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DOES THE CHOICE OF REACTOR AFFECT PUBLIC ACCEPTANCE OF WASTES?

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ABSTRACT

A prime goal of this conference is to suggest future reactor types that would produce greater public acceptability. Presumably the wastes generated by these cycles would, because of lesser amounts or activities, engender fewer disputes over policy than in the past. However, the world-wide arguments over low-level wastes (LLW) suggest this intent is not likely to be achieved. While the activity of these wastes is a tiny fraction of high-level wastes (HLW), the controversies over the former, in Korea, the U.S. and elsewhere, have been as great as for the latter. There is no linear relationship between activity and political desirability. What is needed is a new approach to disposing of and siting all nuclear wastes: LLW, mixed and HLW.

INTRODUCTION

Disposal of nuclear wastes has been, in the opinion of many observers, the Achilles heel of the industry. While it is common to assume that nuclear pioneers paid little or no attention to the subject, a reading of the record shows otherwise. David Lilienthal, first head of the Atomic Energy Commission, was one of many who noted the problem looming on the horizon. In a prophetic book written about four decades ago, he noted that unless the problem was solved, the industry would eventually diminish in public support.

The early leaders of the nuclear industry, like Lilienthal, have sometimes been criticized for not devoting enough effort, both in terms of funds and manpower, towards solving the problem. The unspoken assumption behind this criticism is that if adequate research had been performed in the 1940s or 1950s, say, the problem would be behind us now. There is little or

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no evidence to back up this assumption, although it is commonly held. There has been no demonstration of a linear relationship between spending on wastes studies and public acceptance. In fact, the converse is probably true. As the total amount of expenditures on wastes studies has risen, public acceptance of wastes in their own community (as opposed to taking general actions about wastes) has fallen.

It would take far too much space to detail the dismal history of the waste siting problem. The problem did not arise in the 1980s, as is sometimes imagined. In 1955, long before the first civilian reactor had been built in the U.S., an engineer from the Atomic Energy Commission Reactor Development Division wrote¹:

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 [W]hen we view the future potentialities of the [nuclear] industry, it is obvious that safe, more efficient and economic ultimate disposal of radioactive wastes is one of the major challenges.

GOALS OF THIS CONFERENCE AND THE WASTE PROBLEM

One major goal of this conference is to develop "environmentally-friendly" fuel cycles. This is couched, in the conference literature, in terms of a system being "waste free", although this now seems beyond the realm of technical possibility. As far as is known, no industrial process is completely waste free, although in many cases wastes can be substantially reduced from present-day quantities.

Yet the conference goal of evaluating emerging waste disposal options is sound. Opinion surveys for years have identified waste disposal as one of the main, if not the major, issue concerning the public about the nuclear power option. As questions about U.S. (if not foreign) reactor safety diminish in importance due to the excellent performance in the light of improvements since Three Mile Island, the waste disposal problem has occupied center stage.

Speakers at many previous waste disposal conferences have pointed out that the problem is not technical, but a matter of public acceptance. Yet the overwhelming majority of papers on nuclear wastes in this and other conferences dwell solely on the technical aspects. This paper hopes to rectify, in part, this situation.

DEFINING A SOLUTION

Part of the difficulty we have in solving the waste problem is determining just what constitutes a solution. The waste industry has concentrated so much on intermediate problem-solving that the eventual goal often disappears into the distance.

Thus, for example, a series of studies on risk analysis or geology is often held out as progress towards the eventual goal. It is progress of a type, but it is often unclear how much closer the goal-line is.

Towards that end, a re-definition of the eventual solution is in order. The nuclear waste problem will be solved when the wastes - LLW, HLW, mixed or otherwise - is stored or disposed of in a facility that imposes extremely small risk to its neighbors, and those neighbors are satisfied with the emplacement of those wastes.

It is precisely the last clause of the definition that is often lost sight of in discussions of waste siting. And it is that very clause that has led to the downfall of many attempts in the last three decades to site wastes. Without that clause being satisfied, the solution cannot be complete.

NIMBY - LOGICAL OR NOT?

