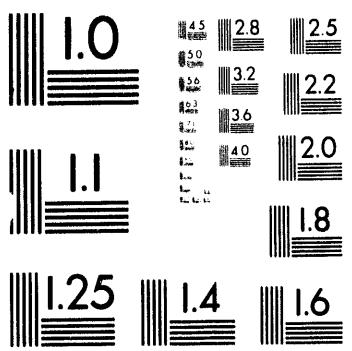
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Conf-940312--39

WSRC-MS-93-470

RISK ANALYSIS FOR NUCLEAR WASTE SITES: WILL IT GENERATE PUBLIC ACCEPTANCE? (U)

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A document prepared for:
presentation and publication at the Society for Risk Analysis PSAM-II Conference on Probabilistic Safety Assessment Methodology
at San Diego, CA
from 03/20/94 thru 03/25/94

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DOE Contract No. **DE-AC09-89SR18035**

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RISK ANALYSIS FOR NEW NUCLEAR WASTE SITES - WILL IT GENERATE PUBLIC ACCEPTANCE?

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INTRODUCTION

Over the past decade, one of the major uses of risk analysis has been to estimate the hazards of existing or potential nuclear waste sites. Its ultimate purpose, aside from meeting regulatory requirements, is to assure local residents that the risks are small, if indeed they exist at all. A wide variety of risk communications techniques have been suggested by social scientists and others to explain the results to non-scientists. However, regardless of the specific techniques employed, the overall process often fails. Potential neighbors often become even more hostile than they were prior to the risk analysis process. As has often been pointed out by sociologists, the risk analysis itself is "captured" by facility opponents. They point out that uncertainties exist in the computations and that zero risk cannot be guaranteed for any of the project phases.

Does this mean that risk analysis should not be applied in finding new waste sites or in evaluating old ones? Few would claim that risk analysis is not necessary, but it clearly is not adequate for producing social acceptance. In the context of waste siting, risk analysis has to carry too heavy a burden. While few risk analysts would claim explicitly that the field is sufficient to solve siting problems, the claims are implicit in the process. The Yucca Mountain controversy over high-level wastes is a case in point. While millions have been spent on various risk analyses - taken in the broad sense - over the years, there is little evidence that many Nevadan minds have been swayed. Indeed, the subject is little mentioned in public debates, except by opponents who note that the risk analyses always find a non-zero risk.

It is clear that other tools, not replacing but in addition to risk analysis, must be used to reach a successful conclusion to the decades-long process. Only in this way can the nuclear industry be freed from the albatross of nuclear wastes, and go on to more productive activities.

A BRIEF HISTORY

Since the beginning of the nuclear era, it has been recognized that the wastes generated would pose a problem to public acceptance. It is sometimes believed that nuclear pioneers disregarded wastes, and that they assumed a future generation could deal with it. The record suggests otherwise. For example, David Lilienthal, the first chair of the former Atomic Energy Commission (AEC), said in a book published four decades ago that unless the problem was solved, the industry would gradually diminish in public support. In the

mid-50s, a sanitary engineer (Lieberman, 1955) from the AEC Reactor Development Division wrote,

> "One has only to consult the popular press to become acutely aware of the militant interest of the public in matters directly concerned with waste disposal and environmental sanitation..."

It is not clear when quantitative risk analysis for nuclear waste sites came into being. From the beginning, it was stressed by regulatory agencies that public health and safety would be protected in the siting and disposition process. By the mid and late 1970s, calculations were being performed, and some had a probabilistic aspect. Risk computations were performed around that time in the U.S. by the Environmental Protection Agency (Energy Daily, 1979); the AEC (Atomic Energy Commission, 1974), Science Applications Inc. (Erdmann et al., 1979), DOE (Department of Energy, 1978), and the American Physical Society (Hebel et al., 1978). Calculations were also performed in Sweden (Karn-Bransle-Sakerhet, 1978).

