

PUBLIC PERCEPTION OF LOW-LEVEL WASTE TECHNOLOGIES:  
DEMANDS ON RESEARCH AND PUBLIC EDUCATION PROGRAMS

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ABSTRACT

The complexities of our political and legal systems, along with both insufficient information and misinformation, has resulted in significant problems in the disposal of radioactive waste. Distrust of the industry and regulators by the public, along with insufficient understanding of public fear by those responsible for waste disposal, has created a delay which shows few signs of early resolution. In light of these problems, this paper will specifically cover low-level radioactive waste disposal and management issues in the Appalachian Compact state of Pennsylvania. It will focus on the public's perception of waste technologies, and related policy issues, and the necessity of research and public education to create a bridge of understanding between those responsible for disposing of this material, those who benefit (the general public) from the creation of the waste, and those who are asked to live near disposal sites.

OVERVIEW

The role of public intransigence in virtually halting the establishment of new chemical and radioactive waste disposal facilities is no secret. Scholars and practitioners of various persuasions have offered suggestions for innovative ways of approaching the public in hope of eliciting greater cooperation. Specifically, incentive schemes, power sharing notions, improved technical options, trust building programs, and public education are the major approaches being offered. However, there have been few, and very limited, attempts to discern what the public thinks of these options. A research project at The Pennsylvania State University during the summer of 1985 did just that in terms of the low-level radioactive waste disposal and management issue.

A random sample of the Commonwealth of Pennsylvania and a random sample of influential members of environmental, civic, and health groups in that state were asked their opinions on various policy options concerning low-level radioactive waste disposal. They were asked about the relative importance of these issues and whether or not they thought the option would promote public cooperation.

In general, the public views power sharing options as more important than incentive schemes; local and state control as more trustworthy than federal control; university experts and environmentalists as more trustworthy sources than the mass media or anti-nuclear groups; below ground disposal with engineered barriers as superior to: (1) conventional disposal trenches, (2) above ground storage, or (3) disposal in old mines; moreover, they perceive a need for more information on this issue. Influential members of environmental, civic, and health groups differ significantly from the general public on some of these judgments.

In response to public inquiries in regards to the Penn State study, "Low Level Radioactive Waste Disposal Siting: A Social and Technical Plan for Pennsylvania."<sup>1</sup> Penn State instituted a comprehensive community education program. This program is called the PIER (Public Involvement and Education on Radiation) Program. This program is administered through the Institute for Research on Land and Water Resources.

PUBLIC PERCEPTION

Introduction

Academic, industry, and government experts have suggested various options as means to win public cooperation on low-level radioactive waste disposal siting. These suggestions include: offering incentives to local communities; providing mechanisms for community input into site development, operation, and monitoring decisions; defusing negative opinions by developing improved disposal technologies; and by providing accurate information on risk factors associated with this material.<sup>2</sup> Incentive programs are currently viewed by the experts as the key to unlock the door to public cooperation. The theory is that incentives restore equity which has been violated by burdening a community with wastes for which they feel no responsibility in having produced.<sup>3</sup> If, however, the basis of public intransigence is distrust of the technology, regulatory agencies, and operators, then incentives can be expected to have a minimum impact on public acceptance. Distrust can only be countered by offering affected communities power sharing options, improved technology, and better information. This study reports the views of the citizens of Pennsylvania on these particular issues.

## Research Methods

In July and August of 1985, a random sample of Pennsylvanians was sent a questionnaire which explained the LLRW problem, asked their evaluation of various policy and technical options and whether they thought the particular option would promote public cooperation with those responsible for siting. A total of 810 questionnaires were returned for a return rate of 56 percent. Returns were distributed throughout the state proportional to the population in each of six regions. The high return rate indicates considerable interest in this issue.

In addition, almost identical questions were asked, in a telephone interview format, of 38 leaders of environmentalist, civic, public health, and radiologic health groups. These people were chosen randomly from appropriate membership directories.

The questions involved the following issues:

### A. Community Input

1. Importance of community input into who operates the site.
2. Importance of community input into site construction decisions.
3. Importance of hiring locals to do site monitoring.
4. Importance of granting local power to shut-down the site.
5. Importance of funds to permit communities to hire independent experts.
6. Importance of choosing the disposal method.

