

On-Site Storage of High Level Nuclear Waste: Attitudes and Perceptions of Local Residents

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No public policy issue has been as difficult as high-level nuclear waste. Debates continue regarding Yucca Mountain as a disposal site, and—more generally—the appropriateness of geologic disposal and the need to act quickly. Previous research has focused on possible social, political, and economic consequences of a facility in Nevada. Impacts have been predicted to be potentially large and to emanate mainly from stigmatization of the region due to increased perceptions of risk. Analogous impacts from leaving waste at power plants have been either ignored or assumed to be negligible. This paper presents survey results on attitudes of residents in three counties where nuclear waste is currently stored. Topics include perceived risk, knowledge of nuclear waste and radiation, and impacts on jobs, tourism, and housing values from leaving waste on site. Results are similar to what has been reported for Nevada; the public is concerned about possible adverse effects from on-site storage of waste.

KEY WORDS: Perceived risk; nuclear waste; social and economic impacts; survey; attitudes.

1. INTRODUCTION

The Nuclear Waste Policy Act of 1982 required the Department of Energy to develop a repository for the permanent disposal of high-level nuclear waste. The predominant form of high level nuclear waste is spent fuel from civilian nuclear power plants. These waste products have long half-lives and, based on EPA standards, must be kept isolated from the environment for up to 10,000 years. For the past 40 years, spent fuel rods have been placed in temporary storage near electric power plants where it was produced.

The Congressional decision to consider Yucca Mountain, about 100 miles north of Las Vegas, Nevada, as a site for the waste has led to an intense debate regarding the economic, social, and political impacts of the repository. General questions have also been raised

regarding (i) whether geologic disposal in a sparsely populated area is superior to leaving the waste near power plants, and (ii) whether the waste problem needs to be resolved now. The Department of Energy has been challenged by the state of Nevada and others who are opposed to developing a repository, and by the electric utilities who want waste removed from power plants.

While research has been conducted on the potential for the repository to have negative social and economic effects in Nevada, there has been little study on analogous impacts if waste remains near the nuclear power plants where it was produced. Such comparisons are needed in order to evaluate alternative waste management strategies. If the social and economic impacts of on-site storage are likely to be small relative to Nevada, and if waste can be safely stored at power plants, then Yucca Mountain might be an inferior option compared to leaving waste at present locations.

As a first step in assessing the social and economic consequences of leaving high level waste at nuclear power plants for the foreseeable future, a survey was conducted among citizens of three counties where spent

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Table I. Summary of Nevada Findings^a

- Given an opportunity to vote on having a HLNWR in their state, an overwhelming number of citizens would vote against it.
- Compared to other environmental hazards, high-level nuclear waste is believed to be one of the most dangerous.
- Compared to any other industrial or municipal facility, a HLNWR is the least desirable, often by wide margins.
- Images of a HLNWR are so negative that they reveal deep dread, revulsion, and anger.
- Perceptions of the risks associated with a HLNWR are closely tied to trust in government and trust in the agencies responsible for repository management, especially the DOE.
- There is widespread belief in the likelihood of accidents at a repository or in the transportation of waste to it and great concern over such accidents.
- Economic concerns appear in some analyses but are often overwhelmed by concerns over safety and health, including that of future generations.
- Knowledge is not a consistent factor in citizen opposition to a repository; it is correlated sometimes positively, more often negatively, and sometimes not at all with repository attitudes.
- If a repository were to be sited at Yucca Mountain the city of Las Vegas and the state would likely suffer substantial economic losses due to a significant convention decline.
- Past experience with other hazardous facilities or with other federal facilities is of only minor significance.
- That opposition to a HLNWR is deep and widespread is revealed in the fact that, almost without exception, perceptions and attitudes toward the repository are unaffected by standard demographic variables.

^a From Ref. 18.

fuel rods are currently being stored. The survey explores the attitudes and perceptions of individuals living near existing sites and hence indicates some of the tradeoffs implicit in alternative waste management strategies.

2. BACKGROUND

The debate about high level nuclear waste storage has focused on the impacts to Nevada, and tended to ignore the consequences of alternative strategies. Current research has focused on the public perceptions of risk as a major impact and the potential for a repository at Yucca Mountain to negatively stigmatize the local region.

An overview of existing survey findings is presented in Table I; the summary is from Ref. 18, but also see Refs. 1, 4, 5, 11, 13, 14, 15, 21, 22, 23. The message of most of the studies is that there will be increased perception of risk that will be “socially amplified” thus leading to potentially large social and economic effects on Nevada. The data indicate that people in Nevada are worried about accidents and their image of the repository is very negative. The nuclear problem is so extreme that risk attitudes and perceptions are largely unaffected by standard demographic and knowledge variables.

The findings have led the Technical Review Committee for the state of Nevada to conclude that, “the so-called ‘standard effects’ of large engineering projects on local employment, housing, and transportation have the potential to be dwarfed by the ‘special effects’ of risk perception and stigma” (pp. 33–34).⁽²⁴⁾ Note that these “special effects” are

Table II. Survey Outline

Introduction to survey	
Knowledge	Trust
Perceived Radiation	Nuclear industry
Nuclear waste	National environmental groups
Waste location and characteristics	DOE
	NRC
	EPA
Perception of risk	Likelihood of accident
Car	Effect of accident
Power	Illness
Temporary storage on site	Death
Transportation	Impacts on area and employment
Permanent disposal	Exposure time
	Clean-up time
Assessment of nuclear power	
Assessment of waste management options	Effect of on-site storage for foreseeable future
On site at plant	Employment
Three or four regional repositories	Business
One underground site in remote area	Tourism
	Home values
	Relocation
	Demographic information

not linked to the occurrence of accidents, but instead to the perception that accidents are possible.

