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Can we learn from failure? Examining US experiences with nuclear repository siting

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Abstract

The United States may well have spent more money in the effort to develop nuclear waste sites than any other nation on earth, but save for the case of a facility in New Mexico that handles only military wastes, every single effort to site a new repository in the last several decades has ended in failure. Given that the siting efforts to date have generally ignored the advice of social scientists, this track record makes it difficult to know whether that advice could lead to outcomes that affected parties would consider "successes" in the US context, but there are important opportunities to learn from what nearly all parties consider to have been "failures." One particularly telling case involves efforts to develop a repository for lower-level radioactive wastes in New York State. There, as in many other US cases, the relevant officials chose to focus on an arbitrarily narrowed subset of work on socio-economic impacts that the agency considered "credible," ignoring social science findings on stigma, public controversy, and so-called "special" impacts related to the radioactive character of the wastes. The officials also appear to have erred in insisting on a top-down, "technical" approach to screening, and in ignoring the very real impacts created by their own actions. Ultimately, the process led to a degree of outcry that was remarkable even in the context of nuclear waste facilities; the citizen blockades and round-the-clock outposts at the boundaries of the selected areas were sufficiently well-organized to prevent even preliminary on-site analyses, meaning that the socio-economic impacts that were excluded from consideration proved to be not just "credible" but vivid, bringing the entire process to a halt, while none of the "credible" biophysical impacts ever took place. The case suggests that essentially universal patterns should be relatively easy to predict, but that unfortunate choices can make the problems of siting even worse.

KEY WORDS: social science; policy; public participation; agency errors; New York; radioactive wastes; recreancy

1. Introduction

One of the points that may already be clear to readers – particularly those who are already familiar with the existing peer-reviewed literature – is that the papers in this compilation represent some of the soundest and most up-to-date thinking available. As the papers help to make clear, there has been growing consensus in the international scientific

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community over the past several decades on some of the key factors that need to be considered – and some of the key mistakes that need to be avoided – in successful efforts to select sites for controversial facilities. At the same time, however, there is still a need for empirical testing.

Clearly, the strongest evidence to support the growing consensus would be present if it were possible to identify a series of siting efforts that proved to be successful, at least in part because those efforts followed the recommendations of the relevant specialists. Particularly within the context and the political culture of the United States, however, such ‘successes’ are extremely rare, due in no small part to the fact that so few of the potential ‘tests’ meet the first of the criteria just identified, where policymakers actually follow the advice of social scientists (for more detailed discussions, see e.g. Jacob, 1990; Rosa and Clark, 1998; for an exception, see e.g. Chess *et al.*, 1992). What experience to date the USA can provide is the form of empirical testing made possible by ‘informative failures’ – cases where policymakers have ignored the recommendations of the social scientific community, and where almost all relevant observers have wound up concluding, in retrospect, that they should not have done so.

This paper focuses on one of the most informative failures the present author has ever observed – an effort to select a site for low-level radioactive waste disposal in New York State. The author served on a committee selected by the National Research Council and the National Academy of Sciences to review the technical basis for the New York State siting decision, and the article draws heavily on that experience. Still, the views expressed here are the author’s alone, and should not be seen as reflecting in any way the views of the National Research Council or the National Academy of Sciences. In addition, while its points are all drawn from the specific case of siting in New York State, it should be stressed here that the intention of this paper is to focus not on ‘blaming’ specific actors and actions, but on identifying the broader lessons that are presented by the case in question. The sections that follow will begin with the basic background information, moving next to a discussion of the New York State case and of the lessons it provides, before closing with a discussion of the broader implications that emerge.

2. The policy context and setting

In the policy framework that exists in the USA, there are multiple categories of nuclear wastes, three of which are particularly important. First, ‘high-level’ wastes (HLW) are by all accounts the most dangerous. Principally the residues of nuclear power plants, these are the radioactive wastes that, by law, need to be isolated from the environment for 10 000 years. As of mid-2002, the federal government has proposed to move all of these wastes to a proposed repository at Yucca Mountain, Nevada, roughly 120 kilometres northwest of Las Vegas. Second, ‘transuranic’ wastes (TRU) include non-natural or artificially created elements with an atomic number greater than that of uranium. Most of these wastes come from nuclear weapons research and production, and in what many nuclear industry proponents consider the only true ‘success story’ of repository siting, these wastes are now being transported to the Waste Isolation Pilot Project (WIPP) buried in deep underground salt deposits near Carlsbad, New Mexico. Third, ‘low-level’ radioactive wastes (LLW) are defined residually, including essentially any radioactive wastes that are not classified as high-level waste, as transuranic waste, or as tailings from uranium mills.

Proponents of repository siting often stress that these last-named wastes come in part from medical facilities, but that 'part' is often extremely small; in the case of the proposed New York State facility that will be considered in this paper, for example, over 90% of the low-level wastes actually came from nuclear power plants. In other respects, save for the fact that the low-level wastes are at least *relatively* less dangerous than high-level wastes, LLW policies tend to be the focus of considerable controversy. At least in the eyes of critics, in other words, these materials are sufficiently dangerous and sufficiently long-lived that 'there is nothing "low-level" about low-level radioactive waste besides its name' (Montague, 1992, p. 1).

