

Low-Level Radioactive Waste Management: The U.S. and South Korea*

*Yearn Hong Choi***

Abstract

This comparative review of the United States' and South Korea's efforts to establish satisfactory sites for low-level and intermediate level radioactive waste (low-level radioactive waste, or LLW) disposal finds that, despite differences, neither nation has succeeded in the last twenty-some years or has viable plans for breakthrough. However, U.S. experiences offer Korea valuable lessons, as three disposal sites predated the 1980 LLW Policy Act, and three continue to operate.

Key Words: Low-Level Radioactive Waste Policy Act, Comparative Policy, U.S., South Korea

* Research for this paper was made possible by the research leave and funding from the University of Seoul in the fall semester and winter break, August 2004-February 2005.

** Yearn Hong Choi is Professor at the University of Seoul Graduate School of Urban Sciences, Korea. He taught at the University of Wisconsin and Old Dominion University before he joined the University of Seoul in 1996. He has published more than 40 scholarly articles in international journals from the U.S., European nations, and Japan. E-mail: yhc@uos.ac.kr.

I. Introduction: A Comparative View

Radioactive waste has been generated in the U.S. since the 1943 Manhattan Project ushered the world into the Nuclear Age of popular and prolific nuclear energy, products, and arms. However, governmental and scientific efforts by the U.S. and other nuclear nations have failed to find politically and technically adequate means of nuclear waste disposal. Fear of radioactivity arouses animosity much more fierce against proximate siting of radioactive waste disposal than that of chemical waste or solid waste disposal, or even prisons.

By late 1980, the 96th U.S. Congress reached some consensus on comprehensive legislation to deal with high-level waste, low-level waste, transuranic waste, and spent fuel. Legislation incorporated many Interagency Review Group and State Planning Council on Radioactive Waste Management principle recommendations. However, impasse in the last week of the session on two issues — application of the policy on defense high-level waste and transuranic waste, and federal government's role in commercial spent-fuel storage — forced Congress on the last session day to break out those provisions of the omnibus bill dealing with commercial low-level waste and pass the 1980 LLW Policy Act.

Civilian nuclear power reactors and nuclear weapons production generate high-level waste — used reactor fuel — and low-level waste — everything else, from discarded protective clothing to contaminated equipment. The latter emits any combination of alpha, beta, or gamma radiation produced by radioisotopes with very short or very long half-lives, is much less radioactive than high-level waste, and is typically buried in the U.S., several European nations, and Japan in shallow landfills. No nation has a satisfactory permanent disposal site for high-level waste, although Norway and the U.S. have designated potential sites. This article focuses on U.S. and South Korean efforts to establish LLW disposal

sites.

While nuclear power generates almost 50 percent of South Korea's electricity, 20-some years of determined effort have failed to yield sites for LLW disposal and interim storage of spent fuel and high-level waste. The president, national assembly members, local executives and council members, and provincial governors have been unable to counter anti-nuclear demonstrations and the "Not in My Backyard!" syndrome of local residents and civic environmental organizations. If this dilemma requires abandoning nuclear power generation, energy shortfalls and environmental and public health threats given temporary LLW storage inside plants would prove devastating.

The U.S. uses Hanford, WA, and Barnwell, SC, dumps for the LLW its 20 percent reliance on electricity from nuclear power creates, but the future is dim. A Betty, NV, site was opened in the 1960s, as in the 1970s were Hanford, Barnwell, West Valley, NY, Maxey Flats, KY, and Sheffield, IL, facilities. However, various problems closed the last three by decade's end, and the Betty location shuttered in January 1993 (Dolan and Scariano, 1990: 57-58).