Where public acceptance of wastes is mentioned, it is often in the context of decrying the NIMBY (Not In My Back Yard) syndrome. However, as will be seen below, the NIMBY syndrome is a logical, although unscientific, public method to deal with large unknowns in the waste field. NIMBY is often supported using the very technical studies produced by government agencies. As Michael Burns², author of one of the major books on LLW, notes, "The NIMBY cry is often hidden behind technical objections (.e.g., the selection methodology was flawed, the wrong waste volume figures were used) that, oddly enough, only seem to come up after the host state [in a compact] is selected, even though the compact members agreed on the selection criteria long before the actual choice was made".

Because the nuclear industry has wrestled for so long with NIMBY, it is sometimes imagined that this industry is the prime recipient of this syndrome. Nothing could be farther from the truth. Hundreds of national newspaper stories in the past few years have noted that the syndrome is alive and well in many non-

nuclear areas. To choose one recent example at random, a proposed Ronald McDonald house, for families with recuperating sick children, was denounced in an Atlanta suburb³.

Public acceptance in terms of nuclear wastes is usually regarded implicitly as a matter for unspecified others to deal with. The reasons why these unknown agencies have, so far, generally not succeeded is rarely discussed in detail.

NOT MERELY A TECHNICAL PROBLEM

It is self-evident that if the nuclear waste question could have been solved technically, there would be few if any sessions here devoted to it. While large efforts have been expended to find waste sites, little real progress - based on the previous definition of what a solution is - has been made under the present system.

Nobody would claim that technical aspects should be removed from a waste siting process. The question then is, what shall be added to it to ensure success? Some form of public education is usually advocated. A community surrounding a potential waste site knows much less about the wastes and its risks than those who have been studying it for years. It then seems logical that if the surrounding community were given more information, they would realize that the hazards were indeed small.

This assumption, while logical on its face, has rarely worked. An example was demonstrated publicly at a recent American Nuclear Society technical meeting in Chicago. A high Department of Energy official, based in Nevada, was describing the many technical studies issued by his office and others dealing with the proposed HLW repository there. He noted that all the documents had been made available to the people of Nevada. Taken as a whole, this undoubtedly was the largest education program devoted to wastes in the history of the U.S., and perhaps the world.

A questioner asked if the DOE official could identify one Nevadan who, after reading one or more of the documents, would say publicly that his or her mind had been changed and that he now supported the repository in the Silver State. The DOE official admitted that he could not name such a person.

This example does not, of course, suggest that education of the public in wastes risks is incorrect. It merely notes that a combination of technical studies and

education (usually based on the studies themselves) is, to date, inadequate. Another element must be added to ensure success.

AN "APPROPRIATE FISSION SYSTEM"?

It is sometimes suggested that if the appropriate fission system could be developed, one with "more acceptable" wastes, the siting problem could be eliminated or at least alleviated. Past evidence suggests otherwise. It is true that both present and past fission systems differ markedly in the activities and types of wastes they generate. The public has difficulty in distinguishing between these differences, no matter how apparent they may be to the technical community. The prime example is the similar attitudes towards HLW and LLW

DISPUTES OVER LLW, NOT HLW

HLW generates far more activity, by any measure, than LLW. Yet public response to both types has been about equally hostile. The prime example in the U.S. are the compacts proposed to deal with LLW by Federal legislation in 1980. Over a decade later, no LLW from any state has been finally disposed of as part of the compact system. The delay has not been attributable to any fundamental technical difficulty, but rather to widespread public opposition.

The process sparked the first American nuclear riot, in Western New York in 1990⁴. Thirty-nine were arrested as protesters charged state police lines on horseback, rolled large snowballs down hills on the troopers, and erected roadblocks. In an indication of the sentiment around the area, none of those arrested ever served a day in jail.

The Republic of Korea has generated considerable HLW from its many nuclear reactors over the years. One might think, on the basis of the activity associated with these wastes, that public attention would be directed there. But when protests did break out, it was over the emplacement of LLW. Nuclear News⁵ described what may have been the world's largest nuclear waste riots:

Rioting over alleged radwaste disposal plans in Korea has led to the firing of South Korea's Minister of Science and Technology, Chung Kun Mo, and the cancellation of the plans. President Roh Tae Woo also fired the provincial police chief for Anyon Island, where the rioting took place

and the alleged disposal site was said to be planned the most violent demonstrations had occurred on the previous day, when a police station was burned to the ground, 73 people were arrested, 22 were reported injured, and as many as 10,000 people were said to have participated to some degree in expressions of protest...

