul: SERI, 2005).p.42.

Island in cooperation with the local government, Chungcheongnam-do (Southern Chungcheong province). As a matter of fact, this institute acted as a radioactive waste disposal site in accordance with the concept of a subordinate agency, despite being known as 'Seohae (west sea) science research center.' This plan was eventually exposed by a major newspaper. Indeed, the way in which journalists obtain certain information is highly controversial – do they come across it by accident or is it intentional? This produces contrary evidence that a sufficient consensus does not exist inside the government. Residents came to know the original purpose of this plan, and opposed it vehemently under the exertion of governmental power. The decision was eventually reversed in 1991. This Anmyon Island case policy was doomed for failure from the very beginning. Even the government, a main agent of decision making, could not reach a consensus regarding this. Naturally, it was impossible to introduce the concept of legitimacy, participation and democratic process. Although it was a very initial stage of the promotional activity, the anti-nuclear movement expressed its views through various channels such as print-outs, presentations, and man to man meetings. Despite this, the government did not consider introducing an education process or any promotional material with could provide people with a more thorough understanding of the issues.

Following this, the government legislated the 'Radioactive Waste Management Program Promotion and Assistance on Periphery Area Act', and committed the preliminary consultation with local residents and assistance to the site by the law. At the heart of this law, Yangsan and Ulchin were designated as candidate sites, although this plan was also canceled due to opposition from the local council.

The government organized the 'Radioactive Waste Management Program Committee' following an order from the prime minister and established a 'Radioactive Waste Management Program Planning Team' in conjunction with the related ministry in

order to select the site. A total of 10 candidates were reviewed in consideration of local receptivity, with the Gulup Island finally being selected. According to the 'Act', Gulup Island was assigned the status of facility site. The government held public hearings, project briefing sessions and open forums in order to secure this site. However, the objection of local people was too strong and potential faults were discovered meaning that the plan was immediately stopped.

In January 1997, the Atomic Energy Committee decided to change the managing department from MOST (Ministry of Science and Technology) to MOCIE (Ministry of Commerce, Industry and Energy), and the leading agency was altered from KAERI to KEPCO (Korea Electric Power Corporation.). In 2000, the government invited voluntarily participation and 7 sites applied for hosting facilities, with all of these sites eventually failing due to opposition from local government leaders.

From 2001, the site selection process was changed as the urgency for a site grew. In accordance with this need, KEPCO set a plan in place to select 4 areas (Yeongdeok, Ulchin, Yeonggwang, Gochang) as candidates for a feasibility study and to appoint a final site following a geological survey and discussions with the local community during a one year period.

Table 3. *Candidate Sites for Radioactive waste management facility and anti-nuclear movement ('86~'03)*

1986~1989	Yeongdeok, Ulchin, Yeongil	Anti-nuclear movement in East sea region
1990	Anmyeon Island	Anti-nuclear campaign on Anmyeon Island
1991~1992	Cheongha	All-at-onceness national anti-nuclear movement ('91~'94)
1993	Jangahn, Ulchin	
1994	Gulup Island	Anti-nuclear campaign on Gulup Island
2003	Wi Island	No place for Radioactive waste disposal

(Source: A study on governance of selecting nuclear waste treatment site, 2007)

C. The Change of Approach for Radioactive Waste Management Facility Siting

Once the government of president Rho was established in February 2003 it announced a new process for site selection. In spite of this, local government leaders of representing the 4 candidate sites refused requests for a preliminary survey. With no resolution in sight, the local leader of Buan eventually allowed radioactive waste management disposal sites despite the opposition of residents in July. This induced immense social conflict, with residents taking part in candlelight vigils and keeping their children home from school. There was also armed conflict between residents and police. The resignation of the minister of MOCIE and the inhabitants' poll concluded this phase of dispute. This poll did not have any legal force, but 92% of voters – 72% of all residents – refused the site invitation, meaning that the government had no choice but to reject the application of the leader of Buan.[25]

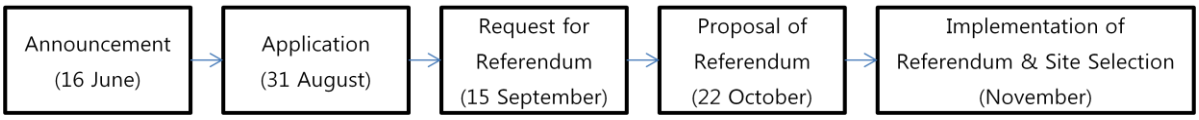
After 19 years of policy failure, the government redesigned the selection process. The government allocated disposal site one for high level and the other for low-intermediate level radioactive waste. They also prioritized the construction of a site for low-intermediate level waste. At this point, a special act for the assistance of local government was established, and a special support fund of 300 billion was allocated for the initial stage of development. Moreover, the local government can receive commission for the movement of 1 billion won per year along with the management of the facility. This included moving the head office of KHNP (Korea Hydro Nuclear Power) to the site.

The government established the committee for site selection to deliberate the process, investigate feasibility, and select the region for inhabitants' poll. The committee was composed of science and technology experts, as well as politicians, management, social experts, journalists, lawyers and NGOs. On 16 June, the government announced

[25] Jin-Chul Rho, "Decision in Siting Policy for Risk Facilities and Risk-Conflict-Focusing on the Selection of Sites for Radioactive Waste Disposal", *Korean Eco Society*, Vol.6 (2004).

new public contest of the site. The 4 sites – Gyeongju, Pohang, Yeongdeok, Gunsan – had received the consent of local government and submitted their applications. Following a feasibility study carried out by the committee, each site was submitted to a referendum, with the site that achieved the highest favorability rating being selected.

Figure 3. Flowchart of the site selection procedure



(Source: Construction of Medium-low Radioactive waste treatment disposal site: Status and issues)

The government announced that the referendum would take place on 2nd Nov. Following this announcement, each local government received the application as absentee voters until 8, Oct. The rates of absentee voters were relatively high, as we can see below.

Table 4. *The outcome of referendum*

	Gyeongju	Gunsan	Yeongdeok	Pohang	Total
Total electors	208,607	196,980	37,536	374,697	817,820
Absentees	79,599	77,581	10,319	82,637	250,136
- Rate (%)	38.1	39.4	27.5	22.0	30.6
Total voters	147,636	138,192	30,107	178,586	494,521
- Absentee voters	70,521	65,336	9,523	63,851	209,231
- Voters at booth	77,115	72,856	20,584	114,735	285,290
Turnout (%)	70.8	70.2	80.2	47.4	60.5
Rate of Favor (%)	89.5	84.4	79.3	67.5	

(Source: Construction of Medium-low Radioactive waste treatment disposal site: Status and issues)

Through this process, Gyeongju was finally chosen as a radioactive waste disposal site in 2005. We have briefly reviewed how the progress of the site selection procedure from 1986 to 2005. The government tried to achieve site selection by increasing compensation, enhancing democratic institution such as the participation of local residents, and building public relationships regarding safety issues. However, prior to the introduction of the competitive site selection procedure, all government efforts had failed.

