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YUCCA MOUNTAIN REPOSITORY DEVELOPMENT

HEARINGS

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED SEVENTH CONGRESS

FIRST SESSION

ON

S.J. RES. 34

APPROVING THE SITE AT YUCCA MOUNTAIN, NEVADA, FOR THE DEVELOPMENT OF A REPOSITORY FOR THE DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL, PURSUANT TO THE NUCLEAR WASTE POLICY ACT OF 1982.

MAY 16, 2002

MAY 22, 2002

MAY 23, 2002

Printed for the use of the
Committee on Energy and Natural Resources

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YUCCA MOUNTAIN REPOSITORY DEVELOPMENT

THURSDAY, MAY 16, 2002

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:38 a.m., in room SH–216, Hart Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. We will call the hearing to order. The committee meets this morning for the first of three hearings on S.J. Res. 34, which is a joint resolution approving the site of Yucca Mountain, Nevada, for the development of the nuclear waste repository.

We have today with us, at the invitation of the committee, Senator Reid and Senator Ensign, who are, of course, the Senators from the most affected State of Nevada, and we have invited them to be here, so that after committee members have asked their questions of either Senator Reid or Senator Ensign, if they wish to ask questions, they are certainly welcome to do that.

The text of the resolution that the hearing relates to, and the rules for its consideration, were laid down 20 years ago in the Nuclear Waste Policy Act of 1982. That act gave the Secretary of Energy the responsibility for picking a site for the development of a nuclear waste repository. It subjected his decision to review by the President, by the Governor of the State that he selected, and ultimately, by Congress. The act gave the Governor the power to veto the site recommended by the Secretary and the President, but it gave Congress the final say on whether to sustain or override the Governor's veto.

Congress took the site selection decision out of the Secretary's hands 15 years ago, when it designated Yucca Mountain as the only site that the Secretary could consider, but the law still required the Secretary to study Yucca Mountain to determine if the site is suitable for a repository, and it still gave the Governor the power to veto the President's site recommendation.

The Department of Energy has been studying Yucca Mountain for 24 years. Based on these studies, the Secretary of Energy has decided that the site is safe for use as a nuclear waste repository. President Bush approved the Secretary's decision, and formally recommended the site to Congress in February. In April, Governor Guinn submitted a notice of disapproval of the President's rec-

ommendations,* which will have the effect of barring the use of Yucca Mountain for a repository unless both Houses of Congress pass, and the President signs into law, the joint resolution before us by July 25. The House passed the resolution by a wide margin last week.

Twenty years ago, the authors of the Nuclear Waste Policy Act in both the House and the Senate spent more time debating the State veto than any other provision in the act, and recognized the gravity of the decision to bury many thousands of tons of highly radioactive waste in a State, and we are determined to give any State chosen to bury this burden the opportunity to appeal its selection to Congress, and to have its concerns heard and carefully considered.

Senator Stennis called the State veto, quote, "An act of essential justice."

At the same time, the authors of the Nuclear Waste Policy Act recognized that, as Representative Morris K. Udall put it, "In the final analysis, the nuclear waste repository is a project in the national interest which must be subject to a national decision." They ensured that the decision whether to approve the Secretary's site recommendation would rest not with the Governor or the President, but with Congress. The expedited procedures for considering the resolution to override the Governor's veto were designed to ensure that both Houses of Congress would have the opportunity to vote on the question, and those procedures were the necessary tradeoff for the State veto.

Although the Nuclear Waste Policy Act itself is silent on the scope of our review, the legislative history of the act offers clear guidance as to what the authors of the act had in mind. Our task, in the words of Senator Howard Cannon, one of the original proponents of the State veto, is to determine "whether the Secretary's decision to file with the Nuclear Regulatory Commission for a license to construct a repository at a particular site has fully considered the objections and concerns submitted by the State Governor." The authors of the act also indicated that the burden of proof—more precisely the burden of going forward with the repository, would rest with the administration.

At today's hearing, we will give Secretary Abraham the opportunity to present the administration's case for going forward. It will be up to the Secretary to show that the State's concerns have been or will be addressed, and to persuade us that the Department of Energy should be allowed to file a licensed application with the Nuclear Regulatory Commission.

Next Wednesday, we will give the State of Nevada an opportunity to present its concerns and its objections to the repository.

And finally, next Thursday, we will hold a third hearing at which we will hear from independent technical experts who have statutory roles in regulating or overseeing the repository program, namely: the Nuclear Regulatory Commission, the Nuclear Waste Technical Review Board, the Environmental Protection Agency, and the General Accounting Office.

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*The Notice of Disapproval can be found in the appendix.

It would then be my intention to schedule a business meeting on June 5 for the committee to vote on whether to report the resolution to the full Senate.

Our task, as the authors of the Nuclear Waste Policy Act made clear, is to decide whether to allow the Secretary of Energy to file the license application with the Nuclear Regulatory Commission. It is not our job to substitute our judgment for the Commission's on the technical questions of whether the geology of the site, or the design of the repository, or the design of the shipping containers comply with the Commission's licensing standards. We have neither the technical expertise nor all of the information we would need to make those judgments. Those questions can only be resolved after further studies and further public licensing hearings. The Nuclear Waste Policy Act wisely left those decisions to the technical experts at the Nuclear Regulatory Commission, subject to our ongoing oversight and judicial review.

Our task, instead, is to give a fair hearing to both sides, and then decide whether the Secretary has presented a strong enough case to allow him to apply to the Commission for a license, or whether the State has identified weaknesses in his case sufficient for us to terminate the program at this point.

Senator Murkowski is not able to be here this morning. I understand Senator Craig might have an opening statement he would like to give, and then we will hear from the witness.

[The prepared statements of Senators Bingaman, Domenici, and Reid follow:]

PREPARED STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The Committee meets this morning for the first of three hearings on S.J. Res. 34, a joint resolution approving the site at Yucca Mountain, Nevada for the development of a nuclear waste repository.

The text of the resolution before us, and the rules for its consideration, were laid down 20 years ago in the Nuclear Waste Policy Act of 1982. The Act gave the Secretary of Energy the responsibility for picking a site for the development of a nuclear waste repository, but subjected his decision to review by the President, by the Governor of the State he selected, and ultimately by Congress. The Act gave the Governor the power to veto the site recommended by the Secretary and the President, but it gave Congress the final say on whether to sustain or override the Governor's veto.

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Twenty years ago, the authors of the Nuclear Waste Policy Act, in both the House and the Senate, spent more time debating the state veto than any other provision in the Act. They recognized the gravity of the decision to bury many thousands of tons of highly radioactive waste in a State, and were determined to give any State chosen to bear this burden the opportunity to appeal its selection to Congress and have its concerns heard and carefully considered. Senator McClure, who chaired this Committee and managed the Nuclear Waste Policy Act on the floor 20 years ago, called the state veto "an act of essential justice."

At the same time, the authors of the Nuclear Waste Policy Act recognized that, as Representative Morris K. Udall put it, "in the final analysis," the nuclear waste repository "is a project in the national interest, which must be subject to a national decision." They ensured that the decision whether to approve the Secretary's site recommendation would rest, not with the Governor or the President, but with Congress. The expedited procedures for considering the resolution to override the Governor's veto were designed to ensure that both Houses of Congress would have the opportunity to vote on the question. Those procedures were the necessary tradeoff for the state veto.

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PREPARED STATEMENT OF HON. PETE V. DOMENICI, U.S. SENATOR FROM NEW MEXICO

Mr. Chairman, I thank you for holding these hearings on issues surrounding the Senate's vote on the resolution that would allow continued evaluation of Yucca Mountain's suitability for a high level nuclear waste repository.

Mr. Secretary, I appreciate your joining the Committee here today to share the extensive deliberations that you conducted to arrive at the decision to recommend approval of the Yucca Mountain site to the President.

Members of this Committee don't need to be reminded of the vital role that nuclear energy plays in our national security. There's no question that it directly impacts our environmental security and our energy security. Without nuclear energy, we would have far dirtier skies and be far more dependent on foreign energy supplies.

I've argued repeatedly that our nation must maintain nuclear energy as a viable energy source far into the future. With advanced technologies, it can become a fuel for centuries into the future. Its clean reliable baseload power will be essential in powering our economic growth for future generations, just as it is a vital component of today's economic successes.

For nuclear energy to continue to support our economy, we must address the waste issue. There's no denying that these wastes represent an area of risk—but every energy source requires a balance of benefits and risks.The risks associated with nuclear waste are ones that we can fully control.

I'm well aware that hundreds of outstanding issues have been identified by the Nuclear Regulatory Commission. And the Department is well aware that they must address each and every one of the NRC issues before the Commission is going to move towards a final license.

In many meetings with the NRC chairman, as well as many of the Commissioners, I've always been impressed with their intent to deal with this, or any licensing issue, through careful study of the relevant scientific facts. The NRC has the expertise to evaluate these outstanding issues, and I'm confident that they will do so with great care. It is not up to the United States Senate to decide on the complex scientific issues that will eventually determine the fate of a license for Yucca Mountain.

Certainly, both sides in the debates about Yucca Mountain have stated their interest in assuring that decisions are based on "good science." For that reason, I want to thank the Secretary for choosing a superb research scientist, Dr. Margaret Chu, to lead the Yucca Mountain program. Dr. Chu, from Sandia National Laboratories, provided leadership for the complex licensing issues associated with WIPP. She is an outstanding choice to lead the Department through the scientific complexities of future licensing actions on Yucca Mountain.

I've been very sorry to see the overblown concerns on transportation in the press lately. Apparently the opponents of Yucca Mountain are so intent on winning this battle that they are willing to use transportation issues to frighten the American people into abandoning nuclear energy. That would be a colossal mistake for our nation and would seriously undermine national security.

The simple fact is that transportation of nuclear materials is a challenging and risky operation, but it is also an operation that has been extensively studied and engineered for success. In the United States, as well as in other countries, the record for transporting spent fuel is superb. Opponents need to remember that the shipping casks for spent fuel are designed to withstand the most rigorous conditions, and routes will be carefully chosen to further limit risks.

In the United States, since 1960, we've shipped spent fuel about 2,700 times and it's traveled over 1.6 million miles. Sure, there have been a few accidents. But no radiation has ever been released in any of them.

The record at the Waste Isolation Pilot Project is also spectacular. In their 3 years of operations, they've logged about 700 shipments traveling over 1.5 million miles. And in Europe. over 70,000 metric tons of spent fuel have been shipped—an amount roughly equal to the total authorized limit for Yucca Mountain.

Furthermore, in any debate about transportation, the simple fact is that route selection and detailed planning will begin at least 5 years before the first shipment and that the total number of shipments in a year will be around 175—a far cry from the 300 million annual shipments of hazardous materials that are currently moving around the country. There will be plenty of time to debate and optimize shipping plans before any spent fuel moves.

In responding to the outstanding issues raised by the NRC, I'm sure the Department will continue to analyze the Mountain and improve their modeling and simulation. That's certainly important research that I fully support. But I want to note that other research is also vital.

I've spoken on many occasions with my concern that the nation's policy of simply treating spent fuel as "waste" deserves careful debate. Spent fuel has immense residual energy content. I'm not convinced that we should be making a decision today that future generations will have no interest in this superb energy source.

I've noted that alternative spent fuel management strategies should be carefully studied and evaluated. Reprocessing and transmutation could not only recover residual energy, but could also vastly reduce the toxicity of the final waste products. Such research was strongly supported in the President's National Energy Policy, and Congress has supported this research very well—with $50 million dedicated to this work in the current year.

I was both amazed and disappointed that the Department chose to effectively zero this promising research in their request for fiscal year 2003. Recently Under Secretary Bob Card has been quoted as favoring research in this area. Mr. Secretary, in my view you should be speaking out on the importance of this research and providing funding for it in fiscal year 2003. If this work is not funded in 2003, the momentum and progress built up over years will be lost.

Mr. Chairman, in my view, the nation is far better served by beginning to move spent fuel into a single well secured repository than to leave it stored in temporary

facilities at 131 sites in 39 states. I look forward to supporting your joint resolution to override the veto of the Governor of Nevada and continue evaluation of Yucca Mountain as our nation's future repository.

PREPARED STATEMENT OF HON. HARRY REID, U.S. SENATOR FROM NEVADA

I want to thank you Chairman Bingaman and Senator Murkowski for allowing me the opportunity to participate in this hearing—and for understanding the importance of this issue to me and to my state, and really to almost every state.

The resolution this committee is considering refers to the President's recommendation of Yucca Mountain, Nevada as the site for disposal of high-level radioactive waste.

But this limited description fails to take into account the full implications of developing a repository there (or anywhere else)—namely, that before dumping the nation's nuclear waste on Nevada, it has to be shipped through 43 states—including the states most members of this committee represent.

So while there are many fundamental problems with the site itself and concerns about the process that led to the President's recommendation of the site, I want to first address the dangers of transporting massive amounts of deadly nuclear waste along the nation's major highways, railroad tracks and waterways.

Bush plan for moving 77,000 tons of deadly high-level radioactive waste requires 100,000 shipments by truck, 20,000 by train and perhaps thousands more by barge.

This idea would be risky at any time, but after September 11, 2001 it is just unthinkable.

The long term radiation contained in each shipment is 240 times radiation released by the Hiroshima bomb.

Shipments will pass by homes, schools, parks, churches, offices.

Shipments jeopardize the safety, health, environment and the lives of many people who live in cities and towns all over the country.

We know there will be hundreds of accidents involving shipments of nuclear waste.

It's not a question of if, but when and where and how severe will these accidents be. And an accident involving a container of deadly nuclear waste is no routine fender-bender. A collision or fire involving a 25-ton payload of nuclear waste could kill thousands.

Yet, the Department of Energy despite knowing there will be accidents recommended this plan without developing a plan for the shipments.

In addition, DOE has failed to provide the millions of people who live near the proposed routes the information they need to understand the risk their families face.

Deadly accidents are not the only concern. Shipping nuclear waste across the country increases our vulnerability to terrorist attack, by adding hundreds of thousands of targets for terrorists to attack with a missile or to hijack or to sabotage.

So transporting deadly nuclear waste is dangerous—and it's a risk our country shouldn't take.

The nuclear power industry and some of its backers suggest it would be better to have nuclear waste at a single site instead of scattered around the country. But this is a false promise, because the nation's nuclear waste will never be consolidated at a single site.

It will continue to be at every one of the operating reactor sites. Spent nuclear fuel rods are so hot and radioactive that they have to be stored at the nuclear reactor site in a cooling pond for 5 years before they can be moved. So developing Yucca Mountain would add to the number of sites with nuclear waste, not reduce it.

There are also risks about Yucca Mountain itself and hundreds of unanswered questions about whether it can be a safe storage facility.

Independent federal experts agree that the science done on Yucca Mountain is incomplete.

> The General Accounting Office, a credible independent agency, chastised the Secretary of Energy for making a decision on Yucca Mountain when almost 300 important scientific tests remain incomplete.
>
> The experts at the Nuclear Waste Technical Review Board, another independent agency, concluded that the technical basis for Yucca Mountain is "weak to moderate".
>
> The Inspector General at the Department of Energy found the that law firm they hired was working for the nuclear power industry at the same time.

There is an alternative. We can safely leave the waste on site, where it will be any way as new waste is added to the existing waste. It will be safe there while

we develop the technology for reprocessing or safe disposal without shipping 100,000 nuclear dirty bombs through your states.

Again, I want to thank you for the opportunity to discuss this important issue.

107TH CONGRESS
2D SESSION

S. J. RES. 34

Approving the site at Yucca Mountain, Nevada, for the development of a repository for the disposal of high-level radioactive waste and spent nuclear fuel, pursuant to the Nuclear Waste Policy Act of 1982.

IN THE SENATE OF THE UNITED STATES

APRIL 9, 2002

Mr. BINGAMAN (by request) introduced the following joint resolution; which was read twice and referred to the Committee on Energy and Natural Resources

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JOINT RESOLUTION

Approving the site at Yucca Mountain, Nevada, for the development of a repository for the disposal of high-level radioactive waste and spent nuclear fuel, pursuant to the Nuclear Waste Policy Act of 1982.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there hereby is approved the site at Yucca Mountain, Nevada, for a repository, with respect to which a notice of disapproval was submitted by the Governor of the State of Nevada on April 8, 2002.

○

STATEMENT OF HON. LARRY E. CRAIG, U.S. SENATOR FROM IDAHO

Senator CRAIG. Well, Mr. Chairman, thank you very much.

As you know, last week, the House passed House Joint Resolution 87, which approves the Yucca Mountain site in Nevada for development as the country's deep geological repository for high level nuclear waste. The House approved this resolution by an overwhelming bipartisan majority vote of 306 to 117. This is a very significant action.

For over two decades, Yucca Mountain has been studied, over $4 billion has been spent on the study of the mountain. The action taken in the House last week, and a similar action soon to be taken here in the U.S. Senate—approval of this resolution—will allow the required licensing process of Yucca Mountain to move forward.

Approval of this resolution is another step, moving further along in what has been a very long and careful process. Congress is not being asked, as our chairman has just said, to judge the licensing of the repository. These technical judgments will be made by the experts at the Nuclear Regulatory Commission in the coming years. What Congress is being asked to do is to permit the Department of Energy, the Secretary, to move forward with the development of Yucca Mountain. We are being asked to allow the Department of Energy to submit a license application for Yucca Mountain.

The Senate will soon begin the process of considering our own Yucca Mountain resolution, which is before the committee, S.J. Res. 34, introduced by the chairman of the Energy and Natural Resources Committee. This morning we are holding the first of a series of three hearings. The chairman has outlined those.

And I must tell you, Mr. Chairman, we are pleased that you are moving expeditiously. You obviously are bringing in all of the right groups to be heard. It is critical that we hear from all sides on this issue.

The Secretary is before us this morning. We look forward to his testimony, and the expertise that he and the Department of Energy bring to this issue.

At the end of these hearings, it is my expectation that my colleagues, and the committee, and me will vote out the Yucca Mountain resolution with a strong bi-partisan vote. Shortly thereafter, in June or July, it is my expectation that the full Senate will also approve Yucca Mountain.

There is something else that my colleagues need to be aware of. This process of our consideration of this resolution is laid out in current law, as the chairman has already spoken to, the Nuclear Waste Policy Act. Under this process, both Houses of Congress must act to overturn Nevada's veto of Yucca Mountain. This is a one-shot deal. Congress gets one bite at this apple. If the Senate fails to overturn Nevada's veto, Yucca Mountain will be abandoned as a repository. The scientific investigation will stop. The Congress and the American people will be right back to square one, where they started decades ago.

I believe that it would be most irresponsible to take that act. The responsible action is to proceed, to allow the experts to make judgment on and decide whether Yucca Mountain can, in fact, be li-

censed for the purpose of a deep geologic repository for high-level waste.

So, Mr. Chairman, I thank you very much for starting this process here in the Senate in a timely fashion, and I look forward to participating.

The CHAIRMAN. Well, thank you very much.

I know several members would like to do opening statements, but I think the way we will proceed is to just provide that there will be 8 minutes of questioning, which Senators can use for opening statements or for questions, or for some combination of those two.

Before we start into that, let us hear from our witness, Secretary Abraham. Thank you for being here. Why not go ahead with your testimony?

STATEMENT OF HON. SPENCER ABRAHAM, SECRETARY, DEPARTMENT OF ENERGY

Secretary ABRAHAM. Mr. Chairman, thank you very much. I appreciate the chance to be here with the committee today.

Mr. Chairman, I believe this committee and the Senate should follow the lead of the House of Representatives and vote to override Nevada's veto, and to allow a full and objective final decision on Yucca Mountain to be made by the Nuclear Regulatory Commission. As you indicated, the history of this program is a very long one. It dates back to Congress's decision in 1982 to begin the process by passing the Nuclear Waste Policy Act, committing to responsibility for radioactive waste disposal in this country.

Since that time, and even actually before it, research had been conducted in conjunction with the site at Yucca Mountain. That research now has spanned 24 years. It has been in excess of $4 billion worth of scientific investigation. To put that in perspective, that is five times longer than it took to build the Hoover Dam; it is six times the entire duration of the Manhattan Project, twice as long as it took to plan and complete the first moon landing. So the commitment, in terms of energy, time, dollars, and research, I think, has been extensive.

It fell to me, upon the completion of this extensive research effort, to reach a conclusion as to whether or not I could recommend this site as being suitable for the storage of nuclear waste. To reach that decision, I have considered the various research projects that have been done, and the science, and to try to determine two basic conclusions.

First, is the site suitable for the development of a repository, based on the evaluation of the science that had been conducted, for a period called the "pre-closure" period? That is the period from when we might start this project, to the point when we might seal the mountain. To give the committee some perspective on that time frame, it is estimated to be anywhere from 50 to 300 years. In short, at its longest, the preclosure period would exceed the actual age of the United States of America.

This is the period in which we would construct the repository, we would accept the waste into it, and we would monitor very closely any developments that might occur.

To my knowledge, no scientific organization has disputed the conclusion that we reached, that during this pre-closure period, the site is suitable and safe for storage, because the task is very similar to that which we have done in other contexts. Yucca Mountain will be a state-of-the-art facility, with a controlled, secure operating environment, in close proximity to an air force range and its protected air space.