Under US law, responsibility for disposal of HLW and TRU wastes falls to the federal government, but two federal laws make each state responsible for its own low-level wastes. First, the Low-Level Radioactive Waste Policy Act of 1980 declared that each state was responsible for its own LLW, as well as encouraging the establishment of interstate compacts (agreements) to reduce the number of sites that would ultimately be required. Although that law contained a deadline of January 1986, no new sites were actually certified or approaching certification as the deadline approached; in response, Congress passed a second law, known as the Low-Level Radioactive Waste Policy Amendments Act of 1985, which added two further inducements. First, Congress decreed that any state that had not built its own disposal site or joined an interstate compact for doing so as of 1 January 1996, would need to 'take title' or accept ownership for all the LLW within its borders; this provision, however, was ruled unconstitutional by the US Supreme Court before it ever took effect. Second, the new law provided that if any two or more states did successfully identify a site for their LLW, those states would be able to reserve the site for their own uses, preventing other states from sending their own LLW to that site.

In its initial response to the 1980 federal legislation, the state of New York entered into negotiations with 11 other northeastern states, but by April 1984, the New York State Energy Office recommended that, instead of joining such a compact, the state should identify a site for its own wastes alone. In July 1986, the New York legislature passed the Low-Level Radioactive Waste Management Act, which followed just that recommendation. The 1986 state legislation also established a complex division of labour, assigning responsibilities to a new Siting Commission, but also to the New York State Energy Research and Development Authority, the New York State Department of Environmental Conservation, and several other entities. The legislation also provided the Siting Commission with relatively specific technical guidance about the procedures to be followed, including 'consideration of all relevant public health and safety, environmental and economic factors' (L. 1986, C. 673, §5, amending ECL Art. 29, §29-0303.5). Starting roughly 10 months after the legislation was passed, in May 1987, the governor appointed the five-member Siting Commission. Soon thereafter, that Commission appointed an Executive Director and other staffers, and began working hard to implement the legislation.

The Siting Commission instituted a 'top-down' screening process that made heavy use of existing data and of then-available Geographic Information Systems (GISs) and computer programmes. The process used a set of 17 'exclusionary criteria' (conditions that, if present, were sufficient to exclude a site from further consideration) and 43 'preference criteria' (focusing on conditions that were used to select from among the remaining sites). By September 1988, the commission had finished the first, exclusionary phase of

its work, eliminating roughly 30% of the state from further consideration. By September 1989, the Siting Commission had moved forward to the selection of 10 'candidate areas', and then of five potential disposal sites, all of which were located in two counties of upstate New York. By that time, however, the entire selection process had become so controversial – as will be discussed below – that it was halted. Within the next few months, the governor suspended the Siting Commission, and the state legislature authorized the establishment of one or more 'independent panels of technical and scientific experts' to review and evaluate the Commission's decisions. In view of the contentiousness of the issue, the governor asked the National Academy of Sciences, through its research arm, the National Research Council, to convene a 'truly independent' evaluation panel.

As is often the case, the National Academy of Sciences/National Research Council (NAS/NRC) moved forward somewhat less quickly, but the resultant committee, on which this author served, ultimately held its first meeting in January 1994. Once that committee was established, it held a total of nine meetings, from January 1994 to October 1995, four of them public meetings in New York State and the other five being closed or 'executive' sessions at NAS facilities. The committee's final report, which was published by the National Academy of Sciences/National Research Council in 1996, identified a relatively extensive set of problems and biases in the site-selection process (see NAS/NRC, 1996). As noted in the introduction to this paper, however, the focus here will be on the subset of the Siting Commission's choices and actions that are most informative about the ways in which the failure to follow relevant social science guidance can lead to siting outcomes that almost all observers see as being relatively spectacular failures.

3. Sins of commission?

Among the problems identified by the NAS/NRC committee were three sets of Siting Commission choices that are particularly deserving of attention or perhaps even recognition: those associated with the use of a *top-down screening technique*, with the effort to *limit the range of socio-economic impacts and concerns* that were considered, and with the *failure to acknowledge the agency's own effects and points of view*. All three sets of these problems in the New York siting effort appear to offer particularly noteworthy lessons to future efforts, and thus the following discussion will turn to each of the three in turn.

3.1. TOP-DOWN SITING APPROACH

Like essentially all nuclear waste siting efforts in the USA to date, the New York Siting Commission had a clear preference for a 'top-down', technocratically oriented selection process. At least in the view of the NAS/NRC committee, this approach did offer an apparently 'efficient' technique for eliminating large areas of the state from consideration in the early stages of the effort to identify a site, particularly in light of the relatively limited capacities of the Geographic Information System (GIS) available at that time. As the NAS/NRC committee went on to note, however, what ultimately mattered most was not just the sophistication of the technology, but the way in which the relevant information was considered and/or excluded from the analysis. Later on, as the remaining areas were examined more carefully, the fundamental weaknesses of the approach became much more difficult to ignore and, as also became increasingly apparent over

time, the true roots of the problem may well have been put in place by the way in which the process was structured from the outset.