Table 5. *The process of site selection*

Period	Process	Outcome	Method
’86-’89	3 candidates by documentary survey – Ulchin, Yeongdeok, YeongIl	Halt of feasibility study due to local disturbance	Designation
’90-’91	Closed investigation on Anmyeon island – implementation as research center	Cancellation due to local disturbance – Distrust regarding the disguised and closed process	Designation
’91-’93	Contest for volunteering candidates & Investigation for candidate sites (SNU) – selection of 6 candidates (Gosung, Jangheung,.)	Failed due to local disturbance	Designation Contest
’93-’94	Proposal as local support project to 3 applied regions	Failure due to local disturbance	Contest
’94-’95	Designated notification of Gulup island	Cancelation of notification following detection of capability fault	Designation
’00-’01	Contest between 46 local governments of littoral districts	Petition from 7 regions, but no application	Contest
’02-’03	Designation of 4 candidates- Ulchin, Yeongdeok, Gochang, Yeonggwang	Failure due to local disturbance	Designation
’03	Contest & Feasibility study- Gunsan, Buan, Samcheok (Opposition of feasibility study - Ulchin, Yeongdeok, Gochang, Yeonggwang)	Gunsan: Detection of capability fault Samcheok: Abandonment Buan: Applied, but failed due to local disturbance	Contest
’04	Introduction of bidding process - referendum	Petition from 7 regions, but no application	Contest
’05 3 Mar. 2 Nov.	Notification of a special law Referendum	Decision of Gyeongju site	Contest

(*Source*: The impacts of information cascade on residents’ collective preference: The case of nuclear waste disposal facility sites)

D. Analysis of Changing Approach

We have reviewed existing studies which analyze the site selection process of certain Korean cases. This chapter will provide a detailed examination of the reasons behind the success and failure of the site selection. The site selection project was classified from the 1st project to the 7th project as below:

- 1st project (1984 ~ 1989) : Ulchin, Yeongdeok, Yeongil
- 2nd project (1990.5 ~ 1990.11) : Anmyeon island
- 3rd project (1991~1994) : Goseong, Yangyang, Ulchin, Yeongil, etc.
- 4th project (1994~1995.11) : Gulup island
- 5th project (1996~2001.7): the whole country
- 6th project(2002~2004): Wi island at Buan district
- 7th project (2004.2~11): the success of site selection at Gyeongju

The change of compensation

The government can provide compensation for inducing local people's acceptance of danger if it emerges that the proposed facility has a potential negative effect. In fact, as local demonstrations grow in intensity, a drastic increase of compensation to local residents can be judged as a policy modification in order to obtain policy receptivity by offsetting the negative awareness of site selection.[26]

Compensation to local residents from the national government has risen dramatically as shown by Table 6. In addition to the special fund, additional benefits also exists such as the movement of a proton accelerator which can lead to regional development in the future, and the relocation of KHNP (Korea Hydro and Nuclear

[26] JuYong Jung, "Radical Change of Policy Acceptance – a case study on the location policy of radioactive waste disposal facilities in Korea", *Korea University* (2008).

Power)'s head office as well as the support of other ministries' local projects. However, despite this policy modification, the resistance of local residents has become increasingly difficult to cope with, specifically with regards to the 6th site selection procedure.

Table 6. *Changes of compensation*

	1st	2nd	3rd	4th	5th	6th	7th
Special Fund (KRW)	-	-	-	50bil.	125bil.	300bil.	300bil.
Additional Benefit	-	-	Support of desired local project	Support of desired local project	Support of desired local project	Moving of Proton Accelerator/ Head Office	Moving of Proton Accelerator/ Head Office
Remarks		90bil. to local govern.		50bil. to welfare foundation		Local developmen t project	Local development project

(*Source:* Radical Change of Policy Acceptance – a case study on the location policy of radioactive waste disposal facilities in Korea, 2008)

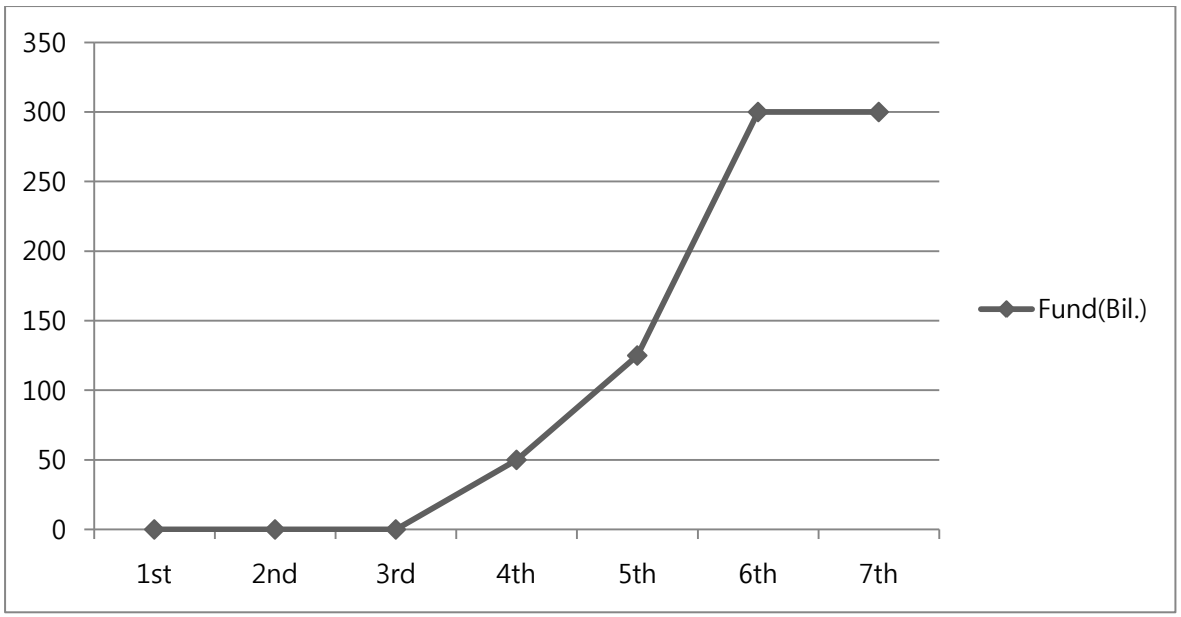


Figure 4. Changes in amount of special fund (Billion KRW)

This initial failure made the national government realize the importance of compensation. The government suggested that a 90 billion KRW special fund be provided

for local development and that land compensation should be paid for the purchase of site at the 2nd site selection project on Anmyeon island. This economic compensation positively affected the enhancement of policy receptivity, as land owners quickly agreed to this site selection.

However, the radical local demonstrations were far more severe than the 1st site selection project, and thus the 2nd site selection was canceled. The reason behind this was that the government expected to ensure policy receptivity by placing emphasis on compensation only, despite the fact that previous analysis at the 1st site explained that the reasons for failure were based on various causes such as closed procedures by peremptory government, distrust and anxiety regarding insufficient information. This demonstrated the impatience of the government, which chose a methodological approach to induce policy receptivity. The situation became more serious when anti-nuclear groups bonded with local residents.

The government announced a plan which supported the long-cherished local project of the radioactive waste management site through a nation-wide presentation. The purpose of this presentation was to enhance public awareness of governmental compensation, and to be done with the closed approach which had been used in the past. Accordingly, 44 regions declared their interest at the initial stage of the 3rd project, thus it seems that compensation led to the enhancement of policy receptivity. However, the resistance of anti-nuclear civic organizations and local residents began when the government announced 6 candidates for the site.

The response of the government to this resistance was to place more emphasis on compensation. The government established the ‘Promotion of radioactive waste management facility and support for periphery areas Act’. This was designed to appease local residents who were opposed to the site. The government did not recognize that the

aggressive activity of anti-nuclear civic groups had led to a sudden spread of opposite opinion. The governmental approach, which had obviously not taken on board lessons from past failures, ironically stiffened the logic of anti-nuclear civic groups ironically – 'The government press local people to bear the risk.'

The government consistently placed emphasis on compensation at the 4th site selection project in 1994. The government expected local people to react positively to compensation once a regional representative agency had been established on the act. In fact, the 'Committee for development and welfare of Deokjeok' was established, and the government provided 50 billion KRW as the fund for regional development. However, residents in Ongjin-gun and Incheon city together with the anti-nuclear civic groups resisted, and the demonstration intensified due to the opinion that the site was not scientifically feasible. The government overlooked a technological review on the safety of the site, since they were convinced of the success of the site and encouraged the institutional framework of economic compensation.

