



## WHITHER NUCLEAR WASTE DISPOSAL?

Thomas A. Cotton

I would like to focus my remarks on two major points made by Mr. Ahearne's paper, "Nuclear Waste Disposal: Can There Be a Resolution?" The first is the argument that is necessary to accept the failure of the geologic repository approach to waste disposal. The second is that the appropriate alternative is to provide a federal location for storing reactor fuel and then to wait for either a new technological solution to the waste problem or for the public to become more accepting of the risks of nuclear waste disposal.

### HAS GEOLOGIC DISPOSAL FAILED?

With respect to the argument that geologic disposal has failed, I do not believe that the evidence is yet sufficient to support that conclusion. It is certainly true that the repository program is not progressing as hoped when the Nuclear Waste Policy Act of 1982 established a 1998 deadline for initial operation of the first repository. The Department of Energy (DOE) now expects the repository to be available by 2010, and that date depends upon a finding that the Yucca Mountain site – the only site that DOE is allowed by law to evaluate – is in fact suitable for use. Furthermore, scientific evaluation of the site to determine its suitability is stopped pending resolution of two lawsuits. However, I believe it is premature to conclude that the legal obstacles are insuperable, since DOE just won the first of the two lawsuits, and chances are good it will win the second.

The concept of geologic disposal is still broadly supported. A recent report by the Board on Radioactive Waste Management of the National Research Council noted that "There is a worldwide scientific consensus that deep geological disposal, the approach being followed in the United States, is the best option for disposing of high-level radioactive waste." [1] The U.S. Nuclear Regulatory Commission (USNRC) recently implicitly endorsed this view in adopting an updated Waste Confidence position that found confidence that a repository could be available in the first quarter of the next century – sufficient time to allow for rejection of Yucca Mountain and evaluation of a new site.

There are concerns about whether the current regulations governing high-level waste disposal could be met by any site, as evidenced by many presentations at a National Academy of Sciences symposium on high-level waste regulation two weeks ago. However, the conclusion that is drawn by many of those voicing this concern is that the problem lies with the regulations themselves, not with the concept of geologic disposal, and that it is the current regulatory structure, rather than geologic disposal, that needs to be reexamined.

Furthermore, the informed scientific community does not generally support the view of the State of Nevada that the Yucca Mountain site is so obviously disqualified that it should be abandoned without further scientific evaluation. The general view seems to be that the only way to resolve the questions about the suitability of Yucca Mountain is to proceed with the technical investigation of the site that is now stymied by lawsuits.

If Yucca Mountain proves to be unsuitable, then I grant that the concept of geologic disposal will face a major challenge. As a result of the Nuclear Waste Policy Amendments Act of 1987 (NWPAA), DOE does not have legal authority to investigate any other sites, and instead would have to go back to Congress with a proposal about what to do next. At this point, geologic disposal will face a major policy problem – how to find other sites? Starting all over with a broad national site screening program and writing off the sites that had been investigated prior to choice of Yucca Mountain as the prime candidate seems unlikely. A

"startover" approach was proposed during the passage of the Nuclear Waste Policy Act and rejected. Nothing that has happened since then gives me any confidence that Congress would be more accepting of that approach now. On the other hand, going back to one of the other sites that was under investigation strikes me as difficult, too. I do not believe that Congress could quickly resolve the question of how to select another site for evaluation, since it could in effect require renegotiating the entire framework of the Nuclear Waste Policy Act.

Lest one despair, however, one should recognize that the NWPAA created an alternative path for finding sites for high-level waste management facilities when it established the Office of Nuclear Waste Negotiator. This is an independent office in the executive branch with authority to negotiate with states or Indian tribes to find terms under which a repository or a monitored retrievable storage (MRS) facility could be sited within their jurisdiction. There are no constraints on the benefits and other provisions that can be included in an agreement, except that they must be submitted to Congress and approved through enactment into Federal law.

The Office was the brainchild of Congressman Morris Udall, who was alarmed that the process of selecting sites through a technical screening process was encountering far more political resistance than had been anticipated when the Nuclear Waste Policy Act was passed. This resistance led to the 1987 amendments that placed all of the high-level waste program's eggs in one basket: the site evaluation process for the first repository was narrowed from three sites to the one at Yucca Mountain in Nevada; the effort to find eastern sites for a second repository was halted; and DOE's recommendation of a Tennessee site for an MRS facility was nullified.