The problems with such top-down approaches often become more evident, for example, in the face of the fact that local citizens may know more about certain characteristics of local sites than will be available in the aggregated data used by the GIS analyst, leading to conversations along the lines of, 'If this is supposed to be a scientific process, how could you have "overlooked" something that everyone [here] knows?' To make matters worse, if this additional information about the site is provided to but still not used by the proponent or siting team – often, as in the case of the New York State Siting Commission, based on the argument that using the additional information would be unfair to other sites – the affected citizens might well interpret such a response as bias or as an unwillingness to be 'educated' by the citizens, or to follow the scientific norm of making use of the available evidence. The need for a two-way openness to 'education' will come up again in the closing pages of this paper.

Further difficulties are often created by the fact that, by its nature, the kind of top-down, apparently technical approach to screening used by the Siting Commission is one that *inherently* requires some group of potentially fallible human beings to assign artificially precise weights (often on the basis of a limited or even non-existent data base) to factors that are often incommensurable (ranging from precipitation patterns, to surface vegetation, to the geological structure below, to the social uses nearby). The Siting Commission justified their weights for different criteria by stating that a group of 'experts' had helped them to select the weights, but this justification clearly failed to satisfy the citizenry, and it also fails to deal with the inherently *non-expert* and value-laden nature of the processes involved in selecting measurements, cut points and units, and the assignment of weights.

For example, even in cases where there may be widespread agreement on a given goal – for example, the desirability of keeping the facility relatively remote from human populations – it is possible to come up with dramatically different decisions by making relatively minor changes in the cut-off points and weighting factors for population densities and distances. A decision to keep the facility a certain distance away from a community of 2500 persons, for example, can lead to the identification of entirely different sites than would a decision to keep the facility twice as far away from a community of 5000 persons, or to avoid all locations having a population density of 1000 persons per square mile – and still other sites would likely be identified if all three approaches, or others, were to be used at the same time.

Matters would not have been greatly simplified even if it had been realistically possible, let alone desirable, for the Siting Commission to have considered geological or climatological criteria alone. In terms of geology, for example, not even the distinguished geologists on the NAS/NRC committee could agree on whether it would be better to favour the New York soils with low clay content, so that any water would pass through the repository zone relatively quickly, or high in clay content, to lessen the amount of water reaching the wastes and to increase the sorption capacity for any radionuclides that might happen to escape containment. In terms of climate, alternatively, the committee could all agree that it would be appropriate to pay attention to the severity of the winters that afflict much of New York State; the way the actual weighting was done, however, created implications that the NAS/NRC committee found to be unsettling. In practice, the Siting Commission assigned a value of 5 (on a scale of 1 to 5)

for regions having an average of 51 or more inches of annual precipitation, while regions having an average of 39 inches of precipitation were given a scaling of 1. The net effect of this approach was to turn a relatively small difference in annual precipitation into a 5-to-1 difference in weighting – and one that reinforced a number of other Siting Commission choices that represented effective biases in precisely the direction that was perceived by local citizens, in favour of moving the site to the less-affluent rural areas of upstate New York, as opposed to the more affluent urban and suburban areas around New York City. In terms of preferring sites that combined geological and climatological factors by being relatively distant from wetlands, to note a final example of this problem, the Siting Commission chose an understandable but nevertheless essentially arbitrary cut-off distance of 1 mile – a distance that could well have been replaced by a different number, such as 1 kilometre, or by different values representing differing distances, either in linear format or in logarithmic transformations. The difficulty of defending the Commission's specific set of choices was further compounded by the order in which the criteria were applied in this case; preferences for areas that were 'distant' from wetlands, but that had 'low' precipitation totals, at least by New York State standards, were applied at a relatively early stage of the screening. In practice, this meant that it was entirely possible for the Commission to eliminate a site at an early stage of the analysis for being 0.9 miles from wetlands (rather than 1.1 miles) and having 42 inches of rainfall per year (rather than, say, 39 inches) – whatever its other performance characteristics – even though the same two criteria would have been much less important during the more detailed analyses that were performed later.

While it can arguably be appropriate to fall back to the position espoused by the Siting Commission – that their process was not intended to lead to the selection of a 'best' site, only an 'acceptable' one – even this response tends not to be very helpful in explaining why, and how, the process would not lead to the selection of another site that the citizens would have considered to be better. It is clearly unreasonable, of course, to expect any group of human beings to identify a 'perfect' site; it is equally unreasonable, unfortunately, to expect the citizens at a selected site – who may care deeply about that site and might harbour a profound distrust of those who selected it – to defer to the very group of persons who, in the eyes of the citizens, have demonstrated their capacity for poor judgement by having identified such a flawed site in the first place.