The potential for large impacts has led some analysts to recommend that site characterization at Yucca Moun-

Table III. Demographic Characteristics

Total number of respondents	
Illinois-Lake County	203
Michigan-Berrien County	202
Michigan-Van Buren County	201
Sex	
Female	52%
Male	48%
Age	
Mean	43
Education	
Elementary or some high school	6%
High school graduate	28%
Trade or vocational certification	4%
Some college	26%
College graduate	23%
An advanced degree	12%
Ethnicity	
American Indian	3%
Asian	1%
Black	4%
Hispanic	2%
White non-Hispanic	87%
Other	3%
Income	
Less than \$30,000	30%
More than \$30,000	65%
Vote-registered	
Yes	87%
No	12%
Housing	
Mean number of residents	2.9
Mean number over 18	2
Own home	75%
Rent	18%
Live with someone who owns or rents	7%

tain be halted.^(6,7,21) One consequence is that waste would remain at power plants for the foreseeable future. One possibility is that the resulting on-site storage would not lead to consequences similar to those forecasted for Nevada (perhaps multiplied by the more than 70 current storage locations) because residents living near nuclear power plants have implicitly accepted a social compact that sanctions nearby storage. Alternatively, proponents of on-site storage have suggested that removal to a central repository will cause waste to be perceived differently (and more negatively) than when it remains on-site.

A recent report comparing storage options suggested that leaving waste at current locations was superior to consolidating waste at a single repository or

at monitored retrievable storage (MRS) facilities.⁽¹²⁾ The analysis assumed a repository or MRS would cause indirect special effects similar to those mentioned by the Nevada Technical Review Board, but that there would be no comparable consequences from leaving waste at power plants for the foreseeable future. If on-site storage can be done safely with minimal adverse consequences then it dominates other waste management strategies.

There are, however, reasons for considering the alternative hypothesis in which the impacts of on-site storage are not negligible. The location of existing facilities partly reflects the economics of electric transmission so that plants are not remote from large population service territories. Further, current sites were never intended, evaluated, or commissioned for intermediate or long-term storage of spent fuel rods. Finally, while there has been little publicity thus far, local concerns may increase as on-site facilities approach capacity.³ This suggests that there is at least the possibility of effects from on site storage analogous to those forecasted for Nevada with the centralized storage option.

Despite this possibility, there has been virtually no systematic study of the potential for perception-based impacts of longer-term on-site storage of nuclear waste. The focus of this paper then is on the response of residents who live near nuclear power plants to a policy decision adopting an on-site storage strategy for the foreseeable future in lieu of a centralized repository for nuclear waste. The intent is to stimulate research that permits a comparison of the likely socioeconomic impacts of on-site vs. centralized nuclear waste storage strategies.

3. METHOD

Two preliminary focus groups were conducted in Evanston, Illinois. The intent was to ascertain overall perceptions, imagery, sensitivities, and perceived risks associated with nuclear facilities. Results of the focus groups were used in developing the survey instrument.⁴

³ Recently, there has been considerable local publicity regarding storage at the Prairie Island plant in Minnesota.⁽¹⁸⁾ There has also been publicity from dry cask storage decisions at the Palisades plant on Lake Michigan. This publicity is one of the reasons why Michigan has joined other states in legal actions to force the Department of Energy to move existing waste.

⁴ Several reviewers have suggested that perceptions of on-site storage might depend on the form of the waste; whether it was in pools of water or in dry cask storage. We intend to pursue this question in future research. It should be noted however that the distinction was not important in the focus groups: attitudes depended on the location and not at all on the form of waste. This is also consistent with Nevada studies in which attitudes were found to depend on a general aversion to nuclear things, not depending on form, and not easily modified by safety assurances from government officials or the NRC.

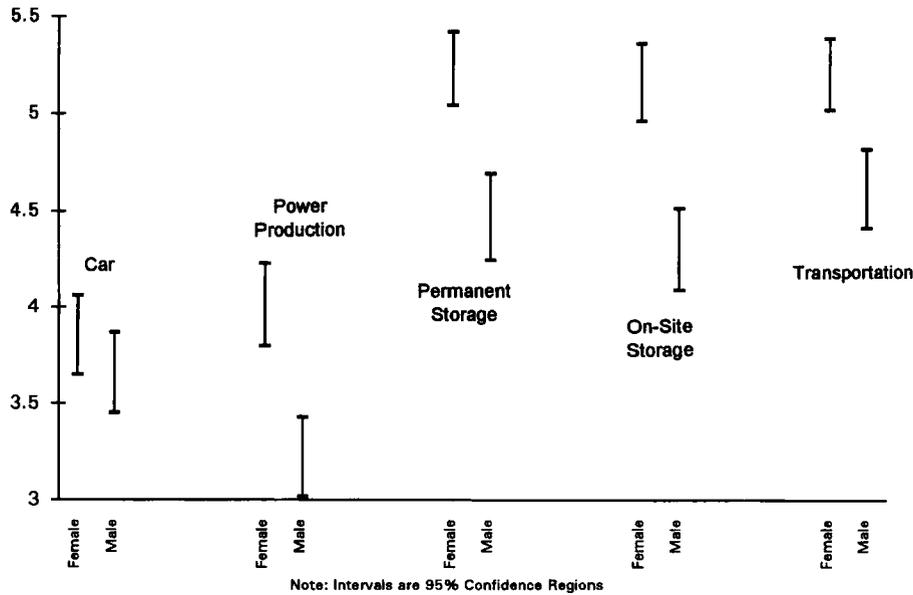


Fig. 1. Perceived risk.