### B. Concessions Directly Involving Health and Safety

1. Importance of a yearly community medical survey.
2. Importance of a restricted access road bypassing residential areas.

### C. Financial Incentives

1. Importance of property value protection.
2. Importance of agricultural price protection.
3. Importance of local tax relief.
4. Importance of a formal agreement by the site operator to hire and purchase locally.
5. Importance to community of revenue received from a surcharge on the waste.

### D. Degree of Trust in Various Site Operators and Regulators

Which of the following is most trusted to operate the site:

1. A State Agency.
2. A State Authority
3. Private Industry.

Which of the following is most trusted to regulate the site:

1. Nuclear Regulatory Commission.
2. Environmental Protection Agency.
3. Department of Transportation.
4. Department of Environmental Resources.
5. A Hypothetical Special Agency Created by the State.
6. Specially Trained Locals.

### E. Preferred Disposal Site Design

How safe are each of the following disposal options?

1. Conventional shallow land burial, trenches.
2. Trenches with engineered barriers.
3. Above-ground structures for long term storage.
4. Inoperative mines.

### F. Other Questions

1. Maximum distance from site a community can be and still receive concessions.
2. Confidence in various information sources on LLRW.
3. Whether they want more information and would attend information sessions.

## Results

Table I summarizes the distribution of responses to the importance items, and the "will it help" option, for the community input, health and safety concession, and financial incentive options. What is most noteworthy in Table I is the relative lack of salience to the public of highly touted, standard incentives such as local tax relief, revenue generated by a surcharge on the waste, and agreements by operators to buy and hire locally. Less than 40 percent of the public feels that these kinds of concessions will promote public cooperation. In contrast, all of the community involvement items are viewed as extremely important by a large majority of respondents and are judged to help promote acceptance by a majority or near majority of respondents. This pattern of responses leads to the conclusion that trust, rather than equity, is the major issue with the general public.

TABLE I

Distribution of Responses to the "Importance" and "Will it Help" Questions (in percentages) for the General Public (N = 810)

Note: The percentage total does not equal 100 due to missing data.

	IMPORTANCE				WILL IT HELP?		
	Extreme	Somewhat	Not-Too	Not	No	Might	Yes
Site Operator	84	12	1	2	5	47	47
Construction	65	27	4	3	6	49	44
Local Monitors	85	10	2	2	4	38	57
Shut-Down Power	79	14	3	3	6	35	58
Monitoring Grants	76	18	3	2	6	44	49
Disposal Method	77	17	2	2	6	49	43
Health Surveys	84	11	2	1	9	48	42
Special Road	75	17	4	3	8	43	48
Property Value	91	7	1	-	8	40	50
Ag Price Value	79	14	2	2	10	47	40
Local Tax Relief	43	34	11	9	16	52	30
Buy Locally	58	28	9	3	9	50	39
Surcharge	51	34	8	5	10	53	35

The two incentives that are judged as extremely important and as likely to promote cooperation by a margin comparable to the community involvement items are property value and agricultural price protections. This may also be viewed as indicating the importance of trust over equity. People anticipate problems with any operative site and want property value protection as insurance against such a likelihood.

The same questions asked of leaders of environmental, civic, and health groups produces a somewhat different pattern of responses. Like the general public, a majority of the leaders view community involvement in selecting the site operator, hiring locals to do site monitoring, giving grants to communities to hire independent experts, and protection of property values and agricultural prices as extremely important. On the other hand, the leaders tend to have more faith in the financial incentives than does the general public. A majority of them feel that the incentives will promote cooperation.

Direct questions of trust and confidence were asked about who the public prefers as a site operator

and who they have confidence in to regulate the site so as to insure public health and safety. The options given for who should operate the site were: a state agency, a state authority, and private industry. Sixty percent of the general public chose a state agency while only 21 percent picked private industry. Apparently, in the absence of trust, people prefer an operator they have some political control over, the state, rather than private industry. This question was not asked of the leaders.

Table II presents the answers, from both the public and the leaders, to the question of who they have the most confidence in to regulate the disposal facility. A majority of the general public expresses high to moderate confidence in the NRC and the EPA at the federal level and the DER, and a special state agency at the state level, and trained locals. However, it is clear that significantly more of the public expresses confidence in trained locals than any other option. This is consistent with the previous interpretation that trust is the major issue and local control is one way for a community to protect its self interests.