In short, it is often not just understandable but scientifically appropriate for citizens to express criticisms about the reasonableness of weights, or about why other important criteria were not given similar weight. The simple fact of the matter is that there is no such thing as a 'best scientific combination' of weights. In light of that fact, any effort to explain or justify the chosen weights can run a significant risk of what one local citizen in the New York State case called 'flunking the straight-face test'. Under such circumstances, in other words, it can become virtually impossible to maintain a credible claim that the chosen process is sufficiently 'scientific' to deserve the ongoing support of affected citizens.

3.2. UNDUE NARROWING OF SOCIO-ECONOMIC CONSIDERATIONS

The second set of problems involved an unfortunate and ultimately arbitrary preference, involving the willingness to consider only a narrow subset of what the Siting Commission viewed as being 'predictable' socio-economic impacts and concerns. As readers of this

journal are already aware, it was once common in scientific and technical circles to seek an analytically convenient (if often empirically implausible) separation between the impacts affecting human beings and those affecting other species in the ecosystem. Perhaps nowhere has this tendency been more clearly in evidence than in the case of the impacts that involve human perceptions and reactions. Ironically, however, these troublesome effects tend to be some of the most striking and consistent of all the impacts associated with nuclear waste.

Even by the time the New York State Siting Commission had begun its work, an earlier committee of the NAS/NRC had spelled out what, by then, had become the consensus in the peer-reviewed literature. As that panel noted, the effort to avoid dealing with the ubiquitous perception-related impacts – trying instead to use a ‘narrow conception’ of socio-economic impacts – could be expected to ‘be greatly misleading to the decision maker’ (NAS/NRC, 1984, pp. 3–4). The very first of the ‘major socioeconomic considerations’ identified by that pane included public responses, with one of the panel’s conclusions being that ‘public concern and perception of threat are exacerbated by mistrust of government . . . and by the appearance of secrecy or desire to exclude the public from governmental decisions about radioactive waste and repository siting’ (NAS/NRC, 1984, p. 10).

A particularly important emphasis involved what the scientific literature of the 1980s called simply ‘special effects’ – those associated with the radiological mission of nuclear waste facilities, including high levels of controversy, polarization, and the potential for stigmatizing of regions and peoples. Even based on the relatively limited research that was available at that time, however, it was already clear to the earlier NAS/NRC panel that the special impacts could be expected to be far too extensive to permit the impacts of the nuclear waste repository to be represented adequately by a focus on the kinds of economic, demographic and civil engineering ‘infrastructure’ concerns that had received so much attention in the context of boom-and-bust studies during the preceding decade. Instead, the National Research Council panel had little difficulty in predicting that ‘the special effects associated with the radiological mission of the repository will interact with, and may well exceed, the more conventional effects resulting from the location of any large industrial facilities in rural communities’ (NAS/NRC, 1983, p. 12).

In general, the research that has accumulated in subsequent years has continued to strengthen confidence in the conclusions of that earlier NAS/NRC panel (see, for example, the compilation by Dunlap *et al.*, 1993). In particular, it has become increasingly clear that, while it may be tempting to view a public outcry as being based ‘just’ on public perceptions, it is neither accurate nor reasonable to do so (for further discussions, see the report of the Interorganizational Committee on Socioeconomic Impact Assessment, 1994; see also NAS/NRC, 1992, 1994). The experiences in New York State provide further reinforcement for the earlier conclusions, plus more than a little irony.

Although there are many times when the members of the NAS/NRC committee began to wonder whether anyone in New York State agreed with anyone else, there was at least one point on which almost everyone seemed to agree: when the Siting Commission announced its selection of sites, the result was a firestorm of opposition. On this point, state officials agreed with the citizens who spoke with the committee, and their agreement was further supported by available newspaper and magazine reports, as well as by the videotapes of nightly news coverage that were made available to committee members.

The citizens in the affected counties seem to have mobilized almost immediately. Within short order, the citizens had established 'sentry shacks' along all of the roads leading into the affected areas, which were staffed 24 hours per day. Referring with pride to the tradition of Paul Revere, one citizen told the NAS/NRC committee that the sentries in those shacks were there 'to spread the alarm' any time they spotted a state-owned vehicle – or, he confided, any time they saw someone coming into the area wearing a tie. Whenever such an alarm was sounded, other citizens would rush to the so-called 'study areas' (and to other strategic locations, such as bridges en route to the study areas) in generally non-violent protests that were intended to prevent the Siting Commission from moving toward certifying or even 'studying' the locations in question.

In one such protest that received extensive media attention, a group of well-dressed senior citizens calling themselves 'Grandparents for the Future' chained themselves across a narrow bridge that Siting Commission vehicles needed to cross on their way to the site. When law-enforcement officials were called in to remove the protesters, one elderly woman insisted on first handing over the American flag that had been draped over the casket of her son, who she reported had been killed while in defence of her country, because if patriotic citizens such as her could be arrested for their actions, then neither America nor its flag continued to hold any value for her.