If there were a linear relationship between waste activity and public hostility towards siting in its backyard, then LLW should be much more acceptable than HLW. The fact that it is not shows that the relationship does not exist, and that the search for "more acceptable" wastes is probably futile.

MUCH GREATER EFFORT PRODUCES ONLY SLIGHTLY GREATER ACCEPTANCE

The quest for more acceptable wastes is undoubtedly fueled by the decades-long search for sites acceptable to their neighbors. Compared with the halting steps taken at the beginning of the nuclear industry in the 1950s, handling and disposal of nuclear wastes is now a sub-industry unto itself. Many attempts have been made to improve the siting process, through legislation, a vast array of scientific research using many disciplines, education, improved risk communication and other techniques. Yet most observers agree that concern about wastes is much greater now than four decades ago, when the hunt for sites began.

The situation is shown in Figure 1. The left-hand, hatched, side of each of the four sections represents the various legal and scientific requirements. They gradually increase from parts 1 through 4, and are shown in the form of volumes of studies generated.

The right-hand side depicts the general level of acceptance of a site within a community. In the first section, acceptance is well below the dotted level required for a positive answer from the community.

The seemingly logical response from regulators and the industry is to increase the volume of requirements and studies in order to convince the affected community that the risks are small. This was done, for example, when the time period for risk calculations for HLW was extended from one millennium to ten.

Results are shown in the second section. A second volume is added. The level of acceptance grows, but it is still far from the approval level

Undaunted, the industry and regulators make the requirements even more stringent, and add to the volume of studies. Results are shown in the third section. A third volume is added. The acceptance level again rises slightly, but it remains well below the approval level.

The process continues. In the fourth section, the requirements have grown so stringent and onerous that the process collapses under its own weight. Siting comes to a halt as its proponents are forced to regroup. In spite of their efforts, the acceptance level within the target community never has reached the approval level.

Increasing research funding and legislative efforts, however, commendable, will not, by themselves, produce a solution. As Graham⁶ noted in 1983, a decade ago, there had been 5700 studies on nuclear waste till that date. By now, the number must be greater than 10,000. This curiously enough corresponds to the number of years for which risk analyses must be calculated for an HLW repository.

The analogy that can be drawn is that of pounding a square peg into a round hole. No matter how much effort is expended, it will not fit. The solution is not to pound harder, but to use a round peg.

WILL RISK ANALYSIS DO THE JOB?

Risk analysis is clearly necessary in the waste siting process. In fact, the waste siting process, both for nuclear and non-nuclear material, has been one of the main consumers of risks analysis. But in the terms used in geometry, it is necessary but not sufficient. If it were the latter, the extensive studies, almost always showing infinitesimal hazards for a properly-designed site, would have convinced millions that tiny dangers could be ignored.

WHAT WILL WORK?

If risk analysis, legislation, education and public relations have not proved up to the task, what will? A novel approach is needed, one that takes account of past work, but that also includes a new element - economics. It is true that past siting approaches have sometimes included economic incentives to local communities. However, they were often added as an after-thought, without involving a potential impacted community in the discussion. For example, the 1987 amendments to the Nuclear Waste Policy Act⁷ held out the promise of millions of dollars in incentives to Nevada, the state

chosen for potential characterization of an HLW repository. But Nevada did not take part in the discussions on this amount. They could thus not be regarded as a volunteer in the process.

If properly applied, economics can straighten out the confusion which exists in the waste siting process, and which is illustrated in Figure 2. The top part of the figure shows the process as it is, with a host of factors - science, policy, engineering, public opinion, standards and others - interacting in a perplexing and unpredictable fashion.