TABLE II

Level of Confidence in Potential Regulators by Both the Public and the Leaders (in percentages) (P = General Public, N = 810; L = Leaders, N = 38)\*

Potential Regulators	Degree of Confidence							
	High Conf		Moderate Conf		Low Conf		No Conf	
	P	L	P	L	P	L	P	L
NRC	23	24	32	45	18	21	18	10
EPA	24	24	33	53	18	18	13	5
U.S. DOT	4	10	18	37	33	37	31	13
DER	20	47	41	40	19	10	9	-
State Agency	16	42	36	32	21	16	15	10
Trained Locals	37	30	31	16	13	40	8	16

\*Percentages do not equal 100 due to missing data.

Leaders of environmental, civic, and health groups, on the other hand, express far more confidence in established regulatory bodies than does the general public. In contrast, they tend to express relatively less confidence in trained locals.

The question dealing with preferred disposal methods was asked somewhat differently of the general public and the leaders of civic, environmental, and health groups. The public was asked to choose the level of safety of standard trenches, trenches with engineered barriers, above ground storage structures, and inoperative mines while the leaders were asked which of those options they viewed as safest and which as least safe. Table III presents the distribution of answers to those questions. For both the general public and the leaders, the preferred option is the trenches with engineered barriers while the option viewed as least safe is the inoperative mines. The relative lack of confidence in above ground storage structures is somewhat surprising given the effort by some environmental groups to promote this option in Pennsylvania.

One final noteworthy finding is the discrepancy on many issues between the general public and leaders of civic, environmental, and health groups. The leaders tend to express opinions more consistent with those of the industry and the federal regulators. This might be an indication of potential conflict if local and regional leaders are viewed as spokespersons for a given community or set of communities. This is evidenced by answers to a question on who they trust to represent the community. Surprisingly, the public tends not to express high trust in local and regional leaders but prefers local citizens, referenda, and town meetings. Disposal companies approaching communities through local officials only, may get a rude awakening when the issue hits the larger community.

TABLE III

Perceived Safety of Four Disposal/Storage Methods by Both the Public and the Leaders (in percentages) (Public = 810, Leaders = 38)\*

Disposal/ Storage Method	General Public				Leaders	
	Perceived Level of Safety				Perceived Safety	
	Very	Somewhat	Not Very	Not	Safest	Least Safe
Trenches	7	38	26	22	8	18
Eng. Trench	27	49	11	8	53	3
Above Ground	6	16	30	41	24	34
Mine	6	15	20	53	13	42

\*Percentages do not equal 100 because of missing data.

In response to the question about how far from the site a community should be to be considered for special concession, 64 percent of the general public picked ten miles or beyond. In expressing degrees of confidence in seven information sources on LLRW both the public and the leaders expressed relatively little confidence in newspapers, TV, and anti-nuclear groups; moderate confidence in state and federal experts; and high confidence in university experts and environmental groups. Finally, a full 65 percent of the general public expressed the need for more information on this issue.

Study Conclusions

The interpretation of this data is quite straightforward. The general public's problem with LLRW disposal sites is one of trust more so than one of equity. Therefore, they emphasize local control in terms of decisions on a site operator, site monitoring, and the ability to close the site in case of problems. Since they anticipate problems they want property values protected and site operators and regulators who are more accessible and politically accountable to the community than the standard private industry and federal agency. Consistent with the traditional American faith in technology, they have more faith in below ground structures with engineered barriers than other disposal/storage options. What is significant is that a large majority of them apparently have not closed their minds on this issue and express a willingness to entertain further information.

PUBLIC EDUCATION

Introduction

The passage of the Low-Level Radioactive Waste Policy Act (LLWPA) of 1980 gave each state the responsibility to provide for disposal of its low-level radioactive waste generated, encouraging compacts among various states to minimize waste disposal sites. Since 1980 no new sites were opened, in fact the law established a January 1, 1986, deadline that could have prevented other states from using the three existing disposal sites in the of Nevada, South Carolina, and Washington who were not part of their compact. The federal government's amendments to the LLWPA of 1980 in the last days of 1985 has provided an extension to the original deadline and established a set of milestones for states to reach between 1986 and 1992. This is required to avert a legal responsibility for low-level radioactive waste and a possible environmental, economic, and public health crisis.