Local law-enforcement officials ultimately chose not to press charges against the non-violent protesters, concluding in essence that the protests were legitimate and that the siting process was not. As the dispute continued to heat up, however, the Siting Commission and other state agencies continued to increase the pressure, eventually sending in an intimidating-looking phalanx of marching state troopers, and even a set of officers on horseback, who rode directly into the midst of the protesters who were marching (slowly) along one access road. The latter incident provided one of the few incidents that a Siting Commission official who spoke with the NAS/NRC committee was able to remember with a smile; he described it as having been 'straight out of the wild West'. One of the citizens who witnessed the incident, by contrast, remembered it with no pleasure whatever, describing it as having involved something more like police-state tactics.

The incident may or may not have come straight out of the wild West, but whatever its other characteristics, not even the marching troopers and the use of horse-mounted enforcement officials proved sufficient to allow Siting Commission vehicles to reach the site they intended to study. Neither on that day nor on any other were the Siting Commission officials or staffers able to do so much as to drive one of their vehicles across the selected sites.

In the end, the impacts considered 'credible' by the Siting Commission never took place. For all practical purposes, there were *no* on-site biological or physical impacts. Not a single shovelful of dirt was turned; not a single Siting Commission vehicle or study team was physically allowed onto the premises of any of the selected study sites. Instead, virtually all of the impacts that actually took place were the ones the Siting Commission considered not to be credible – the 'special' socio-economic impacts associated with the high levels of controversy and low levels of credibility that characterized the waste-siting debate in New York State, and that, with variations, have also afflicted virtually every other effort to select a site for nuclear wastes in the US in the past several decades.

There are at least two reasons why these reactions should not have come as a surprise to the Siting Commission, or to the technical community more broadly. The first is that,

as noted in a more recent report from the (NAS/NRC 1994), while 'changes to physical or biological systems do not occur until a project leads to physical alterations, observable and measurable alterations in the human environment can take place as soon as there are changes in social and economic conditions, which often occur from the time of the earliest rumours or announcements about a project' (p. 130).

The second is that any pattern that is essentially universal should also be one that is relatively easy to predict. As noted by three of the most distinguished scientists ever to have addressed the question, 'The ability to evoke dread in human beings must be counted as one of the key properties of radioactive wastes, not just a passing fact about human life; thus research on why people respond as they do to radioactivity is critical. Not to know that essential fact about nuclear wastes is like not knowing their half-lives, their thermal qualities, or any of their other physical and chemical characteristics' (Erikson *et al.*, 1994, p. 91).

Partly as a reflection of this fact, one of the few ways in which the peer-reviewed social science literature has begun to move away from the report of the 1982 NAS/NRC panel is in the choice of terminology. As noted by a more recent panel (NAS/NRC, 1994), it is less accurate to refer to 'special' or 'pre-development impacts' than to use the more technical terminology of 'opportunity-threat impacts': These impacts reflect 'the patterns of responses that follow the opportunities and threats that attend proposed development. Speculators buy property, economic development opportunities are created, politicians manoeuvre for position, interest groups form or redirect their energies, stresses can mount, and a variety of other social and economic effects can occur These changes have sometimes been called "pre-development" or "anticipatory" impacts, but they are real and measurable. Even the earliest acts of speculators, for example, can drive up the real cost of real estate' (p. 131).

3.3. FAILURE TO RECOGNIZE THE SITING EFFORT'S OWN EFFECTS

The failure to understand the real nature of these opportunity-threat impacts was combined with an equally unfortunate pattern of subsequent choices. Even more clearly in this respect, however, the problem seen in the New York State siting case is one that can also be seen in a number of other experiences, involving the dynamics of the interplay between the relevant officials and the affected citizens.

Given the inherent impossibility of demonstrating a true 'technical superiority' for a site, as discussed above, it should not be difficult to understand the intensity of reactions from citizens who learn that *their* 'back yard' is the one that happens to have been chosen for an objectionable site (for insightful discussions of this point, see for example Edelstein, 1988; Krauss, 1989; Kroll-Smith and Couch, 1991; Erikson, 1994). Particularly if there truly *are* other sites that can reasonably be argued to be at least as good, it should scarcely be surprising if the citizens at the selected site would not be impressed by assurances that the Siting Commission did not *intentionally* single out their community. When emotions run as high as they nearly always do on the subject of nuclear waste, in particular, the predictability of hostile reactions makes it unreasonable to hope that a selected community will be satisfied by assurances along the lines of, 'You should trust us; we're technical'.

Instead, the citizens in the New York case, as in many others, often responded to the Siting Commission's actions with understandable frustration, and even outrage; at times,

these reactions were combined with regrettably high levels of *ad hominem* or personalistic attacks on the responsible parties. These technically trained personnel, in turn, often responded to such attacks with an equally understandable yet equally regrettable set of reactions. Under some circumstances, those responses included the use of an impersonal, 'professional' role, albeit one that the citizens sometimes interpreted as coldness or indifference to their heartfelt concerns. Under other circumstances, the Siting Commission and other comparable facility proponents displayed a wide array of other responses – ranging from defensiveness, to disdain, to derision – that would not normally be seen as signs of professionalism, even though they could not be seen as altogether indefensible under the circumstances.