We also were required, under the various congressional acts, to make a determination as to whether or not the site was suitable for a post-closure period. Here, the test that we were offered was a very stringent one. We were required to consider the safety and security of the site, in essence the suitability of the site not for 300 years, but for 10,000. In short, we had to make a determination as to whether over a period of time, that if you were to go in reverse, would return us to an age in which we were just beginning to domesticate plants, whether or not we could meet a very stringent set of safety standards. These standards, in fact, allow only 15 millirems annual radiation exposure for people living within an 18-kilometer range of this location, and impose a groundwater protection standard as stringent as we use for major cities in this country.

To get there, we conducted most of the research I just mentioned over a long period of time. I might say, just to put this in perspective, we are talking about an annual exposure rate that would have to be less than that which a person might receive making several—just two cross-country airplane flights today. We concluded that, based on a total system performance analysis of the mountain and its prospective designs, we would be able to meet that standard during this time frame.

Now, we recognize that 10,000 years is a long period, and that many potential events could transpire during that period, and so we were not only looking at it from the standpoint of a static environment, but we also took into consideration a variety of factors to be evaluated, and take into account. Those factors included such things as whether or not volcanic activity in the area might pose a higher radiation risk, whether seismic, earthquake activity in the area could conceivably cause us to not be able to meet the radiation standards, whether or not human intrusion could conceivably result in a harmful radiation exposure.

By human intrusion we mean that we tried to evaluate, and were required to evaluate, whether in 10,000 years, somebody digging for oil and drilling through the top of the mountain might cause a radiation exposure to people in this area.

We, of course, did extensive tests on whether or not water from the top of the mountain might somehow seep a thousand feet down into the repository area in sufficient quantities over 10,000 years to somehow penetrate what we believe to be the extraordinarily impenetrable storage packages that will be used, and then have the capacity to somehow carry radioactive material another 800 feet down to the underground aquifer, which is a contained groundwater system.

We only not considered that in the context of the mountain's current location and rainfall exposure, which because it is next to Death Valley is not very high, but we also even took into consider-

ation whether or not we could still meet the standard if a new glacier age were to envelop the region, and then recede—posing, obviously, a much larger amount of water exposure to the mountain. We challenged ourselves in many other ways, and we concluded that the standards that have been set would be met even in the case of these sorts of uncertainties.

Outside external checks and scientific evaluations, and groups including the International Atomic Energy Agency, the U.S. Geological Service, our national labs, and a variety of others, have peer reviewed the work that has been done, and support the findings that we have reached, and I am convinced of the soundness of the scientific basis for the recommendation which I made.

I have visited the site, I have talked to the scientists at great length, I have studied many, many comments that were offered to us by a variety of people who participated in 116 hearings that have taken place, and I did so, Mr. Chairman, with great concern for the people who live in this area, the people of Nevada, as well as others in this country, weighing as best I could their concerns about safety and security. I am convinced that the soundness of this project is established, and that we can move ahead, and should move ahead to allow an ultimate decision by the experts of the Nuclear Regulatory Commission as to the licenseability of this facility.

Once I was convinced that this site was suitable as a repository, I did not move immediately to a final decision, because I also felt it was important for us to consider national interests in whether or not there were sufficiently compelling national interests to go in this direction, and as I have said before, I believe there are a number of strong and compelling national interests that support us moving ahead to the next stage, and ultimately to the construction of the repository.

One is energy security. A site designation clearly, in my judgment, will encourage continuing nuclear energy production in this country. Right now, nuclear energy is 20 percent of our electricity generation. It is important for us in terms of maintaining a diversity of fuels.

Existing facilities, in order to operate through their current life expectancies, and beyond, for license renewals, need the commitment that we seek to make here—to have a means of dealing with nuclear waste. As is well known, a number of the facilities that are operating today are running out of space for the waste that we said we would accept back in 1998, in the original congressional actions.

There is a strong national security argument as well. The most strategic vessels in our navy, the largest ships and submarines are dependent upon nuclear power for propulsion. The spent fuel from those navy reactors is currently temporarily stored in the State of Idaho, under an agreement with the State that is temporary. We do not have a long-term mechanism for dealing with that waste, other than the storage that would take place at Yucca Mountain, and that spent fuel must go to a repository.

In addition, the repository is one of the more important components in the process which we have developed to comply with our end of the nuclear nonproliferation agreements we have reached with the Russian Federation for the disposition of weapons-grade

plutonium. Without the repository, I think that program will be set back, if not stalled.

As I have said many times, there are certainly arguments, in my judgment, that support this site for homeland security purposes. Prudence, I think, dictates trying to store as much of our nuclear waste as we can in this isolated repository, a thousand feet under the desert, where we can consolidate waste that is currently temporarily stored in a variety of places, including decommissioned reactors around the country that no longer function, but where waste remains.

Of course, there is also the argument that is very compelling from an environmental cleanup point of view. Without the repository, waste remains where it is, in temporary locations. In my judgment, that is not in the best interest of the environment in those communities, especially those where we already have the decommissioning of the facilities that generated the waste to begin with, and not to mention, the nuclear material that is at Department of Energy sites, such as Rocky Flats, in Colorado, which ultimately needs to have a final resting place. So for all of those, I think, very strong national interest reasons, the decision to move forward with this is a very important one, and the correct one.

I think it is important in summary, Mr. Chairman, just to put in perspective the choice before this committee and before the Senate. It is the same choice the House had. To override the veto merely allows the Department of Energy to move forward and to seek a final objective evaluation of the work which we have done over the last 20 years by the experts of the Nuclear Regulatory Commission, as to the safety and suitability issues relating to the development of this repository.

A decision not to override ends the process entirely. It leaves the waste where it is, with Congress retaining its responsibilities to deal with the waste, but without a plan to do so. The problem with that is, I think, quite obvious on its face, but there is another factor, and that is that this waste is not going to just sit where it is at if Congress decides to terminate the Yucca Mountain project.

Instead, what we will have, Mr. Chairman, is a variety, I think, of makeshift, ad hoc alternatives, seized upon by people in communities who do not want the waste to remain where it is, who have already been paying into our funds to have it dealt with and removed, and as we have already seen, you will continue to see such activities as efforts to create new storage facilities at alternative sites around the country.

The Nuclear Regulatory Commission already has a request, a license request, before it from the Goshute Indian tribe, in Utah, who, in consortium with some energy companies, are offering their reservation land as a storage site. Whether that license is granted or not, others will be, and we will begin to see the waste moved, but it will not move through the coordinated plan that we have, it will not move under the Federal Government's oversight in the way that we propose, it will not go to a single repository, it will end up in a variety of locations, under a variety of different transportation processes, in my judgment, in a very uncoordinated way, and in a fashion that I do not think really reflects the best interests of the Nation from any of a variety of perspectives.

So for all of those reasons, because the science is sound, because we have been able to demonstrate, I think, clearly, both in a pre- and post-closure period, that the site is suitable and safe, and because we have met the relevant standards, and because of the compelling national interest, as well as the likelihood that in the absence of moving forward, we would find a variety of makeshift undesirable alternatives, that the case is strong for at least allowing this process to go to the next stage, and let the Nuclear Regulatory Commission make a final decision.

I thank you for your time.

The CHAIRMAN. Well, thank you very much.

[The prepared statement of Secretary Abraham follows:]

PREPARED STATEMENT OF HON. SPENCER ABRAHAM, SECRETARY OF ENERGY

Mr. Chairman and Members of the Subcommittee, I am pleased to appear before you today.

On February 14, I forwarded a recommendation to the President, based on approximately 24 years of federal research, that Yucca Mountain, Nevada, is suitable for development as the nation's geologic repository for spent nuclear fuel and high-level radioactive wastes. The President officially recommended the site to Congress on February 15, and pursuant to the Nuclear Waste Policy Act of 1982 (NWPA), the State of Nevada has exercised a disapproval of the President's recommendation.*

I am greatly encouraged that on May 8 the House of Representatives voted, by an overwhelming margin, to pass the Joint Resolution before you today. The expeditious manner in which the House acted, and the wide margin and bipartisan manner by which the Joint Resolution passed, clearly signal this Nation's confidence and readiness to take the next step toward resolving the challenges of permanent waste disposal. Without delay, I ask that the Senate also pass the Joint Resolution, so that the Department may enter the next phase of repository development an expert and independent scientific and technical examination of the safety of the site by the Nuclear Regulatory Commission.

Passing this Joint Resolution, thus overriding the State of Nevada's disapproval, hardly needs emphasis. Twenty years ago, Congress established in law the Federal government's responsibility for the disposal of spent nuclear fuel and high-level radioactive waste. In doing so, Congress foresaw the fundamental national security and energy policy considerations that weigh heavily in favor of proceeding with a geologic repository, and mandated that a repository program be based upon a thorough scientific evaluation of several candidate sites. In 1987, Congress limited that evaluation to the site we consider today: Yucca Mountain.

In formulating this recommendation, I first considered whether sound science supported a determination that the Yucca Mountain site was scientifically and technically suitable for the development of a repository. The scientific evaluation of the Yucca Mountain site had been conducted over a 24-year period; as part of the study, some of the world's best scientists examined every aspect of the natural processes—past, present, and future—that could affect the ability of a repository beneath Yucca Mountain to isolate radionuclides released from any spent fuel and radioactive waste disposed of there.

The Department's scientific inquiries and modeling clearly demonstrate that a repository at Yucca Mountain can meet the Environmental Protection Agency's standards for protecting the health and safety of our citizens. These extremely stringent standards were based on the recommendations of the National Academy of Sciences. What they mean, in terms of the Yucca Mountain site, is that a person living 11 miles away from the site cannot receive more annual radiation exposure during the 10,000-year regulatory period than a traveler receives today from natural sources in three round trip flights from Las Vegas to New York.

In evaluating whether the repository can comply with the Agency's standards, our scientists employed extremely conservative assumptions and considered the impact of events with extremely low probability of occurrence, all erring on the side of public safety. For example, earthquakes were assumed to occur, and volcanic eruptions were evaluated—even though the likelihood of a volcanic event affecting the repository during the first 10,000 years is just one in 70 million per year. Even with these

* The letters referred to in this paragraph can be found in the appendix.

unlikely events analyzed into the Agency's 10,000 year compliance period, Yucca Mountain still meets the EPA standards.

A review of the documentation that accompanied the recommendation clearly reveals that the Department has carefully evaluated the extent to which Yucca Mountain's substantial natural geologic barriers work in concert with the robust engineered systems. We know that Yucca Mountain is in a closed hydrologic basin, a geologic feature that greatly limits the potential migration of radionuclides. Between the emplacement tunnels and the water table, which is approximately 2000 feet below the surface, the geology provides natural adsorption retarding any potential radionuclide movement. The hydrologic features at this site suggest that more than ninety percent of the annual rainfall runs off or is evaporated, meaning less than a half an inch of water travels beneath the surface. Our studies indicate that the vast majority of water samples taken from the mountain are thousands of years old.

Even with this robust geology, our scientists again conservatively considered how engineered barriers 1,000 feet below the surface and 1,000 feet above the water table might corrode by analyzing what would happen during an ice age, if Nevada's climate changed and rainfall increased dramatically. Even including these scenarios, Yucca Mountain still meets the EPA standards.

After thoroughly examining the relevant scientific and technical materials, I have concluded that they demonstrate that the site is scientifically and technically suitable for construction of a repository. As I stated in my recommendation to the President:

> Irrespective of any other considerations, I could not and would not recommend the Yucca Mountain site without having first determined that a repository at Yucca Mountain will bring together the location, natural barriers, and design elements necessary to protect the health and safety of the public, including those Americans living in the immediate vicinity, now and into the future.

Having reached this conclusion, I went on to evaluate whether compelling national interests counseled in favor of moving forward with a geologic repository at Yucca Mountain, and if so, whether there were countervailing arguments so strong that I should nonetheless decline to proceed. This evaluation argued strongly in favor of proceeding, and certainly that there was no basis for abandoning the policy decisions made by the Congress in enacting the 1982 Nuclear Waste Policy Act and the 1987 amendments to that Act. In short, the relevant considerations are as follows.

First, Yucca Mountain is critical to our national security. Today, over forty percent of our Navy's combatant vessels, including aircraft carriers and submarines, are nuclear powered. The additional capabilities that nuclear power brings to these platforms is essential to national security. To maintain operational readiness, we must assure disposal of spent fuel to support refueling of these vessels. We are in the midst of advancing the non-proliferation objectives that have been the welcome result of the end of the Cold War. A geologic repository is an integral part of our disposition plans for surplus weapons grade materials.

Yucca Mountain is an important component of homeland security. More than 161 million people live within 75 miles of one or more nuclear waste sites, all of which were intended to be temporary. We believe that today these sites are safe, but prudence demands we consolidate this waste from widely dispersed, above-ground sites into a deep underground location that can be better protected.

A repository is also important to our nation's energy security. Nuclear power provides 20 percent of the nation's electricity and emits no greenhouse gases. The reactors we have today give us one of the most reliable forms of carbon-free power generation, free from interruptions due to international events and price fluctuations. This nation must develop a permanent, safe, and secure site for disposal of spent nuclear fuel if we are to continue to rely on our 103 operating commercial reactors to provide us with electricity.

And a repository is important to our efforts to protect the environment. A repository is indispensable to implementing an environmentally sound disposition plan for high-level defense wastes, which are located in Colorado, Idaho, South Carolina, New Mexico, New York, Tennessee, and Washington. The Department must move forward and dispose of these materials, which include approximately 100 million gallons of high-level radioactive waste and 2,500 metric tons of defense production spent nuclear fuel.

Finally, I carefully considered the primary arguments against locating a repository at Yucca Mountain. None of these arguments rose to a level that outweighs the case for going forward with the site designation.

Of these, the only one I shall address in my prepared testimony is the concern critics of the project have raised about the "transportation issue." I wish to address this issue briefly, not because I believe there is any real basis for believing these concerns are warranted, but rather, because I believe that simply by incanting the words "transportation of nuclear waste," opponents are hoping they can incite public fear, without any basis in fact, and that this hope has become the last refuge for opposition to the project. The facts, however, are these.

First, the Nuclear Regulatory Commission, working with the Departments of Transportation and Energy, has overseen approximately 30 years of safe shipment of spent nuclear fuel in this country. The Department and commercial nuclear industry have substantial experience to date—some 1.6 million miles—without any harmful radiation release. And the successful and extensive European experience in transporting this type of nuclear material corroborates our experience. The transportation of this material will involve approximately 175 shipments per year, not the 2,800 that the opponents allege. It would also constitute 0.00006% of the annual hazardous material shipments, and 0.006% of the annual radioactive material shipments that occur in this country today.

Second, because the site has not yet been designated, the Department is just beginning to formulate its preliminary thoughts about a transportation plan. There is an eight-year period before any transportation to Yucca Mountain might occur. This will afford ample time to implement a program that builds upon our record of safe and orderly transportation of nuclear materials and makes improvements to it where appropriate. Thus any suggestion that the Department has chosen any particular route or mechanism is completely fictitious. Those decisions have not been made, and cannot possibly start to be made until the site has been designated and the Department has the opportunity to work with affected States, local governments, and other entities on how to proceed.

Third, even without a repository at Yucca Mountain, the need to find a place to put the spent fuel that is continuing to accumulate will lead to the transportation of these materials, and likely quite soon. On-site storage space is running out and not all utilities can find new adjacent land where they can put this material. Therefore, they will devise ad hoc off-site consolidated storage alternatives. Already a consortium of utilities is working on a facility that they have presented to the NRC. Whether or not this effort ultimately succeeds, it is likely that some similar effort will. Thus the transportation of nuclear materials is not a function of a repository at Yucca Mountain, but rather is a necessary consequence of the material that continues to accumulate at the 131 sites in 39 States that are running out of room for it.

Finally, Yucca Mountain critics argue that nuclear materials in transit could be a terrorist target. But they are forgetting the obvious: spent fuel in secure transit to a permanent repository is certainly less susceptible to terrorist acts than spent fuel stranded at the temporary, stationary sites—many very close to major cities and waterways—where it now resides.

Let me close with one last thought. The critics of this program would have Congress overturn the fundamental decisions it legislated 15 years ago—that a single underground repository located at Yucca Mountain holds the greatest promise for the long-term safety and security for the Nation. The great body of scientific work done since then has confirmed the fundamental soundness of the Yucca Mountain site. The only issues remaining are the type that only can be resolved in a Nuclear Regulatory Commission licensing proceeding.

The critics who would upend this path to resolution of the remaining issues have a heavy burden of proof in urging that the policy decision made by Congress in 1987 and the findings of the body of scientific work that examined Yucca Mountain both be abandoned before the NRC has even had the opportunity to pass on whether a repository can safely be sited there. Given the history and the work to date, their burden would be substantial even if this project were not critical to many important national interests. But it is. Rejection of the proposed resolution would leave the country with no ultimate destination for our spent naval fuel, no adequate path for disposing of our own surplus plutonium, thereby making it hard for us to press other countries to dispose of theirs, and no means to complete the environmental cleanup of our defense complex. Utilities may have to start planning to decommission existing nuclear reactors and figuring out how to replace them. Congress would still have to formulate an alternative in view of the statutory obligation that the Government dispose of commercial spent fuel that was legislated in 1982, but that would be no easy task.

In short, a decision to oppose this project's going forward at this stage is a decision to abandon the repository program and subject the country to these consequences without ever letting neutral experts at the Nuclear Regulatory Commis-

sion decide whether that is the right course. Nothing the critics of this project have advanced comes close to meeting the burden of proof they should have to satisfy to warrant proceeding in this fashion. Opposition to nuclear power is not a sufficient ground, since we all, and the United States Government in particular, have an obligation to safely dispose of this waste regardless of any such policy view. Nor are concerns about transportation, for all the reasons outlined above. Rather, opposition to this resolution, and to submitting this question to the NRC, seems warranted only if one is convinced that there is such overwhelming evidence that a repository at Yucca Mountain cannot meet the NRC and EPA standards that it would be a waste of time and money to use the ordinary NRC processes to find out.

Support for the proposed resolution, on the other hand, does not require being convinced that the Department of Energy is right in believing that a repository at Yucca Mountain will meet the applicable standards or that the NRC will decide it should be licensed—although in my judgment the scientific work to date provides ample basis for reaching that conclusion. Indeed, it doesn't even require being convinced that this outcome is the most likely. Rather, all that is required to support the resolution is to believe there is enough of a serious possibility that $4 billion and 24 years of scientific research have produced a sufficient basis for our conclusion that the site can be safely developed as a repository. That conclusion will then subject the extensive scientific basis for the President's recommendation to objective testing in the only official context it can be—an NRC licensing proceeding.

I urge the Senate now to act promptly and favorably on the proposed joint resolution, as the House has done so overwhelmingly on May 8. This will allow the Department to proceed with the next stage of addressing the merits of all remaining issues, by applying the independent expertise of the Nuclear Regulatory Commission.

The CHAIRMAN. We will go back and forth on questions, and do it in the order that people arrived.

One of the issues that has been raised, Secretary Abraham, on this is that the Nuclear Waste Policy Act requires you to file an application for construction authorization with the Nuclear Regulatory Commission within 90 days after the President's site recommendation becomes effective, if the Congress accepts your recommendation, and overrules the governor.

GAO has said that you will not be able to file a license application for another 4 years, rather than 90 days. So assuming the joint resolution is signed into law, are you prepared to file an application within 90 days? If not, what happens if you do not meet that deadline?

Secretary ABRAHAM. Well, I do not believe that the actions we were required to take before reaching a recommendation required us to have a completed or near completed license application. In fact, I think to argue that somehow the 90-day rule was designed in some fashion to stop the process, rather than to expedite it, would be to turn it on its head. I think the 90 days was designed to try to make sure the process could move forward quickly.

When Congress enacted the Waste Policy Act in 1982, it included in the Act a lot of deadlines, which represented its best judgment then of how the various steps could be taken. These deadlines included this 90-day provision. They also, of course, included the requirement that we begin accepting waste in 1998, which we have not done. I think the time frames in the Act have proven to be optimistic on their face, and I do not think that is any reason for the Department not to honor what was, I think, plainly the central objective here, which was to try to move this along as promptly as possible.

The specific answer to your question is, we believe that we will be in a position to provide a license application by the end of the year 2004. We are moving forward to prepare that at this time. I

would note that the Congress has constrained in appropriations the work that might be done by us on the license preparation side of our responsibilities, and instead has been very explicitly funding programs on the site suitability side of our responsibility. I do not believe that the 90-day time frame here is, in any way, a prohibition on us moving forward to seek a license at a date beyond 90 days after the finish of this process.

The CHAIRMAN. One of the arguments the Governor has used is—he says that the poor geology there at Yucca Mountain has forced the Department to abandon reliance on the mountain's geology as a way to isolate the waste, and instead, in his view, the Department is now relying on what the Governor calls a series of fancy engineered waste packages, and a tangled web of man-made contrivances.

To what extent will the repository rely on the geology of the mountain, and to what extent will it rely on waste packages, or drip shields, or other manmade barriers to ensure that the waste remains sealed in this repository?