The compensation for the 5th site project was dramatically increased in 1996. KEPCO (Korea Electric Power Corporation) were then put in sole charge of the site selection, and raised the atomic energy development fund by setting 1.2KRW/1kw and promising to support local government with 260~300 billion KRW. The target of compensation was then expanded to the periphery area and local governments' jurisdiction. However, the 5th site selection project failed in spite of this dramatic expansion of compensation. The procedure of site selection included the agreement of local assembly, and reinforced the political pressure of anti-nuclear civic groups. Anti-nuclear civic groups had begun to exercise political leverage since the Gulup island case, but the government underestimated their capacity as a political force.

At the 6th site selection project on April 2003, the government announced that it

was increasing the special fund to 300 billion KRW. The promotion of a proton accelerator which was created added 460 billion KRW to the movement of KHNP's head office and supported the local project of 10 ministries. Nevertheless, this compensation did not result in policy receptivity. The procedure started with the application of local residents, and was passed through local assembly, before finally a local government head submitted it to the Ministry of Commerce, Industry and Energy. The site was designated by the government, thus the agreement of local assembly was able to directly connect to the site selection. As a result of this, the local assembly was reluctant to express their opinion.

The governor of Buan decided to submit the application for economic application on his own for economic compensation, which led to severe resistance from local people. In addition, the government approved this submission and pushed ahead the site selection. The opposition movement was intensified by the participation of anti-nuclear civic groups and religious leaders. The negative image of the site and distrust toward the government was strengthened, and thus 91.6% of voters in Buan opposed the site selection.

The amount of the economic compensation for the 6th and the 7th projects was almost identical. The only difference concerned new legislation, specifically a special Act regarding the management of medium-low level radioactive waste; a revelation which rallied support and trust among local residents toward the policy and the government. Accordingly, the compensation seemed to relieve any anxiety felt by local residents and helped local residents to recognize the advantages of local economic development. With this said, it is too early to conclude that the main factor in policy receptivity was economic compensation.[27]

[27] Ju-Yong Jung, "Radical Change of Policy Acceptance – a case study on the location policy of radioactive waste disposal facilities in Korea", *Korea University* (2008) : 132.

Diversification of deliberation structure

Groupthink causes errors in group decision making. It refers to the tendency for premature and extreme concurrence seeking among group members. It has been identified as one of the causes of major fiascoes, large planning projects and strategic management.[28] With this in mind, we should accept criticism from various parties regarding policy errors. To permit criticism would be helpful with regards finding errors in the past and rapidly exploring appropriate alternatives.[29]

The government accepted criticism regarding the involvement of various stakeholders in the process of enforcement and decision making to explore new alternatives and correct errors. This was because the government recognized the limitations of exploring various policy alternatives through a dedicated task force for the site selection. Moreover, the government attempted to prevent conflict factors in advance by taking on board the opinions of anti-nuclear groups. When looking at Table 7 below, we can see an improvement with regards to institutional concreteness as time goes by.

Table 7. *Change of deliberation structure*

	1st	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**
Site selection	Ministry	Ministry, Local govern.	Ministry, Local govern., Related organ., Experts	Ministry Local govern., (Pan Govern.)	Ministry Local govern., (Pan Govern.)	Ministry Local govern., (Pan Govern.)	Ministry Local govern., (Pan Govern.)
Draw candidates	Agency	Agency	Agency, Related Govern.	Agency, Related Govern.	MOCIE KHNP KONEPA	Agency, Related Govern.	Related Govern. Local Govern.

[28] Paul Hart, *Groupthink in government: A study of small groups and policy failure*. Lisse, Netherlands: Swets & Zeitlinger Publishers (1990) : 2.

[29] Yeong-pyeong Kim, *Uncertaintiy and Legitimacy of the policy*, Korea University Press (1991).

Selecting candidates	-	-	Local Govern. Citizen	Local Govern. Citizen	Local Govern./ Assembly Citizen	Local Govern./ Assembly Citizen	Local Govern./ Assembly Citizen
Institutional support			Establish Promotion Act		Revision of PeripheryAct	Revision of Atomic Act	Establish waste management Act

(*Source:* Radical Change of Policy Acceptance – a case study on the location policy of radioactive waste disposal facilities in Korea, 2008)

The concreteness of the laws and institutions tended to be strengthened as deliberation structure was expanded. The collapse of site selection made pan-governmental cooperation necessary in order to meet the requirements of local residents and anti-nuclear NGOs. Therefore, modification of the laws and institutions became easier than before. However, the claim that the diversification of deliberation structure improved policy acceptance does not seem very convincing. The demonstration of local residents became more violent until the 6th site selection project, meaning that the site selection was continuously defeated. Methods for enhancing public acceptance level – that is, trust in decision making procedures, trust in institutions, and unfairness of allocated benefits and costs – are not directly applicable to Korean cases in the same context.[30]

Enlargement of local people participation

Public participation in the site selection procedure may delete the avoidance factor and increase endurance factors by improving procedural fairness and the possibility of self-control. It seems natural that people hope to participate in the decision making procedure when the decisions and policy implementation affect their interests. The

[30] Ju-Yong Jung, "Radical Change of Policy Acceptance – a case study on the location policy of radioactive waste disposal facilities in Korea", *Korea University* (2008) : 138.

government attempted to expand public participation in order to secure public acceptance as shown in Table 8.[31]

Table 8. *Change of public participation*

	1st	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**
Selection Method	Driven by Government	Driven by Government	Public Contest / Driven by Government	Public Contest / Driven by Government	Provider Driven Contest	Provider Driven Contest	Public Contest / Referendum
Participation	-	Local Government	Local Citizen	Local Citizen	Local Government / Assembly/ Citizen	Local Government / Assembly/ Citizen	Local Government / Assembly / Citizen
Participation Method	-	-	Application of Local Society / Government Designation	Application of Local Society / Government Designation	Application of Local Society /Assembly Agreement / Government Designation	Application of Local Society / Assembly Agreement / Government Designation	Application of Local Society / Assembly Agreement / Open Competition

(*Source:* Radical Change of Policy Acceptance – a case study on the location policy of radioactive waste disposal facilities in Korea, 2008)

The public participation level was determined according to the site selection method of the government. The first project was implemented using a government-led procedure, meaning that the participation of local residents was alienated. Indeed, this closed procedure was one of the causes of this opposition. The claim that the resistance of residents stemmed from a lack of participation in the government's closed decision making processes seems to be persuasive.

This logic could be applied to the 2nd site selection project. The government carried out prior consultation with the Chungcheongnamdo (local government), but this was in fact a kind of strategy through which to avoid public participation. Local residents

[31] Ibid., : 133

on Anmyon island heavily criticized the government's behavior, and opposed it with anti-nuclear NGOs.[32]

The government adopted a contest site approach in order to enlarge public participation from the 3rd site selection project following the Anmyon island crisis. This contest site approach meant that the government selected the most feasible site as a final candidate among applications of local residents. It seemed as though the government expected higher public acceptance through the contest since economic incentive was determined. However, the backlash from local residents continued contrary to the government's expectations. It was impossible to eradicate all the causes of opposition. Indeed, the contest approach may only have reflected the will of a certain number of residents only, rather than the will of all the residents. In addition, the final candidate was designated by government only, meaning that most of the local residents who did not participate in the decision making process and anti-nuclear NGOs could join easily.

The government announced 5 principles of the site selection – Openness, Clarity, Reliability, Efficiency and Independence – to encourage the substantial participation of local residents. The government added one more method and gave residents the power to select the local project which they felt should be supported by the government. Participants selected this project during the application procedure. Despite this participation method change, there was more radical resistance on Gulup island, with the anti-nuclear civil groups becoming more organized. The participation of residents had its limitations in terms of the fact that the government selected Gulup island as the final candidate. Distrust felt by residents increased as an active fault was found on Gulup island.

KEPCO, the new stakeholder responsible for site selection, recognized that the

[32] Kyongdong Kim, Dooseung Hong, *Nuclear and Regional Society*, Seoul National University Press (1994).

opinions of a portion of residents could not ensure procedural justice, and thus implemented a new contest method – application from the head of local government in the base of local assembly's agreement. However, anti-nuclear civic groups placed political pressure on local Councils and government, which resulted in the failure of site selection. Environmental organizations defeated many movements made by local politicians regarding various environmental issues at that time, and the radioactive waste management site selection was no exception.