There are those members of the technical community who would prefer to remove the non-scientific aspects of waste siting from the process. They would eliminate, for example, the phrases marked "public opinion", "politics" and "organizations". However, under a democratic system this removal is highly unlikely. In fact, when site planners have, in the past, attempted to eliminate these phases, they have been accused of being anti-democratic. In turn, this led to abandonment of many site processes.

Economics, as shown in the lower part of Figure 2, allows the re-organization of the areas into a logical progression. In the first part, which could be called objective, scientific and engineering considerations prevail. In the second part, public opinion holds sway. This will allow a veto of the site proposed, if necessary. In the third and concluding part, the technical aspects again are in control. The second section allows full democratic control of the entire process.

ECONOMICS AND COMPENSATION

Compensation is no longer a question in waste siting. Many siting schemes allow for it. In principle, compensation paid should be the true social cost of the facility to the affected community. However, to date no system for setting the appropriate level has been found. The amounts chosen to be allocated to an eventual HLW repository site⁸ (\$10 to \$20 million annually, depending on the stage of construction) were apparently set arbitrarily by Congress. About the same statement can be made about other compensation schemes for waste sites.

It might be contended that, because many compensation schemes have been unsuccessful in the past, there is little point in devising another. The proposed compensation for the HLW repository is a case

in point. The levels set did not engender much pro-repository feeling in Nevada.

However, one common characteristic of virtually all compensation systems to date has been that the amount is set by a central body, either in Washington or a state capital. There are negotiations from time to time, but all participants know that the final amount can be unilaterally set by the siting agency. As a result, the targeted community believes that it has little or no control over the compensation process. Since control over the process is one of the main issues in and siting system, the lack of financial control is the main reason why past compensation systems have usually failed to persuade many people.

VOLUNTEERS ONLY

Past experience demonstrates that only a volunteer community will willingly accept a waste site. Communities dragooned will resist strongly and, under the U.S. legal system, stand an excellent chance of winning their battle.

The battle has been played out in other countries as well. The Korean example has been noted above. In Brazil, residents near an AIDS colony objected when they had little or no say in the siting⁹. In France, the HLW siting process went along well until a map, drawn up in Paris, showing prospective sites, was made public. Examples can be drawn from most, if not all, industrialized nations.

The silent assumption of the present siting system is that no community would conceivably volunteer, and that coercive methods must be employed to obtain the desired result. Yet virtually most historical evidence on siting undesirable facilities - and by now, there have been hundreds of examples - suggests that a volunteer is most desirable. Every general knows that his chances of success in battle are much greater with volunteers than a group of sullen draftees. The same principle applies to site selection.

THE THIRD CRITERION - ENVIRONMENTAL STANDARDS

The third criterion that any successful waste siting program must meet are environmental standards. No attempt is made here to describe them all; a listing and discussion would take considerable space. But the object must be to judge a potential site on a pass-fail basis. The present system has standards which are

continually ratcheted upwards in the search for ever-smaller risk. As noted above, the U.S. HLW program has had this ratcheting effect in terms of standards, but it apparently has not convinced potential waste states that they will be much safer.

If anything, the debate over scientific standards and criteria has become ever more confused, as a geologist for the U.S. Geological Service claimed that the Yucca Mountain site has undesirable features in terms of waste disposal¹⁰. Printed in the New York Times Magazine in an article sympathetic to the dissident geologist, the story shook the confidence of many who thought that Yucca Mountain was the best site available.

The lesson from the history of changing environmental standards is that searching for the "best" site is akin to looking for the Holy Grail; it likely does not exist. Some sites are better than others, but few if any risk analysts would testify that a particular site is "best".

PASSING THE TRIPLE CRITERIA

A variety of efforts to meet the triple criteria of volunteerism, compensation acceptable to the host community and environmental standards have been made. Prominent in this area has been Howard Kunreuther of the University of Pennsylvania. He and his colleagues^{11, 12} have proposed a form of auction-lottery for waste facilities, one that would attempt to generate public acceptance. However, the lottery aspect would undoubtedly produce resistance from the public, already concerned that many risks are already non-predictable.

The only conceptual system that meets the triple criteria is the reverse Dutch auction (RDA). First suggested in 1989, it has been presented in a number of formats¹³⁻¹⁵. Because of this, it is described only briefly here.