Secretary ABRAHAM. Mr. Chairman, the legislation that governs this issue has never, in any sense, suggested that either a 100 percent geological approach or a 100 percent man-made approach is called for. I think it always contemplated a combination, and that is what we are proposing.

Yucca Mountain has many positive attributes, because of its location and its composition. There is low rainfall. Obviously, it sits near Death Valley. It has a closed groundwater basin, which contributes mightily to the safety features. It is a benign environment for waste packages. It is isolated from population.

The result of all that is that its natural barriers alone are going to protect public health and safety by isolating 99.9999999 percent of the radioactive material which is emplaced in it over 10,000 years. Those natural barriers alone would reduce exposure to—just to put this in perspective—20 percent of the level of exposure which is currently allowable for U.S. nuclear workers. In short, just by its geological factors alone, it brings the potential exposure below that which we have legally permitted to be the case for nuclear workers.

It is still, at that point, higher than the EPA's standards, which are extraordinarily strict, which is why, based on those standards, we have added additional engineered barriers to accomplish the final small ingredient of protection that I referenced earlier.

The CHAIRMAN. One of the concerns that has been raised, the Nuclear Waste Technical Review Board whom we are going to hear from next week, is that the technical basis for the Department's performance estimates is, quote, "Weak to moderate." I guess I would ask whether you share the Board's assessments in that regard, and if you do, why the Department's technical basis is not stronger.

Secretary ABRAHAM. Well, first let me say that we take the Technical Review Board's comments and advice seriously. We have throughout this process—they have a different responsibility than we do. Their recommendations do not go specifically to meeting the EPA targets, or the Nuclear Regulatory targets only. Rather, I think they have tried to offer perspectives on how to perfect the de-

sign of all of the various components to an even higher standard, and we would like to do that as well.

Let me just start by saying that there is no disagreement, I do not think, as I said in my comments, between us, and the Technical Review Board, or anyone, over the safety and suitability of the facility in the first 300 years. Where there have been some concerns raised by the Board that relates to that post-closure 10,000-year period, thereafter. They have identified some issues which they—let me put it this way.

We have come up with what we believe is a basic design approach that will meet these extraordinarily stringent standards. The question is: Can we perfect them? I think the Review Board has asked us, and I think the comments you reference go to the question of whether or not we have done enough research to even perfect them further.

For example, one of the main areas that they have made recommendations on, which I think a lot of the reference points you made before pertains to, is the question of whether or not the repository would be maintained on a hot versus a cold environment, and I think the Review Board believes more research needs to be done to make a determination as to which is preferable, in terms of what could make it even safer than the standard that we could meet, and we are conducting that research as a matter of following-up on their recommendation. So I think that the basis for the conclusion we made as to suitability is strong. I think the issues that they raise are important ones to look at over the period of time we have ahead to perfect the design even better.

The CHAIRMAN. One other question I wanted to ask relates to transportation. A lot of the complaints about this proposal that you are advocating to use Yucca Mountain is that the transportation of the waste to this site will not be safe, and will create a series of new and unnecessary hazards. I would like your reaction to that, and also any estimates you could give us—if Congress were to approve going ahead, as you are requesting, when is the earliest that shipments would actually be made to Yucca Mountain?

Secretary ABRAHAM. Well, let me begin by talking about the safety record we have already achieved. In this country, as well as in Europe, literally, as cumulatively, as much nuclear waste as is contemplated being moved to Yucca Mountain, has been moved over the last 30 years, without any harmful radiation exposure. The track record is an impressive one. I think the chairman is familiar with the many protocols that were established, for example, in the movement of waste to the WIPP facility at Carlsbad, and the same kind of an approach would be taken here, but the point is, we move a lot of waste today, and we have done it safely.

Moreover, just to put some numbers on the record, we move about 300 million hazardous waste shipments per year in this country. Three million of them involve some form of radiological material, and we do it safely, not just our department, but the transportation sector, and the other government agencies. So we can do this safely, number one. Number two, as I mentioned in my comments, this is not a situation that is unique to Yucca Mountain. If we do not go ahead with this program, if it were to be terminated now, as I said, there are already ad hoc makeshift alter-

natives being contemplated by people who have too much waste building up in their temporary storage facilities at nuclear reactors around the country. The question is going to be, not is there or is there not transportation—there will be. The question for everybody to consider is whether it makes more sense to do it in a centralized, highly secure, effective fashion, or to leave it to a variety of alternatives that will be different for each new approach that ultimately is developed by people who have the waste in temporary facilities that they do not wish to retain in those locations.

So it can be done. The time frame that you asked about looks something like this. We believe, as I said before, that we can proceed through final application by the end of the year 2004. We believe that process from there, forward, will be through the year 2006, to the end of 2007, when we believe a license decision could be made.

After that, it will take at least 3 years to construct a facility, and make it capable of accepting waste. So it is eight years, roughly, from now, when we would envision our time frame for the first potential receipt of waste, 2010.

The CHAIRMAN. Senator Campbell.

STATEMENT OF HON. BEN NIGHTHORSE CAMPBELL, U.S. SENATOR FROM COLORADO

Senator CAMPBELL. Thank you, Mr. Chairman. Well, Mr. Chairman, I have no scientific background, whatsoever. They say most of our decisions are really made by our own personal frame of reference, so let me try and do that maybe not only as a Senator who represents Colorado, but as a private citizen, too. I might say that I am happy to see our old colleague here, Secretary Abraham. We do not get to see him much any more with his new job.

I do not know how many on the panel have actually witnessed the awesome power of nuclear fission, maybe with the exception of Senators Ensign or Reid, because they are from Nevada, but I have. I know that this is a little different subject, but it has certainly set something in my frame of reference that I keep thinking about.

In 1952 and 1953, I was stationed at Nellis Air Force Base, which is just out of Las Vegas, as you know, Mr. Secretary, about 90 miles from the location where we are talking about storing this waste, and had the opportunity to witness four, at least four, and as I remember, more than that, four bombs that were set off. Three of them were from the base, in the middle of the night. It was so bright that you could actually read a newspaper without any lights at all for probably a couple of minutes before that brightness died down.

Once I was what was called a perimeter guard, since I was an MP, I think about 6 miles away from where it was set off, with very little protection. We watched it using smoked glass, if you can imagine that. To this date, I wonder—I do not mean to say this as an alarmist, but I wonder about the effects that being close to those things had on the American people who were there, the military guys who were there at the time.

I understand, although I have no absolute documentation about this, that there is still places in Yucca Flats where you cannot go

without some protective clothing, because of those bombs that were set off above ground.

Well, that is one of my concerns. I always kind of factor that in, that I saw those things, and I know other people probably have, too, but one of my other big concerns that I think you talked about somewhat, it still does not satisfy me, though, is the transportation. As I understand it, the Governors do not have the right to veto the route that these shipments come through their State. You mentioned about 175 shipments a year. I do not know how many the total amount is, I guess thousands and thousands over a period of years, but the main route for east-west for Colorado is I-70, right through downtown Denver, which has about 2 million people in the metropolitan area, and a governor that cannot veto that.

It then goes over I-70, Vale Pass, maybe you have been that way, and down what is called Glenwood Canyon. Glenwood Canyon is a major east-west artery, but a very narrow canyon, and most of the tributaries that go into the river beside the highway, and by the way, the train tracks also go there, so you will have the same problem with trains or the highway. Most of that water feeds into the Colorado, which then, in turn, goes to Nevada, to California, to the lower Colorado, to Mexico, and I guess to, in some cases, Arizona, too.

I checked with our Department of Transportation yesterday, and they told me that in 1993, the semis, the heavy trucks, the big trucks, there were 19 wrecks on that road in 1993, sixteen in 1994, 20 in 1995, 14 in 1996, 15 in 1997, 19 in 1998, 11 in 1999, 12 in the year 2000, and I do not have any figures for this last year. So there is no question, trucks are crashing all the time. Of those, 75 percent of the accidents occurred during the daytime, and 75 percent of them were involved with collisions with other vehicles.

Well, I do not blame the Governor of South Carolina, by the way, who has literally said he would call out the guard or throw his body down in front of the trucks if anybody tries to ship any nuclear waste into his State. I understand that. Our Governor in Colorado, Governor Owens, just recently put a moratorium on some shipment of low-level waste that was supposed to be imported by a company that was going to reprocess it in Canyon City, Colorado. I would think if a governor does not do that, or if the Senators, too, do not oppose that, they do not stay in office the next time around, because that is the way people feel.

I also get criticized in my own State, because of my position on it, but every State gains the job base, and all the benefits from producing this stuff, every one of them. They have the jobs. They have the tax base. They have all the good. Sometimes I liken it to the guy who builds a nice home, but forgot to factor in the septic tank, so after he gets his nice home built, he wants to put the septic tank on his neighbor's land. I just think that is morally wrong.

I have been involved with this, I guess, as much as anybody on this committee, having been on it since I have been in the U.S. Senate, and I think I have heard all the scientific reasons why we ought to do it, and maybe there are some. I just think that there is a moral obligation, too, and I am not at all sure we ought to be dumping it in Nevada.

I just wanted to pass that on to you. I really do not have any questions, Mr. Chairman, but I wanted to get that off my chest.

Thank you.

Secretary ABRAHAM. If I could just comment, Mr. Chairman.

First, I would note that notwithstanding the challenge we are having with regard to South Carolina, the Governor of South Carolina, who is a strong proponent of this process, and endorses the decision to go forward with Yucca Mountain——

Senator CAMPBELL. But not in his State.

Secretary ABRAHAM [continuing]. I would also note that, as you are well aware, Senator, the——

The CHAIRMAN. The Governor of Nevada also favors the shipments to South Carolina. It is the NIMBY system. I understand that.

Secretary ABRAHAM. So does Colorado——

Senator CAMPBELL. So does Colorado, and I get criticized for it.

Secretary ABRAHAM [continuing]. Because it is your governor and colleagues who wish us to ship the material from Rocky Flats to South Carolina. So, obviously, this is an ongoing challenge. But I do want to clarify a couple of things.

First of all, under the rules which we have, if the site is designated, we will identify preliminary routes, we will consult with States and tribes through which routes would be used, and the States have the option, as we saw with the WIPP shipments, to provide preferred shipping routes instead through their jurisdictions, which they can designate, and which we will follow.

I would also just add that——

Senator CAMPBELL. Then something has changed, Mr. Secretary, because the last time we dealt with this bill, as I read the bill, it said that the Governors could designate routes, and they could recommend routes, but, in fact, the DOE had the authority to veto that, not to go along with it, and in Colorado, I do not know about some of the other States, but there is on east-west route, except I-70, that is a four-lane highway. The rest of them are all two-lane country roads.

Secretary ABRAHAM. The process, as I understand it, Senator, includes notification of both the Governor, as well as Nuclear Regulatory Commission, escort training for those who would be engaged in the management and the transfer, that is, the local personnel. Advance arrangements will be made with law enforcement agencies along the route. Advance route approval is required by the Nuclear Regulatory Commission, at least one escort to maintain visual surveillance of a shipment, status reports every two hours. There are a variety of those additional protections. We have done this—we have done it.

Senator CAMPBELL. Yes, and I understand that, and I appreciate that, and, in fact, some of those things, including driver training, and funds for local HAZMAT teams, and so on, were put in because of us, some of us, that were not very supportive the last few years of this movement, without additional precautions. So I think that is all to the good.

Secretary ABRAHAM. As I said, I think it is to the good as well. I also would, again, just reference two things. Number one, I believe you are going to have transportation and shipments whether

it is done by this process or by alternatives that are developed by companies who find people willing to store this off-site, and, again, all I can say is, we have had, I think, over the last 30 years a track record, both with respect to this kind of material, as well as our WIPP program that is unblemished, and we are proud of the fact that there have been no harmful radiation exposures, both here as well as in Europe, despite a huge amount of shipments.

Senator CAMPBELL. Well, thank you, Mr. Chairman. Just a last comment: I would recommend that maybe we study shipping it to Michigan.

[Pause.]

The CHAIRMAN. There is no response to that.

[Laughter.]

Senator CAMPBELL. I noticed.

The CHAIRMAN. I call on Senator Landrieu.

Senator LANDRIEU. Thank you, Mr. Chairman.

Thank you, Mr. Secretary.

Let me just thank you for your leadership, Mr. Secretary, on this very difficult issue in helping us to work through it, and to try to provide a plan that is really good for this country, respectful of all of our States, and continues to move us in a very progressive and positive direction to strengthen our economy, and to continue to march forward.

Let me just ask two questions, and then I am going to make just a general comment. You alluded to this, but I think one of the issues that is raised by opponents is this transportation issue. So I would like to go over again, if you could put a little bit more on the record about the safe transportation of waste from the national weapons complex to New Mexico. You referred or alluded to the WIPP program. Could you go over again the results of that transportation, because, as you can see, it has been raised as a concern, and I think it is an important point to reiterate.

Secretary ABRAHAM. It is, and as I have said, I recognize the concerns people have. We believe, just as a preliminary point, it is not the case that failure to go forward with this means no transportation. The question is, who do you think can do it better, the people who have done it for 30 years, without a harmful radiation exposure, or others?

We have a successful program shipping for WIPP, which has resulted in the safe movement of about 20 percent of the shipment trip volume anticipated for Yucca Mountain already, and we actually support the consideration of using the same kinds of protocols here, or something similar, as a starting point to design the system we would use for Yucca Mountain.

Now, just to put that in perspective. With WIPP, we provide assistance with First Responder capacity and capability, through training and other assistance. Over 20,000 First Responders have been trained. We have worked with States to establish shipping protocols, such as time of day, the weather, and other restrictions, notification of the States, of all shipments and provision for feedback on modifying the time of day shipment at the release point, State patrol safety inspections, and DOE radiation inspection of shipping vehicles, and rigorous inspections done prior to the trip, as well as satellite tracking of en route vehicles. All of these, and

more, are part of the protocols of WIPP that have been very effective. We would envision starting with that as a menu to choose from, as we would consider a similar approach at Yucca Mountain.

Senator LANDRIEU. Well, the reason I raise this, Mr. Chairman, I think in this debate, it is very, very important for us to understand that while there might be risk associated with the moving of this material, the Secretary has outlined all of the extraordinary precautions that can and will be, and have been taken, with minimal effect, taken, but what people have to realize is, that right now there is even a larger risk of 131 sites with this nuclear-stored material that are also in populated areas, in some cases, right next door to neighborhoods, very populated neighborhoods.

This is not just a matter of energy security and a mix of fuels, and the importance of nuclear, it is a security issue. With post-9/11, there are possibilities that we will not discuss in detail, but people could imagine, you know, attacks on some of these storage sites. They are in populated areas now. So one of the quotes that I have in my statement is a quote from George Patton, which basically says, "A good battle plan that we act on today can be better than a perfect one tomorrow."

I suggest we have a good battle plan, that we need to act on it, and the argument that it is risky to move it is more risky than leaving it where it is. I do not think the science, or the evidence, or common sense, backs up that second argument. With 131 sites all over the country—primarily in the Northeast, not so much in the Western States—but you can see the grid here of where these sites are, and it is dangerous.

So the plan that you have outlined, I just want to say, I think reduces risk, bolsters our energy security through promoting this nuclear renaissance, as well as answering a real immediate threat to our national security today.

Now, my second question is, this report that has caused a lot of consternation, which has come out about technical defects in the plan, I understand that it was looking at sort of the next 50 years, 50 to 300 years. There were 293 technical items identified in this report. My question is: Are there any potential show-stoppers that you see in those 293, or how would you describe them to us? Are these things that we should be very concerned about? They are technical in nature, and could you give us a little of your feedback on that?

Secretary ABRAHAM. Senator, you are referring, I think, to the 293 agreements, or work, that must be done prior to finishing the license application preparation process. Some have tried to characterize these as defects. They are not. Rather, they are really a checklist items which have been agreed to by the Nuclear Regulatory Commission and the Department of Energy as steps that remain to be done before the application is finished. I do not want to try to do a direct comparison, but we all at different points in our life participated in applying for things, whether it is admission to college, or graduate school, or other similar items. There are a lot of things that you have to provide. They are not automatically in the hands of the people to whom the application must go. It is the responsibility of the preparer to compile those, and we believe that we are in a position to do that.

First of all, the 293 number, which came out some time ago, has already been substantially reduced. Forty-one of the agreements are now completed to the satisfaction of the NRC, which means the number is now 252. We believe by September 30 of this year, a full third of these will be done, bringing the number down to about 200, and we are confident that the remainder are going to be addressed by December, 2004, when we expect to submit the license.

Fifty-three percent of all of these relate to just simply providing documentation that already exists or is in a process of being revised to be appropriate for submission. So these are not showstoppers. These are technical steps that need to be taken on the way to licensing. Just to put one last point on the record here, the Nuclear Regulatory Commission has provided us with a sufficiency letter, the kind of document that indicates that they believe we have met already the sorts of standards that would cause us to move towards this licensing process. They stated that existing and planned work, upon completion, would be sufficient for inclusion in a repository license application.

I mean the choice we would have—to somehow do all of this work before we would even submit a license—is simply not contemplated in the statute. This work is simply part of the process. Actually, we have done quite a bit more, I think, in terms of preparation already than the preparation that is done for the normal licensing of a facility.

Senator LANDRIEU. Mr. Chairman, let me just close with just a one-minute summary. I think the evidence and the testimony suggest that there have been very rigorous scientific and peer review studies that indicate that this is potentially at least the best site in the United States today. The people in Louisiana have already paid $253 million, through additions to utility bills, to build and invest in this site.

It is not just the nuclear energy industry that is at stake, and its future, but it is the security of this nation. Again, in Louisiana, we have three sites, well we have two, but right across the line in Mississippi, we say our sister State, they have three sites. These are very dangerous sites. There is nothing to say that a terrorist could not slam a mortar shell or crash a small plane into one of the 131, of which three I have just cited. Forget trying to sabotage a nuclear facility. It is these dangerous sites. This material is all over the Nation.

I would say that it is in our security to try to move it to a very secure place environmentally, and otherwise, and the faster we get about doing it, I think the better. I just wanted to add that to the record. I am very sensitive to any environmental considerations, but there are compelling national security reasons, as well as energy security reasons, why we should move this process forward. Thank you.

The CHAIRMAN. Thank you.

Senator Hagel.

Senator HAGEL. Mr. Chairman, thank you.

Mr. Secretary, we appreciate you being here this morning, and thanks for your leadership, and that of your colleagues over at the Department of Energy. These are elusive issues that we deal with,

and I would build onto what my colleagues from Louisiana and Colorado have noted, and add one additional observation.

We do not live in a risk-free society. If, in fact, we have the expectations, and standards, and values that we do, that we think are important in this country, to grow our economy, and provide opportunities in a more just and better world, for not just America, but for all the world, then that requires some risk.

None of us today, I suspect, certainly, I do not believe the Secretary is stating this, or implying this, that he can unequivocally state that there is no risk in the transportation of radioactive materials, or in any other part dynamic of this equation. That is as it is, and I suppose we could go back to the time of the loincloth and spears and find less risk in society.

I also note what my colleague from Colorado said about the moral decision here. Well, I would ask the next question, is it more moral to defer this decision, as essentially we continue to do, and leave it to the next generation? Does the world get safer? Is there less risk in 20 years? I do not think so.

The fact is, we must step up to this tough, difficult decision, and I think the 20 years of very intense scientific studies that have gone into this is as sophisticated and complete as any other project in the history of this country, and the Secretary has noted some of the other projects that were rather significant to the future of mankind that took far less time in achieving an objective that what we are today.

When my friend and colleague from Nevada, Senator Ensign, came to see me the other day, he brought up a good point, and I want to ask this question based on Senator Ensign's question to me, and the point he made about the development of alternative spent-fuel management strategies, which you are familiar with, Mr. Secretary. I am speaking specifically of the reprocessing and transmutation technology that is ongoing, developing, and I understand that the Energy Department has put more money back into the budget, which originally my understanding was that it had been zeroed out for this.

The Senator from Nevada makes, I think, a good point. Why not wait until this is developed further, and, therefore, we would minimize the risk of moving, certainly, the intensity of the radioactivity of the material? That is a question I have for you.

The second question, Mr. Secretary, is: What are the consequences, if, in fact, this body, the U.S. Senate, would further delay this decision by sustaining the Nevada governor's veto? Two questions. Thank you.

Secretary ABRAHAM. Thank you, Senator. The first answer is this: Obviously, the Department of Energy engages in research on new technologies and possible alternative ways to deal with nuclear waste, transmutation being one of the issues that has had a lot of attention lately, but the challenge we have is this, that all of the alternative processes which we can foresee today create byproducts themselves that still require disposal someway, somehow—in a repository, in our judgment—to ensure the protection of public health and safety. So that is the challenge, and I will not even get into issues of cost, as well as uncertainty.

As far as the decision not to move ahead, as I have said here before, there are a variety of implications on national security, on the environment, on energy security that are quite clear. I believe that deciding to kill the project—at least now as we are up to the point of allowing a licensing process to occur, and providing for the consideration by the NRC—brings to a halt any immediate issue as to dealing with nuclear waste. That will have an implication, I think, on investment in and the potential for nuclear energy to remain a 20 percent provider of fuel for electricity generation. That has a lot of implications in terms of how we might alternatively provide that level of electricity generation.