Inhaber (Inhaber, 1982) and others, in reviewing these studies, found that the waste risks, while non-zero, were a smaller component of total nuclear fuel cycle risk than any other aspect, such as mining or reactor operation. Since that time, many other reports have been issued, some in conjunction with the proposed characterization of a high-level waste site at Yucca Mountain in Nevada.

Waste risk studies have now been produced in many countries and with varying assumptions. None of them predict that the risk of nuclear wastes, when properly handled and disposed of either above-ground or in geological formations, would pose other than a minuscule threat to human health and safety.

DO RISK STUDIES HAVE ANY EFFECT ON THE PUBLIC?

Risk studies seem to have little effect on public attitudes, which is presumably the intended object of the studies. Surveys of the public in Nevada and elsewhere have indicated little knowledge of or even interest in these calculations.

Perhaps the most graphic example of this was seen during the Chicago convention of the American Nuclear Society in November 1992. A high official of the Department of Energy Office of Civilian Radioactive Waste Management (OCRWM) in Nevada was reviewing progress to date on characterization. He noted that all of the risk studies performed on behalf of his agency were available to the citizens of Nevada. Since OCRWM has made strenuous efforts in terms of public outreach, all of the reports noted in this paper and others issued since the 1970s would be supplied to anyone interested. Presumably at least some of the studies have been read by a number of Nevadans.

An individual in the audience then posed a question. Was the official aware of any Nevadan who had read one or more of these studies and then publicly stated that his or her opinion had been changed from anti-repository to pro-repository? The official was unable to supply the name of any such person.

This exchange suggests that while risk studies have been useful in meeting regulatory requirements, they have not, by themselves, generated much change in public opinion on these sites. The situation described above could be multiplied many times in experiences around the world.

THE PILING-ON OF RISK STUDIES

The risk studies situation is illustrated in Figure 1. In the first part, the dark sheets indicate the studies performed. Public opinion is generally unfavorable in spite of this work. Siting agencies then conclude that the solution is more studies, not a new approach. These studies are performed, and public opinion may shift slightly in favor of the proposed waste site. However, it is still a long way from overall approval.

Undaunted, the siting agency redoubles its efforts, as shown in the third part of Figure 1. More studies are produced, and public opinion is changed slightly. But the goal of general approval is still not reached.

Finally, the process collapses of its own weight, as shown in the fourth and last part of Figure 1. After years, or in some cases, decades, of delay, the process and the accumulated studies are abandoned. The process begins again with new risk studies.

NEW TOOLS TO SOLVE THE PROBLEM

Some decision-makers are aware of the seemingly endless cycle of studies, more studies, abandonment and restart. They have searched for another tool to solve the problem. Some, such as the Decision Research group in Oregon (Kunreuther et al., 1988), have proposed greater "trust" between risk analysts and the public. However, many of the proposed techniques to generate trust have been employed in the past, with few beneficial effects from the viewpoint of project sponsors.

For example, social scientists suggest that trust can be produced by having officials of a project readily accessible to any member of the public. This credo has been followed in the Yucca Mountain situation. The home phone number of the chief Department of Energy representative is listed in the phone book, available to any critic. Yet the level of opposition there remains strong, with all officials who have been elected state-wide for years being opposed to the Yucca Mountain project.

THE NEGOTIATOR APPROACH

Another approach, some distance from risk analysis itself, is that of a "negotiator". Community groups have often pointed out that the plethora of agencies concerned with siting have made it difficult for citizens to evaluate the facts. Congress, in the 1987 amendments to the Nuclear Waste Policy Act, provided for a federal negotiator for high-level wastes. David Leroy, former lieutenant governor of Idaho, was appointed to this position in 1990 (Nuclear News, 1990). His tenure lasted until June 1993.

In principle, a negotiator could reduce the conflicting signals often produced by the various bureaucracies of DOE, EPA, the Department of the Interior, and others. However, the authority given the negotiator by law is unclear; his relationship to the Secretary of Energy and the head of the civilian high-level nuclear waste office remains cloudy (Inhaber, 1991).