The survey was conducted in three counties near existing nuclear power plants that have on-site storage facilities. The locations were Lake County, Illinois where the Zion plant is located; Berrien County in Michigan with the Palisades plant; and Van Buren County, Michigan that contains the Cook plant. All of the plants are located on the southern part of Lake Michigan. The Michigan plants are across the lake from Chicago, and the Zion plant is north of Chicago at the Illinois-Wisconsin state line.

The surveys were conducted using a computer assisted telephone interviewing system, through the University of New Mexico Survey Research Center. Sample sizes of over 200 interviews were done for each county, for a total of 606 respondents.

4. RESULTS

An outline of survey topics is shown in Table II and an overview of respondent demographic characteristics is presented in Table III. Topics included perceived risks associated with various phases of the nuclear fuel cycle as well as self-assessed and actual knowledge concerning radiation and nuclear power. Respondents were asked for their preferences for managing nuclear waste. With recent interest in trust and confidence as a factor in facility siting, trust ratings for institutions associated with nuclear waste were also obtained. Finally, perceived impacts from on-site storage were considered.

Questions were asked about the perceived likelihood of an accident as well as a variety of economic impacts if it became known that the local facilities would be used to store nuclear waste for the foreseeable future.

Separate figures are presented below for men and women and sometimes for Michigan and Illinois respondents. Much of the previous research on environmental attitudes has found significant differences in perceptions and attitudes between men and women.⁽¹⁷⁾ There also might be State differences due to the greater publicity about waste in Michigan. The partition by region and gender provides an initial assessment of the role of standard demographic variables in determining attitudes, perceptions, and knowledge.^(10,20)

4.1. Perceived Risk

Questions were asked about nuclear powered electricity production, temporary on-site storage, transportation, and permanent disposal of nuclear waste. Risk ratings were calibrated against a question concerning the risk of driving a car. Responses are shown in Fig. 1. Intervals for the mean response are depicted; they are centered at the average response with a length determined by the standard formula for the 95% confidence interval for a normally distributed mean.

The figure shows production of electricity to be the least risky component of the fuel cycle. Its risk score is not significantly different from driving a car. The per-

ceived risks for storage, transportation, and disposal are much greater, averaging a full point higher than the risk from power production. The most frequent answer to these later questions fell at the "extreme risk" end of the scale.

Consistent with the literature on risk perceptions, there were significant differences between men and women. Women perceive greater risk for all phases of the fuel cycle. These differences do not seem to arise from a different calibration of risk as there was not a significant difference between women and men for the car-risk question. In our data, women perceive greater risks for nuclear activities even relative to other activities like driving a car. This contrasts with the Nevada results reported in Table I in which nuclear attitudes did not depend on standard demographic variables; Ref. 16 reports gender effects with regard to nuclear waste attitudes and perceptions.

4.2. Knowledge

Respondents were asked to rate their own knowledge concerning the production of nuclear power (referred to here as "self-assessed knowledge"). They were also asked a number of factual questions meant to assess their general knowledge of radiation and nuclear power.

Perceived Knowledge. Self-assessed knowledge fell about in the middle of the seven point scale; the average and median scores were 4.64 and 5, respectively. Respondents in Michigan reported slightly greater self-assessed knowledge than those individuals in Illinois (perhaps reflecting the greater media attention to nuclear issues in the Michigan communities surrounding the power plants), but the differences were not large. However, there was a statistically significant difference between men and women with men tending to put themselves closer to the "very knowledgeable" end of the scale.

Factual Knowledge. Two composite knowledge scores were constructed for each individual. A radiation knowledge index was constructed from the questions on radiation and waste characteristics, while an institutional knowledge index was built from the questions about the institutions that manage waste. An answer was considered correct if "definitely true," or "probably true" was the response when "true" was the correct answer, and similarly for the questions where false was the correct answer.

Examples of radiation knowledge questions were; (i) Since the detonation of the first atomic bomb, man-made radiation is known to have resulted in new species of plants and animals, and (ii) To the best of your knowledge, is the fuel in a nuclear power plant a liquid (like

water or gasoline), a solid (like rock or metal), or a gas (like natural gas or air)? An example of an institutional question was: To the best of your knowledge, once the spent fuel is removed from a nuclear power plant, where is it usually stored? (i) At the nuclear power plant, (ii) In a central storage facility owned by the federal government (iii) In a private storage facility away from the plant, or (iv) Somewhere else?

Of the six radiation knowledge questions, an average of 2.8 were answered correctly. Of the six questions in the institutional knowledge category, 2.7 were answered correctly (see Fig. 2). (Examples: 71% of the respondents knew that the NRC was the agency responsible for regulating the nuclear power; only 42% knew that nuclear fuel was a solid; only 40% knew that nuclear fuel was stored on-site. Some indication of the absence of publicity in the Midwest about nuclear issues was the small number (11%) who correctly named Nevada as the state under consideration for a storage facility; 65% said they did not know or did not answer).

The factual knowledge scores were significantly higher in Michigan than in Illinois, reflecting the greater publicity about nuclear issues in Michigan. There were also gender differences with men scoring almost a full point higher on the knowledge scale.

4.3. Assessment of Nuclear Power and Waste Options

People were asked for their assessment of the current level of nuclear powered electricity production, and also their preferred options for managing waste. Respondents indicated that current levels of nuclear powered generation is about right. There was no discernible difference between Michigan and Illinois. But consistent with their different risk perceptions, men tended to favor slight increases in nuclear power whereas women thought there should be decreases.