Second, it has an implication on the issue of national security. As I mentioned, our naval reactors program is dependent upon ultimately being able to dispose of the waste from the propulsion systems. Right now, the State of Idaho is under a temporary agreement providing a location for that, but the State of Idaho expected that we would dispose of that at some point in this fashion, and I think that it is hard to tell what would be the continuity of that program.

I mentioned the non-proliferation programs, which are directly affected by our ability to dispose of plutonium through the conversion of it to MO_X. This process creates a byproduct that has to go somewhere, and we have already found that the Governor of South Carolina, and people of that State are very concerned about having a pathway out of South Carolina for the byproducts of the plutonium disposition that we might conduct there.

So there are all of those factors, as well as the issue I have raised before, and that is, I think people will engage in their own self-help efforts. Right now, the waste is at 131 sites. A lot of them are near major cities, on important waterways, and the communities that are affected directly do not want the waste to stay there, and they thought they had been paying all this money into our Federal treasury to get it out of there by the beginning of 1998. That has not happened. It will at least be 12 years late.

So I do think you are going to have alternatives develop of the sort that have already begun, and I do not think that is even the most prudent or safe way to deal with it. So I think those are the kinds of implications.

Senator HAGEL. Thank you.

The CHAIRMAN. Thank you.

Senator Craig.

Senator CRAIG. Mr. Chairman, thank you very much.

Mr. Secretary, when the decision that you proposed to the President came about I was making an effort to contact you for a variety of other reasons, and I know that you sequestered yourself, and spent a good deal of time studying this issue. You had had exposure to it as a Senator. I do not think you had had the need to understand it in the depth that you have gained, and I appreciate that a great deal.

I say that as somebody who does know a bit about it, and has dealt with this issue in a positive and negative sense for a long time, and I do not mean just Yucca Mountain. I mean spent fuel, and waste, and materials. While I am not cavalier at all about nuclear waste, high-level waste, I think you develop a level of prag-

matism, because you understand the extreme measures this country has gone through historically to protect human safety, once we got through the learning curve in the very early days, and, therefore, built, in extraordinary ways, the materials, the equipment, the shields, and the containers in which high-level waste is trafficked, and as a result of that, we have, as you have noted, a phenomenal record of safety.

Just recently, in my colleague's State of Wyoming, a truck left the road because of a wind storm, and it had waste on it. They picked it up, and put it back on the truck, and left. Why? Because the integrity of the containers was so substantial that there was no problem. While none of us like to see that, the reality is now, with the Tru-Pak situation, that we are moving transuranic waste out of Idaho to Carlsbad, it is a phenomenal track record.

I invite my colleagues to come and see it, and to understand it, and to watch the GPS trafficking, and to know where those trucks are at every moment of their movement is something to be seen and understood, not feared, because if the public knew of the amount of trafficking of high-level waste today around the country, I do not know that they would be alarmed, I think they would be very surprised to find out that this has gone on for decades in phenomenally safe and secure ways.

My colleague from Colorado has a right to be concerned. We have moved a good deal of waste out of his State to Idaho and to other places over the last good number of years. Ironically, now that we are using Tru-Pak, we are not saddling it all up in 50-gallon drums, and throwing tarps over it, and wrapping bungee cords around it, and heading out, and that is how a good deal of waste left his State over the years, but we do that much differently today than we have in the past, and we understand the concern of the public, and rightfully so, and I think that is responsible.

I have some letters in response to an article in *Science Magazine* that I will ask unanimous consent, Mr. Chairman, that they become a part of the record.* Senator Murkowski has asked that they become a part of the record.

The CHAIRMAN. They will be included in the record.

Senator CRAIG. Many of us have been to the WIPP facility at Carlsbad. We know that is low-level transuranic waste, a perfect example of what has gone on, and I will give this information to my colleague from Colorado, because it is very important that we understand the scope and the magnitude of what we are dealing with here, but Rocky Flats environmental/technological site, we have moved 499 shipments, and that is 395,412 road miles, from Colorado, out to New Mexico, to my knowledge, not one incident, and that is because of the great concern that we have today about how these issues get handled.

To deal with the high-level waste issue, and to deal with a permanent repository that takes us down the road further, remember, as I said, in my statement, and you said so clearly, Mr. Secretary, this is the next step in the licensing process. We are passing judgment on your findings to see if we can move it the next step.

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*The letters have been retained in committee files.

If we do not go to the next step, and if we do not develop a repository, you have spoken some to the environmental management program at DOE, and how we handle INEEL waste in Hanford, and, of course, we have the Savannah River issues. Where do we go from here, if we do not go where we appear to be headed at the moment?

Secretary ABRAHAM. Well, I cannot answer that question, because it is the case that the statutes bring this process to an end, if Congress were to not act to override the veto of the State of Nevada, and so it would be left, I think, for the Executive Branch and the Legislative Branch to have to begin at square one, trying to decide if there is some other process, approach, et cetera, that could be used.

Given the duration that has been involved in getting to this point, I do not expect, I would not at least anticipate that that resolution would happen very swiftly, but all of the implications I mentioned in commenting on this to Senator Hagel would, of course, come into play. Failure to override just simply ends the Yucca Mountain project. It does not, however, eliminate the Government's responsibility, from the Nuclear Waste Policy Act, to accept statutory responsibility for the waste. So it is not a situation where people will be essentially left to fend for themselves, it means that we would have to determine what the Government will do in the face of having collected billions of dollars for the purpose of the disposition of this waste.

Senator CRAIG. Well, many of my questions have been alluded to or responded to in some form. Let me move to the concern that my colleague from Nevada has, and it is rightfully so for him to express and question why we cannot do something else.

In light of the current level of high-level materials that are out there now that would ultimately seek final disposition at Yucca Mountain, both commercial and public, and the ongoing generation of waste at this time, we have not just accumulated a volume and stocked, we have an ongoing process here of waste accumulation, because of that 20-plus percent of our energy that is generated by nuclear and an anticipation, I hope, on my part, and a good many others, that in a cleaner environment and a concern on climate change, and all that, we are going to have a new reactor design, and new concepts out there that will generate high-level waste.

Is it not true that while we search for new technologies, and ways of applying it, and you are correct to say waste streams occur as a result of these new technologies, or applications, to reduce the overall waste, and if we create reactors that burn more efficiently, and, therefore, leave less waste or less material to be processed, while we may diminish the waste stream, a waste stream will be there, and with the volume we have now, it is at least my reaction, and see if I am not right, Mr. Secretary, that with the volume we have now, and the intent that a large portion of that will go to Yucca Mountain, there is still clearly a need to do what the Senator from Nevada is doing, so that another Yucca Mountain, or another repository, at some time in the future, will certainly—we need to lessen the need for that by new applications.

Secretary ABRAHAM. Well, it is hard to prophesy what new technologies could be. We have a waste disposition problem before us

today. I do not see a transition to the kind of alternatives anybody has talked about in the near future, because of a variety of issues. We have not built a new nuclear facility in this country in about 30 years, so the notion that we would engage in the construction of an as yet developed scientific alternative, whether it is a reprocessing, or a transmutation system, anywhere in the foreseeable future, to me, is extraordinarily unlikely.

Clearly, even if we did, as I mentioned before, there will be waste as a byproduct of that, and so it still calls for the need to move forward at this time. Again, the speculation that has taken place over a long period of time on alternatives has yet to yield one that I think this country is even remotely close to considering, or that science is close to endorsing at a level that comes even near the kind of safety endorsement that I believe we can provide here.

Senator CRAIG. Last question, Mr. Chairman, and thank you for your tolerance. We have on the table before us a model of a fuel assembly. I think a lot of folks have been sitting out there saying, "What is that sitting there?" That is what would be transported to Yucca Mountain, and stored.

I think there are myths and there are realities, there are illusions, and there are facts, as it relates to this issue. Those would be transported in containers, and then, of course, the container that is being developed now, which would be considerably more substantial to meet these 10,000-year tests, as such, but I think what is important for me to understand, is that items like that do not go boom. Items like this do not explode. They radiate. They have some heat, but they do not go critical, and we understand that, and the scientists understand that, and that is what is important as we deal with these issues.

These kinds of items transported, even if the truck were to leave the road, and they remained in their container, and they were jostled around, do not go critical, meaning explode, because that is the character of them, and it is important, I think, for us to understand that. Is that not your understanding, Mr. Secretary, and that is what we are looking at here in this item?

Secretary ABRAHAM. Obviously, in the environmental impact statement, and every one of the scientific processes that have already been engaged in, because we have moved the exact type of thing that we are proposing to move to Yucca Mountain in the past, evaluations of safety have been extensive, and you are correct in the conclusion, the issue of harmful radiation exposure is one that we take at the highest, most serious level. We have an unblemished 30-year track record of being able to move this material. The issue is not one of explosions of this material, as it is in a nonexplosive state. But we do not just consider explosiveness; we also consider whether or not we can package this in a fashion that protects the public from any kind of exposure, should there be any kind of incident.

Senator CRAIG. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Thomas.

Senator THOMAS. Thank you, Mr. Chairman.

Thank you, Mr. Secretary. I think you have covered this very well, and I appreciate it. I will be rather quick.

First of all, it is my understanding that the South Carolina concern was not so much on transportation as it was simply on the timely processing issue, and transportation really is not the issue, but the State of South Carolina's concerns have been whether or not there was a pathway for the materials that came into the State to leave, and the commitment of both Congress as well as the Executive Branch are making sure that the things that we indicated would happen, in terms of building facilities to dispose of the plutonium would happen.

I have heard, of course, and I understand the concerns, some of Nevada's concerns. One, they said they have not had an opportunity to be heard. How do you react to act?

Secretary ABRAHAM. I am sorry?

Senator THOMAS. Nevada sometimes indicates they have not had the opportunity to be heard in this decision.

Secretary ABRAHAM. Well, we conducted an extensive number of hearings. Somewhere in here I think I have the total number. But as we have moved ahead with this process, there have been a variety of stages in which public comment and public hearings were available. The total number of hearings that I think have been conducted—we have had 198 days of comment periods, just on the site recommendation. We have had 66 hearings in Nevada over a 4-month period, including 1,419 witnesses, and 605 comments received. So there have been extensive public opportunities for participation in the process just in this set of final stages, as well as participation in other stages, as well as various reports and preliminary actions were subjected to public comment.

Senator THOMAS. I see. There is also an allegation that the siting guidelines were changed to make it possible for Yucca Mountain to meet them. How do you react to that?

Secretary ABRAHAM. Well, I find this frustrating, because the changes that took place were changes brought about because in 1992 Congress changed the way that this process should be conducted. It changed the standards that were to be applied. The Environmental Protection Agency and the Nuclear Regulatory Commission responded to those changes in the 1992 act, and we obviously had to change in response to that as well.

It is a little bit frustrating, because the purpose of our changes was to make our regulations consistent with the new congressionally directed EPA standards and Nuclear Regulatory regulations. So that is the reason. The implication that this was done to somehow make this work just is wrong. It was because we had to meet a different standard that was put in motion by Congress's actions in 1992.

Senator THOMAS. Assuming we go forward, as I hope we will, what is necessary now before the Department and the administration makes a final recommendation?

Secretary ABRAHAM. Well, actually, that process has occurred. We have made the recommendation. Now, it is Congress's decision whether or not to move this process ahead to licensing, which would be the next stage. So as I have said from the beginning, the issue is: Do we end the whole process now, because that, in effect,

is what happens if the Nevada veto stands, or do we give it to the NRC—I mean there has been, obviously—there are two Senators here from Nevada, and they and others have criticisms about the science, and they called into question a variety of issues, which will have been debated at great length.

There are two cases here. The case we make is that this is, in fact, a suitable site that will protect the safety and meet the standards. And then there is the argument that it will not. My view is that it would be in the interest of the American people to let the objective decision-making process of the licensing of the facility by the Nuclear Regulatory Commission be a final decision.

We believe—I strongly believe the recommendation that the site is suitable is the correct one, but I am willing to subject that analysis to the experts of the NRC. I hope the other side would be the same way. If they think they are right, then this is the appropriate venue in which to have an ultimate decision made.

Senator THOMAS. Some of the broad decisions, such as transportation, I have even heard that they would have an effect on the economy of Las Vegas. This has been going on for 24 years, is that not right? We have spent over $4 billion so far.

Secretary ABRAHAM. Well, I think that in 1987, the specific decision to focus on the site in Nevada was finalized by Congress, and that has been 15 years. So in 15 years, the specific and only work has been done towards determining whether or not Yucca Mountain is suitable.

Senator THOMAS. I see. Well, I just feel very strongly. As has already been expressed to you, we have a problem. We have a situation. We have to find a solution, and this appears to be the best solution before us. So thank you very much for your work.

And thank you, Mr. Chairman.

Senator REID. Mr. Chairman, for the information of the members, we should have a vote about 11 o'clock.

The CHAIRMAN. All right. Senator Domenici.

Senator DOMENICI. Thank you.

Mr. Secretary, I think you know that I have been concerned that we need to be doing research today to enable better utilization in the future of the large amount of energy that remains behind as spent fuel, and furthermore, technologies that would provide better energy recovery, and also allow us to reduce the toxicity of final waste products.

Since the existing powerplants, even if we add no more, will fill Yucca Mountain, we obviously need to have better approaches to spent fuel management a lot more than just a Yucca Mountain. I think we should be studying those better principles.

This was strongly supported in the President's national energy policy. I saw it there as something he wanted to get done, but I was disappointed that the DOE budget request for 2003 effectively provided no resources for the research projects on this topic, even though they had been started last year by Congress. Can you discuss the interest of the Department, and your thoughts on this particular approach to waste?

Secretary ABRAHAM. You know, I said before, and recently in a speech expressed that the views in our energy policy about the need for more research in this area remain intact. I do not think—

and I think the budget was a reflection of the concern—that it makes as much sense to invest this level of money in some of these programs if we do not resolve this issue of Yucca Mountain first, because in my judgment, if there is not much of a future for nuclear energy—because we are not going to deal with this waste, or if there is a decision in the other direction—that should, I think, have some impact on the level of research that we would conduct. But I appreciate the concerns you and I have talked about before, and we are not shutting the door on that type of research in the future.

Senator DOMENICI. Mr. Secretary—and these are just my last observations—I want to congratulate you on the efforts you have made in working with Russia in your short term as the Secretary. It is clear that they have a completely different view of nuclear power and spent fuel than we do. They actually think the spent fuel rods are the residue of the legacy of the Cold War, if there is one, and they think it is very valuable, because they want to use it.

So we are working with them, because we want to get the waste products, like plutonium and others, out of the marketplace, and I think we are going to succeed in doing some really major things in this area. And it will probably change the opinion of many people with reference to nuclear waste and nuclear policy, once they get going and we cooperate with them. So I commend you for that, and I also, on this one, commend you for your courage. It is time we move on, vote, and decide what America is going to do about this. Thank you very much.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Reid.

Senator REID. Thank you very much, Mr. Chairman.

Secretary Abraham, the changes about which you spoke in 1992 related only to the NRC and EPA, and not DOE. Are you aware of that?

Secretary ABRAHAM. Well, the changes that were set in motion——

Senator REID. Answer that question. They were not directed to DOE; they were directed toward the NRC and the EPA.

Secretary ABRAHAM. Our need is to meet standards that are set by the NRC and the EPA, and so we are governed by what is the level of exposure and the nature of the standards that we were called upon to test. I mean the Energy Policy Act directed the EPA to develop a site-specific standard, which changed the mechanism by which we would be evaluated. Obviously, we had to change, therefore——

Senator REID. We have a vote coming up real soon, and you understand, having been a Senator, that we have to leave when the vote occurs.

Secretary ABRAHAM. I remember actually waiting for witnesses to answer that sometimes went too long, so I will do my best to keep that perspective as well.

Senator REID. I feel, Secretary Abraham—I know of your academic background. You are a very smart man. You are a graduate of Harvard Law School. I think one of the problems, and I am just

speaking for myself, is that we get answers just like the one you gave me, and you do that very well. You do not answer the questions.

For example, you talk about environmental need to move this waste to Yucca Mountain. I am sure you are aware that there are 500 local environmental groups, 49 national environmental groups who all oppose everything that you are doing regarding nuclear waste. Are you aware of that?

Secretary ABRAHAM. I am aware that there are strong opinions on both sides of the issue, Senator, but in my judgment, leaving this waste in temporary storage facilities all over the country, and particularly at the sites in the Department of Energy's complex——

Senator REID. You see, Secretary Abraham, with all due respect, there is going to be stuff around in those sites anyway. You are not going to leave the stuff. It is going to be there. As you are aware, they are going to continually generate nuclear waste. There are a few sites that are going to be shut down. Of course, we read in the paper this morning that there is a $2 billion project to try to start one up in Alabama.

So those sites—you realize that when you take one of those spent fuel rods out, you cannot move that thing any place for at least 5 years. It has to stay in a cooling pond for 5 years. So those places are still going to be there, and to say, again, with deep respect that I have for you and the office you hold, there is not necessarily going to be this mass transportation that is going to take place anyway, because you know that there are scientists who say "Leave it where it is in dry cast storage containers."

I am working with Senators Clinton and Lieberman, and others, to make sure that those sites where we generate nuclear waste, but also generate nuclear power, are safe. We have real concerns—significant members of the Congress, House and Senate—about the safety of those facilities, and we believe that they can be made safer, and that leaving these containers where they are, in either underground or above-ground storage, would be certainly safer than trying to move them around.

I will also say, Mr. Secretary, you talked about the shipment of waste around Europe, nuclear waste. You, of course, are aware that they have tried to move stuff in Europe on a number of occasions. People tie themselves to railroad tracks, chain themselves to railroad tracks. In fact, Germany has just given up on it. In fact, Germany has scrapped their nuclear waste repository program, because they cannot move the waste. That is a fact.

The Department of Energy has spent—now I will ask you a question, rather than giving one of those Senatorial speeches of which you are so familiar. I want to make sure that Senator Ensign has time to ask his questions. The Department of Energy has spent billions of dollars studying the Yucca Mountain. I have heard $4 billion around here today. I think it is closer to $7 billion, as you are aware.

How much of that has been spent on transportation? You may not know the breakdown today, but would you get that back to us very quickly?

Secretary ABRAHAM. I will, and I note that it was one of the major components of the EIS, the Environmental Impact Statement's preparation, so I will get that for the record.

[The information follows:]

TRANSPORTATION COSTS

From fiscal year 1983 to 2000, the Office of Civilian Radioactive Waste Management has spent $268 million on transportation and development of transportation casks. This information is from the enclosed report *Monthly Summary of Program Financial and Budget Information, as of August 31, 2001,* page A-3, items Engineering Development (a) and Transportation System.*

Senator REID. I would also, in providing that number, if you would also provide us with any and all documents or memos produced by the DOE on the transportation of any kind of hazardous waste, I would really appreciate that, too. That should be in some of the work that you have done.

Secretary ABRAHAM. I would be glad to.

[The information follows:]

TRANSPORTATION OF HAZARDOUS WASTE DOCUMENTS

I have enclosed three documents that respond to your request for Department of Energy (DOE) documents or memos produced on the transportation of hazardous waste. The DOE brochure *Spent Nuclear Fuel Transportation* includes a chart (page 10) on hazardous materials. The chart references a U.S. Department of Transportation document, *Hazardous Materials Shipments,* that is also enclosed. Also enclosed are slides detailing DOE shipments of hazardous materials, both radioactive and nonradioactive.**

Senator REID. I would say, Mr. Secretary, that it is really not—and I think this is some of your Harvard logic, but we have to sort right through that. The fact that they have transported 3 million tons of hazardous waste has nothing to do with the transportation of the nuclear waste. Hazardous substances, we know that that could be a gown that somebody wore when they were doing an X-ray, or having an X-ray taken. I mean it is really minimal stuff.

Hazardous waste has a very low threshold. Some of it is more dangerous than others when you get into some of the caustic acids and stuff that are hauled around, but you add all those together, the 3 million tons of hazardous waste together, it would not have nearly the punch of one truckload of nuclear waste.

There is a group of scientists who have no dog in the fight, who said that one truckload of nuclear waste—that is, spent fuel canisters—would have 240 times the radioactivity of the bomb that was dropped in Hiroshima, and we know that a shoulder-fired weapon will pierce one of those canisters. So I just think your example about 3 million tons of hazardous waste is not well taken.

We are going to have a vote very shortly, and so if—I would stop, so Senator Ensign would have some time.

The CHAIRMAN. Senator Ensign.

Senator ENSIGN. Thank you, Mr. Chairman. I want to go back to this—because you have made a big deal of it in the press, I want to go back to this, you know, 131 sites versus one site. Senator Landrieu had talked about that.

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*The report has been retained in committee files.

**All enclosures have been retained in committee files.

Senator Craig, you have talked about that it is going to go forward, you know, transportation is going to go forward no matter what.

When we start Yucca Mountain, when Yucca Mountain starts, what are the estimates that you have, as far as the number of tons of nuclear waste that would be in the country, already produced?

Secretary ABRAHAM. There is about 45,000, I think, today, if we are—you know, 10 years down the road, that is another 20,000.

Senator ENSIGN. Okay. About 65,000, thereabouts. It will take what, about 5 years to get the shipments up to what the DOE estimates are, approximately?