From the viewpoint of risk analysis, it is instructive that the negotiator made little if any use of the extensive risk studies sponsored by DOE, EPA and others. He may have brought them to the attention of the counties and Indian tribes to whom he wrote, but they apparently played a negligible part in the discussions he held.

COMPENSATION - THE ULTIMATE TOOL?

To date, the amount of nuclear industry concern has been much greater for risk analysis than any risk compensation to a potential community or state. The results suggest that the industry and the public might be better off if the proportion of concerns had been reversed.

Compensation has been a tool in siting, both in conjunction with and separate from risk analysis. Observers inside and outside the nuclear industry have said that communities should be fully compensated for the detriment caused by a waste site (Ackerman, 1977; Bacow and Milkey, 1982), but until recently no methodology for setting the appropriate amount has been devised. In consequence, compensation amounts have been selected arbitrarily, leading to rejection by affected communities.

For example, in the case of Yucca Mountain, the original amount of compensation proposed in a Congressional committee in 1987 was $100 million annually. By the time the bill emerged from Congress, the amount was whittled down to $10 or $20 million annually, depending on the stage of construction. Whatever the level of funding, it was chosen without any apparent input by Nevada or Nevadans.

In a more recent case in France (Nuclear News, 1991), a fee of about $10 million annually was to be paid to affected communities. However, as long as the fee amounts are

set by outsiders and not the affected community, there will be a tendency to reject the amounts proffered. This took place in Nevada, and is on the way to happening in France.

It is evident that compensation systems have been treated as if they are all equal. However, there are as many types of compensation systems as there are varieties of risk analysis. Just as risk analysis must be carefully constructed to yield valid results, so a compensation scheme must be devised to achieve the goals of fairness and equity. In many instances, these twin goals can be reached only with adequate community control over the entire process. The present siting system, with or without compensation, offers little or no control to communities accepting wastes. The implicit assumption is that allowing this control would result in the facility being shut down or not constructed at all.

A number of solutions to the above-noted problems have been suggested. Kunreuther and others at the University of Pennsylvania (Kunreuther, 1987) have proposed compensation-lottery systems, with the goals of ensuring equity and an open process. Others (Inhaber, 1991) have propounded auction-style systems, in which communities would, in effect, set the level of compensation they think adequate.

The reverse Dutch auction system of Inhaber is shown in the next two figures. Figure 2 shows the steps until the first (and probably only) bid is made; the latter traces subsequent steps. It is assumed that a state wishes to site a waste facility somewhere in its boundaries. Counties are relevant political jurisdictions. The principles can be applied to siting high-level waste, where the states would be the relevant political entities.

After announcement of risk and environmental ground rules, the siting authority gradually raises the bonus level. The graph shows increments of $10 million, but other amounts can be used. Since communities often do not have the technical expertise to evaluate the complex criteria, they will be allowed to hire consultants at no cost to them to perform this task. Those who do are under no obligation to bid.

The bonus level rises until a community decides to make the first bid. At this point, the process transfers to Figure 3. The proposed site is considered by regulatory agencies - EPA, NRC or state bodies. At the same time, most of the bonus (perhaps 2/3) is paid into a trust fund. Many citizens will believe that, regardless of the safeguards, their community will not receive the bonus, but the trust fund will reassure them. If the site exceeds the criteria (even by a small amount) the process is completed and the total bonus is paid. If it does not, the auction continues, starting at the previous level. Eventually, a second community will come forward. The process is completed with the minimum number of complaints of unfairness and favoritism.

The reverse Dutch auction is apparently the only system that allows for volunteerism and payment of the correct social cost to the affected community.

In the phrase used in geometrical proofs, risk analysis is regarded as necessary for siting, but not sufficient. In these new systems for siting, risk analysis is not abandoned but is no longer the sole driving force.