Perhaps the most regrettable responses, however, were those in which citizen concerns were simply dismissed – treated as being ill-informed, ignorant or otherwise invalid. There are two main difficulties with such a response. First, any such act of dismissal fails to acknowledge an important *similarity* between agency personnel and the members of the broader public: the agency personnel, like the members of the public, base their actions on their own perceptions; indeed, they could scarcely do otherwise. Second, as noted in yet another National Academy report, it is clearly not accurate to assume that none of the impacts should be seen as resulting from the actions of facility proponents – in this case, the Siting Commission and the other relevant agencies of the state of New York – and neither is the approach a helpful one:

[A]gency staff members often are tempted to argue that the critics of agency policies are 'emotional' or 'misinformed' (Hance *et al.*, 1988). These characterizations fail to acknowledge salient socioeconomic effects – and create new ones as well. They are 'guaranteed to raise the level of hostility between community members and agency representatives and ultimately stand in the way of a successful resolution of the problem' (Hance *et al.*, 1988). Such challenges can lead people to be resistant *in principle* to matters they might otherwise be willing to consider more dispassionately.... [F]or a community to have its reality disregarded by a powerful authority is profoundly alienating; it [also] leaves no common ground on which the community and the authority can stand. The public often believes that [the] ... government fails to take its concerns seriously or even to understand them (NAS/NRC, 1992, p. 25).

In the New York State case, as well, state officials clearly contributed to the polarization process; whether intentionally or not, their tendency to dismiss their critics proved to be quite difficult to distinguish from the common political tactic of 'diversionary reframing' – the effort to divert attention away from uncomfortable topics, such as the level of credibility of a facility proponent, by reframing the discussion as being 'about' another topic (for further discussion, see Freudenburg and Gramling, 1994).

When citizens respond sceptically to official claims about the safety of a proposed site, in other words, most of the relevant social scientists and public involvement specialists would advise that the appropriate response would be to address the reasons for the citizens' scepticism. Among skilled political actors, however, it is common to see instead the use of the well-worn if not always accurate political precept that the best defence is a good offence, specifically including either subtle or blatant attacks on the credibility of critics.

Some of the most important characteristics of any line of criticism – including the degree to which those criticisms should be seen as 'reasonable,' 'important' or 'legitimate' – are not, after all, matters of scientific fact. Instead, they inherently involve questions of

judgement – and of political skill. One of the common characteristics of skilled bureaucratic survivors, moreover, seems to be a highly developed awareness that, if others can be convinced that an expectation is not ‘reasonable’, or ‘legitimate’, then the expectation can usually be avoided or ignored (for further discussion, see Freudenburg and Gramling, 1994).

As part of this technique, project proponents and their technically trained personnel will often claim, with at least some justification, that the citizens who confront them are being unreasonably emotional, ‘ignorant of the facts’, or unwilling to be ‘educated’. Part of the problem with such claims, however, is that one of the prerequisites for any would-be ‘educator’ is credibility – and credibility tends to be in particularly short supply in controversies such as these. Another part of the problem is that, as noted by virtually any manual on risk communication, a willingness to be educated tends to be a two-way street, as does a *lack* of a willingness to hear the arguments of the other side. Perhaps the broadest problem, however, is that such attacks on the legitimacy of opponents are often neither accurate nor effective.

In an earlier or simpler era, it might have been true that public concerns about a proposed site would have been limited to a small, unrepresentative minority. It might even have been true, at least for short-term political purposes, that the ‘efficient’ way to deal with such concerns would have been to dismiss them rather than to take them seriously. Today, however, to make such assertions is to provide evidence to a broad cross-section of the citizenry that the responsible parties are acting irresponsibly. Even if there is no intention on the part of technical personnel to dismiss, rather than to deal with, citizen critics, such characterizations tend to contribute to what is sometimes called ‘the spiral of stereotypes’ (Freudenburg and Gramling, 1994, pp. 91–2). Once a situation becomes so polarized that the persons on different sides of an issue stop talking to one another – but not *about* one another, as in characterizing the concerns of the other side as being ill-informed, self-serving or irrational – the net effect can be to make the polarization a self-reinforcing process.

Ultimately, in other words, whatever the short-run political efficiency of ignoring or dismissing opponents’ concerns, the strategy is one that entails substantial long-term risks (NAS/NRC, 1984, 1992; cf. Freudenburg and Pastor, 1992). In addition to solidifying the opposition to a proposed action, as suggested by the NAS/NRC report quoted above (1992, p. 25), the strategy tends to worsen the socio-economic impacts that are created in affected communities and regions. Those impacts are created not just when people are faced with threats over which they have little effective control, but also when there are *conflicts* over whether a proposed development represents threats, opportunities or both.