What impact, if any, does public education have on this issue of low-level radioactive waste disposal? The impact of this type of program can never be fully assessed, but its importance and role in the public involvement process is crucial. A misinformed, frightened, and intransigent public can only stifle the necessary disposal of this waste, increasing or compounding potential problems.



Over the past 28 months The Pennsylvania State University has found that a comprehensive, ongoing continuing education program with full-time staff, a program office, and a support system, namely The Pennsylvania State University through the Institute for Research on Land and Water Resources, can be very effective in reaching the public. The public who want to know more than what they receive through the popular press or special interest groups. The myriad of ways to inform, educate, and involve the public can never make the experiences dull. Rather, these several ways educate the public on technological issues which they will face. Fear is the greatest enemy to technological advances that society may wish to enjoy.

During 1985 the PIER (Public Involvement and Education on Radiation) Program reached over 20,000 people in 68 different locations in the state of Pennsylvania. Thousands of others were reached through clubs and organizations that wrote about the PIER Program in newsletters or magazines. The PIER Program staff and faculty in the Institute for Research on Land and Water Resources provided feedback to questions from many state and federal legislators and their staff. Every federal and state legislator and members of the Governor's task force on low-level radioactive waste was sent reports through the Institute's mailing system or directly from the PIER Program office.

#### Program Management

During the past 28 months the PIER Program has developed a motto, "Have Need and Audience, Will Travel." The funding for this program has been provided to The Pennsylvania State University through an unrestricted grant for continuing education from the Westinghouse Corporation.<sup>4</sup>

The program has made 90 percent of its program presentations off the main campus of The Pennsylvania State University. Many of the programs were run with as few as six to as many as over 500 people in the audience. In each instance a community or governmental agency or group had to invite the PIER Program to come to their conference, congregation, or community to make a presentation. In all cases the program staff asked the invitee for agenda items or questions to be discussed prior to setting the final program outline. The University also requested that public notice of the program be made and this was encouraged. Many of the community groups were given assistance or provided with news release information. A local television cable company, local commercial television and radio stations were notified of the meeting to make as many people as possible aware of the topic to be presented and later discussed. Several state legislators invited the PIER Program into their legislative districts. One state representative asked the University to conduct three programs in his district. He attended each one and introduced and welcomed the presenters to his constituents.

Sometimes programs were run for as little as one hour while others lasted as much as a full day. The average meeting was approximately two and one-half hours. This enables three speakers to review the basics of radiation; the different waste technologies; and the importance of environmental elements such as geology in waste disposal siting. The program agenda has included six broad areas with their specific subtopics throughout its program development. They are:

- 1) NEED FOR PUBLIC INVOLVEMENT  
Public Health and Safety  
Waste Generation: A Fact of Life and Status of LLRW Developments
- 2) UNDERSTANDING THE PROBLEM  
Radiation Awareness  
What is Radiation  
Types of Radiation  
Uses - Benefits/Risks  
Health Effects  
Explaining the Waste Forms
- 3) WASTE DISPOSAL METHODOLOGIES  
Research and Technology
- 4) ENVIRONMENTAL CONSIDERATIONS  
A Geological Environment and Ecological Concerns
- 5) SOCIAL CONSIDERATIONS  
Socioeconomic Analysis
- 6) REGULATION/CONTROL  
Regulatory Bodies  
Rules/Procedures  
Quality Control/Assurance

#### Research Demands

As the issue of waste receives more attention, the impacts on its operational and developmental level increase proportionately. One area that always seems to grow with attention is research. Research is a vital link to technology development and transfer. The PIER Program learned early in its program life that many issues needed clarification, more study, and verification. The public's desire to know more about the various types of alternative technologies to low-level radioactive waste disposal and management was one of the early research topics. Two graduate students who expressed an interest in studying low-level radioactive waste disposal techniques were financially assisted by the Program under the direction of University faculty.