The government failed to provide any differentiated public participation policy for the 6th site selection project, meaning that they had to propose significant additional incentives and to expect agreement from local residents. However, the participation method of the 5th and 6th project could not eliminate the political pressure of anti-nuclear NGOs, because most local politicians were interested in their re-election, and as such, watched residents' reactions carefully. In addition, public participation was enlarged as the referendum was introduced, but the single application of a local governor at Buan seemed to lack procedural legitimacy. Indeed, resistance was still intense and it was difficult to expect rational and objective judgments from local residents.

The government site selection procedures had failed despite the continuous expansion of public participation. Public participation was one of the reasons behind enhanced public acceptance level, but it is difficult to find causal relations with procedural legitimacy. Meanwhile, there was a referendum at the 7th site selection project, the result of which was significantly different. Four local councils resolved the site selection agreement, and the resistance movement turned into the approval movement. A new rule was put into play – a competitive site selection.[33]

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[33] Ju-Yong Jung, "Radical Change of Policy Acceptance – a case study on the location policy of radioactive waste disposal facilities in Korea", *Korea University* (2008) : 135.

Main reasons of siting failure

Almost all of the policy corrections which the government attempted throughout the site selection procedure seemed to focus on the elimination of resistance. The government attempted to cover up local resistance by increasing compensation, enlarging public participation and diversifying deliberation structures in order to ascertain the main causes of this resistance.[34]

These efforts certainly contributed to an improvement in public acceptance level. If there was no compensation for locally unwanted land uses or decision making in an undemocratic way, it was natural to struggle with radical resistance. However, the crucial point was that the government focused more on adopting new artificial methods for covering the resistance of local residents than they did on recognizing casual texture in order to handle artificial causes and situational condition together. The possibility of repeated failure would only arise if methods for raising public acceptance level failed to recognize causal texture. Indeed when this was recognized it caused the government to adopt an experimental alternative policy.[35] For example, with the 3rd site selection project, the government attempted to implement the site selection procedure in island areas to avoid regional resistance despite the fact there had been more radical resistance movement of residents and anti-nuclear groups at the 2nd site selection project. Indeed, this can be viewed as a typical policy correction failure.

An alternative policy for ensuring public acceptance was not limited by the relationship with government and local residents. It involved a complex structure of various causes – political situations, economic situations, social issues and activities of stakeholders who affect recognition of local residents, and so on. However, the government did not focus on this kind of complexity.

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[34] Ibid. 138.

[35] Yeong-pyeong Kim, *Uncertaintiy and Legitimacy of the policy*, Korea University Press (1991).

One of the main problems in the study of organizational change has to do with the fact that the environmental contexts in which organizations exist are themselves changing at an increasing rate, under the impact of technological change. This means that they demand consideration for their own sake. Towards this end a redefinition is offered, at a social level of analysis, regarding the causal texture of the environment.[36]

It seems impossible to consider all kinds of causal texture and to recognize the causal structure of public acceptance. Moreover, we cannot be sure that the new alternative policy would achieve the intended interactions, when we can recognize the causal structure perfectly. The interaction among various textures, timings and stakeholders can generate chaos and disorder, whilst also rendering policy alternatives useless. Therefore, it could be said that every policy decision returns to the problem of uncertainty, and accompanies policy errors.[37] The government must identify all possible causes which affect public acceptance, and attempt to recognize causal structure.

Key features of changing public receptivity

The correction of policy failure did not yield only negative results. The democratic procedure was improved by including the agreement of local council, which reduced the distrust of local residents. People began to take an interest in site hosting due to increased compensation, and continuous public relations which reduced negative opinion regarding radioactive waste management facilities. In other words, the government can identify the demand of local residents through several failed cases and error correction. With this in mind, the foundation for rapid change of public acceptance could be prepared. If the government were to implement site selection in a closed process or did not provide proper compensation for acceptance of risk, public acceptance level

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[36] F. E. Emery, E. L. Trist, "The Causal Texture of Organizational Environments", *ORGANIZATION CHANGE: A COMPREHENSIVE READER* (1965) : 18.

[37] Yeong-pyeong Kim, *Uncertaintiy and Legitimacy of the policy*, Korea University Press (1991).

could simply not be high. Thus, the policy correction aimed at fulfilling residents' demands was necessary in order to achieve a rapid change in public acceptance.

The new rule of game - competitive hosting through the referendum - made candidates gather information on competitors, revise their own strategy for agreement, and explore new strategies. In conclusion, public opinion tilted to host the site. The purpose of the four competitors was to achieve the 1st prize only, as the 2nd prize meant defeat. Therefore, blocking opposition was strengthened and emphasis was placed on the agreement of public opinion. All candidates limited anti-nuclear NGO activity, and emphasized that there would be no repeat of the 'Buan case.' Supporters submitted the application of meeting in advance in order to block opposition campaigns and to criticize the anti-nuclear civic groups. Indeed, the activities of opposition groups were decreased and abandoned. Radical change of public acceptance is only possible when conditions are present which can rally more support than opposition and achieve continuous positive interaction.[38]

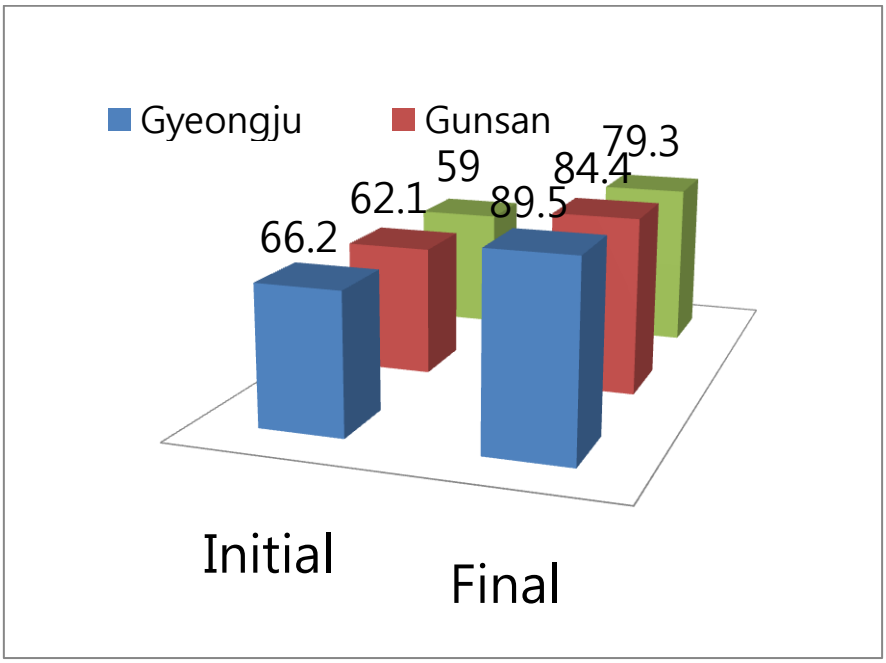

Figure 5. The result of referendum after the competition

[38] Ju-Yong Jung, "Radical Change of Policy Acceptance – a case study on the location policy of radioactive waste disposal facilities in Korea", *Korea University* (2008) : 135.

E. Remained Conflicts

Despite the eventual success of the site selection, there remained challenges with regards to managing the facility in a sustainable manner. There remained an anti-nuclear movement, as well as demonstrations and on-going conflicts. To resolve the communication problem of social conflict, the deliberate democracy was accepted as a new paradigm in the most useful way. However, we can see that the democratic system and policy led to a paradoxical result. The government introduced an innovative framework as governance is the base of transparency and participation. However, this was transferred to the local elite alliance. The referendum became a measure of political legitimacy, and some criticized this referendum for being an unfair game without a judge. There were many problems pertaining to the poll – preliminary poll movement by the local government, falsifying of absentee ballot, open ballot, proxy voting, provision of money and values, and instigating regionalism.[39] Therefore, the question arises, how will the site selection be evaluated? Is it the splendid achievement of deliberative democracy as the government insisted? Or, is it a plausible story of an unfair game as stated by anti nuclearists ? Moreover, if the referendum was taken with justice, are there no matter?