CONCLUSIONS

Ultimately, the approach of suggesting to citizens that they study and understand risk analyses may be fundamentally at odds with the American experience. As a professor of history (Diggins, 1987) has noted, the U.S. Constitution was based in part on the philosophy of David Hume, a Scottish philosopher. Hume argued that the aim of government should not be to exhort citizens to attain grace or virtue. In the case of risk analysis, this state would be achieved by understanding its complex mathematics and elaborate assumptions. Rather, Hume's philosophy proceeded under the assumption that man is a pleasure-seeking creature, in pursuit of material gain. The reverse Dutch auction system outlined here would be instantly recognizable to him.

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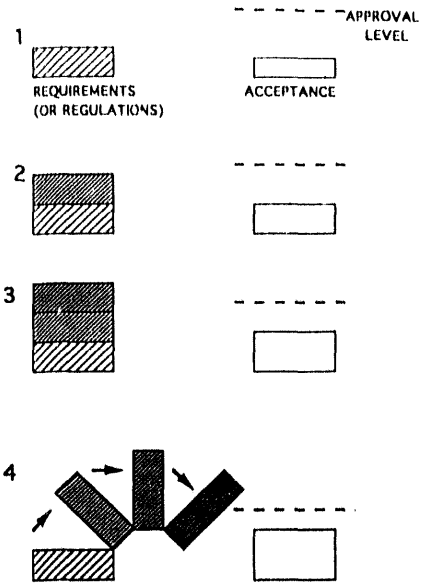

Figure 1. An analogy to the "overkill" of regulations designed to generate waste acceptance. The pile of requirements continually mounts. However, the amount of public acceptance never gets to the dotted approval level. Finally the requirements collapse of their own weight, and the process begins anew.