In addition, one of the most stressful experiences of all – particularly for patriotic citizens who still believe the civics-textbook principle that the government is supposed to reflect the will of the governed – is to find that not just ‘unreasonable protesters’, but they themselves, are treated as if their most heartfelt concerns are imaginary or irrelevant (Krauss, 1989; Brown and Mikkelsen, 1990; see also Levine, 1982). In a number of such cases, moreover, people *do* react with increasing frustration, even rage, especially if they are repeatedly ignored or treated with condescension or contempt. The ironic net result can be that the agency’s opponents truly can start to sound and act ‘emotional’, but that they can do so as a direct result of the agency’s own actions (Freudenburg and Gramling, 1994, p. 139–40).

4. Lessons for the future?

The logic behind a symposium such as the present one is that it is important to look not just back, but also ahead. Rather than merely recounting the problems that were encountered, accordingly, is it possible to identify a more rational way of dealing with these predictable socio-economic impacts in the future? One reason for concluding that it may in fact be possible is that, although public opposition to nuclear facilities has been remarkably consistent, the New York case itself illustrates that the opposition has been far from constant. While literally every attempt to select a civilian nuclear waste site in the US in the past several decades has resulted in deep opposition, the actual levels of opposition have varied considerably across sites. Overall, the existing body of literature and experience would appear to suggest that the intensity of public opposition is a function of three sets of factors: the nature of the *nuclear materials* involved, the nature of the *community or region* selected as a disposal site, and the way in which the *siting process* is carried out. Closer consideration of these three sets of factors, in conjunction with an appreciation of other lessons identified here, could do much to encourage a less disruptive approach to siting in the future.

Nuclear materials clearly do possess the potential to create significant health risks, if they are not properly managed, but the problem goes deeper than that: additional problems are created by the fact that radiation hazards are not literally 'empirical' – that is, radiation cannot be seen smelled, heard or otherwise detected by the (unaided) five senses. This characteristic means, among its other implications, that nuclear materials, like the other examples of what Erikson (1994) calls 'a new species of trouble', can create an *ambiguity of harm* and a growing body of empirical research on technological hazards suggests that such an ambiguity of harm may actually create higher levels of measurable stress than do well-understood levels of harm (for reviews, see Vyner, 1988; Freudenburg and Jones, 1991; Erikson, 1994). The non-empirical nature of radioactivity also means that, rather than being able to establish a clear sense of controllability over the hazard, the public finds itself dependent on sophisticated radiation monitoring equipment and, importantly, on those who are responsible for running that equipment. In cases where the levels of responsibility and management prove to be lower than they should have been, the effective result can be to send to the broader public a 'signal' (Slovic, 1991) that the competence and reliability of experts should not be taken for granted (see also Alario and Freudenburg, 2003; Freudenburg, 1993; US Secretary of Energy Advisory Board Task Force, 1993).

In terms of the *community characteristics*, US nuclear waste siting efforts have often focused on areas that could not be considered to have a high level of confidence in the competence and trustworthiness of public officials, whether in nuclear or other respects. (Such is also the case with the Yucca Mountain siting effort, which focuses on a region of the American west that has been the location for decades of nuclear weapons tests, and where 'downwinders' – people who were unfortunate enough to have been 'downwind' from above-ground nuclear weapons tests in earlier decades – are quite clear about their distrust of the US Department of Energy and the federal government in general.)

The New York Siting Commission also appears to have identified regions that were characterized by a significant and understandable sense of distrust toward the relevant authorities, in that case including long-established patterns of dominance over rural, 'upstate' areas by the more powerful and prosperous urban and suburban interests

'downstate', around New York City, as exacerbated by previous waste siting issues in particular. As the NAS/NRC committee ultimately concluded, moreover, the screening process used by the Siting Commission actually did include multiple sources of bias that – whether intentionally or not – further increased the likelihood of selecting the less-affluent rural areas of upstate New York, rather than locations that might have been closer to the more powerful urban and suburban areas around New York City.

Finally, the New York State *siting process* – while in many ways reasonable or at least understandable – served in other ways to exacerbate the socio-economic impacts that could be expected. Under the New York State law of the time, the Siting Commission felt it had little choice but to follow what is sometimes called the MAD approach to decision making – to Make, Announce and then Defend a choice of a preferred site. As indicated by the foregoing discussion, unfortunately, such an approach tends to exacerbate any concerns that people might have about official trustworthiness, even under the best of circumstances – and those were not the best of circumstances.

The complexity of the site-selection process was sufficiently great as to make a number of the selection decisions difficult even to explain, let alone to defend. This approach, when combined with the non-empirical nature of radiation and the context of community distrust, worsened both credibility problems and frustrations – further increasing the public's need to depend on experts they did not trust for the technical information that they needed but were unable to obtain from other, more trusted sources. When these problems led the human beings in the selected counties to criticize and attack the Siting Commission, often quite vigorously, the human beings who made up the Commission responded in a way that was also quite understandable, but that was nevertheless regrettable. The responses sometimes included a degree of defensiveness or even a reciprocal hostility that many members of the public – again, regrettably but understandably – took as evidence that the Commission had 'something to hide'.