Secretary ABRAHAM. Yes. I mean we have estimated—I mean we have used a conservative estimate in terms of the amount going to Yucca Mountain of 3,000 tons per year.

Senator ENSIGN. And we produce 2,000 a year.

Secretary ABRAHAM. That is a function, though, of a variety of factors, of which the least of which is congressional decisions as to how much appropriation—you can move more potentially, if you——

Senator ENSIGN. The bottom line, though, is your estimates are 3,000—you start with 65,000 tons. How many years does that get us to get to the waste to Yucca Mountain?

Secretary ABRAHAM. Well, you know that it is about a 70,000 metric ton facility. So it is about 23 years, I guess.

Senator ENSIGN. Wait a second. We are shipping 3,000 a year. We produce 2,000 a year. That is a net shipping of 1,000 a year.

Secretary ABRAHAM. Well, you asked how long to fill the facility, and the answer is——

Senator ENSIGN. I did not say fill. I said ship all the stuff that we are going to have. Okay? We produce 3,000 a year, or 2,000 a year, we ship 3,000 a year. That means we are netting out, from what we have around the country, going to Yucca Mountain, about 1,000 a year.

Secretary ABRAHAM. At the end of 23 years, we will have 70,000 at Yucca Mountain. That is correct.

Senator ENSIGN. Mr. Secretary, just follow me here.

Mr. Abraham. Okay. I am trying.

Senator ENSIGN. You produce 2,000 a year.

Secretary ABRAHAM. Right.

Senator ENSIGN. Okay? You ship 3,000 a year. You start with 65,000 metric tons of this stuff. Okay? Around the country, you have 65,000 metric tons, and you are producing an additional 2,000 a year.

Secretary ABRAHAM. Right.

Senator ENSIGN. But if you are only shipping 3,000 a year, that means that your net taking from around the country to Yucca Mountain is about 1,000.

Secretary ABRAHAM. What it means, by my calculation, is that at the end of 23 years, you will have 70,000 in Yucca Mountain, instead of the different sites around the country. That is the bottom line. There will be 70,000 metric tons that will not be at these——

Senator ENSIGN. Yes, I agree with that.

Secretary ABRAHAM [continuing]. Temporary sites——

Senator ENSIGN. I agree with that.

Secretary ABRAHAM [continuing]. Of 131 facilities.

Senator ENSIGN. Mr. Secretary, I agree with that. The point I am trying to make is, there still will be all this nuclear waste——

Secretary ABRAHAM. We will be producing more, and there is——

Senator ENSIGN. Not only that. Not only producing more, there will still be nuclear waste all over the country for many, many decades to come.

Secretary ABRAHAM. Right. I would predict two things: First, that, yes, there will be, and that it will be at more sites than we have today, because a lot of the current sites will decide they should move off-site the waste that is currently stored there. So instead of 131 sites, you are going to have it at more sites if we do not move ahead and——

Senator ENSIGN. But the bottom line is: We are not going to just have one site, and that is what you have—kind of what you have led people to believe, is we are going to have one site. This stuff is going to be around, so there are still going to be a lot of targets out there.

You have talked about national security, that it would be safer to have it at one site. Well, if you could scoop it all up and have it at one site, I would agree with you, but it is not going to be that way. We are going to have it at sites around the country. I do not mean to be combative here. I just want to make sure that we fully understand——

Secretary ABRAHAM. I appreciate your concern.

Senator ENSIGN [continuing]. That there are many sites, and there will continue to be many sites. As Senator Reid pointed out, it takes at least 5 to 10 years to cool in the cooling pond.

Secretary ABRAHAM. But, Senator, as you know, we have a number of decommissioned sites right now.

Senator ENSIGN. And I agree with that.

Secretary ABRAHAM. If we move it from there, those will be done, instead of the current situation——

Senator ENSIGN. Decommissioned sites, I think you have a point there.

Secretary ABRAHAM. Also, at the Department of Energy sites, where we are hoping to close the site, we will be able to do that, if we have Yucca Mountain, but now——

Senator ENSIGN. Okay. I want to get to the transportation, because—there is no question that there will be many, many sites out there, and not just one site.

To get to the transportation issues: The transportation of nuclear waste, when you transport it, you cannot surround it with as much concrete, obviously, because of the weight factors, as when you store it on-site. These canisters that are going to surround these things, you can surround them with more concrete than you can when you transport them.

Secretary ABRAHAM. Well——

Senator ENSIGN. Yes? It is obvious.

Secretary ABRAHAM. That would seem obvious, yes.

Senator ENSIGN. Okay. The point is that when you transport them, you do subject them—you have seen or I am sure you have seen the video of the Toe Missile breaching one of these things——

Secretary ABRAHAM. Right.

Senator ENSIGN [continuing]. And they said——

Secretary ABRAHAM. Let me point out to the Senator that the TOW Missile was not breaching a transportation cask, but one of the permanent storage casks.

Senator ENSIGN. Correct, but there have not been studies done on the transportation cask, correct?

Secretary ABRAHAM. But the point is: You are recommending we would keep these in storage at the current sites, and it was, in fact, one of those casks that got penetrated by a TOW Missile.

Senator ENSIGN. But not with the concrete surrounding it.

Secretary ABRAHAM. Well, we have not tested that, but you raised the issue of a cask being penetrated.

Senator ENSIGN. But you have——

Secretary ABRAHAM. That is not the kind of cask we are talking about. It is the one you are talking about——

Senator ENSIGN. The point is: Why move forward when we have not studied some of these things? This is what we are talking about here.

Secretary ABRAHAM. We are not going to transport these, except in Nuclear Regulatory Commission certified transportation casks. I mean we are not going to just put them in garbage cans and move them across the country. We have done it here and in Europe without any harmful radiation exposure over the last 30 years.

Senator ENSIGN. Mr. Secretary, the point that we are trying to make is this: First of all, dry cask storage, according to the DOE, is safe for a hundred years. These containers are safe for a hundred years. If they are not safe, then we have a major problem in the country, and I agree, we need to make them even more safe than they are today.

But the point is that they can store this stuff, according to the DOE, for a hundred years. The bottom line is: We have time to study transportation in a better way than we have today. There is no hurry.

Yucca Mountain is, what, $58 billion, according to the latest estimates, $57 billion to $58 billion? Okay? The 1995 estimate, it was, what, $30-something-billion? And then the 1998 estimate, it was $48 billion, $47 billion. Now, the 2001 estimate, it is up to $58 billion, and the DOE has said that is not even the final number.

Secretary ABRAHAM. Senator, the rule changes that continue to take place, that we have had to adjust——

Senator ENSIGN. There would be——

Secretary ABRAHAM [continuing]. To have been a major factor in that change.

Senator ENSIGN. The bottom line is: It is incredibly expensive. That is the same amount of money as all 12 of our aircraft carriers combined. It is a huge amount of money.

Secretary ABRAHAM. It is an expensive process and the American ratepayers have already been and will continue to be paying for it.

Senator ENSIGN. But they will not pay enough to pay for Yucca Mountain at those costs.

Secretary ABRAHAM. We believe that at this point that our actuarial tables suggest that the monies being spent will, in fact, meet the current projected costs.

Senator ENSIGN. By what year?

Secretary ABRAHAM. I am not sure. I will have to get that——

Senator ENSIGN. Could you get that number for us?

Secretary ABRAHAM. I will be glad to.

[The information follows:]

FEE ADEQUACY ANALYSES

DOE's most recent fee adequacy analyses (and all previous analyses) have indicated that the current fee is adequate to fully fund the planned waste disposal program. I have enclosed two documents to support this conclusion: *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program* and *Nuclear Waste Fund Fee Adequacy: An Assessment,* both dated May 2001.*

Tables 4 and 5 in the *Nuclear Waste Fund Fee Adequacy: An Assessment* show that the fund balance at the end of waste emplacement in 2042 ranges from $9.1 billion to $45.6 billion in constant 2000 dollars for two different economic assumptions. These balances in 2042 exceed the target, which would provide a sinking fund for monitoring and closure of the repository.

Senator ENSIGN. Get that number for us. The point that we are trying to make is, one, that the dry cask containers are good for a hundred years; and, number two, why risk the transportation when we have not completely and fully studied the transportation? And because there is no hurry to go forward with Yucca Mountain, if dry cask storage is good and safe for a hundred years, do not risk the transportation; let us take some of the money and invest it in what Senator Domenici is talking about. Instead of building Yucca Mountain, take some of that nuclear waste trust fund money and put it into the recycling technology.

We do not know whether it is going to work or not, but we have time. If we have a hundred years, what is the hurry? I would suggest to you that the DOE has been very, very biased in its view towards Yucca Mountain, and the reason that I would say that, I would point it out, obviously, you, in earlier testimony, said that there was not—you do not know what you are going to do if we do not go forward with Yucca Mountain. We do not know what we are going to do.

Well, to not have plan B in place, or at least be thinking of plan B, I think is irresponsible for the DOE. That indicates to me that, what if Yucca Mountain would have proved not suitable? That means DOE has said, you know what, we are putting all of our eggs in one basket. That proves to me that the Department of Energy has completely tunnel visioned toward Yucca Mountain, because you do not even have plan B put into place if it is deemed unsuitable.

Secretary ABRAHAM. Well, I would be glad to answer and comment on each of those. First of all, with regard to the bias of the Department, I do not believe that to be the case. I have met with and talked to many of the people who participated in the research on this, and I believe them to have been fair and objective. However, I am willing to subject the decision we have made to the Nuclear Regulatory Commission's objective, neutral experts. If you are right, and we are wrong, then you should be willing to do that as well.

Second, as far as having a backup plan, the Congress has not authorized us to do so. We, instead, have been limited very carefully,

* The enclosures have been retained in committee files.

in terms of the appropriations we have received, to do one thing, and that is to determine the suitability of this site as a repository for the nuclear waste.

Now, if Congress wanted to have alternative plans, they could have funded them, they could have given the guidance to do so. They did not.

With respect to the issue of dry cask storage, the fact that we might be able to develop a dry cask that can become for a hundred years sufficient to protect the material is not the issue. The issue is, is there room at the current facilities for this elaborate building process, and this additional amount of waste that would be developed there over the next hundred years.

Senator ENSIGN. Is that a scientific problem or just a political problem?

Secretary ABRAHAM. It is a physical problem at some of the facilities. There is not enough room for it.

Senator ENSIGN. You just have to build a bigger concrete pad.

Secretary ABRAHAM. Well, in some facilities, they are going to run out of space altogether, and that does not even take into account the issues of regional decisions as to whether or not people want this——

Senator ENSIGN. That is politics.

Secretary ABRAHAM [continuing]. At those local facilities. So what you will get, as I have said already, is the transportation of the waste to some new off-site location. Whether it is in Utah, or it is in Nevada, or someplace else, I do not know, but what I would point out is this, we have not done, nor have you, the research to study the various 131 facilities to determine any of the kinds of considerations, as far as seismology, volcanic activity, or anything else.

We are being told we have not done enough research, after $4 billion, to move it to Yucca Mountain. There has been virtually no research done as to the physical situation at the 131 sites to just leave it there in a slightly harder container. But in my judgment——

Senator ENSIGN. Does that mean that they are unsafe now?

Secretary ABRAHAM. Pardon?

Senator ENSIGN. Does that mean that they are unsafe now?

Secretary ABRAHAM. I have not done the research as to its feasibility for a hundred years. It is safe today.

Senator ENSIGN. Is it still going to have waste there?

Secretary ABRAHAM. It is safe today. It will have a lot more waste if we leave it there.

Senator ENSIGN. Okay. But some waste versus a lot more waste, it is still unsafe. If it is unsafe, it is unsafe.

Secretary ABRAHAM. Well, to answer your other point, which is the one that Senator Domenici and others have raised, which you have talked to me about, and I think we have had a good conversation on before, and that is the issue of these alternative technologies, transmutation, and so on. We are, I think, going to continue to research those, but I do not want people to lose sight of a couple of things.

First of all, even if we were to perfect the science to do that, there will have to be facilities developed, and remember, this is in

a Nation which has not sited a nuclear facility in an awfully long time. Those facilities are going to be around the country, and all of this waste is going to have to get to those facilities.

Senator ENSIGN. I agree.

Secretary ABRAHAM. So we will still have a lot of these issues, and we will have a byproduct at the end that needs to be stored in a permanent, in my judgment, underground repository. So that is not, in my judgment, a sufficient——

Senator ENSIGN. Just to clarify that point, though, the scientists that tell me about some of these transmutation issues, and things like that, the nucleotides, the radioactive half-lives of those, would be dramatically reduced, so that licensing a facility, you know, you maybe have hundreds of years, instead of tens of thousands of years of radioactive half-lives. Well, it is much easier to build a facility for hundreds of years than it is for ten thousand years.

Secretary ABRAHAM. I would say, Senator, if the science ultimately confirms that we can move ahead with this, it will be interesting to see what the communities of this country, who have, at least for quite a long time, resisted having new facilities built there, think about it. It may they will be receptive, but even if they are, we are talking about moving an awfully lot of waste to them anyhow.

Senator ENSIGN. Mr. Chairman, I appreciate your indulgence. Just my last comment. I think that the potential is there, and that is our point, is that we do not need to hurry with this thing. We have time. The dry cask storage, I think, affords us this time, and we should be going forward with this research, because I think it is so much better of a potential answer, and if it is not a potential answer, then we will need a permanent repository, but we ought to at least take the time, research it, research the transportation, but let us take our time with this. We have literally decades to do this. We do not need to spend the tens of billions of dollars on Yucca Mountain right now.

Senator REID. Mr. Chairman, as you can see, my prediction of the vote at five-after did not come true.

The CHAIRMAN. We appreciate having your expertise on the timing of these floor votes.

[Laughter.]

Senator REID. Mr. Chairman, I would like to just say this. I appreciate very much your allowing us the ability to come and ask some questions, make some statements regarding Secretary Abraham, and what he is doing, but I hope I did not offend you by all my Harvard talk, because I forgot you were Harvard, also.

The CHAIRMAN. That is quite all right. Quite all right. Let me see if any Senator has additional questions.

Senator CRAIG. Very quickly, Mr. Chairman.

The CHAIRMAN. Senator Craig, then Senator Domenici.

Senator CRAIG. Very quickly, because—I think Senator Ensign has asked an important question about why not a second strategy. In 1987, the Congress of the United States removed that strategy. They directed the Department of Energy to go one path. So it is not the Department of Energy that does not have a second strategy, it was the wisdom of the Congress in 1987, and largely, be-

cause of the mounting costs of a multiple strategy approach. So that is the answer to that question.

Senator ENSIGN. Senator, just briefly, I was making the point not necessarily for a second site, but for a backup of second strategy——

Senator DOMENICI. Dry cask——

Senator ENSIGN. Well, at least studying dry cask storage as an alternative. Is that, in fact, a safe thing, and costing it out on an accurate cost basis, and that kind of thing.

Senator CRAIG. Lastly, Mr. Chairman, while it is arguable that—and I am not about to sit here and say that 131 sites are unsafe today, that is not the issue. The issue is they were temporary by design. From the beginning, they were not permanent sites. They were designed to be temporary, until a permanent site was designed. So the argument that the Secretary makes about the extensive study that went into these sites, study went into them, but for a hundred-year lifetime, not a 10,000-year lifetime. It is important that we understand that they are temporary by definition, and to make them permanent is a wholly different approach that I do not think any of us have contemplated.

Lastly, I look forward to the testimony next week from both the Senators from Nevada, and the Governor. We will be pleased to have them before the committee. I know this is of critical concern to their State, and I say that with great sincerity, because I know how sensitive my State is to the issue of nuclear materials, and how they would be handled. So I look forward to having you here next week to testify.

Secretary ABRAHAM. Thank you.

The CHAIRMAN. Senator Domenici.

Senator DOMENICI. Mr. Chairman, might I first say to the Nevada Senators that we have sitting there in the front row, Dr. Margaret Chu. Frankly, we have never had anyone as qualified in these matters as that professional woman, and we are glad that she is on——

The CHAIRMAN. You're biased. She's from New Mexico.

[Laughter.]

Senator DOMENICI. She worked at Sandia National Laboratories, where she got her education and expertise.

The CHAIRMAN. She has a great education.

Senator DOMENICI. Yes, and she is good, and she will be fair. Mr. Secretary, I believe, and on this round, I want to compliment you with reference to the way you have handled the concerns of the people of Nevada. As a matter of fact, you had an option to select a regulatory standard that was less rigid than the one you chose, and you chose the most rigid protective standard that was before you.

You put the Environmental Protection Agency right in the middle of determining the validity of the regulations. Most people thought you should have used the Nuclear Regulatory Commission, because they know more about it, et cetera, but they were thought to perhaps be a little too much pro-nuclear, so you and the President's other Cabinet member recommended to him that you proceed with the Environmental Protection Agency as the final standard there for this project.

I, frankly, believed when you made that decision that you finished this project, that it was not going to make the standards. I still believe it is so rigid, that it will be extremely difficult to make it. When it is finally challenged in court, it will be a close call, but I think you did that just because of the way you and this administration are. You went as far as you could to be absolutely sure, and I commend you for it.

Senator REID. Mr. Chairman.

The CHAIRMAN. Senator Reid.

Senator REID. With all due respect, my friend, Senator Domenici, that was done, because you had to do it. That was done by statute, as you are aware.

The CHAIRMAN. Had to, and wanted to.

Senator REID. Yes. So, Mr. Chairman, I would also like to say to my friend from Idaho, I appreciate his concern, and I have great respect for him, but I would say that Senator Ensign was not implying, nor am I, that the 134 sites should be permanent repositories. We are saying they should be left for temporary storage, and the dry cask storage containers, of course, are a product everyone recognizes will be safe up to a hundred years.

Anyway, again, thank you very much, Mr. Chairman, for allowing us to mess up your committee.

[Laughter.]

The CHAIRMAN. Thank you very much.

And thank you, Senator Ensign.

And we appreciate you, Mr. Secretary, taking so much time with us. The hearing is adjourned.

[Whereupon, at 11:27 a.m., the hearing was recessed, to be reconvened on May 22, 2002.]

YUCCA MOUNTAIN REPOSITORY DEVELOPMENT

WEDNESDAY, MAY 22, 2002

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES
Washington, DC.

The committee met at 9:30 a.m., in room SH–106, Hart Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. The hearing will come to order. This is the second in the committee's hearings on S.J. Res. 34, which is a joint resolution approving the site at Yucca Mountain, Nevada, for the development of a nuclear waste depository.

Last week we heard from the Secretary of Energy. He explained why the resolution that we introduced at his request should be approved, why he should be allowed to apply to the Nuclear Regulatory Commission for a license to build a repository at Yucca Mountain.

Today we consider the State of Nevada's objections to the repository, and tomorrow we hear from the agencies that have been charged with regulating or overseeing the repository program.

The Nuclear Waste Policy Act gives the Governor of Nevada the power to veto the President's nuclear waste repository site recommendation. Governor Guinn exercised that power on the 8th of April, without objection. His Notice of Disapproval and the statement of reasons accompanying that notice will be included in our record today.*

The committee invited Governor Guinn to testify today, but he was unable to be here. In his absence, the views of the State of Nevada will be presented by a panel of witnesses chosen by the Senators from Nevada, in consultation with Governor Guinn. They are Mr. Robert Halstead, who is the transportation advisor with the Agency for Nuclear Projects in the State of Nevada; Dr. James David Ballard—he's an expert on terrorist tactics related to nuclear waste transportation; Dr. Victor Gilinsky, who is a former member and chair of the Nuclear Regulatory Commission; the Honorable Rocky Anderson, who is the mayor of Salt Lake City, Utah; Mr. Michael Ervin, Sr., vice president of the Peace Officers Association of California; and Dr. Stephen Prescott, who is the executive director of the Huntsman Cancer Institute in Salt Lake City, Utah. In addi-

*The Notice can be found in the appendix.

tion, Mr. Jim Hall, the former chair of the National Transportation Safety Board, will also testify on behalf of Nevada's views, but he was unable to attend today, and we will hear from him at the beginning of tomorrow's hearing.

We have again invited the two Senators from Nevada, Senators Reid and Ensign, to sit with the committee and ask questions, and if they are able to be here this morning, they will be recognized after committee members have the chance to speak or to ask their questions.

Why don't we go ahead and take about 6 minutes, or up to 6 minutes, for each of the witnesses. Your full statements will be included in the record, so that you do not need to just read them into the record. If you could, summarize or identify the main points you think the committee needs to be aware of before we make any decision on this issue. Why don't we start with Mr. Halstead. Thank you very much for being here.

[The prepared statements of Governor Guinn and Senator Reid follow:]

PREPARED STATEMENT OF HON. KENNY C. GUINN, GOVERNOR OF NEVADA

Honorable Mr. Chairman and members of the Committee, my name is Kenny C. Guinn and I am Governor of the State of Nevada. These written comments are submitted for inclusion in the hearing record. The state of Nevada compliments Chairman Bingaman for holding this important hearing and providing an opportunity for every member of the Senate to review in detail an issue of profound national importance—whether to proceed with the development of Yucca Mountain in Nevada as a site for a national nuclear waste repository. This is an issue that will tangibly affect tens of millions of Americans and it is hurtling toward finality in a manner that is premature, unnecessary and ill-conceived.