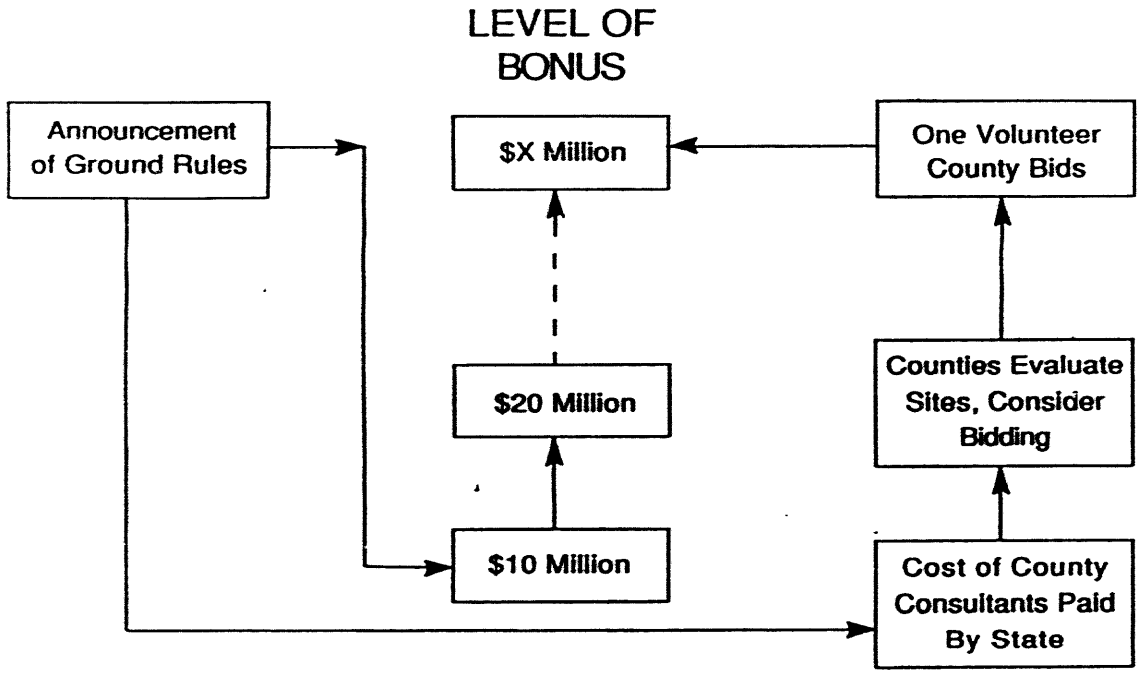

Figure 2. Pre-bid steps in the reverse Dutch auction for waste facilities. They begin with the announcement of the environmental criteria or ground rules. After each county (or other political jurisdiction) evaluates the regulations, the auction begins. The velocity of the bonus rise is set by the siting authority. As the price increases, a volunteer community will eventually bid.

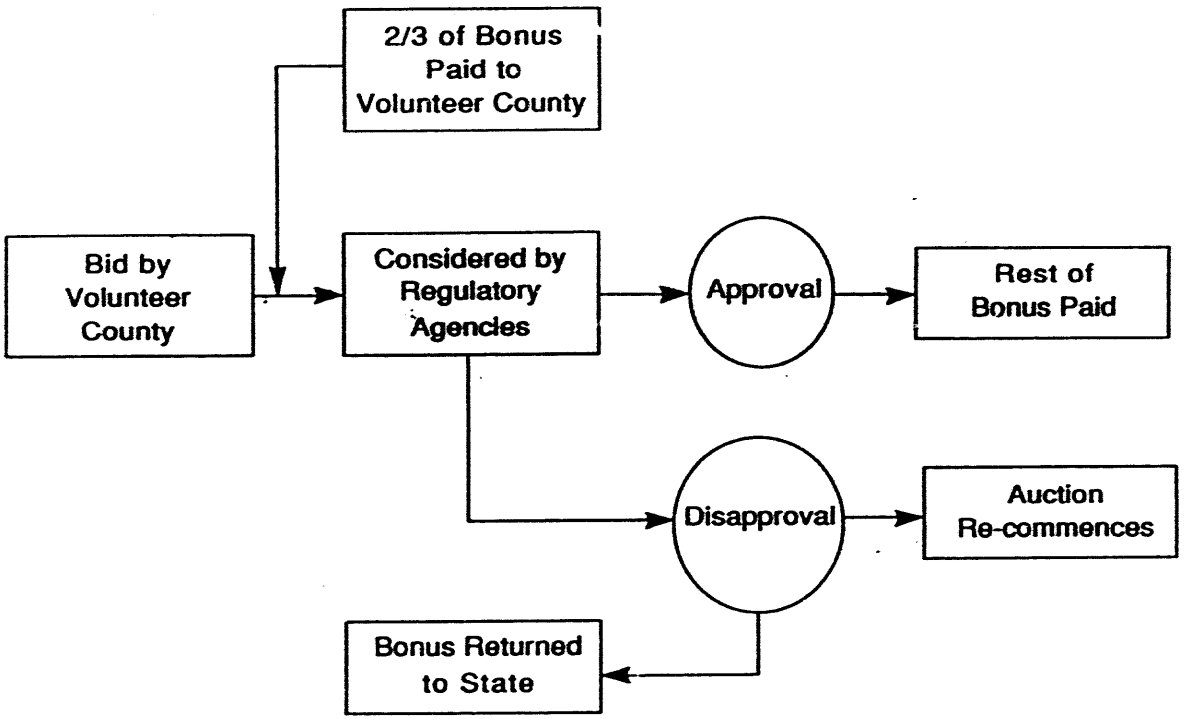

Figure 3. Post-bid steps in the reverse Dutch auction. After a bid is made, it must still pass environmental muster. The arrow to the right of the bid box ensures this. To produce confidence on the part of the bidding community that the bonus will indeed be paid in a timely manner, most of the funds is transferred to a temporary trust fund after the bid is made. If the proposed site meets the pre-announced environmental criteria, the total bonus is paid. If it does not, the auction begins again, starting at the bonus level previously achieved.

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