Similar to the perspective of democracy, the referendum is meaningful when there is enough information regarding the issue and sharing opinions. This referendum premised competition among other local governments, and stimulated the encouragement of regionalism. In this situation, can the social consensus be evaluated as part of a democratic procedure? After the initial survey, each local politician employed a different approach in their region. In the case of Gyeong ju, the local government promoted actively using mass media and the press, whilst a promotional organization attempted to

[39] Sun-Jin Yun, "The construction of radioactive waste management facility : Current Status and Issues", *Energy Focus* (2005) : 24.

persuade residents one to one.[40] At the first poll, the rate of voting in favor was 66.2% in Gyeongju, 62.1% in Gunsan, and 59% in Yeongdeok. After fierce competition for inducement, the rate became 89.5% in Gyeongju, 84.4% in Gunsan, 79.3% and in Yeongdeok. In Gunsan, acts of violence were carried out by residents and organizations to oppose this move (KukminIlbo, 2005).

IV. A COMPARATIVE STUDY ON PERIODIC CHANGE OF SITING APPROACH FOR RADIOACTIVE WASTE MANAGEMENT FACILITY

The time required to construct a repository, emplace waste, and to seal and close the repository is at least 50 years. Indeed this is according to the most optimistic plans which have been put forth for the U.S. and other national programs. Some national programs envision a period of at least a century before accomplishing the geological disposition of high-level radioactive waste (HLW). Leaders in the governments of democratic societies have to deal with many controversial issues whereby local and provincial interests and attitudes must be balanced against national goals. One can observe in many areas of the world strong conflicts among nations and ethnic groups, whose roots in public attitudes go back many centuries. Progress in resolving these conflicts has often required arduous negotiation, innovative leadership from within each of the parties and from outside mediators, and patient efforts to make progress in small steps.

Similar processes may be needed in the nuclear waste context regarding the related concerns of dread, distrust, and concerns about inequities. Progress will not come

[40] Yeong-Jong Kim, "Analysis on policy network along radioactive waste management facility site selection", *Journal of Policy Science*, 9(4) (2005): 305.

over night, and continued controversy, criticism, and dissent should be expected. There have not been many policy problems which require a half-century deliberation process. Knowledge is now accumulating on new methods by which to achieve public decisions.[41] During the coming years, there will be a significant, ongoing challenge with regards to alleviating pressures on waste managers to revert to a very short decision and evaluation cycle. The change of approach regarding site selection has shown characteristic aspects, depending on the culture and history of each country. This study roughly categorizes these characteristic aspects of site selection.

A. One way decision by Government (1960~1970)

Countries who built radioactive waste management facilities in the 1960s took the position of the government driven process. In fact, it was the most common way to select the site at that time. The concept of 'citizen participation' and 'anti nuclear movement' had not yet emerged, meaning that the radioactive waste management facility could be built without serious opposition and resistance.[42]

In the case of France, all siting decisions were made by the government based on technical judgments regarding the merits of the site, and did not involve much participation from the public nor local officials prior to 1990. Four sites were selected in this way and geological surveys at various levels were conducted. However, the implementer, ANDRA, experienced local opposition, and in some cases, violent demonstrations occurred. This led the French government, in 1989, to declare a

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[41] Renn,et al. *Competence and Fairness in Citizen Participation : Evaluating Models for Environmental Discourse*, Kluwer, Dordrecht. (1995).

[42] Seong Kyong Cho, *The Reverse Side of the Radioactive Waste Management Facility - the Danger on Doma (Defend Only My Area)* (Seoul: SERI, 2005) : 70.

moratorium on all site investigations.[43] The La Manche radioactive waste management facility of France was built in 1969. There was no specific conflict between local residents and the government as there was little inception on the radioactive waste management facility. However, the side effects from this simple site selection have emerged with the passage of time. Indeed, contaminated material from the corrosion of metal drums leaked into underground water due to lax management. Following this, the French government addressed this problem with engineering and technology, whilst an investigation was also carried out and monitoring was coordinated with local residents. According to this process, most local residents are trusting regarding the 'safety issue.' However, there remained a burden - the doubtful attention of other regions on the agricultural and marine products of this region.[44]

B. Decide-Announce-Defend Method (1970~2000)

The detail format has been changed with the passing of time. Indeed, the DAD (Decide-Announce-Defend) method has been most commonly used to establish and operate the policy of the radioactive waste management system. First of all, this method involves the selection of a site based on technological analysis to fulfill the needs of the facility. Throughout the selection process, there are no discussions with other stakeholders (or interest groups) who expect a different decision. Following this, a government announces the established policy to its citizens. However, most of the citizen oppose and resist the policy announcement, as previously summarized. Therefore, the government creates many options to defend their choice against citizens' opposition.

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[43] *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges, ed.* Committee on Disposition of High-Level Radioactive Waste Through Geological Isolation, et al. (Washington, D.C: NATIONAL ACADEMY PRESS, 2001).,136.

[44] Seong Kyong Cho, *The Reverse Side of the Radioactive Waste Management Facility - the Danger on Doma (Defend Only My Area)* (Seoul: SERI, 2005) : 71.

Armour explained that governments choose a DAD method, because they regard the decision of sites like radioactive waste management facilities as an inherent right of them. However, as the society becomes diversified, the unilateral decisions of governments arouse a strong opposition from related stakeholders and local residents. Consequently, the expected efficient policy implementation cannot be achieved, and the policy itself is abandoned.

The case of the UK demonstrates the main problem encountered when siting excludes the participation of local residents and transparency. In the early 1990s, NIREX, the organization in charge of managing radioactive waste, selected a site near Sellafield based on multi-attribute utility analysis. NIREX requested approval for a research facility which would investigate underground rock, but Cumbria, the local government rejected the approval. NIREX appealed, before responsibility for the decision was handed to the minister of the Ministry of Environment following a long confirmation hearing. The hearing investigator submitted a guideline of rejection to the approval to the minister of Ministry of Environment. In conclusion, NIREX decided to give up the site of Sellafiled in 1997.

The reasons for the approval rejection involved a long history of lack of transparency regarding the NIREX research for a site selection. NIREX did not propose any other alternative candidate sites, and insisted that discussions regarding the local effect of a radioactive waste management facility should be delayed until after the feasibility study of the site. These kinds of attitudes would certainly not gain the trust of local residents. NIREX has enhanced transparency and created improvements such as the recent operation of public hearings, although they have been unable to recover the trust of local residents.[45]

[45] "One Step at a Time," *In The staged development of geologic repositories for high-level radioactive*

In France, site-screening criteria prior to 1991 covered purely geologic safety aspects as previously mentioned. The French government requested a future direction for siting to OPECST, the parliament's science evaluation office, after the announcement of Moratorium on every feasibility study before 1989. The public hearing was led by Christian Bataille, as a member of the National Assembly went through the pass of 'Waste Act' in 1991. According to this, France decided to search for a site, research the waste treatment process and investigate other site options.[46]

C. Joint Research and Mutual Agreement (1990~)

New approaches to managing environmental conflicts, particularly environmental negotiation and mediation, have been increasingly employed since the early 1970s in order to help resolve some of these disputes. These processes are new to citizen groups, and differ from the established strategies and tools. The techniques include collaboration among contending interest groups instead of adversarial relationships; they involve consensus decision-making rather than judgments by authorities. Consequently, dispute resolution processes require new, and different skills as well as perspectives on the part of citizens.[47]

In France and the UK, earlier negative experiences regarding site selection have led to the re-evaluation and redirection of the overall national programs. In France a period of successive crises meant that, in 1991, a law was put in place which instituted a new approach to waste management in general, and site selection in particular, with