4.1. BROADER LESSONS: SCIENCE AND 'THE HUMAN ELEMENT'

One final conclusion from the existing body of research on siting controversies that is worthy of emphasis here is that citizens do often express a desire for 'the best site', in a 'purely technical' sense, but that what they are actually asking for will tend to be quite different from what many scientists imagine. Instead, closer examination will often reveal that citizens desire a process that is truly equitable, unbiased and fair – particularly in the sense of being fair to the values that are most important to the specific citizens involved (see for example Rayner and Cantor, 1987; Creighton, 1980; Dietz *et al.*, 1989; Freudenburg, 1993; Slovic, 1993). The major appeal of science and technology is in the fact that, while public confidence in the institutions of science may have decreased in recent years, science is still perceived as fair by a relatively high proportion of the populace (for a review, see Marrett, 1984). In short, in many cases, when people call for a 'scientific' selection process, they are in effect asking for a fair and balanced process – one that takes the citizens' concerns just as seriously as do the individual citizens themselves.

The desire for a 'totally unbiased' approach to decision making is easy enough to understand; indeed, it has deep historical roots. As Frank pointed out in a classic law article (1932), societies have long shown distrust for 'the human element' in decision making. Under what might be called the first models in the US for dealing with this

problem, namely the early modes of trial, the emphasis was on ordeals, judicial duels, 'floating' tests for witches, and other ways of making decisions that were 'considered to involve no human element. The judgment [was] the judgment of the supernatural, or "the judgment of God"' (p. 582). The nineteenth century equivalent of the earlier distrust for human judgement, according to Frank, was reliance on a body of impersonal legal rules. Under this second model of decision making, 'rationality' was thought to emerge through a dependence on rules that were derived from self-evident principles, thus reducing the human element in decision making to a minimum (see also Monahan and Walker, 1985). In the twentieth century, the emphasis on such abstract 'universal principles' has declined, and a third model has emerged, placing increased emphasis on the fairness and balance of science. Unfortunately, one of Frank's major conclusions was that 'the human element in the administration of justice by judges is irrepressible . . . [T]he more you try to conceal the fact that judges are swayed by human prejudices, passions and weaknesses, the more likely you are to augment those prejudices, passions and weaknesses For judges behave substantially like the human beings who are not judges' (Frank, 1932, p. 580-81).

So do scientists. More precisely, although scientists do not always behave just like the human beings who are neither judges nor scientists, there are a great many similarities; some of the ones that have been documented in empirical studies include failures to foresee failure modes, insufficient sensitivity to problems of small 'sample' sizes, failures to understand system interdependencies, overconfidence in estimates, insufficient sensitivity to the statistical vulnerability of low-probability estimates, and a consistent failure to recognize the problems that are outside a given expert's area of expertise, particularly in cases involving human beings and their organizations (for a review of accumulated evidence, see Freudenburg, 1992).

At the same time, it would be inappropriate to suggest that there are no differences between scientists and the rest of the public; there are indeed differences, many of which can offer important advantages for societal decision making. These differences include generally high levels of training, technical competence and professional ethics; unfortunately, there are also differences that can prove to be more problematic in making values-based decisions about technology. Scientists and engineers, for example, tend to place more emphasis on cost-containment and efficiency than do most citizens, while placing less emphasis on long-term safety (Fischhoff *et al.*, 1981; Nealey and Hebert, 1983; Lynn, 1986; Freudenburg, 1988, 1993; Johnson and Petcovic, 1988; Kraus, 1992; Flynn *et al.*, 1994). These choices, to note the obvious, can fail to provide precisely the kind of extra protection of public health and safety that is often being sought by the citizens who call for a 'more scientific' approach to environmental risk decisions.

Given the assembled evidence, accordingly, efforts to seek a 'purely technical' approach to facility siting appear to be singularly ill-advised. Scientific or technical training provide no inherent advantage in making decisions that combine facts and values; indeed, most scientists are far more comfortable in trying to exclude the 'non-technical' considerations from their analyses than in trying to incorporate them in a meaningful way. In addition, the effort to depict these inherently complex decision processes as 'purely technical' ones may actually do more to augment than to eliminate the influences of values, blind spots and other aspects of what Frank called 'the human element'. More broadly, there is growing evidence (see for example Slovic, 1993) that

the naive hope for a selection process that is 'strictly scientific' may have an unfortunate if unforeseen consequence: it may be placing on the institutions of science and technology a burden that they are simply unable to support.

Years ago, when public scepticism towards the political world was not nearly so great, the policy-world consequences of a 'scientific' pronouncement about the safety of a site might well have been an increased level of public trust for the site. Today, in all too many cases – and particularly in cases involving nuclear wastes – a very different outcome may be far more likely. When these ingredients are mixed together in a context that includes a public that has become deeply sceptical of the institutions of society in general, and of the credibility of those who deal with nuclear wastes in particular, the net result can actually be a decrease in the credibility of scientific and technological institutions rather than an increase in the credibility of siting decisions. That, in fact, appears to be precisely what happened in New York State; it may ultimately prove to be the outcome that is most likely to emerge in other contexts as well.

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