The Negotiator was just appointed and confirmed this summer, and has not had a chance to test Congressman Udall's theory that a cooperative negotiated approach might be able to break the siting impasse. The Negotiator might be able to identify another candidate repository site now, so that it could be characterized in parallel with Yucca Mountain, or later, if and when Yucca Mountain were found to be unsuitable. Alternatively, the Negotiator might be able to work out a deal with Nevada whereby DOE would be able to proceed with scientific evaluation of the Yucca Mountain site without having to cope with continuous guerrilla warfare from the state.

I should emphasize that the experience to date does not warrant a summary judgment that the Negotiator will fail because no community would want a radioactive waste facility. In fact, there have been communities that have supported having such a facility. The cities near the DOE reservation at Hanford, Washington supported location of a repository there; and Oak Ridge supported hosting an MRS facility, subject to specified terms and conditions. The town of Carlsbad, New Mexico, near the DOE Waste Isolation Pilot Plant for transuranic waste, probably also counts as an example of willing host to a radioactive waste management facility. The resistance appears to come more from the other parts of the affected states, among people who do not see much prospect of immediate benefit and fear the possible negative economic impacts of the "stigma" associated with hosting a "nuclear waste dump."

In summary, until the legal efforts to gain access to the Yucca Mountain site have been played out, the site has been scientifically evaluated, and the Negotiator has had a fair chance to cut a deal, I believe it is premature to conclude that the geologic repository effort has failed. This is not to say that wild optimism is warranted at this point; just that despair is not appropriate either.

## SHOULD WE STORE THE SPENT FUEL AND WAIT?

The recommendation that the Federal government provide long-term storage for high-level waste and simply wait for positive developments on the disposal front has been considered several times during the last two decades. The first was in 1974, following failure of a 1972 Atomic Energy Commission (AEC) effort to site a geologic repository near Lyons, Kansas. The AEC's successor, the Energy Research and Development Agency, proposed building

a retrievable surface storage facility (RSSF) to allow the Federal government to accept waste while taking decades to pursue disposal options. This proposal was dropped after strong criticism by the Environmental Protection Agency (EPA) and environmental groups that this would lead to inadequate emphasis on permanent disposal. The idea resurfaced about five years later, when the Senate passed a nuclear waste bill that put primary emphasis on provision of Federal long-term monitored retrievable storage facilities, and demoted geologic disposal to an R&D program instead of the main focus of Federal waste management efforts. However, the House of Representatives never accepted this approach, and the focus of the Nuclear Waste Policy Act of 1982 was on timely development of geologic repositories. DOE was also directed to develop a site-specific proposal for an MRS facility as well, but not as an alternative to the repository. The NWPAA of 1987 nullified DOE's selection of a site in Oak Ridge Tennessee, but went on to authorize construction of an MRS – subject to severe constraints that tied its construction and operation closely to the repository, precisely in order to prevent the MRS from being used to allow the repository to be indefinitely deferred.

The position that Federal storage should not be an alternative to permanent disposal represents one of the clearest points of consensus underlying the Nuclear Waste Policy Act. There were many consensus-building efforts involving a wide range of interested parties prior to passage of the Act. All of those efforts produced agreement that the Federal waste program should concentrate on developing a permanent disposal option in general and geologic repositories in particular. Much of the resistance to provision of a Federal storage facility has been based on the concern that once such a facility was available, there would be little pressure to get on with the more difficult and expensive job of developing a permanent repository, and that the storage facility would itself become a de facto repository.

DOE's current goal is to provide an MRS facility to allow Federal waste acceptance by 1998, the target date for the repository contained in the Nuclear Waste Policy Act. In this they agree with the suggestion of Mr. Ahearne. However, they also are maintaining a primary focus on timely characterization of the Yucca Mountain site.

In my view, provision of a Federal storage facility of some sort is probably necessary if we are to have any Federal waste program at all in the long run. The reason is that continued program funding may be directly linked to Federal interim storage policy because of the connection between anticipated Federal waste acceptance and the nuclear waste fee. It has been the policy of the Federal Government since 1970 that the generators of high-level radioactive waste would pay the full cost of its disposal. The NWPA modified that policy by requiring that the payment be made at the time the waste is generated instead of at the time it is delivered to the Federal government for disposal. The shift to a front-end fee was justified, and ultimately supported by the utilities, as a *quid pro quo* for a commitment in the NWPA to provision of a Federal repository by a date certain and for contracts with the utilities providing for the Federal government to begin accepting spent fuel for disposal when the repository was available.