Since Congress passed the LLW Policy Act in 1980 and Nuclear Waste Policy Act for high-level waste disposal in 1982, amending both in the 1980s, no new LLW site has been established, while in 2002 the Bush administration advocated Yucca Mountain for high-level waste disposal. The 1980 act charged each state with disposing of waste generated within its borders, expressly encouraging compacts among neighboring states to plan and build regional site(s) to equitably share the burden of disposal. In 1985, as no compacts had been ratified or sites selected, Congress amended the act to mandate site deadlines. It provided that on January 1, 1993, the three states with sites (WA, SC, and NV) could refuse LLW generated outside their borders by states not in their respective compacts; and that in January 1996 each state would take title to, possession of, and legal responsibility for all LLW generated

within its borders. However, New York State challenged the constitutionality of the act before the Supreme Court. In June 1992 the court struck down the “take title” provision, as it applied to states that were not members of a compact, but the act’s framework of incentives encouraging development of disposal facilities remained fundamentally intact (Nuclear Energy Institute, 2004). In 2004, no new disposal site had been designated or built.

II. South Korea: Repeated Search and Failure

Since its first nuclear power plant generated electricity in 1978 at Kori, South Korea has heavily relied on nuclear power, as it must import all petroleum and natural gas. Its total installed capacity was 13,716 MWe in 2001 (Ministry of Commerce, 2001), 16 reactors in Kori, Wolsong, Ulchin, and Younggwang generate power, and more reactors are slated. The power plants, hospitals, and research labs create radioactive waste. Spent fuel has been stored in distilled water inside power plants, and LLW housed in temporary facilities inside power plant compounds.

Korea’s many efforts over 20 years to locate a permanent disposal site for LLW and interim storage for spent fuel have failed. They have included Ministry of Science and Technology (MOST)

Table 1. Status of Radioactive Waste Storage (As of Dec. 2000)

Nuclear Power Stations		Storage Capacity (Drum)	Cumulative Amount (Drum)	Year of Saturation (Expected)
Location	Number of Reactors			
Kori	4	50,200	30,597	2014
Younggwang	4	23,300	11,388	2011
Ulchin	4	17,400	10,625	2008
Wolsong	4	9,000	4,660	2009
Total		99,900	57,270	

Table 2. Status of AR Spent Fuel Storage (As of Dec. 2000)

Nuclear Power Stations		Storage Capacity (MTU)	Cumulative Amount (MTU)	Year of Losing FCR
Location	Number of Reactors			
Kori	4	1,737	1,154	2008
Younggwang	4	1,696	769	2008
Ulchin	4	1,563	524	2007
Wolsong	4	4,807	2,311	2006
Total		9,803	4,758	

* Source: Korea Hydro and Nuclear Power Co. (2001).

secretive attempts in the 1980s and offers of inducements to local governments in the 1990s. During 2000 and 2001, the Korea Electric Power Corporation mounted a major public education campaign on the safety of LLW disposal and promised sizeable compensation to cooperative local governments. This paper reviews Korea's history of siting efforts and failure.

In the mid-1980s, MOST nominated 25 candidate sites from an initial 89 and, in consultation with the Battelle, finally selected 3 in North Gyeongsang Province — Ulchin, Youngduk, and Youngil — primarily because the province sponsored 12 reactors. The government then dispatched several scientists to examine geological formations and environmental conditions, upon which local residents responded with shock and violent protests that included highway blockages.

The authoritarian regime was no match for the fury, and backed off in March 1989. The first democratic presidential election in 1987 had clearly energized citizens to throw off the authoritarian suppression suffered from 1961 to 1987 and fundamentally alter the social atmosphere in a way the government had failed to appreciate.

MOST then renamed the proposed site the Nuclear Research

Center and approached Choongcheong and Jeolla provinces, having selected Anmyeondo Island, Buan, Younggwang, and Uphaedo Island as possible sites. When negotiation with South Choongcheong Province was leaked to the press, local Anmyeondo Island residents protested. Again the effort was abandoned, and MOST's minister, a renowned nuclear scientist, was fired for mismanagement.

The new minister, a career newspaper reporter and editor educated in sociology at Seoul National University, recognized siting as a political and social issue, and asked a Seoul National University social science research institute to reexamine the candidate sites in terms of social climate. When local residents of the six proposed sites violently protested, the minister withdrew to consider means of making siting more palatable. He proposed financial inducements, a sort of community development fund, and the National Assembly passed legislation to provide attractive funding to a receptive locality.