The PIER Program has contributed to three research programs during 1985. These research projects were:

1. Richard J. Bord, Ph.D., "Opinions of Pennsylvanians on Policy Issues Related to Low-Level Radioactive Waste Disposal," The Pennsylvania State University, College of Engineering, Institute for Research on Land and Water Resources, September 1985. (Dr. Bord's study and findings were discussed at the beginning of this paper.)
2. Gary M. Morlang, "Radionuclide Release Pathway Modeling of a Surface Low-Level Radioactive Waste Disposal Facility," Masters of Science Thesis, Nuclear Engineering Department, December 1985.

Description: This thesis examines two LLRW disposal methods; shallow land burial trench and an above ground disposal vault for the release of radionuclides and their health effects. This thesis applies the Environmental Protection Agency's PRESTO-EPA-POP computer code as its *evaluative modeling* tool.

Findings: Quantitative values for health effects and radiation exposure are presented for both types of facilities. A comparison demonstrates the feasibility of using an above ground disposal facility and determines its overall effects to the general population. For the cases considered, the above ground vault facility resulted in slightly lower radiation doses to the population than in the shallow land burial trench facility. The radiation dose levels to the public, for accident or non-maintenance conditions as well as normal operation, are exceedingly small (.02 to 3 person-mrem/yr).

3. Marcus H. Voth, "Determination of Optimum Alternative LLRW Disposal Site/Disposal Technology Combinations," Ph.D. Candidate Thesis, Nuclear Engineering Department.

Description: This thesis examines the optimal methods in considering a disposal site and disposal technology of LLRW. The researcher is using technically supported methodology to develop a model for determining an optimum waste technology within certain site characteristics. The proposed model will demonstrate a methodology which can be expanded to include additional alternative disposal technologies and evaluation criteria. Four disposal technologies are included:

- Part 61 trench
- above ground vault
- below ground vault
- grouted trench

Evaluation criteria marking up the factor of merit will include:

- safe isolation of the LLRW from the biosphere
- economics of site selection development and operation
- transportation impact of LLRW

Each site will be evaluated based on such characteristics as:

- LLRW generators
- hydrology
- geology
- meteorology
- demographics

Findings: Preliminary findings on radiation dose indicate that the impact from transportation has been underemphasized relative to the radiological release pathways at a disposal site.

Other work at The Pennsylvania State University has included the further development of the Low-Level Radiation Monitoring Laboratory under the direction of William A. Jester, Ph.D., Associate Professor of Nuclear Engineering. In 1985 Dr. Jester was the recipient of the Joan Hodges Queneau Paladium Medal given jointly by the National Audubon Society and the American Association of Engineering Societies, Inc. He received this award in recognition for his achievements in research and his environmental concerns.

#### Summary

Both continuing education, via a technology transfer mode, and research are necessary to provide people with the tools necessary to make informed decisions about risky technologies and policy makers to understand, and cope with, public fears. The successful disposal of radioactive wastes will not take place in an atmosphere which fosters public distrust of waste technology and management. Neither does the misperception of the public by waste industry and regulators promote successful siting. Increased understanding in all parties involved is the only realistic hope we have of solving a problem that few people want to face. This paper has presented a discussion of multiple efforts to increase and promote greater understanding.

#### REFERENCES

1. Witzig, W. F., W. P. Dornsife, and F. A. Clemente, (eds.), Low-Level Radioactive Waste Disposal Siting: A Social and Technical Plan for Pennsylvania, Final Report for Subcontract No. C29-007909, EG&G, Idaho, Inc., 1983.
2. Ibid.; Texas Low-Level Radioactive Waste Disposal Authority, Siting A Low-Level Radioactive Waste Disposal Facility in Texas: Local Government Participation; Mitigation, Compensation, Incentives, and Operator Standards, Texas Advisory Commission on Intergovernmental Relations, Austin, Texas, 1985.
3. Howell, R. E. and D. Olsen, Citizen Participation in Nuclear Waste Repository Siting, Report for the Western Rural Development Center in Accordance with USDA-DOE Interagency Agreement, DE-1A-97 80 ET, 1981; Jordan, J. M. and L. G. Melson, A Legislator's Guide to Low-Level Radioactive Waste Management, National Conference on State Legislatures, Denver, Colorado, 1981.
4. Vincenti, John R., A Penn State Continuing Education Program on Low-Level Radioactive Waste Disposal and Management: Lessons Learned, Waste Management '85, Vol. 2, pp. 3-5, Arizona Board of Regents, 1985.