As is widely known by this time, Nevada considers the Yucca Mountain project to be the product of extremely bad science, extremely bad law, and extremely bad public policy. With regard to Yucca Mountain, each of these elements is strongly negative on its own and when the three are combined, the totality of their weight cannot, and should not, be ignored.This project has failed to meet the scientific criteria established by this very body for a deep geologic repository, it has failed to meet the law in numerous instances and ways, and it would implement an unprecedented public transportation policy that literally puts tens of millions of Americans at risk on a routine basis.

Attached to this statement are three documents: 1) the Notice of Disapproval and an accompanying Statement of Reasons I filed with the U.S. Congress pursuant to Section 116 of the Nuclear Waste Policy Act; 2) a copy of a recent peer review report commissioned by the U.S. Department of Energy (DOE) and conducted for DOE by the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD); and, 3) a copy of an affidavit from John W. Bartlett, DOE's former Director of the Office of Civilian Radioactive Waste Management, outlining his experience overseeing the Yucca Mountain project and his reasons for concluding that the Yucca Mountain site is unsuitable for use as a high-level nuclear waste repository. Please consider these attachments as part of my written testimony to the Committee.

For the reasons stated therein, as supported and augmented by the information in this written testimony, we in Nevada believe that the Senate should take no further action in support of the Yucca Mountain project.

THE IAEA/OECD REPORT ON THE UNSOUND SCIENCE OF YUCCA MOUNTAIN

I would like to call the Committee's attention to a new document, a key document, which recently appeared from within the scientific community that excoriates the scientific work of DOE in connection with Yucca Mountain. Numerous independent scientific reviewers have now evaluated the project during the past year, and all have reached the same conclusion: There is nowhere near enough information to certify the suitability of the Yucca Mountain site for high-level nuclear waste disposal, and the information that is available suggests the site is woefully unsuitable geologically.

This latest report, the aforementioned peer review report commissioned by DOE from the International Atomic Energy Agency and the Nuclear Energy Agency (IAEA) of the Organization for Economic Cooperation and Development (OECD), reaches shocking new conclusions. These agencies assembled some of the world's leading scientists to evaluate, over several months, the total system performance of Yucca Mountain as represented by DOE and its computer models. Among other things, these leading scientists concluded that DOE lacks sufficient information even to build a model to predict the suitability and hydrogeologic performance of the proposed repository. According to the peer review group, the water flow system at Yucca Mountain is "not sufficiently understood to propose a conceptual model for a realistic transport scenario."

Moreover, according to the peer review group, DOE's level of understanding of the hydrogeology of the site is "low, unclear, and insufficient to support an assessment of realistic performance." DOE's sensitivity studies in its computer models "do not give any clues to the important pathways for the water in the system." Perhaps most troubling of all, in DOE's performance model of Yucca Mountain, "increased ignorance leads to lower expected doses, which does not appear to be a sensible basis for decision-making."

It is truly amazing to me, as an elected executive official, that DOE commissioned this peer review report many months ago, and then made a final "site suitability" determination to the President and the Congress in spite of its stunning conclusions.It shows once again, in my view, that politics has long prevailed over science when it comes to Yucca Mountain. This is another reason for Nevada to redouble its efforts to stop this project—government bureaucrats seem unable to pull the plug, even in the face of shocking independent evidence that the science is bad or nonexistent.

THE PECO SOLUTION AND THE MYTH OF ONE CENTRAL STORAGE SITE

It is almost certain that, even if Yucca Mountain proceeds, every nuclear utility in the United States will nonetheless have to build an interim dry storage facility for their inventories of spent nuclear fuel, if they have not already done so. This is because Yucca Mountain will not be ready to receive high-level radioactive waste until long after spent fuel pools at reactor sites have been filled to capacity. Moreover, as I have explained in my Statement of Reasons, Yucca Mountain will not reduce the number of storage sites across America for 60 to 100 years, even if no new plants are built, and Yucca Mountain will never reduce the number of storage sites as long as nuclear reactors continue to be built and operated.

In July 2000, the Department of Energy reached an agreement with PECO Energy Company, a division of Exelon Corp., the nation's largest nuclear utility, for managing spent nuclear fuel from PECO's Peach Bottom nuclear plant in Pennsylvania.

The PECO alternative is simple: If DOE is unable to take PECO's spent fuel by a date certain, PECO will build a specially-constructed dry cask spent fuel storage facility at the Peach Bottom plant for storage of their spent fuel until such time as a permanent federal repository, or alternative, is operational. PECO will be allowed to reduce its contributions to the Nuclear Waste Fund (a $9 billion fund collected from the nation's nuclear plant operators through annual assessments), and use those funds to pay for the new facility.

At PECO's request, DOE must become the title holder, owner, operator, and NRC licensee of the Peach Bottom independent spent fuel storage facility and its contents no later than five years after permanent shutdown of the Peach Bottom station, but no sooner than five years after the full 40-year license term of the station.

As explained in my Statement of Reasons, the PECO deal is the safe, practical, economic alternative to a severely flawed Yucca Mountain project. It represents what utilities are planning to do, and will have to do anyway, in the real world. I urge the Committee to explore the PECO deal carefully, and to question DOE and the nuclear industry as to why it has recently been ignored, or even hidden from public view.

So the cat is out of the bag—opening Yucca Mountain will not reduce from 131 to one (1) the number of sites where high-level waste and spent nuclear fuel is stored in America. As long as nuclear reactors continue to operate, which is the main purpose of developing a waste "solution," there will continue to be waste stored above-ground at reactor sites across the nation. In fact, at current rates of spent fuel production, if Yucca Mountain were to open and be filled to capacity by around 2036, there would still be just about as much spent fuel stored at reactors sites as there is today. And that amount would continue to pile up for years to come, even if no new reactors are built, because nuclear plants generate about 2,000 tons

of spent fuel each year, and will continue to do so regardless of what happens with Yucca Mountain.

To borrow a popular phrase, "Do the Math." Today, approximately 46,000 tons of spent fuel is stored at the nation's reactor sites. By the time shipments start in 2011, DOE's earliest predicted date, there will be at least 64,000 tons. Yucca Mountain is being designed and licensed to hold only 77,000 tons, and is probably physically incapable of holding more. The law precludes it from holding more.

DOE hopes to be able to ship 3,000 tons of waste per year to Yucca Mountain. But nuclear plants will continue operating on renewed licenses for decades beyond 2011, so spent fuel inventories will continue to grow at the rate of 2,000 tons per year. Thus, the net depletion rate will be only 1,000 tons per year.

If DOE meets its shipping targets, it will take approximately 25 years to fill Yucca Mountain with 77,000 tons of waste and spent fuel. But by then, operating reactors will have produced an extra 50,000 tons, leaving approximately 37,000 tons of spent fuel still sitting at reactor sites across America—a mere 9,000 tons less than we have today.

In short, on the day Yucca Mountain is filled to the brim, we would largely be right back where we started. Indeed, the 131 sites identified by DOE will not be reduced to one, but will in fact have risen by one. And in the interim, at least 50,000 shipments of highly radioactive waste will have been made through 43 states, almost every major city, and thousands of towns in between.

TRANSPORTATION ISSUES

The main thing I want to bring to your attention are the issues and concerns associated with the proposed massive campaign to transport 77,000 tons of nuclear waste across the nation for up to 38 years. Some have accused Nevada of fear mongering simply for honestly and sincerely raising the many questions that these shipments to Yucca Mountain pose for our nation's citizens. But these are extremely legitimate questions, and they deserve legitimate answers.

In its Environmental Impact Statement for Yucca Mountain, DOE's own numbers point to as many as 108,000 high-level waste and spent nuclear fuel shipments to Yucca Mountain. Almost every state, and most major metropolitan areas, will be affected by these shipments. More than 123 million citizens reside within one-half-mile of the proposed transport routes. The modes and methodologies for shipment have not yet been determined, much less analyzed. For example, we recently learned from DOE that as many as 3,000 barge shipments may be involved, traversing numerous port cities and harbor areas. According to DOE's own analyses, a single accident scenario could produce thousands of latent cancer fatalities and lead to many billions of dollars in cleanup costs.

Secretary Abraham testified last week that DOE now believes most spent fuel shipments would take place by rail, but that suggestion raises its own set of questions about practicality and physical possibility. For example, many reactor sites do not have rail access, and there are no known plans to create such access, so some form of truck or barge transport and transfer will still be necessary for many shipments. Additionally, in Nevada alone, DOE is proposing to construct more that 400 miles of new rail lines—that is more new rail capacity than we have built in the entire United States in the last century. My point, which I think is well illustrated by the Secretary's testimony announcing yet another change in approach, is that the transportation issue is a major concern—it is one that will affect literally millions of Americans, but it has not been well thought out. We are being asked to accept DOE platitudes and industry assurances in response to our questions and concerns, but that is not good enough, and it will not be good enough when the first problems arise, and we know they will.

Another very troubling aspect of this issue is that DOE has never done an analysis of the terrorism risks associated with mass transport to Yucca Mountain. In a recent brief filed in NRC license proceedings by nuclear utilities for the proposed Private Fuel Storage facility in Utah, the nuclear industry took the position that it is essentially no one's jurisdiction, other than the U.S. military, to evaluate terrorism risks in spent fuel transport. According to the utilities, this is not a proper subject for analysis by DOE, the NRC, the Department of Transportation, or the industry itself. In short, if you believe the industry, this is an area that only Congress can now evaluate, or direct others to evaluate. Put another way, if Congress does not order such an analysis to be done, none will be done. In the wake of September 11, failure to perform such an analysis would appear unwise.

And there is something else our experts now tell us: DOE has never done an evaluation of the nuclear criticality risk of a spent fuel cask getting struck by a state-of-the-art armor-piercing weapon. In recent nuclear industry advertisements and

press statements, it was suggested that if a warhead penetrated a cask, authorities would simply dispatch an emergency crew to "plug it up." This assumes the dose rate in the vicinity of the cask is not a lethal one. It assumes that the warhead does not essentially liquefy the contents of the cask, if it is not already liquid. It assumes that any inner explosion in the cask would not so alter the geometry of the contents that the contents would go critical, obliterating the cask. It assumes that the cask is not over a river or on a barge and will not subsequently fill with water, a neutron moderator. It assumes that the cask is not filled with U.S. or foreign research reactor spent fuel, which is usually comprised of highly-enriched, or weapons-grade, uranium.

Finally, there are questions regarding the casks that will be used for shipping high-level waste and spent nuclear fuel to any repository. First of all, very few casks exist today, so the ones that would be used for a 38-year shipping campaign to Yucca Mountain are still in various stages of development. That might be acceptable if we knew they were going to be subjected to rigorous physical testing prior to use, but that is not intended. Instead, computer and some limited scale-model testing is the planned method of assessing cask integrity. Those ancient tapes we have all seen of discarded shipping casks being dropped from helicopters, run into cement walls and hit by trains—none of that is planned for the new generation of casks. NRC Commissioner Greta Dicus recently testified that NRC does now plan to physically test one cask, but that is the first time such an announcement has been made, and we therefore remain, respectfully, skeptical about what will actually be done.

So for now, we are being asked to believe recent industry claims that the new, not-yet-built casks can withstand "all but the most advanced armor-piercing weapons" and a "direct hit by a fully fueled Boeing 747." These wild claims are not based on actual testing, and we know from tests conducted at Sandia National Laboratories in the 1980s and by the U.S. Army at Aberdeen Proving Grounds as recently as 1998 that even very robust casks are vulnerable to attacks from small missiles. Shouldn't the new generation of casks be subjected to full-scale physical testing under a range of conceivable scenarios, including an attack by terrorists willing to give their own lives?

THE ROLE OF THE NUCLEAR REGULATORY COMMISSION

The final issue I will raise is the notion being promoted here in Washington, and adopted by some mainstream media organizations, that Congress can responsibly move DOE's Yucca Mountain site selection forward because all remaining issues related to the site's suitability would be reexamined and resolved in licensing proceedings before the NRC. That is not the case.

In fact, under current rules for licensing Yucca Mountain, which Nevada is challenging in court, NRC will not be examining or determining the geologic suitability of the Yucca Mountain site at all. Under the Nuclear Waste Policy Act, this critically important task was supposed to have been performed by DOE. But DOE recently revised the rules, and in doing so virtually abdicated this function. NRC will essentially be determining only whether DOE's man-made waste packages can keep radiation emissions to within standards set by the Environmental Protection Agency.

In simple terms, NRC will be determining the suitability of the waste containers that DOE will put inside the mountain, but it will not be examining the suitability of the mountain itself at all. That's like making sure every deck chair on the Titanic can hold the heaviest passenger, without ever bothering to make sure the ship can float.

Under this approach, DOE is both the promoter and arbiter of the suitability of the Yucca Mountain site. There is no independent government oversight. That's how we used to regulate things nuclear until we learned the hard way that it was necessary, indeed vital to the protection of public health and safety, to separate the promotional and regulatory aspects of the government's involvement in nuclear energy. (For example, witness the $250 billion cleanup bill taxpayers now face for the nation's mismanaged nuclear weapons complex.) But that's exactly happening with Yucca Mountain, and the result is a site recommendation that was made prematurely and against the strong concerns of virtually the entire scientific community and the U.S. General Accounting Office.

CONCLUSION

Today, the President's recommendation to move forward with Yucca Mountain is heading down the path to finality, and only the Congress can stop it by choosing not to override my Congressionally-authorized site veto. If the matter of site suitability really were up to the NRC, Nevada and the scores of independent scientists

alarmed by DOE's premature and falsely based site recommendation would be considerably reassured. But such is not the case.

If Congress overrides my veto and simply punts to the NRC, the suitability of the Yucca Mountain site will never be independently reviewed by any government authority, barring a court order. We will seek that court order, but we believe Congress should accept its responsibility, recognize that the Yucca Mountain project is fatally flawed on numerous fronts, and not act to override my veto.

PREPARED STATEMENT OF HON. HARRY REID, U.S. SENATOR FROM NEVADA

I want to thank you Chairman Bingaman and Senator Murkowski for allowing me the opportunity to participate in this hearing—and for understanding the importance of this issue to me and to my state, and really to almost every state.

The resolution this committee is considering refers to the President's recommendation of Yucca Mountain, Nevada as the site for disposal of high-level radioactive waste.

But this limited description fails to take into account the full implications of developing a repository there (or anywhere else)—namely, that before dumping the nation's nuclear waste on Nevada, it has to be shipped through 43 states—including the states most members of this committee represent.

Today, we are going to hear from witnesses who will tell us about the risks the Department of Energy's program will entail—these include risks in Nevada and more importantly, risks all over the country where this waste will be shipped.

The Secretary said it best last week when he acknowledged that the Department of Energy has only had preliminary thoughts about a transportation plan for this waste. That's like a someone building a hospital with no doctors.

So while there are many fundamental problems with the site itself and concerns about the process that led to the President's recommendation of the site, I want to first address the dangers of transporting massive amounts of deadly nuclear waste along the nation's major highways, railroad tracks and waterways.

Bush plan for moving thousands of tons of deadly high-level radioactive waste requires 100,000 shipments by truck, 20,000 by train and perhaps thousands more by barge over 40 years.

This idea would be risky at any time, but after September 11, 2001 it is just unthinkable.

The long term radiation contained in each shipment is 240 times radiation released by the Hiroshima bomb.

Shipments will pass by homes, schools, parks, churches, offices.

Shipments jeopardize the safety, health, environment and the lives of many people who live in cities and towns all over the country.

We know there will be hundreds of accidents involving shipments of nuclear waste.

It's not a question of if, but when and where and how severe will these accidents be. And an accident involving a container of deadly nuclear waste is no routine fender-bender. A collision or fire involving a 25-ton payload of nuclear waste could kill thousands.

Yet, the Department of Energy despite knowing there will be accidents recommended this plan without developing a plan for the shipments.

In addition, DOE has failed to provide the millions of people who live near the proposed routes the information they need to understand the risk their families face.

Deadly accidents are not the only concern. Shipping nuclear waste across the country increases our vulnerability to terrorist attack, by adding hundreds of thousands of targets for terrorists to attack with a missile or to hijack or to sabotage.

So transporting deadly nuclear waste is dangerous—and it's a risk our country shouldn't take.

The nuclear power industry and some of its backers suggest it would be better to have nuclear waste at a single site instead of scattered around the country. But this is a false promise, because the nation's nuclear waste will never be consolidated at a single site.

It will continue to be at every one of the operating reactor sites. Spent nuclear fuel rods are so hot and radioactive that they have to be stored at the nuclear reactor site in a cooling pond for 5 years before they can be moved. So developing Yucca Mountain would add to the number of sites with nuclear waste, not reduce it.

There are also risks about Yucca Mountain itself and hundreds of unanswered questions about whether it can be a safe storage facility.

Independent federal experts agree that the science done on Yucca Mountain is incomplete.

The General Accounting Office, a credible independent agency, chastised the Secretary of Energy for making a decision on Yucca Mountain when almost 300 important scientific tests remain incomplete.

The experts at the Nuclear Waste Technical Review Board, another independent agency, concluded that the technical basis for Yucca Mountain is "weak to moderate".

The Inspector General at the Department of Energy found that the law firm they hired was working for the nuclear power industry at the same time.

There is an alternative. We can safely leave the waste on site, where it will be any way as new waste is added to the existing waste. It will be safe there while we develop the technology for reprocessing or safe disposal without shipping 100,000 nuclear dirty bombs through your states.

Again, I want to thank you for the opportunity to discuss this important issue.

STATEMENT OF ROBERT J. HALSTEAD, TRANSPORTATION ADVISOR, AGENCY FOR NUCLEAR PROJECTS, STATE OF NEVADA

Mr. HALSTEAD. Thank you, Mr. Chairman.

I'm Bob Halstead, Transportation Advisor for the Agency for Nuclear Projects, State of Nevada.

My pre-filed comments today summarize my analysis of the Department of Energy's final environmental impact statement for Yucca Mountain, which was released on February 14, 2002. Although high-level nuclear waste is an integral part of DOE's repository proposal, there is no transportation plan in the final environmental impact statement

In my summary comments today, I'd like to emphasize three points about the Department of Energy transportation proposal.

First, construction of a repository at Yucca Mountain would result in tens of thousands of shipments of high-level nuclear waste. DOE proposes to move 70,000 metric tons of high-level nuclear waste from 77 sites to Yucca Mountain over 24 years.

By DOE's own account, the mostly legal weight truck scenario could result in 53,000 shipments over 24 years, or about 2,200 per year. DOE's mostly rail scenario, when the associated heavy-haul truck and barge shipments which are required to make it feasible, are included could result in 22,500 shipments over 24 years, or about 935 per year.

Now, after 24 years, under DOE's proposal, there would still be 49,000 metric tons of high-level nuclear waste at 63 commercial sites and five DOE sites in 33 States. And it is not clear what DOE proposes to do with these remaining wastes. But DOE's final EIS says that moving these wastes would require an additional 14 years and could require 22,500 additional shipments by rail, truck, and barge, or 56,000 additional shipments by legal-weight truck.

Well, we've gotten most of the numbers out of the way, Mr. Chairman. My second point is that a severe transportation accident or a successful terrorist attack on a shipment could unfortunately have catastrophic consequences.

Now, 90 percent of the waste that would be shipped to the repository would be commercial spent nuclear fuel, which is an extremely hazardous material. Without shielding, a person standing next to a spent nuclear fuel assembly would receive a lethal dose of radiation in 1 to 5 minutes. Each spent fuel shipping cask loaded

with spent fuel, would contain so much Cesium 137, the most dangerous radionuclide, that a one percent release in the city could cause thousands of cancer deaths unless cleaned up at a cost of billions of dollars.

In the final EIS, DOE acknowledges that a severe accident or a terrorist attack could result in a release of radioactive material, and DOE admits that the cleanup cost could range from $300,000 up to $10 billion. Nevada's studies show that a severe accident, such as the Baltimore rail tunnel accident of last year, could cause widespread contamination costing somewhere in the rage of $10 to $14 billion to clean up. And if not cleaned up, it would cause between 4,000 and 28,000 cancer deaths over the following 5 decades.

Nevada studies also show that a successful terrorist attack in an urban area using a 1950's era weapon against the newly designed truck cask could cause a large enough release to result in 300 to 1,800 latent cancer fatalities, assuming a 90 percent blast penetration. Full perforation of a truck cask, which is what we think would occur in an attack involving a state-of-the-art weapon like a TOW missile, could cause a factor of ten increase, resulting in 3,000 to 18,000 latent cancer fatalities and a cleanup that would certainly exceed ten billion dollars.

My third point is simply that DOE has no transportation plan presently that addresses these safety and security issues. DOE has searched rail as their preferred mode of shipment for safety reasons, but in fact DOE has no plan for maximizing rail use. And after 20 years of studying potential rail spur routes in Nevada, DOE can't even say which Nevada rail spur route they prefer.

If they use the mostly legal-weight truck option, they've put forward no plan for picking the safest highway routes for the 53,000 to 108,000 cross-country truck shipments that would occur, nor do they have a plan for managing other aspects of truck safety, nor do they have a plan for addressing the post September 11 risks of terrorism against these shipments. And incredibly the Department of Energy not only has no plan for enhanced transportation safety regulations, such as the mandatory use of dedicated trains or full-scale cask testing; in fact, both DOE and the nuclear industry actually oppose mandatory use of dedicated trains and mandatory full-scale cask testing.