As the date for initiation of the service for which the utilities and their ratepayers are paying becomes more distant and uncertain, it is possible that someone concerned about the fee – a utility, a ratepayers group, or a public utility commission – might challenge the legitimacy of continued payment. This possibility may be most significant if utilities are required to provide long-term interim spent fuel storage, facing them with increasing direct costs for at-reactor storage in addition to fee payments to the Federal government. In summary, if the Federal government fails to provide a timely waste management service in exchange for the fee, there ultimately may be no more fee to pay for any Federal waste management program. Without the waste fee, development of a disposal capacity will depend upon appropriations from general revenues, the situation that existed before the NWPA was passed. The prospect for ample funding from taxpayers' money is rather bleak considering the current state of the deficit. Put simply, continued progress on disposal may depend upon timely provision of Federal storage to justify continued payment of a fee.

Let me now turn to the second part of the "store and wait" option: waiting for a better disposal technology, or for the public to become more accepting of the geologic disposal solution. My main point is that the history of attempts to provide Federal storage facilities suggests that such attempts will be particularly strongly resisted if storage is clearly part of a strategy involving long-term deferral of efforts to develop permanent disposal. There is little or no evidence from experience to support the idea that we can proceed with Federal interim storage facilities in the absence of a working consensus about the approach to disposal, and we are a long way away from agreement about abandoning the geologic disposal effort.

I believe there is a workable alternative between the "store and wait" option and the Admiral Farragut approach of "damn the torpedoes, full speed ahead" on geologic disposal. To stick with the naval metaphor, the option is to deploy the minesweepers and proceed ahead slowly. That is, adopt a more flexible, experimental approach to site investigation and repository development not driven by a rigid schedule, as the Board on Radioactive Waste Management recently recommended. This is the approach being taken by other countries pursuing geologic disposal. It involves explicit recognition that the repository cannot provide a timely and predictable basis for acceptance of spent fuel from utilities, and should not be subjected to schedule pressures arising from the need to provide such acceptance. Thus it does require provision of Federal storage. But it also requires the continued commitment to keep pushing ahead in the repository program.

I believe that a basis for reestablishing a working consensus about the direction of the high-level radioactive waste management program might be found in this combination of a more experimental approach to investigating the Yucca Mountain site and developing a repository there (if the site proves suitable) with provision of an early MRS facility that can allow the Federal government to adhere to its side of the bargain made with the utilities and their ratepayers when the NWPA was passed.

Why might the interested parties agree to this approach? The utilities and the nuclear industry would get Federal waste acceptance, but would have to agree to support a more flexible and experimental (and probably slower) repository program. (It is possible, by the way, that a nominally slower approach on the repository, not geared to providing large scale operation as quickly as possible, might actually lead to earlier initial operation at small scale. That is, it might lead to an earlier demonstration of the existence of a permanent solution to the waste problem.)

Environmental groups, which generally have opposed Federal storage, would have to tolerate Federal waste acceptance independent of a permanent repository in exchange for continued utility funding of a disposal program and a less pressured repository development effort. They would probably also have to accept evaluation of the Yucca Mountain site instead of a "startover" approach. There is little chance that Congress or the utilities would agree to, or fund, any approach that involved dropping Yucca Mountain as a potential candidate site without further scientific investigation. One Congressional staffer who has been deeply involved in all of the high-level waste legislation observed last year that Congress would not drop the site except for compelling scientific reasons [2]. The best hope of an acceptable compromise in this area appears to be to focus siting investigations on determining as quickly as possible whether there are any features that would clearly make the site unsuitable. This has been suggested by the State of Nevada, the NRC, and the Edison Electric Institute, and has been proposed by DOE as a major new thrust in a report to Congress last year. What remains to be done, however, is to define what evidence might lead to a conclusion that the site should be abandoned, and what test program would most efficiently and credibly provide that information.

There are, of course, other parties with an interest in the Federal high level waste program. These include the State of Nevada and the states hosting nuclear power plants, which will become the default storage sites if no Federal facilities are made available. Direct discussions among the full range of interested and affected parties will be required to determine whether the potential agreement I have described can become a reality.