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waste, ed Committee on principles and operational strategies for staged repository systems and national research council. (Washington D.C: The national academies press, 2003). p.169

[46] *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges*.,136

[47] James E. Crowfoot and Julia M. Wondolleck, *Environmental Disputes : Community Involvement in Conflict Resolution* (Washington D.C: Island Press, 1990) : 1

responsibility, transparency and democracy as lead principles.[48] This law specified that work would continue in parallel on a 15-year time scale on developing repository projects, studying waste treatment (including partitioning and transmutation), and further clarifying the issues associated with surface storage.[49]

The new approach to site selection seeks consensus with, and actively involves, responsible territorial communities. The Law institutes a local information and monitoring committee on each underground laboratory site. A mediation mission by Mr. Christian Bataille, Member of Parliament, led to the appointment of one site for an underground laboratory – with a second site still being sought.[50]

In 1994 with the agreement of the local communities, the mediator proposed 4 sites, out of an initial potential list of 30 sites, to the government. These sites were: La Chapelle-Baton, situated in the Vienne Département, in a granite formation overlain by a thick sedimentary cover; Marcoule, in the Gard Département, in a thick clay formation; and two sites subsequently merged into a single Eastern site at the boundary between the Départments of Meuse and Haute-Marne. This site, also in clay, was acceptable to both adjacent communities.

The geological reconnaissance programs went smoothly, and in 1996 ANDRA prepared three EIAs which were submitted to the local communities through an interactive public enquiry, as well as to the local assemblies, to several review bodies (including the Commission Nationale d'Evaluation, created by the Waste Act), and to the government. In France, local authorities do not have power of veto. The final decision came on December 8, 1998, when the government decided to go ahead with the sinking

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[48] OECD, "Public Information, Consultation and Involvement in Radioactive Waste Management," *In An International Overview of Approaches and Experiences*, (NUCLEAR ENERGY AGENCY ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, 2003).,24.

[49] *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges*.,136.

[50] "Public Information, Consultation and Involvement in Radioactive Waste Management.",24.

of a shaft and the building of an underground research laboratory at one of the three sites (the Eastern site, at the village of Bure), and to drop the two other sites. Work is now in progress at the Eastern site where, by February 2001, the shaft had reached a depth of 50 meters. The Marcoule site was abandoned because of local opposition, essentially from the wine growers, who argued that the siting of a waste facility would jeopardize the image of the local wine, Côtes du Rhône, independent of whether the site was shown to be safe or not. The La Chapelle-Baton site was abandoned, not because of local opposition (on the contrary, local support existed at this site), but essentially because the Commission Nationale d'Evaluation expressed a number of scientific reservations about the intrinsic quality of the site.

The government also decided that a new site in a granite formation was to be selected. The 1991 Waste Act specifies that at least two sites must be examined prior to 2006. At that time, the parliament will examine the outcome of the research program pursued from 1991 to 2006 on the geologic disposal option, and also on the separation-transmutation option and the surface storage option.

Accordingly, the French Geological Survey and ANDRA carried out a survey of potential granitic sites in France, starting with existing literature and data without any local field work. From an initial list of approximately 200 potential sites, using various geologic criteria, the list was shortened to 15 new sites, distributed mostly over two areas, Brittany and Central France. This list was handed over to the government in October 1999 but was not released to the public. Rather than using a member of parliament to seek approval from potential local communities, the government appointed three high-ranking civil servants, none of whom had any prior links with the nuclear establishment, to conduct local discussions in some of the 15 selected areas. These officials prepared informative documents to be presented in the local communities. The official visits to the

15 sites and their local communities were set to commence when, in January 2000, the map showing all 15 sites was leaked and posted on the Internet by an opposing non-governmental organization. The result was that all 15 selected sites were antagonized upon the discovery that they had been selected without knowing about it. Following this, any subsequent discussions proved very difficult for the three officials. They encountered strong local opposition and demonstrations, some of which were violent. The government decided to stop the process, and none of the proposed 15 sites were selected. At present, it is unknown what the next move will be, since a second site must be identified if the terms of the 1991 law are to be fulfilled.[51]

In the UK, the refusal of the Nirex Rock Characterization Facility at Sellafield in 1997 led to a complete reappraisal of radioactive waste management policy. A Parliamentary enquiry in 1999 recommended that the government go ahead with underground disposal but that its policy must be comprehensive and must have public support. The government replied that it would seek public views but that it would look at all waste management options before endorsing one particular plan. After consultation, Ministers announced the creation in 2003 of a new independent body to oversee the review and to recommend the best option, or a combination of options if necessary.

The events of 1997 also led Nirex to adopt a new Transparency Policy (1999) with a dialogue on the future long-term management of wastes. A number of dialogue processes are now being tested and used. Although it is too early to evaluate, the new approach has received initial positive response. In Spain, a delay in the program allowed for a strengthened educational program, which met with a very favorable response.[52]

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[51] *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges.*,137.

[52] "Public Information, Consultation and Involvement in Radioactive Waste Management.",24.

Sweden is the representative country which tried to solve the conflict on nuclear issues since the initial stage. The radioactive waste management facility of Sweden was built on the trust of citizens. In Sweden, local communities have veto power over decisions affecting local planning in general, and particularly facilities which have the potential to affect the environment. Situations are also foreseen in which the government can overrule the local veto on grounds of national interest. Facilities for radioactive waste disposal are mentioned in this context, and the circumstances under which the government would use this power have been rigorously debated. On the basis of interaction with various segments of the public in the early feasibility studies for siting, the Swedish implementing organization, SKB, has clearly stated that it will conduct investigations and build a repository only in a community where there is local acceptance or tolerance for it, thereby respecting the spirit of the community's veto power. Local officials and members of the public have taken an increasingly active role in evaluating program plans and setting conditions. In addition, Sweden has set forth specific plans for a phased implementation procedure, with part of the repository being backfilled, sealed, and monitored for decades before completing the rest.

The Oskarshamn experience in Sweden demonstrates how an EIA process can be carried out as a fruitful and effective exchange by all parties in understanding the risks to the public posed by a nuclear waste storage facility. Elected representatives of the community were extremely active in developing the technical competence to evaluate program proposals and in ensuring that the implementer would be informed of local views and needs. When Oskarshamn (already a nuclear site) was named as the preferred site for a HLW encapsulation plant by SKB in 1992, the municipality announced two main prerequisites. First, municipal participation in discussions and investigations was to be paid for by the Nuclear Waste Fund; second, the primary concerned parties (SKB and

the licensing authorities SKI [Swedish Nuclear Power Inspectorate] and SSI [National Institute of Radiation Protection]) would accept the formation of a forum for environmental impact assessment. A local "reference group" is a standard feature in large or controversial Swedish siting discussions.

As competence to evaluate the program was built up through six multipartite working groups which have remained active, the implementer's competence itself was "stretched" to respond in a satisfactory way to the questions posed by the community. This non-adversarial but determined dynamic, led by elected officials, is considered by the partners involved as contributing directly to a more robust set of management options, and a more tightly knit and informed community. This strong public involvement assures that a final consent or veto decision will be made on adequate grounds.[53]

Canada's siting efforts for a low-level waste (LLW) facility in the Canadian province of Ontario were based on "voluntary participation of local communities in a collaborative, joint decision-making manner" (MEMR, 1990) including "structural and process guarantees that local participation [was] and remain[ed] voluntary."[54] The process came close to completion but was ultimately unsuccessful, in part due to "uncertainty about government resolve to continue the process as designed."[55] For example, the federal government refused to accept the community agreement in principle negotiated by a task force and the community.[56] Comparative evaluations of a number of

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[53] *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges.*,135.

[54] Peelle, E. "Voluntary versus directed siting—Or somewhere in-between? In: High-Level Radioactive Waste Management", *Proceedings of the 5th Annual International Conference, Las Vegas, Nev. May 22–26 . La Grange Park, Ill.* : American Nuclear Society . Vol. 1 (1994): 205.