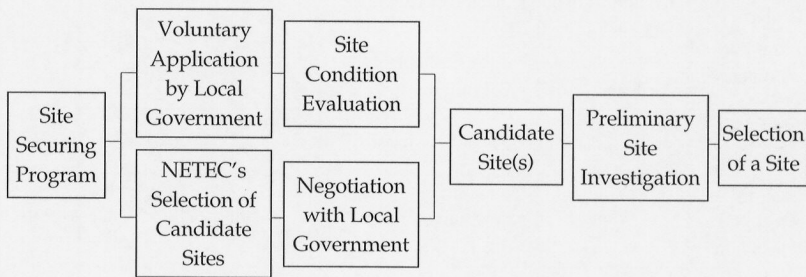
Some residents of two towns — Jangan, Yangsan County, South Gyeongsang Province, and Kisong, Ulchin County, North Gyeongsang Province — expressed interest, but violent confrontations between them and residents opposed made daily headlines in major national newspapers for several weeks and the government gave up.

MOST searched yet again, and from 592 candidate sites, then 53, then 10, finally proposed Gulupdo Island in the Yellow Sea. Its few fishermen and their families accepted the site, as they planned to move inland, and the government ignored violent demonstrations neighboring islands people mounted. However, after several geologists visited the island, their critical report revealed that the Korea Institute of Geology found an active fault. The project was aborted.

The long years of struggle led the government in June 1996 to create the Nuclear Environment Technology Institute (NETEC)

under the Korea Electric Power Corporation (KEPCO) to manage radioactive waste sites, from selection, to construction, to operation. KEPCO was reorganized and NETEC became a part of a new company, Korea Hydraulic and Nuclear Power Company (KHNP), created in April 2001. In 2000, NETEC prepared a voluntary local application process designed to induce site acceptance (Figure 1).

Figure 1. Procedure for Acquisition of National Radioactive Waste Management Site



In June 2000, NETEC mailed letters with brochures to 46 coastal area local governments as part of a public education program and 3000 billion won financial package offer designed to sell site acceptance. The package promised all local governments within a 5-km radius of a facility projects to increase residents' incomes, construct public facilities, and boost education, and subsidies for electric bills and low interest loans.

Public education regarding the site's necessity and application program amounted to a public relations campaign. Initially, from July to October 2000, nationwide informational ads targeted TV, radio, and print media, and NETEC staff briefed 46 local governments. From October 2000 to January 2001, NETEC approached localities interested in learning more about experiences with safe radioactive waste disposal in Japan, the U.S., and Europe and invited local leaders to its Taejon headquarters. Finally, from Feb-

Table 3. Financial Support Program for the Site's Surrounding Community

Program	Region	Supporting Activities	Supporting Amounts (Unit: 100 Mil. ₩)		
			Construction (5yr)	Operation (30yr)	Total
Special Support Program	• Entire Region of Local Government with the Site	• To be Determined after Negotiation with Local Government — within Scope of Basic Support Program	1,672	–	1,672
Basic Support Program	• Within 5km Radius of a Sub-County or Town	• Income Increase Project • Public Facilities • Education	327	587	914
Subsidy Program	“	• Subsidy for Electric Bill	35	207	242
Welfare Support Program	“	• Low Interest Loan	10	–	10
Industrial Park Support Program	“	• Business Loan	13	78	91
Total			2,057	872	2,929 [†]

* Note: [†] Total 205 billion won to be expended within five years from the start of facility construction.

** Site Objective: Disposal of LLW and interim storage of spent fuel.

- Applicant: Local government head with local council consent.
- Application Period: July 2000 - June 2001.
- Site Area: Coastal 500,000 pyung (408.45 acres or 16,529 km²).
- Site Requirements: Environmentally sound.

ruary to June 2001 it focused on several communities interested in applying. Community leaders toured Japan's Rokashomura site to observe safe operations.

Next, NETEC established field offices in Younggwang, Jindo, Kangjin, Gochang, Yangyang, and Boryung. Rokoshomura's town head visited Korea to deliver lectures on safe operations to community members. Yet local Younggwang and Kangjin councils and executives failed to respond to a petition inviting the facility

signed by nearly 50 percent of residents, and detractors again violently confronted supporters. Unlike 1985-1995 clashes, however, popular support was significant. The drag emanated primarily from local leaders and National Assembly members who, conscious of approaching local elections in 2002, bowed to idealistic environmental NGOs and scuttled the effort.