Evaluation of Waste Management Alternatives. Respondents were presented with three currently discussed options for storing nuclear waste. The average responses showed greatest opposition to a regional repository, with on-site and permanent repositories receiving about the same level of support (see Fig. 3). The distribution of responses revealed clustering at the ends of the scale with either strong opposition or strong support. For on-site storage, 22% reported strong support, but 24% were strongly opposed; the remaining answers fell uniformly between the extremes. For the question concerning regional storage the most frequent response (25%) was strong opposition. For "a single underground storage

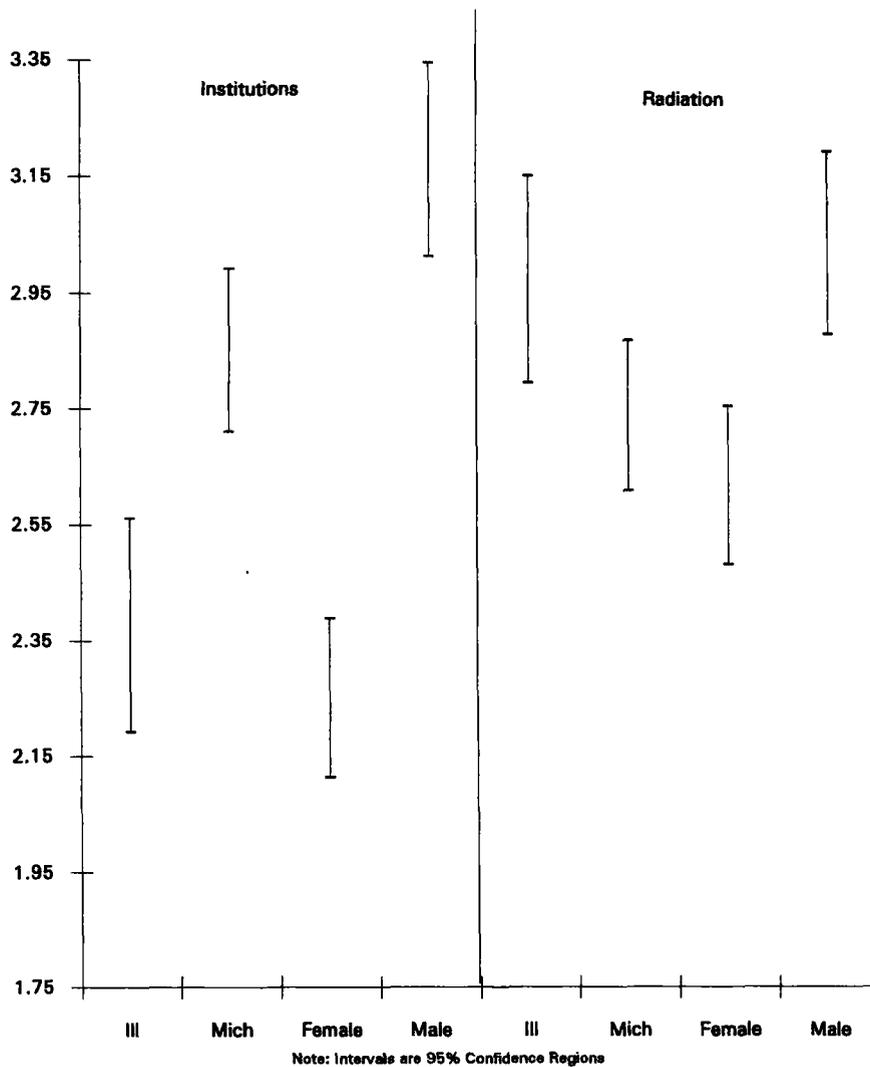


Fig. 2. Knowledge.

site in a remote area" 28% were strongly opposed, but 22% strongly supported the option, and the rest fell uniformly in between. These patterns appeared in responses from both states and from men and women.

The absence of clear NIMBY response (in which waste should be in someone else's backyard) was consistent with what had been observed at the focus groups. When presented with a range of storage options, participants initially opted for the NIMBY solution, but changed when informed that Nevada residents did not want the waste. Focus group members struggled for consensus, while recognizing the waste would ultimately have to be in someone's backyard.

4.4. Trust

There has been recent emphasis on trust as a key ingredient to management of nuclear waste. Opposition

to the DOE's characterization of a repository by residents in Nevada, combined with evident lack of trust and confidence in the DOE, has led some analysts to suggest a causal connection; namely, that lack of trust is the main reason for opposition.⁵ (2.8.9) The survey there-

⁵ The absence of progress in the related area of low-level radioactive waste suggests caution in relying too much on trust and confidence as a cause of (or solution) to the waste problem. For low level waste there is no DOE involvement, there is no direct bomb stigma (stigma might actually be positive because of nuclear medicine's contribution to the waste), and siting groups have sought to build trust among local residents. Still, there has been no progress in identifying locations for storing waste.⁽³⁾ Creating and maintaining trust is obviously important, but its absence for institutions charged with managing nuclear waste does not mean that it would have been any easier to resolve issues. Resolving disputes in which all parties do not come out ahead on all aspects of a solution might cause some participants to lack trust if only because, on some criterion, they have fared poorly.

fore included several questions on trust that were meant to provide a baseline for comparing attitudes on trust in institutions.

The highest trust score was for environmental interest groups, followed by the Environmental Protection Agency (EPA), the NRC, the DOE, and finally the nuclear industry. Trust in the nuclear power industry was slightly greater among Michigan respondents. The point estimate indicated men had greater trust in institutions, but the difference was not statistically significant.

What was the relationship between trust and the level of support for the various nuclear waste management options? As was found in earlier research,⁽⁸⁾ the greater the trust in the Department of Energy, the greater the support for a centralized nuclear waste repository strategy (correlation = 0.16, $p < 0.0001$). However, this relationship held between trust for DOE and all three repository strategies. Interestingly, the same pattern of relationships—more trust associated with greater support—held for other involved government agencies (including the Environmental Protection Agency and the Nuclear Regulatory Commission) in roughly the same magnitudes. Thus, the link between trust and nuclear waste policy support is not unique to DOE and a centralized repository strategy, but holds across quite different strategies and governmental agencies.