[55] Peelle, E. "Voluntary versus directed siting—Or somewhere in-between? In: High-Level Radioactive Waste Management", *Proceedings of the 5th Annual International Conference, Las Vegas, Nev. May 22–26 . La Grange Park, Ill.* : American Nuclear Society . Vol. 1 (1994): 205.

[56] Richardson, P.J. "A review of benefits offered to volunteer communities for siting nuclear waste Facilities", *Stockholm : Swedish National Co-ordinator for Nuclear Waste Disposal* (M 1996:C) [on-line]. Available at: http://www.radgiv-karnavf.gov.se/publikat/incitame.htm.

such efforts involving both LLW and hazardous waste indicated that it is "very difficult for large bureaucracies to surmount internal constraints and technically oriented norms and goals to meet requirements (of voluntary siting programs) for responsiveness and adequate implementation."[57]

Between 1990 and 1993, the Belgian government agency responsible for waste management in Belgium, ONDRAF/NIRAS, conducted a survey of the Belgian territory to identify zones where a near-surface repository for low-level short lived wastes might possibly be installed. The survey was based on technical and scientific criteria, of which the most important was geologically favorable conditions. In total, 98 such zones were identified, and the results were made available in a report. However, that report was rejected unanimously by all municipalities concerned. Given the deadlock, the government decided that further studies should concentrate on the existing nuclear zones: power reactors, fuel cycle industries, and major research facilities.

ONDRAF/NIRAS opted for a new approach which would involve local authorities, two universities, and local populations in the site selection and planning of such a repository through the creation of local partnerships. Two such partnerships are already operational for the Mol-Dessel zone to consider technical, safety-related, social, economic, and environmental aspects. The final assessment and responsibility, primarily for aspects related to long-term safety, are the exclusive prerogative of ONDRAF/NIRAS. The conclusions of this exercise should be available no later than 2002.[58]

Of all countries, Finland has probably had the most success in moving toward siting a deep repository with maximum community involvement and public confidence.

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[57] Peelle, E. "Voluntary versus directed siting—Or somewhere in-between? In: High-Level Radioactive Waste Management", *Proceedings of the 5th Annual International Conference, Las Vegas, Nev. May 22–26 . La Grange Park, Ill.* : American Nuclear Society . Vol. 1 (1994): 210.

[58] *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges :* 138.

From studies at a number of potential sites, the choice was narrowed to two sites which already have nuclear facilities, with an emphasis on demonstrating that the geological conditions at these sites were no less suitable than at others. The EIA process was seized on as a means for in depth consideration of public concerns and needs. Thereafter, competition even broke out between the two communities seeking to host the Finnish spent fuel repository. The balance achieved in Finland between geological and societal criteria for site choice certainly warrants further study.[59]

D. Lesson Learned from other countries - To Improve Citizen Participation

Strategies of partnership, power sharing, collaboration, and negotiation allow a host community to proceed with a siting process which relies less on trust in some external authority rather than on the host community's own capabilities and evaluation.

Specific mechanisms which may be helpful in such an approach include the following:

- Community participation in all phases of the siting process;
- Support for independent consultants;
- Community review of facility design and safety systems;
- Monitoring of facility performance;
- Property value protection; and
- The right to initiate appeals for facility shutdown if health and safety standards are violated.

Such actions to empower local communities in both siting and facility development may be the key to improved siting success. Different means may be used to

[59] Ibid.139.

develop these recommended features. The Environmental Impact Assessment (EIA) requirement has been used, particularly in Scandinavia, as an opportunity to conduct social impact assessment. The EIA process therefore becomes a means by which extra-technical aspects of risk can be discussed, documented, and taken into account.[60] The five country examples which follow, showing the experience of different countries with siting, may be useful as illustrations.[61]

The political leaderships of various nations have reformulated nuclear waste programs in order to emphasize the need for societal choice. Concerted efforts are being made to design, adapt, test, and carry out new procedures for, and approaches to, decision making. Two broad types of shift are particularly apparent.

The first type of shift seen today in many countries concerns the consideration given to needs, concerns, views, and judgments which lie outside the central waste management system. Examples include the following:

Collaborative research with volunteer communities to obtain equitable implementation. For instance, a "volunteer principle," in which one begins the siting process by eliciting expressions of interest from communities over a wide region or in the entire country, has been attempted in France, Sweden, Finland, Canada, and other countries.[62] The widespread adoption and elaboration of the concept of reversibility, often absent from early program concepts and introduced by public demand. Examples of this include the European Union's concerted action program, CNE (National Commission for Evaluation) in France, and KASAM (National Council for Nuclear Waste) in Sweden

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[60] Äikäs, T. "Underground research facilities: Enhancing public confidence for geologic repositories", *Proceedings of the Conference on Geologic Repositories: Facing Common Challenges, Denver, Colo., October 31–November 3* . Washington, D.C. : Department of Energy (1999): 95–96 .

[61] *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges :*132.

[62] Richardson, P.J. "A review of benefits offered to volunteer communities for siting nuclear waste Facilities", *Stockholm : Swedish National Co-ordinator for Nuclear Waste Disposal* (M 1996:C) [on-line]. Available at: http://www.radgiv-karnavf.gov.se/publikat/incitame.htm.

which have collected input on reversibility. Sweden has pushed the concept of reversibility to the point of submitting the entire repository to a pilot evaluation period.

The second type of shift involves clarification of institutional identity and the relative roles of stakeholders. Examples are the following:

The sharing of decision power among nuclear authorities and national and local representations. For instance, France shifted emphasis from evaluating designated sites for repository suitability, to creating a "responsible, democratic, transparent" management process and placing HLW management choices in the hands of parliament (the 1991 Waste Act). Finland will also seek parliamentary approval for a design concept and submit this concept to local examination. In Sweden, the Swedish Nuclear Fuel and Waste Management Company (SKB) has promised to make site investigations only in communities where such investigations are accepted.

The remodeling of implementing agencies is taking place in order to increase trust. For instance, in 1991 France recreated ANDRA (National Radioactive Waste Management Agency) as a new agency independent of the Atomic Energy Commissariat and other waste producers. The 1998 Seaborn Committee Report to the government of Canada and recommended the establishment of a new management agency "at arms length from the utilities and AECL (Atomic Energy of Canada, Limited), with the sole purpose of managing and coordinating the full range of activities relating to the long-term management of nuclear fuel wastes . . . subject to . . . policy direction from the federal government, and to regular public review, preferably by parliament" (CEAA, 1998, p. 3). Plans are being made in the United Kingdom to hold a public consultation to address options for waste management, including how to make Nirex an independent organization (Observer, 2000).[63]

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[63] *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical*

E. Risk Communication for the Siting Procedure

To solve this conflict between announcing agents and the public, the communication strategy begins by listening to the public and moving in a more acceptable direction. Risk communication is an interactive process of exchange of information and opinion on risk among risk assessors, risk managers, and other interested parties. Working the crowd is essential for a technology such as nuclear energy, which depends on the public's acceptance to host plants, invest in industry firms, and support government subsidies and loan guarantees. Proponents want the world to believe that the public will be increasingly open to an energy source which directly produces no greenhouse gases, while opponents want the world to believe that the public will increasingly fear accidents, cost overruns, the uncertain future of nuclear waste, and the diversion of weapon-grade material to bomb making. Therefore, management must consider communication in all activities. (Baruch, 2009) In this case, the policy to construct a radioactive waste disposal system was postponed repeatedly in spite of all the government's efforts during many years. Finally, in 2005, it was concluded to that a site in Gyeong-ju city should be selected at after 20 years of conflict and enmity.

If the nuclear energy industry is to be regarded as a responsible partner with the public, it must change the way it communicates. (Greg, 2011) Corporate management must think of its external communications as key parts of the firm's activity, and not as an undesirable necessity. Rowan[64] has identified five possible goals of risk communication. They are: building trust in the communicator; raising awareness (e.g. of a potential hazard); educating; reaching agreement (e.g. on a particular strategy for cleaning up a hazardous waste site); and motivating action (e.g. encouraging people to practice safe sex

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Challenges : 129-130.