Table 4. Local Communities that Submitted Petition

Community	Petition Date	# of Petitioners / # of Voters	Ratio (%)
Younggwang	June 21, 2001	21,636 / 49,400	43.8%
Gochang	June 29, 2001	13,573 / 54,000	25.1%
Kangjin	June 15, 2001	16,387 / 37,000	44.3%
Jindo	June 28, 2001	6,150 / 32,000	19.2%

When KHNP took over, its basic plan proposed first selecting candidate site(s) and then negotiating in depth with local governments before making final nomination(s), with a 2008 target year. It promised a transparent, open, and democratic selection process, with candidate sites, results of site surveys/characterizations, and site development plans disclosed. The final decision was to depend on mutual understanding and credibility with the selected local government (Choi, 2001).

Korea launched a massive public education campaign. It enhanced the compensation package for local residents, university research and development funds for a linear accelerator, and other benefits to provincial government in 2002 and 2003. However, after the Buan County chief executive volunteered Wido Island as a candidate site and the North Jeolla provincial governor endorsed the idea, a violent mob physically assaulted and hospitalized the former and threatened the latter. Opposing residents proposed a local referendum and the central government was forced to abandon yet another site (Choi, 2003).

III. The U.S.: A Future Crisis?

The LLW Policy Act established a federal policy holding each state responsible for disposing of LLW generated within its borders:

- (1) Each state is responsible for providing for the availability of capacity either within or outside the state for the disposal of commercial LLW generation within its borders.
- (2) LLW can be most safely and efficiently managed on a regional basis.
- (3) States may enter into compacts that may restrict the use of regional disposal facilities to LLW generated within the region.

Regionalization through formation of interstate compacts was the primary vehicle most states chose to assume their responsibilities. In 1986, six regional compacts were formed: Northwest Compact (Washington, Oregon, Utah, Idaho, Arkansas, Hawaii); Southeast Compact (South Carolina, Georgia, Alabama, Mississippi, Florida, North Carolina, Tennessee, Virginia); Rocky Mountain Compact (Nebraska, Wyoming, Colorado, Arizona, New Mexico); Midwest Compact (Illinois, Indiana, Ohio, Michigan, Wisconsin, Minnesota, Iowa, South Dakota, Nebraska, Kentucky); Northeast Compact (New York, Pennsylvania, Maryland, Delaware, Massachusetts, Connecticut, Rhode Island, Vermont, New Hampshire, Maine); and Central Compact (Kansas, Oklahoma, Arkansas, Louisiana). Texas, California, West Virginia, and North Dakota were unaffiliated (Choi, 1984: 13-20, 1986: 83-91). Yet, despite a January 1, 1986, goal for operational regional disposal facilities, by 2004 no new sites were established.

Three regions had existing facilities: the Northwest at Hanford, WA; Southeast at Barnwell, SC; and Rocky Mountain at Betty, which closed in the early 1990s. The promise of interstate

compacts retreated when each state envisioned its neighbor as host and continued to resist nuclear dumps within its own borders or region. The Barnwell dump will continue to receive the nation's waste until 2008, but thereafter only Atlantic Compact waste from South Carolina, Connecticut, and New Jersey. The U.S. Ecology site in Richland, WA, accepts waste from 11 Northwest and Rocky Mountain Compact states. A new Texas law expects to provide Class A/B/C disposal capacity for Texas Compact (Texas and Vermont) members by the end of 2007 or so. Envirocare of Utah site accepts the bulk of the nation's Class A waste, as it exacts what are considered reasonable disposal fees. Class A waste requires minimum disposal precautions, as does Class B waste, while Class C waste must be isolated from future "inadvertent intruders" (Murray, 2003). By July 1, 2008, given the present trajectory, 34 states will lack recourse for B/C waste.