In it, the confusion of the top section of Figure 2 is eliminated. The process can be divided into three parts. In the first, the environmental standards - taken in the broad sense - which will govern the eventual waste site are specified. They are fixed in that no attempt will be made to make them more stringent to placate public opinion. This then corresponds to the "objective" part of the lower left-hand corner of Figure 2.

The difficult part, at from the viewpoint of waste sitters, then comes next. How to convince a community to accept the wastes? The present method is to persuade the community from outside, with the aid of pamphlets, scientists at public lectures, public relations personnel, and so on. The RDA reverse that process, in that it relies on citizens to convince themselves. This is achieved by means of a rising bonus, widely publicized. In that way, citizens can balance the risks of the proposed site (very low, although non-zero) and financial benefit they personally will derive.

For example, the siting authority (or waste generators) would announce,

“This month we are offering a bonus of \$10 million to any jurisdiction that would come forward with a site that would meet the pre-announced criteria. If nobody comes forward, next month the bonus would be \$20 million. It will keep rising until a volunteer appears.”

The amounts in the preceding paragraph are, of course, arbitrary. They could be adjusted depending on circumstances. It is likely that, given past history, the bonus for HLW would be substantially higher than for LLW.

A VOLUNTEER APPEARS

The rising bonus would induce a community to come forward. No community would be forced to accept wastes. All communities would have cost-free access to outside funding to investigate the often-complex regulations, but none would be under obligation to bid.

After a community stepped forward when their true social cost was met, the third part of the process would begin, that shown in the lower right-hand corner of Figure 2. The proposed site would be investigated to ensure that it met the pre-announced environmental criteria. It is possible that a community might submit a site that does not meet the criteria. If it were to do so, the process would again return to the bidding stage.

Is finding a volunteer community an impossible dream? Evidence suggests otherwise. In fact, the purpose of the present system is to allow citizens to balance risks and benefits to come to a favorable decision from the viewpoint of waste generators. However, the benefits are often so vague and indistinct - an unknown number of jobs, a promise that a state legislature or Congress will make payments at some unspecified date - that citizens are often acting logically

in rejecting a waste site. In the RDA, the bonus would be immediate and in cash, if that is the form the volunteer community wanted. There would be no speculation over the level of future benefits to the community. It would know exactly what it was getting.

The RDA would then meet all three of the major siting criteria. All environmental regulations would be met. A volunteer, not a draftee, would be supplied. And the community would receive an amount exactly what it wanted, and not a dollar less.

THE BEST SITE?

Note that the RDA makes no attempt to find the "best" site in the nation or the world. The site that is volunteered will meet environmental regulations, by definition, but may not be the "best" available. The concentration on the "best" site arose from an attempt to convince prospective neighbors that a perfectly objective method was used in site selection. Since these prospective neighbors often doubt that any method can be fully objective, the RDA abandons that unachievable goal.

IS IT A BRIBE?

The complaint might be made that the RDA is a disguised bribe to an effected community. There are a number of reasons why it is not.

First, compensation is not equivalent to bribery. If it were, then almost all of the systems designed to site wastes could be accused of bribery. Most, including Federal legislation on the subject, offer something of value - employment, better roads, schools and the like - in return for the opportunity to site wastes. The RDA is no more guilty of bribery than these other systems.

Second, bribery is in pursuit of an illegal or unethical goal. Siting wastes has been approved by Congress, the Executive Branch and most state governments on many occasions. Siting wastes is then clearly not illegal.

Third, bribery always has a specific target. But the RDA targets no community. The volunteer is, by definition, self-selected.

For these and other reasons, the RDA is not a system of bribery. Undoubtedly any siting system that uses compensation in some form will be accused of bribery by those who wish the present impasse to

continue. But unfounded charges should not be confused with the truth.

THE U.S. NUCLEAR WASTE NEGOTIATOR

Elements of the RDA are contained in the actions of David Leroy, the U.S. Nuclear Waste Negotiator, appointed in mid-1990¹⁶. His task, in addition to the system laid down in three pieces of Federal legislation, is to find a site for HLW. He did not begin by characterizing, or attempting to characterize, a site scientifically. Rather, he called for volunteers from counties and Indian tribes. A number responded, after it was made clear they could withdraw from the process at any time.