[64] Rowan KE, "Goals, Obstacles, and Strategies in Risk Communication: A Problem-Solving Approach to Improving Communication About Risks," *Journal of Applied Communication Research* (1991).

or reduce the levels of radon in their homes). Because of this multiplicity of purposes, different strategies of risk communication may be appropriate for different goals. For example, simple vivid risk communication messages are best for raising awareness, while stakeholder participation methods are likely to be more appropriate for reaching agreement on a course of action. Even the measures of success may vary depending on the purpose of the risk communication effort.

The multiplicity of risk communication purposes and measures of success means that the process of needs assessment should be prioritized before the actual undertaking of a risk communication effort. Needs assessment consists of answering a series of questions in the process of planning a risk communication effort. It is intended to be fairly general Ð , that is, to help risk communicators think through the who, what, and why of their need to communicate risk analysis results or risk-informed regulatory decisions before designing specific risk communication messages. For example, Lundgren & McMakin[65] noted that the scope of a risk communication message may be constrained by legal requirements, institutional policies, and audience characteristics, all of which need to be understood.

Accumulated experience throughout many countries and a growing body of social science research indicate pathways for improved siting strategies. A set of "siting guidelines"[66] highlights the issues that a process of siting hazardous facilities should expect to encounter. These guidelines should not be regarded as an operational manual for siting or as any sort of "ultimate" answer to managing a siting process. The guidelines are intended simply as useful advice drawn from experience on siting hazardous facilities in a number of countries.

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[65] McMakin A Lundgren R, *Risk Communication: A Handbook for Communicating Environmental, Safety, and Health Risks* (Columbus OH Battelle Press, 1998).

[66] Kunreuther, H. Fitzgerald. K&Aarts, T. "Siting Noxious Facilities: A Test of the Facility Siting Credo" *Risk Analysis*, 13(3) (1993).

The guidelines address three key features of any siting process. The first set relates to goals and objectives: instituting a wide participatory process, seeking consent that the status quo is not acceptable, and working to develop trust. The second set concerns appropriate outcomes: choosing the best solution to the problem, guaranteeing that stringent safety standards will be met, fully addressing negative aspects of the project, making the community better off, and using contingent agreements. The third set relates to appropriate processes: using a volunteer system (even one of competitive bidding), aiming for geographic fairness in burden sharing, setting realistic planning schedules, and keeping a range of options open at all times. (Lesbirel & Shaw, 2000)

V. Conclusion

Through the comparative study between cases of various countries, this study covered conflicts around the selection of a nuclear waste disposal site. The study also reviewed how the risk communication played a role in resolving environmental conflict. One additional puzzle remains, namely to identify the reason why many approaches to site selection have failed and how the Gyeong-ju managed to achieve consensus.

The Roh government introduced an ‘innovation framework’ paradigm to enhance economic autonomy. He recognized this conflict as resulting from failure of centralized decision making processes which excludes local government and civil society. He therefore attempted to initiate innovative framework through which to develop horizontal decision making, a regional competition system and democratic policies such as the referendum. The central government evaluated the competitiveness of local government and provided a discriminative incentive. This competitive framework led to infinite competition among local governments – local governments tried to procure national

projects which guaranteed stable investment.

Discussions regarding factors affecting the site selection of radioactive waste management disposal can be categorized as the provision of economic incentive, public participation on policy decision making and the difference of risk identification. To solve this conflict, it is necessary to understand differences on an ideological basis of pros and cons.[67] In essence, supporting a particular side is based on neutral techno-centeredness. They regard nuclear waste as an unavoidable by-product which results from the resolution of an energy problem. They believe that the development of science and technology as well as accurate information provision can solve the problem of site selection. In contrast, the arguments of opposing sides are based on ecology. They feel that the crisis of human civilization has resulted from excessive use of technologies and that only an ecological approach can solve this problem. From their perspective, a 'social consensus on non-nuclear energy' is the priority, as it would allow for safe management steps to be taken towards the efficient use of existing nuclear power plant sites.[68]

This site selection issue could well lead to environmental damage, the violation of property rights and change of local economy.[69] It is the NIMBY facility which could cause negative externality - noise, damage to health, destruction of nature and a fall in the economy of certain regions. Meanwhile, it could also distribute benefits to a broad range of national territories, and thus cause an imbalance of the cost-benefit situation.[70] If there is no economic incentive to residents of sites, this will arouse resistance. When the government utilize this economic incentive, fairness of distribution is important as well as

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[67] Jin Seok Jeon, "The study on Policy Change for Building the Nuclear Waste Dump through Advocacy Coalition Framework", *Study of Local Government*, Korean Local Government Society, Vol.7, No.4 (2003).

[68] Sohee Kim, " Remained task and significance of demonstration against the radioactive waste disposal site in Gulup Island", *Environment and Life* (1995).

[69] Paul Slovic and others, "Perceived Risk, Trust, and the politics of Nuclear Waste" *Sciences* 254 (1991).

[70] Soonae Park, Jihan Lee, "Policy Failures: Siting a Radioactive Waste Disposal Facility in South Korea), *Environmental Policy*, Vol.13, No.2 (2005) : 90

the amount of finance. Ranking incentive according to the distance from the main facility is difficult, and neighboring districts may be dissatisfied. The Korean government recognized the importance of economic incentive after the first failure of 1986. From the zero base, the amount of special fund has been increased rapidly – 90 billion won in 1990, 125 billion won in 1994, and 300 billion won in the final decision.

One of the characteristic features of radioactive waste is the uncertainty of risk. Expert says that it is contained within safe radiation shielding in an iron drum with concrete, and a thorough monitoring system is in operation. However, it is impossible to prove safety perfectly, and these risk factors can be linked to serious problems such as irreversibility of recovery, wide scope and long term effect of damage.[71] The human perception of radiation risk can itself lead to physical, psychological, social and economic harm, often regardless of the radiological harm itself. Risk communication is a tool used for managing these risks, and should be given much greater emphasis at the most senior levels of any organization concerned with the peaceful application of nuclear science. (Ropeik, 2008) With regards to this selection of a site, the local government promoted public relations but residents suffered from information asymmetry. The information from the opposing side was not delivered effectively.[72]

As we can see in 'Incentive policies to site hazardous facilities' (Kunreuther, 1991), the resistance of residents showed similar features regarding the developing decision. Throughout the process, we bore witness to undemocratic procedures, closed information sharing, concerns with safety, declines in trust level regarding transparency and oppressive action toward residents. The policy acceptance level is determined on the base of trust between residents and policy executors, and decision making processes

[71] Dong-Gun Byun, "Matter of energy policy and radioactive waste management policy in south Korea" 2000).

[72] Sun-Jin Yun, "The construction of radioactive waste management facility : Current Status and Issues", *Energy Focus* (2005).

should have openness and transparency. The level of awareness regarding risk also differs between experts and residents. According to the survey on assessment of risk, residents regard the leakage of radiation as seriously as the crisis of nuclear war.[73] In the early stage of site selection, the government led the discussion unilaterally, but after the failure on Anmyon island, they started to promote public relations in order to gather the opinions of local government and residents from the 3rd plan for site selection. However, this framework could not identify the core needs of residents, and thus the government attempted to compose a committee from the 4th plan. This committee was also limited to the materialization of economic incentive, rather than for collecting public opinions, meaning that it failed to achieve solid trust from residents. Through the 5th and 6th plan, the discussion framework was also enlarged to all related governmental organizations, foundations, local politicians and NGOs. It enhanced the institutional framework as well as the diversity of discussions and acceptance of residents.

[73] Yearn-Hong Choi, Young-Min Oh, "A longitudinal survey of public acceptance of radioactive waste disposal site: case of wido", *Journal of Korean association for policy studies* (2004).

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