After 24 years, no new state or compact disposal facility has opened, let alone been licensed, developed, or even designated. Zacha (2004: 14-17), American Nuclear Society *Radwaste Solutions* editor, reviewed the 1980 act with regard lawsuits. "In fact, it appears that the only beneficiaries of the act today are lawyers, who are doing a thriving business. There are lawsuits pending against North Carolina (a reluctant host state being sued by its compact), Nebraska (another reluctant host state whose governor was found to have actively tried to scuttle licensing activities), and California (being sued by U.S. Ecology for recovery of the \$160 million the company spent in developing the California site). In addition, there is a countersuit by Nebraska against the compact. As with many lawsuits, these have been ongoing for several years and probably still have several more years to run." Steven Kraft, Nuclear Energy Institute (NEI) director of waste management concurred with her view in his meeting with me at NEI on September 3, 2004.

What options can waste generators and other relevant actors

pursue to move beyond this impasse? For many nuclear power plants, reduction or elimination of B/C waste generation is the solution. Pacific Gas and Electric waste engineer Miller (2003: 24-28) describes an effort by several allied plants west of the Mississippi River under the Strategic Teaming and Resources Sharing (STARS) program. Primarily, tactics involve changing out resin beds more frequently and revising packaging methods. Utilities are also examining extended waste storage capacity and more effective waste treatment methods.

Also, South Carolina budget shortfalls could induce the state to maintain the Barnwell facility, hoping through B/C disposal fee increases to generate needed income. At this time, nothing suggests such an inclination, but it closed and reopened Barnwell once before it, so precedent does exist.

Envirocare of Utah could pursue B/C licensure in the future depending in part on the climate in the state legislature and capital. If Utah's November election replaces outgoing Governor Mike Leavitt — recently appointed U.S. EPA head — with a leader sympathetic to nuclear power/radioactive waste management, matters might move forward. In any event, progress depends on each state being accountable for radioactive waste generated within its border or delivered to it as regional host.

In a 1983 commentary on regional compacting in *Pollution Engineering*, Secretary of Defense Assistant for Environmental Quality Choi (1983: 6) observes,

Despite its low-level, this waste generates fear. No one wants radioactive waste in his or her backyard. Fear is due to radioactivity and our imperfect control of it. Our state of knowledge should be attributed as a major cause of the fear. Even today, monitoring is an imprecise science: different types of radiations causing varying effects to various parts of the body are registered differently by detection devices. Furthermore, such factors as radiation pathways and mobility and mechanisms whereby radioactivity might concentrate in organisms are not

completely understood. Small wonder, then, that reputable estimates of the hazards posed by exposure to low levels of a particular type of radiation may differ by very large factors. There are the basic disagreements that, in part, fuel much of the debate over the radioactive waste problem.

He goes on to emphasize the nuclear scientist's role as public educator (*Ibid.*):

Nuclear scientists should educate (or explain) the need of nuclear power and products, safety of the burial technology, and find the science and technology to reduce and minimize radioactive wastes. Technology to reduce and minimize waste volume is progressing. Democracy established 200 years ago in the U.S. cannot cope with the modern scientific age if the citizens are not knowledgeable about the issues and problems of the society and nation. Modern politics should accommodate modern science and technology and *vice versa*. The scientists' role as educators in post-industrial democratic society is larger than they may realize.

Exorbitant disposal costs and lack of disposal sites have encouraged waste generators — industry, government, utilities, and academic and medical institutions — to adopt new technologies that have reduced the volume of LLW sent to commercial disposal sites by more than one half. In 1980, more than 3.7 million cubic feet of LLW were disposed of commercially. In 2001, "traditional" LLW (higher radioactivity levels, low-volume) declined to 140,147 cubic feet, a 96 percent reduction, even as the number of nuclear power plants increased by more than 50 percent. In addition to that traditional LLW, the Utah Envirocare facility disposed of more than 1.2 million cubic feet of low-activity, high-volume, low-level waste through decommissioning nuclear facilities and site cleanup activities (Nuclear Energy Institute, 2004).