4.5. Likelihood and Impact of an Accident

Respondents were asked about the likelihood of an accident. The specific question was: As you may know, spent radioactive fuel is now being stored at operating nuclear power plants. How likely do you think it is that there will be an accident involving these radioactive wastes which would result in the release of radiation into the environment? On a 10-point scale, where zero means an accident will never happen, and ten means an accident is certain to happen, where do you place your views regarding the possibility of an accident?

Responses fell over the full range, but were skewed slightly toward the “certain to happen” end of the scale; 21% of the sample thought an accident was “nearly certain” and gave scores of 9 or 10 (see Fig. 4). Consistent with their higher risk assessments, women viewed accidents as more likely by a full point. There was little difference between states.

Effects of Accident. Respondents were asked to consider what would happen if an accident resulted in the release of the radioactive wastes into the environment. Options included whether people near the facility would die or become ill. They were also asked about effects

on work and the time needed to clean up the area if there was an accident.

Responses were fairly consistent; people thought an accident would cause people to become seriously ill and die and that living in the area would continue to be dangerous for many years. Regarding clean-up of the waste, men were more likely than women to think that it would be possible to remediate the site of the accident. Michigan respondents thought waste could be cleaned up, but Illinois respondents were more likely to think that clean-up would be impossible.

4.6. On-Site Storage for the Foreseeable Future

A number of questions were asked concerning possible economic impacts from continued on-site storage. The idea was to compare and contrast responses with those that have been reported for Nevada.

The first questions dealt with the effect on home values. The question was: Suppose that it became widely known that a nuclear power plant within 50 miles of your home was to become a storage site for high-level nuclear waste for the foreseeable future. What do you suppose would be the effect on the value of your home?

The most frequent response was that individuals believed that values would decrease (39%), though many (34%) thought there would be no change in the value of their home or chose not to answer the question, and 2% thought values would increase (see Fig. 5). Among those who foresaw a decrease there was about a 25% reported drop in home values (see Fig. 6). Responses between Illinois and Michigan and between men and women were similar.

Relocation. People were asked if on-site storage for the foreseeable future would or would not make it likely they would move to another area. Responses were at both ends of the scale with 31% saying it would not increase the chance they would move and 21% saying it would greatly increase their chance of relocation. Consistent with other parts of the survey the Illinois and women respondents expressed a significantly greater likelihood of moving.

Employment, Business, and Tourism. People were asked for their assessment of economic impacts on the local area if it became widely known that a decision had been made to opt for on-site storage for the foreseeable future. The response patterns for employment, business, and tourism were similar (see Fig. 7). Responses were skewed toward the “adverse impact” end of the scale with Illinois residents and women perceiving largest impacts.

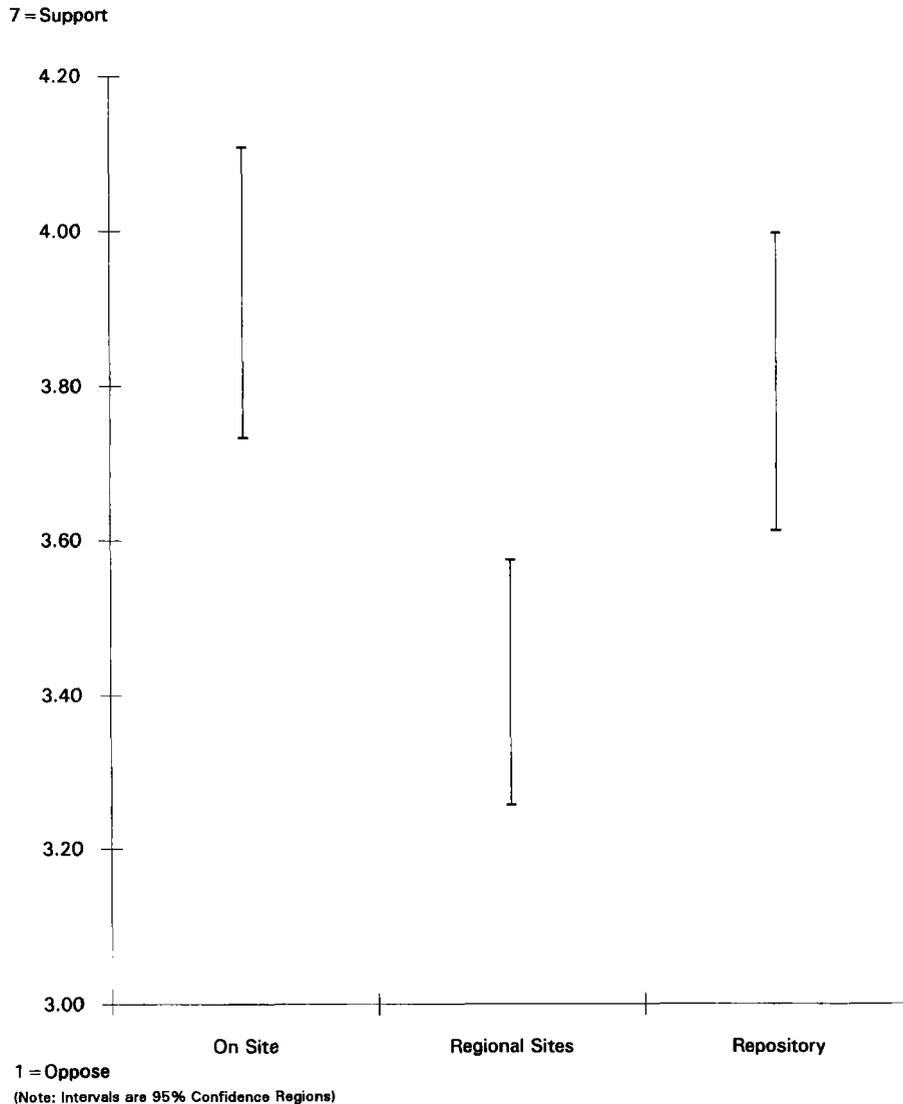


Fig. 3. Storage preferences.