Thank you very much for the opportunity to testify this morning.

[The prepared statement of Mr. Halstead follows:]

PREPARED STATEMENT OF ROBERT J. HALSTEAD, TRANSPORTATION ADVISOR, AGENCY FOR NUCLEAR PROJECTS, STATE OF NEVADA

I am Robert J. Halstead, Transportation Advisor, Agency for Nuclear Projects, State of Nevada. I have worked on nuclear waste transportation issues for the past 24 years. I have been Transportation Advisor to the Nevada Agency for Nuclear Projects since 1988. My primary responsibility is assessment of the impacts and risks of transporting spent nuclear fuel and high-level radioactive wastes to the proposed Yucca Mountain repository site. In addition to reviewing the U.S. Department of Energy's Draft and Final Environmental Impact Statements for Yucca Mountain, my recent work for Nevada includes managing contractor studies on the vulnerability of shipments to sabotage and terrorist attack, on the radiological consequences of severe highway and rail accidents, and on radiation exposures from incident-free shipments.

From 1983 to 1988, I was senior policy analyst for the State of Wisconsin Radioactive Waste Review Board, an agency created by the Wisconsin Legislature to represent the State in dealings with the U.S. Department of Energy, the U.S. Nuclear

Regulatory Commission, other federal agencies, and nuclear electric utilities. I advised the Board and Wisconsin's congressional delegation on federal legislation that resulted in the Nuclear Waste Policy Act of 1982, and the Nuclear Waste Policy Amendments Act of 1987. I monitored on-going spent nuclear fuel shipments; evaluated transportation impacts of repository candidate sites in Wisconsin, Minnesota, and Michigan; and represented the Board on all matters pertaining to transportation.

From 1978 to 1983, I worked for the State of Wisconsin Energy Office. I evaluated utility plans for nuclear and coal-fired power plants, and represented the State in proceedings before the Public Service Commission of Wisconsin. I prepared policy recommendations on transportation of coal, petroleum, spent nuclear fuel, and low-level radioactive wastes.

I have also worked as a consultant on nuclear waste transportation and storage for the States of Minnesota, Tennessee, and Texas. I also advised the Law and Water Fund of the Rockies on the transportation impacts of the Private Fuel Storage facility proposed for the Skull Valley Goshute Reservation in Tooele County, Utah.

THE U.S. DEPARTMENT OF ENERGY'S FINAL ENVIRONMENTAL IMPACT STATEMENT FOR YUCCA MOUNTAIN

The Department of Energy (DOE) released the Final Environmental Impact Statement (FEIS) for Yucca Mountain on February 14, 2002. The FEIS was made available from DOE's website (www.ymp.gov) shortly thereafter. DOE apparently published no paper copies of the FEIS for direct distribution to the public. DOE has apparently provided paper copies of the FEIS to DOE Reading Rooms in some cities.

The FEIS "analyzes a Proposed Action to construct, operate and monitor, and eventually close a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain." [p. 1-3] Transportation of spent nuclear fuel and high-level radioactive waste from 72 commercial and 5 DOE sites across the United States is an integral part of DOE's Proposed Action. The Proposed Action would "require surface and subsurface facilities and operations for the receipt, packaging, possible surface aging, and emplacement of spent nuclear fuel and high-level radioactive waste" and "transportation of these materials to the repository." [FEIS, p. 2-5]

DOE has made no final decisions about the transportation options proposed in the FEIS. Decisions about "how spent nuclear fuel and high-level radioactive waste would be shipped to the repository (for example, truck or rail) and how spent nuclear fuel would be packaged (uncanistered or in disposable or dual-purpose canisters) would be part of future transportation planning efforts." [FEIS, p. 2-5] For shipments nationally, "DOE would use both legal-weight truck and rail transportation, and would determine the number of shipments by either mode as part of future transportation planning efforts." [FEIS, p. 2-13] "DOE could use one of three options or modes of transportation in Nevada to reach the Yucca Mountain site: legal-weight trucks, rail, or heavy haul trucks." [FEIS, p. 2-48] The FEIS does not contain a specific transportation plan. DOE's discussions of potential transportation scenarios and DOE's transportation impact analyses are spread over more than 750 pages in the FEIS Summary, eight chapters, and four appendices.

In order to obtain print-optimized files for the FEIS Summary and Reader's Guide, it is necessary to go to DOE's website and download 48,425 KB. To obtain the eight chapters and four appendices dealing with transportation and related issues, it is necessary to download more than 113,300 KB.

PROJECTED NUCLEAR WASTE INVENTORIES AND SHIPMENT NUMBERS

Under the Proposed Action, DOE would transport 70,000 metric tons of heavy metal (MTHM) of spent nuclear fuel and high-level radioactive waste to a repository over 24 years (2010-2034). The Proposed Action complies with Section 114(d) of the Nuclear Waste Policy Amendments Act. The FEIS also evaluates the transportation impacts of the entire projected inventory of about 120,000 MTHM over 38 years (2010-2048). [Pp. S-77 to S-78]

The FEIS estimates the total projected inventory of commercial spent nuclear fuel (SNF) and high-level radioactive wastes (HLW) to be generated through 2046. This inventory, referred to by DOE as Module 1, includes 105, 000 MTHM of commercial SNF, 2,500 MTHM of DOE SNF, and 22,280 canisters of DOE HLW (equivalent to about 11,500 MTHM). DOE also evaluates a projected inventory, referred to as Module 2, in which 2,000 cubic meters of Greater-than-Class-C (GTCC) waste, and 4,000 cubic meters of Special-Performance-Assessment-Required (SPAR) waste, are added to Module 1. [FEIS, p. S-78, and Appendix A]

Yucca Mountain, under DOE's Proposed Action, would receive the following wastes over 24 years (2010-2033): 63,000 MTHM of commercial SNF, 2,333 MTHM of DOE SNF, and 8,315 canisters of DOE HLW (equivalent to about 4,667 MTHM). [FEIS, p. S-78] At the end of DOE's Proposed Action, in 2034, there would still be about 42,000 MTHM of commercial SNF stored at 63 nuclear power plant sites in 31 states, 167 MTHM of DOE SNF stored at DOE sites in 4 states, and 13,965 canisters of DOE HLW (equivalent to about 6,833 MTHM) stored at DOE sites in 3 States. Additionally, all of the projected GTCC and SPAR wastes would also still be stored at 63 commercial and 4 DOE sites in 32 states. [FEIS, Pp. S-78, A-2 to A-16, and J-10 to J-22]

DOE developed two national transportation scenarios—"mostly legal-weight truck" and "mostly rail"—in order to estimate the number of shipments required under the Proposed Action (24 years) and under Modules 1 and 2 (38 years). DOE adopted this approach "because, more than 10 years before the projected start of operations at the repository, it cannot accurately predict the actual mix of rail and truck transportation that would occur from the 77 sites to the repository. Therefore, the selected scenarios enable the analysis to bound (or bracket) the ranges of legal-weight truck and rail shipments that could occur." [FEIS, p. J-10] DOE states that the "estimated number of shipments for the mostly legal-weight truck and mostly rail scenarios represents the two extremes in the possible mix of transportation modes." [FEIS, p. 6-35] Table 1 shows the number of shipments estimated by DOE for these transportation and inventory scenarios.

Table 1.—DOE ESTIMATED NUMBER OF SHIPMENTS FOR TRANSPORTATION SCENARIO COMBINATIONS

Inventory scenario	(Mostly truck) truck shipments	(Mostly truck) rail shipments	(Mostly rail) truck shipments	(Mostly rail) rail shipments
Proposed Action (2010-2034) ..	52,786	300	1,079	9,646
Module 1 (2010-2048)	105,685	300	3,122	18,243
Module 2 (2010-2048)	108,544	355	3,122	18,935

Source: DOE/EIS-0250, Table J-11

DOE's "mostly legal-weight truck" national scenario would result in the largest number of shipments. Over 24 years, there would be more than 53,000 shipments, or about 2,200 per year. Over 38 years, there would be about 108,900 shipments, or about 2,870 per year. By comparison, over the past 40 years, there have been less than 100 shipments per year in the United States.*

DOE's "mostly rail" national scenario would result in fewer cross-country shipments than the "mostly legal-weight truck" scenario. Over 24 years, there would be more than 10,700 cross-country shipments, or about 450 per year. Over 38 years, there would be more than 22,000 cross-country shipments, or about 580 per year.

However, the "mostly rail" cross-country shipment numbers do not include barge and heavy haul truck shipments from 24 reactor that lack rail access, which would add 2,200 shipments for the Proposed Action and 4,065 shipments for Module 2. Nor do the DOE numbers include the heavy haul truck shipments required in Nevada if there is no rail spur to Yucca Mountain, which could add 9,646 shipments for the Proposed Action and 18,935 shipments for Module 2.

When the barge and heavy haul truck shipments are included, DOE's "mostly rail" total for 24 years could be more than 22,500 shipments, or about 935 per year. DOE's "mostly rail" total for 38 years could be more than 45,000 shipments, or about 1,185 per year.

YUCCA MOUNTAIN SHIPMENT MODES

The DOE "mostly legal-weight truck scenario" is the only national transportation scenario that is currently feasible. All 72 power plant sites and all 5 DOE sites can

*There were about 3,025 shipments in the United States between 1964 and 1997, about 92 per year. Reliable estimates of worldwide cask-shipments, through 1998, range from 24,000 to 40,041. Most of the international cask-shipments moved in trains carrying multiple casks, so the actual number of shipments would be considerably less, but precise information is unavailable. The estimate of 40,041 cask-shipments worldwide was published by the International Atomic Energy Agency in July 1999 and includes the following country totals: United Kingdom, 28,854; U.S.A., 2,425; Germany, 1,612; France, 1,570; Japan, 1,399; and Sweden, 900. Source: R. Pope, IAEA, "International Experience with SNF/HLW Transport," Presentation before the U.S. National Academy of Sciences, National Transportation Research Board, Washington, DC, September 11, 2000.

ship by legal-weight truck. At present, there is no railroad access to Yucca Mountain., and the feasibility of long-distance heavy haul truck (HHT) transport of rail casks in Nevada is unproven.

The DOE "mostly rail scenario" is unlikely to occur. Even if DOE is able to develop rail access to Yucca Mountain, the objective of shipping 90 percent of the commercial SNF by rail is unrealistic. DOE acknowledges that 25 of the 72 power plant sites cannot ship directly by rail. Nevada studies show that number could be up to 32 sites. The "mostly rail" scenario assumes that DOE can ship thousands of casks by barge into Boston, New Haven, Newark, Jersey City, Wilmington (DE), Baltimore, Norfolk, Miami, Milwaukee, Muskegon, Omaha, Vicksburg, and Port Hueneme (CA). Alternately, DOE would have to move thousands of casks from reactors to rail lines using HHTs, each of which will require special state permits and route approvals.

The "mostly rail scenario" assumes that DOE can construct a new rail spur to Yucca Mountain, 99 to 344 miles in length, at a cost of more than $1 billion. Even the shortest of the five spur options would be the largest new rail construction project in the United States since World War I. Environmental approvals, right-of-way acquisition, and litigation could delay rail construction for 10 years or more. In the FEIS, DOE declined to identify a preference among the five potential rail corridors to Yucca Mountain.

The alternative to rail spur construction, delivery of thousands of large rail casks by 220-foot-long HHTs over distances of 112 to 330 miles on public highways, is probably not feasible. HHT route constraints include highly congested segments through rapidly urbanizing areas, and steep grades and sharp curves through high-mountain passes. All of the potential HHT routes would require substantial upgrading, and would likely cost more than a rail spur. State permits and operating restrictions apply to all use of HHTs in Nevada. In the FEIS, DOE declined to identify a preference among three potential locations for intermodal transfer stations.

Certain programmatic and policy factors favor truck shipment, especially during the first 10-15 years of repository operations. DOE's "hot repository" thermal loading strategy may require truck shipment of 5-10 year-cooled SNF. Some utilities may exercise contract options to ship 5-10 year-cooled SNF from storage pools by truck, rather than shipping older SNF by rail. DOE's transportation privatization plan does not require transportation service providers to ship oldest fuel first or to maximize use of rail. Indeed, under DOE's fixed-cost contracting approach to privatization, rail transportation may not be cost-competitive with legal-weight at many sites.

YUCCA MOUNTAIN TRANSPORTATION ROUTES

In the Draft EIS, DOE chose to conceal the specific routes used for impact and risk analyses in Chapter 6 and Appendix J. DOE did not identify the routes in its Federal Register notice nor in its public notices of scheduled hearings. During the public hearings that began in September, 1999, DOE provided some state-specific transportation maps at individual hearings around the country. But DOE did not release national maps showing the full cross country routes from shipping sites to Yucca Mountain until sometime in late January, 2000, near the end of the public comment process

In the Final EIS, DOE decided to reveal the routes used for risk and impact analysis. DOE included national and state maps. [FEIS, Figure J-5, and Figures J-31 to J-53] The FEIS states that "DOE has not determined the specific routes it would use to ship spent nuclear fuel and high-level radioactive waste to the proposed repository." [FEIS, p. J-23]

The FEIS truck routes were generated by the HIGHWAY computer model, and generally represent the quickest truck travel routes consistent with the current Federal routing regulations (HM-164). DOE refers to these as "representative" routes. [FEIS, p. 6-5] However, with two exceptions, DOE's cross-country routes agree with the highway routes identified in previous routing studies by DOE and Nevada contractors. Absent additional state designation of preferred alternatives or DOE policy decisions, we believe that these are the most likely highway routes to Nevada, with two notable exceptions.

In between publication of the Draft and Final EISs, the State of Colorado exercised its authority under U.S. DOT regulations to prohibit SNF and HLW shipments on I-70 west of Denver. Colorado took this action to avoid shipments through the Eisenhower and Glenwood Tunnels. Under the Colorado designation, shipments would be diverted north or south on I-25. Nevada routing analyses show that the new preferred route to Yucca Mountain for shipments using I-70 would be through the Northeastern Denver metropolitan area to I-25, then connecting with I-80 at

Cheyenne, Wyoming. For reasons we do not understand, DOE's FEIS map has the trucks on I-70 turning north on I-29 to connect with I-680/I-80 near Omaha, so that the major stream of shipments from the Southeastern region avoids Kansas and Colorado altogether. [Figures 35, 39, and 47] Preliminary analysis indicates that DOE's route choice could add more than 20 miles to each of tens of thousands of shipments, compared to the new preferred route in Colorado. We are continuing to study this route.

A second DOE highway route of concern was called to our attention by the State of Pennsylvania. DOE's FEIS map shows shipments from six reactor sites using the Pennsylvania Turnpike (I-76) West of Harrisburg. [Figure 49] Pennsylvania authorities informed us that all placarded hazardous material shipments must use bypasses to avoid four tunnels along this segment of the Turnpike, and that no SNF shipments have ever used this route. It is not clear how DOE could have missed these restrictions, since the Pennsylvania bypass requirements are clearly stated in a U.S. DOT guidance document cited as a reference in the FEIS. We are continuing to study this route also.

Otherwise, DOE's FEIS routes agree with those identified by Nevada as most likely routes to Yucca Mountain. The primary truck routes out of New England and the Middle Atlantic states converge on I-80/90 near Cleveland, pick up shipments from Midwestern reactors, and follow I-80 west from Chicago through Des Moines, Omaha, Cheyenne, and Salt Lake City to I-15.

The primary truck routes out of the South are I-75 from Florida, I-24 from Atlanta, and I-64 from Virginia. These routes converge on I-70 near St. Louis, and follow I-70 west through Kansas City and Denver to I-25, then join I-80 near Cheyenne.

The primary route from the Pacific Northwest is I-84 to I-15 in Utah. Other major routes are I-40 and I-10 from the Mid-South and I-5 in California. These routes converge on I-15 in Southern California.

As with highway routes, DOE chose to conceal the rail routes analyzed in the Draft EIS DOE until late January 2000, near the end of the public comment process. In the Final EIS, DOE decided to reveal the rail routes used for risk and impact analysis. DOE included national and state maps. [FEIS, Figure J-6, and Figures J-31 to J-53] These routes were generated by the INTERLINE computer model, and generally represent the most direct routes to Nevada consistent with the current industry practice of maximizing freight-miles on the originating railroad.

Since DOE has not yet identified a preferred rail destination in Nevada, the map shows all potential cross-country routes from the 77 sites. For about 85 percent of the originating locations, the most likely route is unchanged by the Nevada destination. DOE's rail routes to Nevada generally agree with the rail routes identified in previous routing studies by DOE and Nevada contractors. While mergers and other rail industry developments would continue to affect routing, Nevada believes that the FEIS map shows the most likely rail routes to Nevada.

The primary rail routes out of New England and the Middle Atlantic states are the former Conrail mainlines from Buffalo and Harrisburg to Cleveland and Chicago. These shipments switch to the Union Pacific near Chicago, are joined by shipments from Midwestern reactors in Illinois and Iowa, and continue west via Fremont, Gibbon, Cheyenne, and Salt Lake City to Nevada.

The primary routes out of the South are the CSXT from Atlanta to East St. Louis, and the Norfolk Southern from Atlanta to Kansas City via Birmingham and Cairo. These two streams merge on the Union Pacific in Kansas City, and in turn merge with the northern UP shipments at Gibbon, Nebraska. Other major rail routes are the UP from Oregon via Boise, and the UP and BNSF from California and the Southwest via San Bernardino and Daggett.

The potential highway and rail routes identified in DOE's Final Environmental Impact Statement could affect 45 states and the District of Columbia. More than 123 million people currently live in the 703 counties traversed by DOE's highway routes, and 106 million live in counties along DOE's rail routes. DOE predicts that between 10.4 and 16.4 million people will live within one-half mile of a transportation route in 2035.

RECENT SPENT NUCLEAR FUEL SHIPMENTS

During the past two decades, nuclear power plants and research facilities in the United States have made relatively few off-site shipments of SNF. The U.S. Nuclear Regulatory Commission (NRC) regulates such shipments, and maintains a detailed SNF shipment database. Between 1979 and 1997, the most recent period reported by NRC, there were 1,334 domestic shipments containing 1,453 metric tons uranium

(MTU) of civilian SNF. Table 2 summarizes significant characteristics of these shipments.

Table 2.—U.S. CIVILIAN SNF SHIPMENT EXPERIENCE, 1979–1997

Amount Shipped	1,453 MTU (76.5 MTU per year)
Total Shipments	1,334 (70 per year)
Truck Shipments	1,181 (62 per year)
Rail Shipments	153 (8 per year)
Truck Share of SNF Shipments	88.5%
Rail Share of MTU Shipped	75.5%
Average Truck Shipment Distance	684 miles (82%<900 miles)
Average Rail Shipment Distance	327 miles (80%<600 miles)
Shipment Origin & Destination	70% East of Mississippi River (935/1334)
Number of Reactor Sites Making One or More Shipments.	27 (9 sites>2 shipments)

Source: NRC, NUREG-0725, Rev. 13 (October 1998)

During the same period, the U.S. Department of Energy made several dozen shipments of Three Mile Island reactor core debris and intact commercial reactor SNF. These shipments were not regulated by NRC, and were therefore not included in the NRC database. There were also an undisclosed number of naval reactor fuel shipments, estimated at several hundred.

RADIOLOGICAL CHARACTERISTICS OF SPENT NUCLEAR FUEL

Spent nuclear fuel (SNF) from commercial power reactors would comprise about 90 percent of the wastes shipped to the repository. DOE acknowledges that SNF is "usually intensely radioactive." [FEIS, Pp. S-3, 1-6] Otherwise, the Final EIS provides little information on the radiological characteristics of SNF that affect transportation safety until the reader reaches Appendices A, F, and J.

Fission products, especially strontium-90 (half-life 28 years) and cesium-137 (half-life 30 years), account for most of the radioactivity in SNF for the first hundred years after removal from reactors. Fission products, which emit both beta and gamma radiation, are the primary sources of exposure during routine transportation operations. Cesium-137 is the major potential source of irradiation and contamination if a shipping cask is breached during a severe transportation accident or successful terrorist attack.

Table 3, based on data developed by DOE, illustrates the general relationship between SNF age (cooling time) and the two radiological characteristics most important for assessing SNF transportation risks, total activity and surface dose rate. The table is based on average characteristics of older SNF (pressurized water reactor fuel with a burn-up of 33,000 MWd/MTHM). The average SNF assumed by DOE in the FEIS [p. A-13] (pressurized water reactor fuel with a burn-up of 41,200 MWd/MTHM), for shipments to Yucca Mountain, would be even more radioactive.

Table 3.—RADIOLOGICAL CHARACTERISTICS OF COMMERCIAL SPENT NUCLEAR FUEL

SNF age (years cooled)	Total activity (Curies)	Surface dose rate (Rem/Hour)
1	2,500,000	234,000
5	600,000	46,800
10	400,000	23,400
50	100,000	8,640

Source: U.S. DOE, DOE/NE-0007, 1980.