However, nuclear waste management is basically political, not scientific. In another commentary, Choi uses the 2004 presidential

election campaign in Nevada to illustrate how politics dangerously intrude in waste disposal decisions (Choi, 2004):

Political campaigns have an idealistic appeal to the public. Senator John Kerry, campaigning in the state of Nevada, made a very serious statement not to use Yucca Mountain as the nation's high-level nuclear waste disposal site. I wish he had not made such a statement, because it represents a setback in the U.S. waste program.

President George W. Bush made a courageous decision to designate Yucca Mountain as a permanent nuclear waste disposal site two years ago. His decision was unpopular in Nevada, but the U.S. Congress endorsed his decision. It had taken more than 20 years to reach that stage. The U.S. Department of Energy has been searching for the best available site in the nation since the passage of the Nuclear Waste Policy Act in 1982. The Nuclear Regulatory Commission's licensing process is the project's next hurdle. Sen. Kerry cannot reverse the progress made so far.

What is Sen. Kerry going to do? He proposed searching for an international review and consortium, which have been discussed and studied in the circle of the National Research Council scientists and engineers. Russia and China may propose disposal sites in the Central Asia and Gobi Desert for permanent disposal of high-level nuclear waste and spent fuel. It may be possible in distant future. Whatever the future will be, however, the U.S. cannot dispose of its nuclear waste in the Central Asia or Gobi Desert. Transportation would simply be too costly.

If the U.S. rejects the Yucca Mountain site on the grounds of geological safety, I don't think any site can be considered safe in this world. If that is the case, then all nations should close down their nuclear power plants and stop nuclear weapons production. We can stop nuclear weapons production, but can we close down the nuclear power plants? The U.S. can, because it relies on nuclear power for only 20 percent of its electricity, but South Korea, my home country, generates 50 percent of its electricity from nuclear power. China, India, Japan, and Southeast Asian nations are expanding their nuclear power programs to supply their future energy needs. Shut-

ting down the Yucca Mountain program will have an enormous impact on the world energy utilities. If there is no safe disposal site, all nuclear power plants should be shut down.

Tons of research works and findings on high-level waste disposal have accumulated since the 1980s. Based upon those findings, the U.S. Department of Energy proposed the Nevada site. There is probably no one best site, but it is fair to say that Yucca Mountain is one of the best available sites. If idealistic environmentalists are seeking no-risk society, they will fail. In this world, seeking a no-risk society is an impossible mission. It seems to me that some American politicians and intellectuals are seeking no-risk society. The U.S. scientists and engineers have examined and reexamined the research findings, and made a positive response to President Bush's decision. I trust their work.

The Democratic Party has maintained a good environmental image. But giving up the Yucca Mountain site is environmentally unethical. The Clinton administration postponed the decision to finalize the Nevada site for political reasons. The U.S. has generated nuclear waste since the Manhattan Project in 1940s. There should be a site for disposing of the waste. Avoiding the responsibility is not a wise president's job, although it may be a good politician's tactic. President Bill Clinton could also have ratified the Kyoto Protocol, or could have made an attempt to ratify it. He did not. The Bush administration made a decision against the Protocol, a decision that has been harshly criticized by the international community. President Clinton was also responsible for the failure of California's search for a disposal site for low-level waste on federal land in California. I wonder whether the Clinton administration deserved its high evaluation in the field of environmental policy and management.

I wish Sen. Kerry had proposed no more nuclear power plants and nuclear weapons production in the U.S., but did not clearly say this. Or that he had proposed a retrievable disposal facility in Nevada, assuming that future science can find and invent safer disposal site and methods. He did not say that either. He just said, "No Yucca Mountain site for disposal under my presidency!" His declaration is political, no more, no less, and he is turning the world back to 1982.

The U.S. nuclear energy industry is also having difficulty in finding low-level waste disposal sites. The two disposal sites in South Carolina and Washington that existed prior to the 1980 Low-Level Radioactive Waste Policy Act had been taking the waste from the 50 states. The 1980 act proposed that low-level waste disposal should be the responsibility of state or interstate compacts, but no new site has been opened. This is a very serious problem for the U.S., and it has set a bad example to outside world. Finding nuclear waste disposal sites is the most difficult task in American politics. I hope Senator Kerry knows it.