To date, approximately 20 counties and Indian tribes have responded to Leroy's request, and three groups have entered the second, more intensive stage¹⁷. The Leroy system differs from the RDA in that compensation, although promised to be adequate, will still be a matter of negotiation between a volunteer community and Congress.

ELIMINATING NEGOTIATION

Negotiations of this type has been the rock on which the waste-siting process has foundered in the past, and it could well play that role in the future. In a sense, eliminating negotiating is counter-intuitive. What seems to be a logical way of proceeding is to lock all the participants behind closed doors, and keep the doors closed until agreement is reached. The RDA eliminates the negotiation stage, since a community considering volunteering must decide in advance how much compensation is adequate. If the rising bonus level reaches that amount, it receives what it asks for. There can be no accusations of closed-door pay-offs. All factors are in public view, the intent of the National Environmental Policy Act and many other pieces of legislation affecting siting.

THE JAPANESE COMPENSATE FOR CONTROVERSIAL FACILITIES

In Japan, according to Budd et al.¹⁸, "compensation of costs due to perceptions has historically been internalized into the Japanese siting process, and has been a major factor in the public acceptance of nuclear facilities". The funds come from a national tax on electricity, similar to that which is part of the U.S. National Waste Policy Act of 1982. However, the

Japanese tax is collected on all electricity generators, whereas the U.S. tax applies only to nuclear generators.

While the RDA is apparently not part of the Japanese siting process for nuclear facilities to date, there is considerable emphasis on compensating affected communities to the greatest extent possible. As Budd et al. note,

“the strategy observed in Japan is one explicitly aimed at compensating certain individuals for both contingent (i.e., actual out of pocket expenses) and perception costs, the latter typically remaining external to the U.S. process. The result is a process for siting nuclear facilities that is looked upon with envy by proponents of nuclear power in other countries. Until the recent episode in Wakawama prefecture, Japanese power countries have never failed in their siting efforts”.

The phrase “never failed” may be reversed to “never succeeded” to describe U.S. efforts at nuclear waste siting, without excessive exaggeration.

Constance Horning, a Fulbright scholar who has studied the Japanese policy with respect to non-nuclear wastes, has come to similar conclusions¹⁹. For waste-to-energy facilities, a type of plant which is often approved in general in the U.S. but extremely difficult to site, Hornig writes,

“municipal governments offer neighboring residents various amenities in the [siting] agreements. These ... include public baths and swimming pools (heated by steam from the waste-to-energy facilities), and community recreation centers with gymnasiums, meeting rooms, aerobic dancercise halls, and baseball diamonds ... landscaping with goldfish ponds and rock gardens”.

In short, the Japanese approach seems to take account of the total, including psychological, cost to nearby residents. The two papers quoted suggest that the present U.S. process does not.

SUMMARY

In summary, the reverse Dutch auction offers a way out of the waste-siting maze of the nuclear industry. In a sense, it is counter-intuitive. Each of the steps in the present siting process is inherently intuitive - making regulations ever more stringent to produce greater public support, negotiating with the local

community, and so on. But the sum of these seemingly reasonable steps produces a result that is unreasonable from the viewpoint of the nuclear industry - a lack of waste sites.

The counter-intuitive and yet ultimately successful nature of the RDA may be illustrated by an analogy, shown in Figure 3. A paper clip can hold a few sheets of paper tightly. When more sheets are placed in its hold - corresponding roughly to the voluminous studies expected to persuade local communities that wastes can be safely stored there - they tend to slide out, making the clip useless. If the metal prongs are reversed, however, the clip can hold a substantial number of papers. By being counter-intuitive, the desired result is achieved.

The overall cost of the RDA should be lower than the present system, given the large amounts spent to date without specific sites chosen. Very few expenditures are required under the RDA until the site is accepted by neighboring communities. Until that acceptance is given, the nuclear industry will continue to labor under a severe disability.

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Figure 3. - The Paperclip Analogy for New Waste Siting Options.

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