For the employment question, responses were skewed toward the “employment would fall a lot lower” end of the scale, though the most frequent response was that employment would stay about the same (few thought there would be an increase in employment). The patterns for new business formation was similar with responses skewed to the “fewer new business moving in” end of the spectrum. Similarly, most thought that on-site storage would result in about the same or fewer tourists into the area.

4.7. Regression Results

Is increased knowledge associated with lower perceived risk? Are the differences in female–male risk per-

ceptions merely due to differences in other variables such as knowledge and education? And do increased perceptions of risk make it more likely that a person would say they would move if nuclear waste was left on-site? Preliminary answers are provided by regressions involving variables that have been previously identified in the literature as important factors determining perceived risk.

Table IV presents results for perceived risk. The table shows separate regressions for each perceived risk category. Independent variables were: gender (0 = female), location (0 = Illinois), radiation knowledge, factual knowledge, self-assessed knowledge (with 1 indicating the greatest and 7 least self-assessed knowledge), age, and education.

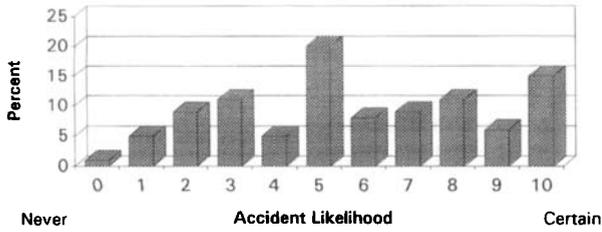


Fig. 4. Perceived likelihood of an accident.

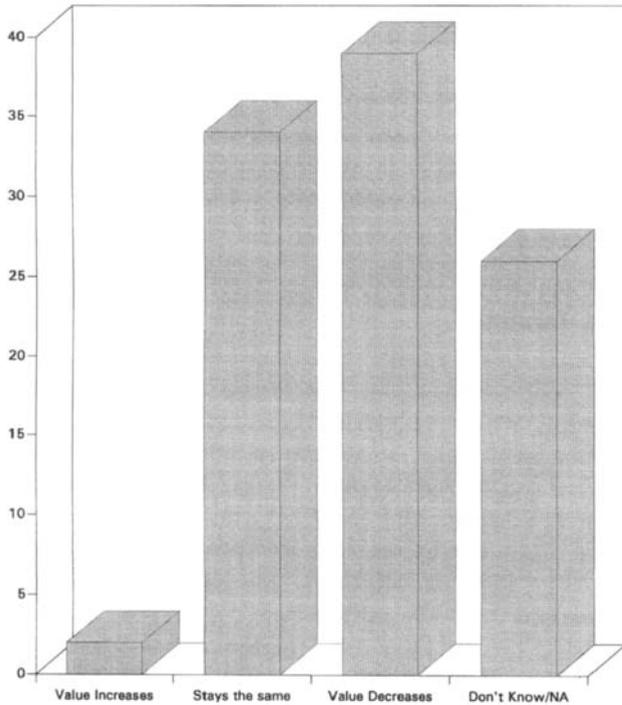


Fig. 5. Effect of on-site storage on home values.

Simple correlations (not shown) indicated that increased knowledge was associated with decreased perception of nuclear risk. The fact that men scored higher on knowledge suggested that knowledge might be a proxy for the observed gender differences in risk perceptions. Table IV shows that this is not the case; gender differences persist even after controlling for the other factors affecting risk perception. Greater knowledge continues to be associated with decreased perceived risk, but gender is the quantitatively most important determinant of perceived risk. With knowledge and education held constant, men score about a half point lower than women on perceived risk.

Table V shows regression results for the Home-Move question. Independent variables include gender, location, perceived risk of temporary storage, age, the

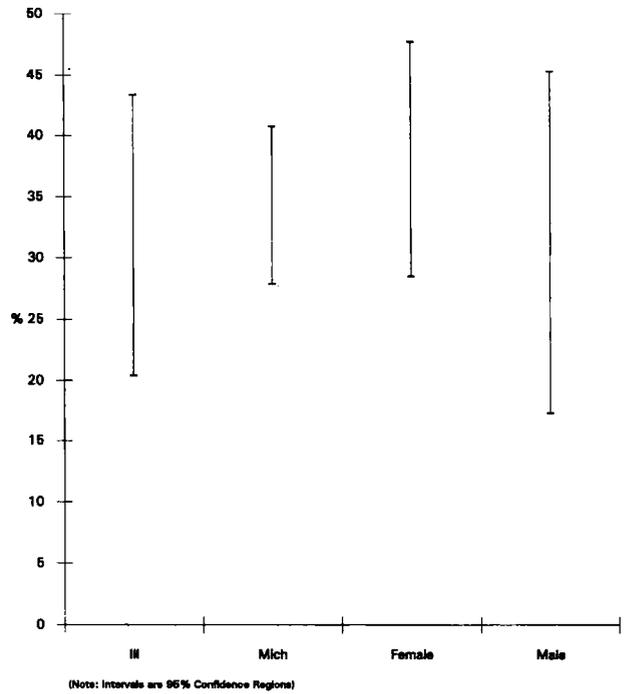


Fig. 6. Change in home values for those who thought values would decrease.