While, George W. Bush won the 2004 presidential election, Senator Kerry, in the author's view, should not have used waste siting as a campaign issue. In June 2004, the U.S. General Accounting Office declared the current situation precarious and urged NRC to safeguard storage facilities given the safety and security risks that temporary storage solutions create. It emphasized federal oversight to assure disposal availability and the conditions of stored waste (U.S. General Accounting Office, 2004).

IV. Conclusion: Where from Here?

In Korea, violent popular protest and anti-nuclear environmental groups for two decades since 1980 prevented progress towards locating a permanent disposal site for LLW and interim storage of spent fuel. However, the 2000-2001 campaign met less resistance. A public education program relating safe LLW disposal and interim spent-fuel storage in Japan, the U.S., and Europe, and promising monetary compensation persuaded almost half of Younggwang County residents to express willingness to sponsor a site. Progress halted, however, when local politicians made the political calculation that anti-nuclear agitators were more powerful and ignored KHNP and popular support. The 2003 Buan

County tragedy unfolded as the National Assembly member rejected the district siting proposal and violent assaults were mounted by anti-nuclear forces against the county chief who joined residents in endorsing Wido Island as a candidate site.

Clearly, politicians must be educated on nuclear waste issues and take action. The Korean president and National Assembly members have been silent and deferred site decision-making to the future. They would do well to heed the example of President Bush and Congress, who endorsed the Yucca Mountain site despite Bush's unpopular war in Iraq and anti-environmental profile. In the end, as in the U.S., Korea's president will select a site and the National Assembly will accept or reject his decision by simple majority vote. The U.S. Congress passed the Nuclear Waste Policy Act in 1982 specifying that the secretary of energy recommend high-level waste disposal sites to the president, whose decision would be accepted or vetoed by Congress. Congress accepted Bush's decision to use Yucca Mountain. The widely endorsed 1980 LLW Policy Act mandated each state or interstate compact to manage LLW, but the ensuing 20 years have produced dismal outcomes. As in Korea, political calculations have thwarted progress as scientific and technological policy are fodder in the fight for popular votes — as when Democratic presidential candidate Senator Kerry, campaigning in Nevada, vowed to reject the Yucca Mountain site.

The intellectual community similarly has dodged the issue. The Korean Atomic Scientists' Association, Korean Environmental Policy Studies Association, and Korean Waste Management Association have been absent in policy debates, yet could play a critical buffering role, mediating between the government (KHNP) and environmental groups. While governments worldwide have failed to definitively win public trust in their operation of nuclear power plants, this is especially true in Korea due to its long history of authoritarian suppression. That the government both operates and

regulates nuclear power plants abets public fear, despite no serious mishaps thus far. KHNP and the Ministry of Industry and Resources receive MOST cabinet-level scrutiny, and the Korea Atomic Energy Commission comprises reputable scientists, yet because all are government arms, input from independent intellectual leaders is critical. To assure the public that disposal site selection, construction, and operation are reliable, Korea should adopt institutional arrangements similar to the U.S., where U.S. Energy Department site studies are thoroughly reviewed by GAO, the National Research Council, and the Nuclear Waste Technical Review Board created by Congress.

The Korea Environmental Federation, one large environmental NGO, in search of compromise with the government offered "If you promise not to construct any more nuclear power plant, we will help your search effort," only to be told, "That is an impossible counterproposal to be considered." The intellectual community could put forth other options, such as "Until safe operation of a disposal facility is demonstrated for five years, future construction of nuclear power plants will be shelved," or "The government will cut the number of future nuclear power plants constructed if environmental NGOs join search efforts." Such proposals have never been made. Instead environmentalists focus mainly on energy price hikes, conservation, and renewable energy sources in Korean energy policy debates and the government uses its estimates of future energy needs as evidence that more nuclear and coal-burning power plants must be constructed.

Both environmental groups and the government must abandon rhetorical policy proposals and assay future energy needs without bias to move beyond confrontational politics. The intellectual and professional community could significantly facilitate this process.