## REFERENCES

1. *Rethinking High-Level Radioactive Waste Disposal*, Board on Radioactive Waste Management, Commission on Geosciences, Environment, and Resources, National Research Council (1990): vii.
2. Cooper, B. S., "Focus Shifts from Capital to Nevada," *Forum for Applied Research and Public Policy*, (Fall 1989): 26-28.

# NUCLEAR WASTE DISPOSAL: CAN THERE BE A RESOLUTION?

## DISCUSSION

The discussion of this session covered the problems of radioactive waste management in a broad sense, focusing on issues ranging from the siting of a permanent United States geologic repository to the current programs in other countries, and included consideration of whether a definitive decision regarding how to dispose of such wastes needs to be made at the present time.

It was asked, if geologic disposal is chosen as the preferred method, whether there would be any advantage in naming perhaps three locations in a single state as potential sites rather than just one, in an attempt to isolate the technical issues from the social issues of siting. Mr. Ahearne responded that he did not think that such a process would solve the problems of siting. He gave as an example past low-level siting discussions in North Carolina. As long as there were several sites under consideration (in this case, three), the process proceeded well, but as soon as a particular site was selected, it became paralyzed again.

Mr. Cotton replied that it is an open question in any event whether the federal government can force any state to accept a repository. He also noted that once the federal-state relationship becomes adversarial, all hope is lost of accomplishing anything. He added that it is not at all clear what will happen concerning the Yucca Mountain site in Nevada. Even if the state loses several pending lawsuits, it is questionable whether there will be a change in attitudes among the population to begin to balance costs and benefits. A federal negotiator, charged to broker waste site acceptance by communities, has been appointed and might be able to function successfully under such a circumstance.

One participant stated that, according to some students of such situations, a community or its leaders will not consider accepting both compensation and a facility if they believe the facility is fundamentally unsafe. Effectively one can not trade safety for economic benefits. So if the safety of such a facility is considered to be poor, he asked, can we reach the point where economic compensation can be seen as anything other than a bribe? He also pointed out that, with regard to a federal repository, some of the opinion surveys nationwide indicate that a significant population think a single repository is the least equitable solution. There is a great deal of sympathy with Nevada's position in not wanting to be singled out as the sole recipient of nuclear wastes. On the other hand, we can go to the opposite policy extreme and keep the wastes near sites where the benefits which it produced are captured, at the point where the power is generated. This is the current *de facto* policy. How long people will accept that option is also an open question; available evidence indicates that they do not like that option either.

Mr. Cotton agreed with the view that the people must be convinced of the safety of a facility first before one may discuss economic benefits. However, he pointed out, in the example of the proposed interim waste storage facility to be sited in Tennessee, safety was not a contentious issue. Even the state governor in his statement decrying the facility spent one and a half pages saying it was safe. The controversy came down to arguments about perceived economic effects. At the proposed site of Oak Ridge, people generally accepted the expected level of safety and were also expecting some economic benefits. So, there is some evidence that waste facilities can be made locally acceptable.

With regard to the equity of using only one repository, Mr. Cotton questioned whether the opinion survey mentioned previously had included people in the east who would be subject to

the hazards of an eastern repository. He explained that an eastern repository was an underlying fact of the initial national repository plan. There would be one repository in the east and one in the west – but the plan fell apart when the realities of finding a site in the east came home to the people who live there. The resulting opposition was implacable.

Mr. Ahearne also agreed with the point that compensation must not become a bribe. In order to avoid the appearance of offering a bribe, the industry must wait passively until the government completes selection of a repository site.

One participant repeated Mr. Ahearne's view, that the obvious policy choice would be to do nothing now. Doing so may or may not solve the public acceptance aspect of the waste problem, but it would not solve the overall problems of nuclear power. He asserted that until people decide that nuclear wastes are a lot less desirable than coal wastes, for example, they will not be willing to accept solutions dealing solely with nuclear waste. People do not like to deal with undesirable things, but when all alternatives are undesirable, ultimately they deal with them. However, until there is a more candid discussion on the coal problem, society will not make much progress on nuclear waste disposal. He asked why there is not a more candid discussion of the coal problem, and answered with the view that many of those in a gathering such as this conference are as heavily invested in coal as in nuclear. Certainly the utilities, and many of the equipment suppliers are. There is nothing wrong with that, it is just a fact. Until recognition of this reality occurs, we will temporalize and wait, with the result that we will eventually build gas turbines as all other new generation options become precluded by events. He concluded with the question of what could be a worse elective energy policy than installing a lot of combustion turbines and making ourselves still more reliant on Middle East oil?