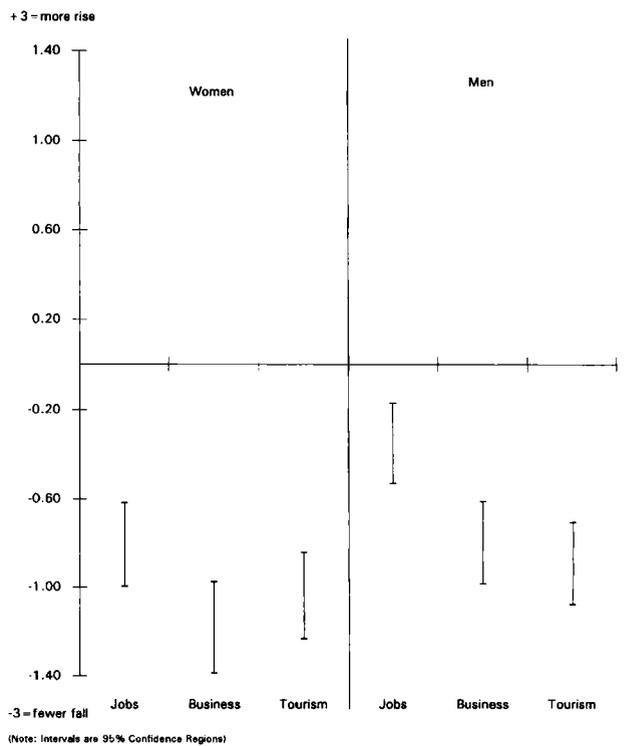


Fig. 7. On-site storage effects.

Table IV. Perceived Risk Regressions

	Car	Power	Temp. storage	Transport	Permant storage
Intercept (<i>t</i> -stat)	3.62 8.03	4.83 11.19	5.50 12.63	5.30 12.61	5.92 13.43
Gender (<i>t</i> -stat)	-0.29 1.83	-0.46 2.98	-0.64 4.13	-0.42 2.82	-0.51 3.21
Residence (Ill. or Mich.)	-0.04	0.14	0.19	0.23	0.16
(<i>t</i> -stat)	0.22	0.87	1.21	1.52	0.99
Radiation knowledge	-0.03	-0.16	-0.17	-0.15	-0.18
(<i>t</i> -stat)	0.57	2.77	2.96	2.64	3.00
Institutional knowledge	0.15	-0.20	-0.08	-0.04	-0.15
(<i>t</i> -stat)	2.37	3.37	1.28	0.76	2.53
Self-assessed knowledge	0.10	0.20	0.13	0.14	0.10
(<i>t</i> -stat)	1.94	4.05	2.75	3.00	2.02
Age	0.00	-0.01	-0.01	0.00	0.00
(<i>t</i> -stat)	0.71	2.07	1.25	0.69	.82
Education	-0.08	-0.14	-0.04	-0.05	-0.06
(<i>t</i> -stat)	1.58	2.70	0.72	1.09	1.11
Adjusted R^2	.105	.121	.111	.071	.098

Table V. Home-Move Regression

	Likelihood of moving
Intercept	3.79
(<i>t</i> -stat)	3.32
Gender	-0.35
(<i>t</i> -stat)	0.88
Residence (Ill. or Mich.)	0.24
(<i>t</i> -stat)	0.44
Risk of temp. storage	0.37
(<i>t</i> -stat)	3.61
Age	-0.01
(<i>t</i> -stat)	1.87
Distance from plant	0.00
(<i>t</i> -stat)	0.72
Income	-0.29
(<i>t</i> -stat)	1.02
Education	-0.12
(<i>t</i> -stat)	0.82
R^2	.095

distance from the plant as reported by the respondent, income, and age. None of the variables are significant,

except for perceived risk; the greater the perceived risk, the greater the reported likelihood of moving.

The regressions indicate gender and knowledge are important determinants of perceived risk, and perceived risk influences the willingness to move. The low R^2 values mean there is considerable variability in risk perceptions after accounting for demographic characteristics. This variability is due to the inherent "noisiness" of the risk perception signal. The simple correlations (not shown) among the four nuclear questions (transportation, storage, generation, and disposal) were all positive, significantly different from zero (so, high perceived risk for one nuclear category is associated with high risk for other nuclear categories), but the correlations are modest; squared correlations are never greater than .36. Hence, while there is evidently a common "nuclear" factor affecting risk perceptions, it does not lead to identical perceptions across the nuclear categories.

4.8. Summary

Our results indicate that on-site and centralized repository storage of high level nuclear wastes may result in the same kinds of perception-based impacts. There are, in fact, strong reasons to suspect that on-site storage will be received with about the same degree of enthusiasm from nearby residents as would a centralized repository from its neighbors. Nuclear waste risks are perceived very differently nuclear power risks; there appears to be no "carry over" of acceptance from one to the other. Furthermore, among the counties surveyed there is a perception that a deliberate policy of on-site storage for the foreseeable future will lead to socioeconomic harms, including loss of jobs, tourism, and businesses. Indeed, these are precisely the kinds of harms reported for a centralized repository in Nevada.

5. CONCLUSION

Our survey results indicate that on-site nuclear waste storage would be perceived as a costly and unwelcome strategy by people who live near nuclear power plants. They believe that, should it become widely known that nuclear waste would be stored on-site for the foreseeable future, tourism, jobs, and business relocations would all be adversely affected. Furthermore, there would be substantial fear of accidents and their consequences. Our results differ from those summarized for Nevada⁽¹⁸⁾ in that attitudes and perceptions appear generally consistent with standard demographic and knowl-

edge variables. Perceived risk is lowest among groups with greater knowledge, and women and men show consistent differences in attitudes and risk perceptions.