The report "Understanding Risk" emphasizes meaningful input from stakeholders and targeted analysis — with input from

the physical and social sciences — as key to sound environmental management decisions. Social trust, public deliberation, and transparency are essential to radioactive waste-disposal site selection and operation. Particularly troublesome has been confusion over facts and purposes. Both the public and environmental groups make no distinction between LLW and high-level waste, meeting government searches for LLW disposal sites as though permanent disposal of high-level radioactive waste were at issue. The intellectual and professional community must bring scientific and rational decision-making to the site selection process.

Research clearly correlates many factors with trust. At the most basic level, individual psychology, the structure and organization of various government levels, the operation of relevant organizations, transparency in governmental decision-making and problem solving, culture, encounters with institutions and views about their roles and responsibilities, and relationships with political authorities and other key individuals are important. History, loyalty toward employers, and job security impact trust in communities that host LLW facilities and rely on the local nuclear industry for jobs. More subtly, our democratic system, the economy, and world events exert influence (Meadd, 2003: 30-35).

The government (KHNP) has failed to explain reliance on nuclear power in energy policy and its connection with radioactive waste management. Despite the expense of imported petroleum, Koreans are not convinced that nuclear power is critical to national survival and prosperity. The government also lacks a long-range plan for site selection, construction, and operation, having wasted 20 years in ad hoc efforts quickly abandoned in the face of resistance. Though trial and error are part of any undertaking, forethought that envisions various scenarios and recourses is critical for discussion among the government and environmental NGOs/residents to make peaceful headway.

In the process, Korea should join international forums to cre-

ate international efforts to locate, construct, and operate regional disposal sites. Russia and China have hinted they might provide Central Asia and Gobi Desert sites, with Korea and Taiwan to provide funds and technology. The U.S. National Research Council has been organizing an international forum to ease waste management, and Korea should participate in such international consortiums (Choi, 2001). Failed 2004 Democratic presidential candidate Senator John Kerry, also proposed international review of and cooperation on high-level waste and spent fuel disposal.

References

- Choi, Yearn Hong, "Wasteful Politics," *The Washington Times*, September 8, 2004.
- _____, "No Body Wants Nuclear Waste Dump!" *The Korea Times*, August 11, 2003.
- _____, "Endless Search, Endless Failure, Endless Conflict: The Siting of a Radioactive Disposal Facility in South Korea," *Radwaste Solutions*, Vol. 9, No. 3 (2002).
- _____, "Policy with Uneasy Implementation: U.S. Radioactive Waste Management," *The Journal of Social, Political and Economic Studies*, Vol. 11, No. 1 (1986).
- _____, "Issues of New Federalism in Low-Level Radioactive Waste Management," *State Government*, Vol. 57, No. 1 (1984).
- _____, "Low-Level Radioactive Waste Regional Compacting," *Pollution Engineering*, Vol. 15, No. 7 (1983).
- Dolan, Edward F. and Margaret M. Scariano, *Nuclear Waste: The 10,000-Year Challenge* (New York: Franklin Watts, 1990).
- Korea Hydro and Nuclear Power Co., *Annual Report on Radioactive Waste* (2001).
- Meadd, Ellen, "The Dynamics of Public Opposition: Lessons from Low-Level Waste Management," *Radwaste Solutions*, Vol. 10,

No. 6 (2003).

Miller, Clint, "Looking to the STARS to Reduce Class B/C Waste," *Radwaste Solutions*, Vol. 10, No. 6 (2003).

Murray, Paymond L., *Understanding Nuclear Waste* (Columbus, Ohio: The Battelle Press, 2003).

Nuclear Energy Institute, "Disposal of Low-Level Radioactive Waste," Fact Sheet (August 2004).

U.S. General Accounting Office, "Low-Level Radioactive Waste: Disposal Availability Adequate in the Short Term, but Oversight Needed to Identify Any Future Shortfalls," A Report to the Chairman, Committee on Energy and Natural Resources, U.S. Senate. GAO-04-604 (2004).

Zacha, Nancy J., "There is No Commercial Low-Level Waste Disposal Crisis in the United States — Yet," *Radwaste Solutions*, Vol. 11, No. 3 (2004).