Returning to the issue of advanced reactor designs from the previous day's discussion, one participant expressed the view that the waste question can be separated from those of the second generation of power reactors, because whatever the waste situation is now will not be made much worse by the addition of some new reactors. This view was in variance with that of some skeptical elite groups, most notably the Union of Concerned Scientists (UCS), which had made a public statement that before any new reactors are built, including those of the next technological generation, there should be a demonstration that safe methods of disposal are available and a repository site specified. However, even if all of these conditions were met, this participant added, the next federal administration could undo the whole arrangement. Therefore, advanced reactor designs should allow for spent fuel storage at the reactor site for the life of the plant. The storage capacity need not be installed from the start of operations, but some flexibility should be included in the design to add it on later.

The question was asked, "As a functioning permanent geologic repository seems rather far away into the future, say the year 2010 at the earliest, what are the objections against building a monitored retrievable storage (MRS) facility right now? Is an MRS feasible, what must be done to obtain one, and is that a recommended interim solution?"

Mr. Cotton's answer: "The Nuclear Waste Policy Act Amendment of 1987 authorized the Department of Energy to construct an MRS. At the same time, the Congress specified several restrictions on its use. The restrictions were added to keep the MRS from becoming an alternative to a permanent repository. The DOE cannot locate a repository at a different site until they have formally recommended what to do with Yucca Mountain. This means completing the site examination, determining whether it is satisfactory, and recommending whether to use it. Afterward, repository construction and operation are all linked to specified steps of the development of the repository. The schedule is very tight, so we would not be able to get an MRS into operation more than a few years ahead of the repository under the current legal mandates. The position of the DOE is they want those mandates softened or removed, which could be done by direct legislative amendment.

"Alternatively, the anticipation is that we could find a willing repository host community through the work of the Federal Waste Siting Negotiator. If so, the relevant agreement

would have to be passed by the Congress as legislation, and therefore would in effect become law. It could include changes in the existing restrictions upon repositories. So the amendment would come into existence as part of the Congressional approval of an agreement, rather than as something formulated in an abstract fashion before an actual site were selected. I do not think anyone in Congress will want to deal with this issue again until there is a site actually identified where the local community wants to host a facility."

One participant pointed out that one of the justifications used for assuming there might be a resurgence of interest in nuclear power is that we will have to take into account some of the negative consequences of other power generation sources, such as acid rain and potential global warming. It is difficult, therefore, to expect society to accept a technology where the consequences of that technology have not been taken fully into account. With this argument the nuclear power advocates are asking another industry to internalize their externalities. Should not the nuclear power industry have a plan for doing so before it is proposed as an alternative to other externalities?

Mr. Ahcarne's response: "That argument was raised in the past, even before the issue of increased carbon dioxide emissions became prominent. How could you possibly continue with a nuclear power program until you have a repository to put the waste into? My argument with regard to nuclear waste is that, in the current state it is in, I do not find it to be such a great hazard that I feel a need to find somewhere to put it away immediately. Consequently, on a comparative risk basis, I find surface storage to be an acceptable risk. However, I am not saying I think this is the position which the public would adopt.

"Many uncertainties exist with regard to the effects of the increased use of fossil fuels and the effects upon the atmosphere and climate. Concerning such effects, it will not be possible, such as it is with radioactive wastes in a stored cask, to put them aside with the hope of finding some other alternative approach. Once a lot of trace gases having half-lives of 50 to 100 years enter the atmosphere, you cannot go back and say you would rather do something different with them. There are problems with most energy generation sources. You try very hard to develop all of the alternatives which you might wish to use, but once they are reasonably mature, you will still be faced with the issue of fossil versus nuclear fuels. It seems to me that my suggestions on how to handle high-level wastes are much better than what we have been trying to do."

Perhaps the most valuable part of the discussion was that which provided some small insight into the situations in Germany, Canada, and Sweden. It was expressed that the situation in Germany has many similarities to ours and, in fact, is subject to a great deal of influence from the United States. The German panelist gave as an example the fact that the decision not to use salt mine repositories in the United States is used by opponents of such facilities in Germany.