Overall, these results provide hints of how residents near nuclear power plants will perceive a policy in which high level nuclear waste is left on-site for the foreseeable future. While our survey was limited in its size and scope, and the sample included only three of the approximately 70 sites where waste exists, it does indicate that residents near nuclear power plants express the same kinds of reservations about an on-site storage strategy as those obtained from Nevada residents about a centralized storage strategy. These conclusions are tentative, however: more conclusive findings await a direct comparison between residents in Nevada and those near nuclear power plants. Further, more work is needed regarding the stated intent reported in surveys and eventual behavior. Nevertheless, there is ample evidence to question the expectation of benign consequences of on-site storage. Future analysis of nuclear waste options should include the potential for perception based impacts of longer-term on-site storage of nuclear waste like those that have been forecasted to occur in Nevada.

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REFERENCES

1. G. W. Bassett and R. Hemphill, "Perceived Risk, Stigma, and Potential Economic Impacts of a High-level Nuclear Waste Repository in Nevada: Comment," *Risk Analysis* 11(4), 697-700 (1991).
2. G. W. Bassett, "A Question of Waste, Not Trust," *Forum* 9(1), 126 (1994).
3. D. Coates, V. Heid, and M. Munger, "Not Equitable, Not Efficient: U.S. Policy on Low-Level Radioactive Waste Disposal," *Journal of Policy Analysis and Management* 13(3), 526-538 (1994).
4. D. Easterling, V. Morwitz, and H. Kunreuther, Estimating the Economic Impact of a Repository from Scenario-Based Surveys: Models of the Relation of Stated Intent to Actual Behavior, Agency for Nuclear Projects, Nuclear Waste Project Office, Report No. NWPO-SE-035-90 (1990).
5. D. Easterling and H. Kunreuther, The Vulnerability of the Conventional Industry to the Siting of a High Level Nuclear Waste Repository. Mimeo.
6. K. Erikson, "Out of Sight, Out of Mind." *New York Times Magazine* March 6, p. 34 (1994).
7. J. Flynn, R. Kasperson, H. Kunreuther, and P. Slovic, "Time to Rethink Nuclear Waste Storage," *Issues in Science and Technology* 8(4), 42-48 (1992).
8. J. Flynn, W. Burns, C. K. Mertz, and Paul Slovic, "Trust as a Determinant of Opposition to a High-Level Radioactive Waste Repository: Analysis of a Structural Model," *Risk Analysis* 12(3), 417-429 (1992).
9. J. Flynn and P. Slovic, "Nuclear Waste and Public Trust," *Forum* 8(1) (1993).
10. H. Jenkins-Smith and G. W. Bassett, Jr., "Perceived Risk and Uncertainty of Nuclear Waste: Differences Among Science, Business and Environmental Group Members," *Risk Analysis* 14(5), 851-856 (1994).
11. R. E. Kasperson, O. Renn, P. Slovic, H. Brown, J. Emel, R. Goble, J. X. Kasperson, and S. Ratick, "The Social Amplification of Risk: A Conceptual Framework," *Risk Analysis* 8(2), 177 (1988).
12. R. Keeney and D. von Winterfeldt, "Managing Nuclear Waste from Power Plants," *Risk Analysis* 14(1), 107-130 (1994).
13. H. Kunreuther, W. Desvovges, and P. Slovic, "Public Perceptions of Risk from the Proposed Nuclear Waste Repository," *Environment* 30(8), 17-33 (1988).
14. H. Kunreuther and P. Slovic, Forecasting the Adverse Economic Consequences of A Nuclear Waste Repository in Nevada, paper presented at the 1989 AAAS Meeting (1989).
15. H. Kunreuther, D. Easterling, W. Desvovges, and P. Slovic, "Public Attitudes Toward Siting a High-Level Nuclear Waste Repository in Nevada," *Risk Analysis* 10(4), 469-484 (1990).
16. C. K. Mertz, J. Flynn, and P. Slovic, The 1994 Nevada State Telephone Survey: Key Findings, State of Nevada, Agency for Nuclear Projects (December 1994).
17. R. E. O'Connor and R. J. Bord, Are Women Really More Environmentally Concerned? Gender Differences and the Politics of Environmentalism, Paper presented at the Midwest Political Science Association, Chicago (April 1994).
18. E. A. Rosa, R. Dunlap, and M. Kraft, "Prospects for Public Acceptance of a High Level-Nuclear Waste Repository in the United States: Summary and Implications," in R. E. Dunlap, M. E. Kraft, and E. A. Rosa (eds.), *Public Reactions to Nuclear Waste: Citizens' Views of Repository Siting* (Duke University Press, Durham, NC, 1993), pp. 291-324.
19. R. E. Russell, "Nuclear Waste, Policy Meltdown," *Public Utilities Fortnightly* July 1, 15-17 (1994).
20. P. Slovic, "Perceptions of Risk," *Science* 236, 280-285 (1987).
21. P. Slovic, M. Layman, and J. H. Flynn, "Lessons from Yucca Mountain," *Environment* 33(3) (1991).
22. P. Slovic, J. H. Flynn, and M. Layman, "Perceived Risk, Trust, and the Politics of Nuclear Waste," *Science* 254, 1603-1607 (1991).
23. P. Slovic, M. Layman, N. Kraus, J. H. Flynn, J. Chalmers, and G. Gesell, "Perceived Risk, Stigma, and Potential Economic Impacts of a High-Level Nuclear Waste Repository in Nevada," *Risk Analysis* 11(4), 683-696 (1991).
24. Technical Review Committee for the State of Nevada, Interim Statement of the Technical Review Committee (January 1990).