The Canadian participant described their current situation: "In Canada, our process is very different than in the United States. Emphasis is on the process rather than on the actual disposal concept. The design and approval process started at least ten years ago and the focus has been on the technical issues of the disposal concept. The concept developed by Atomic Energy of Canada, Ltd. (AECL) is one of geological disposal. Much work was done at the Whiteshell Laboratory in Winnipeg, with money and participation from the United States. The Atomic Energy Control Board established very strict acceptance criteria, similar to those of the United States. An example criterion allows a maximum cancer risk of  $10^{-6}$  per year, over a period of something like 10,000 years. Attainment of this standard has yet to be demonstrated. The first stage of work is essentially complete; the concept has been studied in depth and relevant reports issued. The major technical issues have been more or less resolved. I believe that the required demonstration can be achieved.

"The second part of the storage process, which we are entering now, is very important. This is a public and scientific review of the concept, without regard for where or even whether

it will be implemented. The skeptical elite will be involved in scrutinizing the technical feasibility of this geological disposal concept. At the end of three to four years, the political decision will then be made as to whether we will dispose of the waste, when such disposal will take place, or whether reprocessing will be considered. It is only after that step that a process will start to select a site. Site selection will involve a volunteer approach."

One participant who had worked with the Swedish nuclear power program for many years related some aspects of their waste disposal program that allow it to work well. "Sweden has very strong anti-nuclear factions committed to shutting down the industry. The government and opponents required the industry, before they could even start up their final reactors, to adopt a schedule for waste disposal with a conceptual design and a safety analysis that would survive international review. This was seriously accomplished on a technical basis, and it survived review by international groups.

"Second, they set a schedule for establishing the repository which had in it the very elements Mr. Cotton is talking about. They did not set that schedule on the basis of public perception, but on the basis of when they needed to have an operational facility. That date was set at the year 2020. And because of the same arguments as Mr. Cotton, they put into place an interim storage facility which now exists and is working. I cannot say that they have solved all technical problems, but they are on schedule and making excellent progress. Sweden has instituted many organizations such as Intracoin, Hydracoin, and Intraval, which are international groups performing bench-marking studies in hydrogeologic problems. United States participation has been rather limited, although that is changing. The Swedish have prospered in their international work, especially in Europe. We are on our way out, partly because we have selected a repository site so different than anyone else's, being on saturated rock, but it is not all that bad. We have not recognized the value of international work and have not made it part of our program."

SESSION EIGHT

**USE OF FAST - SPECTRUM REACTORS FOR HLW BURNING**

ACTINIDE RECYCLE

Charles Till and Yoon Chang

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ACTINIDE BURNING AND WASTE DISPOSAL

Thomas H. Pigford

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## INTRODUCTION

### Session 8 – Use of Fast-Spectrum Reactor For High Level Waste Burning

As the rigidity of the impasse governing establishment of a national nuclear waste disposal facility has become more evident, interest has grown in alternative means of disposal of at least some waste forms. A leading option in this category is that of 'actinide burning'. This concept is an old one and has lately received renewed interest, due to potential improvements offered by the Integral Fast Reactor (IFR) concept. With actinide burning many of the longest-lived nuclear high level waste species are transmuted in a reactor to isotopes having much shorter half-lives, thereby reducing the amounts of waste needing highly secure storage facilities for durations greater than a millennium. Whether this concept would be attractive would depend upon many factors, including: costs, the purity with which different species could be separated, rates of transmutation and amounts of long-lived species which cannot be transmuted.

The keynote paper was presented by Dr. Yoon Chang, Director of the IFR Project at the Argonne National Laboratory. The respondent paper was given by Prof. Thomas Pigford, Professor of Nuclear Engineering at the University of California, Berkeley. Prof. Pigford has devoted his career to nuclear chemical engineering, and has long been a leader in related education and research.

The keynote paper argues that the promise of successful actinide burning is sufficiently great to justify an ambitious research program attempting to realize its benefits. The respondent paper emphasizes that these benefits will be expensive, delayed at least one or two decades and likely be too small to justify great enthusiasm at this time.

The following discussion reflected little clear consensus, beyond the idea that even if the payoff of actinide burning were likely to be small and long delayed it could still be worth pursuing because the eventual results might be better than this expectation, and the current high level waste disposal alternatives are not promising.