After one-year in a water-filled storage pool, unshielded SNF is so radioactive that it delivers a lethal, acute dose of radiation (600 rem) in about 10 seconds. After 50 years of cooling, the total radioactivity (measured in curies) and the surface dose rate (measured in rem/hour) decline by more than 95 percent, but SNF can still deliver a lethal radiation exposure in minutes. The lethal exposure time for unshielded SNF is less than one minute after 5 years cooling, less than 2 minutes after 10 years, and less than 5 minutes after 50 years.

DOE assumes that the average age (cooling time) of SNF shipped to the repository would be about 23 years. [FEIS, p. A-13] DOE calculates that the average rail cask shipped to the repository would contain a total radioactivity of 2.1 million cu-

ries, including 816,000 curies of Cesium-137. [FEIS, p. J-33] While DOE does not provide specific data for the average truck cask, it would about one-sixth as much as the rail cask (355,000 curies total activity, including 136,000 curies of Cesium-137). For accident and sabotage consequence analysis, DOE assumed that the casks would be loaded with SNF aged 14-15 years, [FEIS, p. J-52] which would double the radiological hazard, compared to average SNF. [FEIS, p. 6-46] However, repository shipments could include 5-year cooled SNF in truck casks and 10-year cooled SNF in rail casks, resulting in significantly greater radiological hazards than those evaluated by DOE.

ROUTINE TRANSPORTATION IMPACTS

NRC regulations allow a certain amount of neutron and gamma radiation to be emitted from shipping casks during routine operations and transport (1,000 mrem/hr at the cask surface and 10 mrem/hr 2 meters from the cask surface). The dose rate allowed under NRC regulations results in near-cask exposures of about 2.5 mrem per hour at 5 meters (16 feet), in measurable exposures (less than 0.2 mrem per hour) at 30 meters (98 feet), and calculated exposures (less than 0.0002 mrem per hour) at 800 meters (one-half mile) from the cask surface. [FEIS, p. J-38] Cumulative exposures at these rates can result in adverse health affects for some workers and some members of public. Moreover, the very fact that these exposures would occur has been shown to cause adverse socioeconomic impacts, such as loss of property values, even though the dose levels are well below the established thresholds for cancer and other health effects.

The FEIS acknowledges that routine radiation from shipping casks poses a significant health threat to certain transportation workers. In the most extreme example, motor carrier safety inspectors could receive cumulative doses (200 rem over 24 years) large enough to increase their risk of cancer death by 10 percent or more, and their risk of other serious health effects by 40 percent or more. DOE proposes to control these exposures and risks by severely restricting work hours and doses for certain jobs. [FEIS, Pp. J-44 to J-45]

EXPECTED NUMBER OF ACCIDENTS

DOE and the nuclear power industry are quick to point to their record of safely shipping limited quantities of spent fuel during the past 30 years. What DOE and the industry do not publicize is that, prior to 1971, there were, in fact, transportation accidents and incidents that resulted in radiation releases. Between 1957 and 1964, there were 11 transportation incidents and accidents involving spent fuel shipments by the US Atomic Energy Commission and its contractors. Several of these incidents resulted in radioactive releases requiring cleanup, including leakage from a rail cask in 1960 and leakage from a truck cask in 1962. There is no comparable data for the period from 1964 to 1970, when utility shipments to reprocessing facilities began.

Between 1971 and 1990, there were six accidents and 47 regulatory incidents involving spent fuel cask shipments. Most of the regulatory incidents involved excess radioactive contamination of cask surfaces (often referred to as "weeping"), but a few involved violations that could have contributed to increased accident risks. Three accidents (two truck, one rail) involved casks loaded with spent fuel. Fortunately, no radioactivity was released in these accidents, although one truck accident was severe enough to kill the driver. However, the record clearly indicates that accidents do happen and that the potential for accidents involving radiation releases exists.

DOE contractors evaluated these SNF accidents and incidents, and developed historical SNF accident and incident rates for use in projecting the impacts of future shipments to a Yucca Mountain repository. [OCRWM, YMP/91-17] These accident and incident rates have not changed appreciably, because of the relatively small number of shipments and shipment-miles during the 1990s. DOE chose to ignore this information in preparing the transportation impact analysis for the FEIS.

Table 4 shows the results of applying the historical accident rates for U.S. SNF shipments to the projected shipment-miles for DOE's "mostly legal-weight truck" and "mostly rail" scenarios, plus an additional scenario developed by Nevada which assumes that each site ships based on its current modal capability. The Nevada analysis concludes that 160–390 accidents and 850–2,400 regulatory violations would be expected over 38 years if future shipments were to be as safe as past shipments.

Table 4.—PROJECTED REPOSITORY TRANSPORTATION ACCIDENTS AND INCIDENTS, 2010-2048.

Scenario & mode	Shipments	Shipment-miles	Accidents	Incidents
Mostly Truck (Sites)				
Truck (77)	108,544	227,735,000	159	2,391
Rail to NV (1)	355	181,000	2	4
HHT in NV	355	118,000	NA*	NA*
Mostly Rail (Sites)				
Truck (6)	3,122	8,657,000	6	91
Rail to NV (77)	18,935	37,484,000	364	727
Rail in NV	6,312	2,039,000	20	40
Current Capabilities (Sites)				
Truck (25)	27,435	65,784,000	46	691
Rail to NV (52)	14,886	28,353,000	275	550
Rail in NV	4,962	1,603,000	16	31

*NA—Not Available.

TRANSPORTATION ACCIDENT AND TERRORISM IMPACTS

In the Draft and Final EISs, DOE acknowledges that a very severe highway or rail accident, or a successful terrorist attack using high energy explosives, could release radioactive materials from a shipping cask, resulting in radiation exposures to members of the public and latent cancer fatalities (LCFs) among the exposed population

In the Draft EIS, DOE evaluated a "maximum reasonably foreseeable accident scenario" involving a rail at a generic urban location. Following the accident severity categories designated by the NRC Modal Study, DOE estimated the consequences of the most severe (category 6) rail accident using the RISKIND computer code. DOE estimated that the accident would release and disperse enough radioactive materials to inflict a collective population dose of 61,000 person-rem (enough to give 61,000 persons a one rem dose) and cause about 31 latent cancer fatalities.

In the Final EIS, DOE changed the basis of its transportation risk assessment, relying solely upon a controversial new NRC contractor report prepared by Sandia National Laboratories (NUREG/CR-6672). As a result, DOE's estimated consequence of the " maximum reasonably foreseeable accident scenario" involving a rail cask was reduced to a collective dose of 9,900 person-rem and 5 latent cancer fatalities. [FEIS, Pp. 6-45 to 6-47, 6-49 to 6-50]

The FEIS acknowledges that the July 2001 Baltimore rail tunnel fire was so severe that it would have resulted in a release of radioactive materials if a rail cask had been involved. [FEIS, p. 6-50] The FEIS also acknowledges that clean-up costs following a severe transportation accident could range from $300,000 to $10 billion. [FEIS, p. J-73]

As part of its review of the Draft EIS, the State of Nevada commissioned several SNF accident consequence analyses by Radioactive Waste Management Associates (RWMA). In 2000, RWMA reexamined the DEIS truck and rail accident estimates, using the RADTRAN and RISKIND computer models and a range of credible alternative assumptions. In 2001, RWMA estimated the consequences of a rail SNF accident similar to the July 2001 Baltimore rail tunnel fire. Also in 2001, RWMA studied the consequences of credible worst case truck and rail accidents at representative urban and rural locations along potential Nevada highway routes. These studies concluded that DOE systematically underestimated the consequences of severe transportation accidents. The results of these studies are reported in State of Nevada impact report, A Mountain of Trouble, which can be accessed on the web at www.state.nv.us/nucwaste, or obtained in hardcopy by request from the Nevada Agency for Nuclear Projects (phone: 775-687-3744).

The Nevada-sponsored study of the July 2001 Baltimore rail tunnel fire concluded that it would have resulted in significant release of radioactive materials. It burned for more than three days with temperatures as high as 1500° F. A single rail cask in such an accident could have released enough radio-cesium to contaminate an area of 32 square miles. Failure to cleanup the contamination, at a cost of $13.7 billion, would cause 4,000 to 28,000 cancer deaths over the next 50 years. Between 200 and

1,400 latent cancer fatalities would be expected from exposures during the first year.

In both the Draft and Final EISs, DOE acknowledges that SNF truck casks are especially vulnerable to terrorist attack and sabotage. DOE and NRC testing in the 1980s demonstrated that a high-energy explosive device (HED) such as a military demolition charge could breach the wall of a truck cask. DOE sponsored a 1999 study of cask sabotage by Sandia National Laboratories (SNL) in support of the DEIS. The SNL study demonstrated that HEDs are "capable of penetrating a cask's shield wall, leading to the dispersal of contaminants to the environment." [DEIS, p. 6-33] The SNL study also concluded that a successful attack on a truck cask would release more radioactive materials than an attack on a rail cask. [DEIS, p. 6-34]

In the Draft EIS, DOE estimated that a successful attack on a GA-4 truck cask in an urbanized area under average weather conditions would result in a population dose of 31,000 person-rem, causing about 15 cancer fatalities among those exposed to the release of radioactive materials. In the Final EIS, DOE updated its sabotage analysis, assuming the cask contained more radioactive SNF and assuming a higher future average population density for U.S. cities. The Final EIS estimated that the same successful attack on a truck cask would result in a population dose of 96,000 person-rem and 48 latent cancer fatalities. [FEIS, Pp. 6-50 to 6-52] In neither case did DOE evaluate any environmental impacts other than health effects. In particular, DOE ignored the economic impacts of a successful act of sabotage in both the Draft and Final EIS.

Analyses prepared for Nevada by RWMA estimated sabotage impacts would be considerably greater than DOE's estimate. RWMA replicated both the Draft and Final EIS sabotage consequence analyses, using the RISKIND model for health effects and the RADTRAN model for economic impacts, the SNL study average and maximum inventory release fractions, and a range of population densities and weather conditions.

The Nevada-sponsored study of the Final EIS scenario concluded that an attack on a GA-4 truck cask using a common military demolition device could cause 300 to 1,800 latent cancer fatalities, assuming 90% penetration by a single blast. Full perforation of the cask, likely to occur in an attack involving a state-of-the art anti-tank weapon, such as the TOW missile, could cause 3,000 to 18,000 latent cancer fatalities. Cleanup and recovery costs would exceed $10 billion.

Public perception of transportation risks could result in massive economic costs in communities along transportation routes. Even without an accident or incident, property values near routes could decline by 3% or more. In the event of an accident, residential property values along shipping routes could decline between 8% and 34 %, depending upon the severity of the accident.

RAIL SHIPMENTS, DEDICATED TRAINS, AND RAILROAD SAFETY

Even if DOE is able to implement the "mostly rail" transportation plan, DOE's opposition to dedicated trains and other accident prevention measures raise grave concerns about DOE's commitment to transportation safety. The Association of American Railroads (AAR) has long contended that spent fuel should only be shipped in so-called special trains—dedicated or unit trains hauling only spent fuel and other radioactive materials, operating under special safety protocols such as speed restrictions (now 35 to 55 mph), buffer car specifications, and train passing rules.

Current USDOT regulations allow shipment of spent fuel casks in general freight service. The July 19-23, 2001, Baltimore rail tunnel fire has been cited as a prime example of the dangers of shipping spent fuel in mixed freight trains. The Baltimore fire has also rekindled calls for Federal regulation of spent fuel rail routing.

Nevada believes the following safety measures should be mandatory: (1) spent fuel should never be shipped in mixed freight trains; (2) spent fuel should always be shipped in dedicated trains; (3) these trains should operate under strict speed limits (35-55 mph) and special passing rules; (4) U.S. DOT should regulate the selection of rail routes to minimize shipments through urban areas; (5) federal emergency response teams and security escorts should accompany all rail shipments at all times. DOE and the nuclear industry oppose these mandatory safety regulations.

FULL-SCALE PHYSICAL TESTING FOR SPENT FUEL SHIPPING CASKS

NRC does not currently require full-scale physical testing of shipping casks as part of its certification process. Cask designers are allowed to demonstrate compliance with the NRC performance standards through a combination of scale-model testing and computer simulations. Nevada has long urged NRC to require full-scale

testing as part of certification. Alternately, Nevada has suggested that DOE require full-scale testing as part of the procurement process. NRC is currently proposing demonstration testing of a "representative" shipping cask as part of the Package Performance Study being conducted by Sandia National Laboratories. Nevada has not formally opposed NRC's proposal, but it is not an acceptable substitute for full-scale testing of each new cask design prior to certification.

Nevada has proposed a five-part approach to full-scale testing: (1) meaningful stakeholder participation in development of testing protocols and selection of test facilities and personnel; (2) full-scale physical testing (sequential drop, fire, puncture, and immersion) prior to NRC certification; (3) additional computer simulations to determine performance in extra-regulatory accidents and to determine failure thresholds; (4) reevaluation of previous risk study findings, and if appropriate, revision of NRC cask performance standards; and (5) evaluation of costs and benefits of destructive testing of a randomly-selected production model cask.

Nevada believes that comprehensive full-scale testing would not only demonstrate compliance with NRC performance standards. It would improve the overall safety of the cask and vehicle system, and generally enhance confidence in both qualitative and probabilistic risk analysis techniques. It could potentially increase acceptance of shipments by state and local officials and the general public, and potentially reduce adverse social and economic impacts caused by public perception of transportation risks.

Nevada estimates that the cost of a full-scale regulatory fire test for a truck cask would be less than $5 million. Comprehensive regulatory testing (drop, fire, puncture, and immersion) of a truck cask (up to 30 tons) would be between $8 million and $15 million. Comprehensive regulatory testing of a large rail cask (up to 125 tons) would cost $12 million to $25 million for the first cask, including the cost of required upgrading at the testing facility. By comparison, Nevada estimates the life-cycle cost of the repository transportation system at about $9.2 billion.

None of the SNF shipping casks currently used in the United States have ever been tested full-scale. This fact was confirmed by NRC Chairman Richard Meserve in letters to Senator Harry Reid dated April 2, 2002 and April 24, 2002. DOE has no plans for full-scale testing of the casks which would be used for shipments to Yucca Mountain. DOE and the nuclear industry oppose mandatory full-scale testing.

The CHAIRMAN. Thank you very much.

Before we proceed with the witnesses, let me see if Senator Murkowski or Senator Craig have a statement they'd like to make here at the beginning.

STATEMENT OF HON. FRANK H. MURKOWSKI, U.S. SENATOR FROM ALASKA

Senator MURKOWSKI. Thank you, Senator Bingaman.

I want to welcome the witnesses, and please do not mis-characterize my comments, because I do appreciate your input.

I was under the impression this was the opportunity for Nevada to be heard, and I'm looking over the list of the witnesses. I see Wisconsin, Michigan, Maryland, Utah, Sacramento. I don't see representation from Nevada. I can only conclude that perhaps Nevada's interest is not of the intensity that I once thought it was. Otherwise, we would be hearing from Nevada.

I've been on this committee for 22 years. We've had hundreds of witnesses discussing all facets associated with Yucca Mountain—at least 30 hearings. And they've all been worthwhile. However, they're a rehashing of issues that are associated with Yucca, such as transportation. And evidently the discussion today is going to involve pretty much around transportation, which to me is a separate issue that involves the licensing.

As you and I know, there is an extraordinary amount of high-level nuclear material that moves across our country safely. It's moved for many decades and will continue to move. So I'm not par-

ticularly motivated by the concern again over transportation, because these are "what ifs."

And the reality of this particular issue is nobody wants the stuff. It's got to go somewhere. Those that have it want to get rid of it. The only way to get rid of it is to transport it. And you're still left with the reality that nobody wants it.

I was just looking over here, relative to the circumstances that the Government finds itself in because of this dilemma, and as you may recall, gentlemen, the Federal Government was supposed to take this waste in 1998 under a contract with the nuclear power industry.

Well, the Government wasn't ready to take that waste even though the rate payers have paid in some $17 billion. The claims against the Federal Government for not taking the waste in 1998 are estimated to be somewhere between $40 and $80 billion. I grant you most of this will go to lawyers. But nevertheless we've seen a significant industry develop just on litigation. And, of course, the fall guy is the U.S. taxpayer.

I would hope that today's hearing would lead into a recognition that we want to resolve this issue and get on with it. So I'm a little disappointed that we've not heard from the State of Nevada, because it's my understanding that that was the proposed schedule, to hear from the State of Nevada on the reasons why the Governor vetoed the selection of Yucca Mountain as a repository for high-level wastes and spent nuclear fuel.

Now, as a sidelight for the mayor of Salt Lake, it would be interesting to see if the Goshute—I've been out there and looked at it, and they got a pretty rough piece of real estate when they were handed that particular land selection. I think you'd probably agree with me. There wasn't anything else left. They drew the short straw. But in any event they have offered to take this waste and store it in a temporary repository. It would be interesting to see if this is ever resolved, because it addresses an issue that—for those of us in the west—have always speculated on. Is there really a tribal sovereignty government-to-government relationship, where they can bypass the attitude of the State or the city of Salt Lake? We may come to a resolution of that. We may not. But that would be an interesting issue for the courts. But I'm fearful that it would take so long that we'd never get to it.

Now, I was looking forward to hearing from the Governor and the legislature about the reason for the State's veto, as well as for many other Nevadans who may be opposed to this. I think this would have been important, because while the Nuclear Waste Policy Act is very clear on the administration's responsibility for site selections, it's ambiguous on the criteria for the State of Nevada to accept or veto that decision. Unfortunately, we're not going to have the opportunity today, because no one from the State is appearing to speak on behalf of the State.

Instead, we have a slate of witnesses who will speak to issues that I think are unrelated to the limited question before this committee, and that is the question of the sufficiency of the site selection. The concerns that our witnesses will raise go to other issues—transportation—that will be addressed by the administration and the Nuclear Regulatory Commission during the licensing process,

where it is most appropriate. Because the witnesses will not be speaking to the direct issue before the committee, one could easily assume, as I have implied, that the State does not have an issue with the site selection.

In any event, Mr. Chairman, we've provided an opportunity for the Governor, the delegation, and other officials from the State of Nevada to appear before the committee to discuss the veto, and they have chosen to decline.

I do not want to suggest, however, that the issues these witnesses will address are not important. They are very, very important. They are simply not pertinent to the decision on the resolution before our committee at this time.

The fact is, like it or not, we are now transporting spent fuel and legacy waste and will continue to do so, whether the destination is Yucca or Hanford or the Goshute reservation or in New Mexico or in the granite depositories associated with Vermont. But I'm not going to push that too far, although it comes to mind once in a while.

Even if we were to uphold the Governor's veto and all the spent fuel and waste remained permanently on site, say in New York or several sites in California or the shores of the Chesapeake Bay, Lake Michigan, or elsewhere, we would still continue to transport waste. The committee, however, should take comfort in knowing that apparently the State of Nevada doesn't seem to have any objection to the actual site selection decision itself, and when all is said and done that is the only issue before the committee at this time.

My good friend from Nevada, on my left, may have a difference of opinion. But we are disappointed that Nevada is not here to speak on the issue.

Thank you, Senator Bingaman.

The CHAIRMAN. Let me—we usually just have opening statements from the chair and the ranking member. Let me just ask if any of the other committee members wish to make an opening statement. If they do, they could.

Senator CRAIG. No, Mr. Chairman. I'm anxious to hear from the witnesses. Thank you.

The CHAIRMAN. Senator Thomas.

STATEMENT OF HON. CRAIG THOMAS, U.S. SENATOR FROM WYOMING

Senator THOMAS. Thank you, Mr. Chairman. Just very briefly.

I just want to indicate that in our home paper in Wyoming, some deputy assistant attorney from Nevada had this stuff in there about transportation, that every 10 minutes there's going to be something going through all of our towns and so on. The fact is that isn't true. The projection here is 175 annual shipments. There's three million shipments of radioactive waste done every year now. So I just hope that when we talk about this issue, we can try to get down some facts and not the scare tactics that are being used currently, at least as I see it in my paper.

Thank you, Mr. Chairman.

The CHAIRMAN. Next we'll hear from Dr. James David Ballard, who is with Grand Valley State University, Office of Criminal Justice, in Grand Rapids, Michigan.

I'm very glad to have you here. Please go ahead.

STATEMENT OF JAMES DAVID BALLARD, Ph.D., ASSISTANT PROFESSOR OF CRIMINAL JUSTICE, GRAND VALLEY STATE UNIVERSITY, GRAND RAPIDS, MI

Dr. BALLARD. Good morning, Mr. Chairman and members of the committee. As you mentioned, my name is James David Ballard. And I am a former resident of Nevada, a graduate of UNLV. So I kind of represent the State even though I live in Michigan these days.

The proposed shipments to Yucca Mountain facility will come from energy-, research-, and defense-related facilities. These shipments will traverse the roadways, railways, and shipping lanes of America. The proposed program will require decades of effort to complete. Removing such radioactive cargoes from the confines of their existing safe and secure facilities and exposing them to the dangers inherent in a massive transportation effort is not an optimal safety or security risk reduction strategy. Make no mistake. Terrorism is a threat to these shipments.

Counter-terrorist experts recognize these cargoes for what they could become, potential weapons of mass radiological contamination. September 11 showed that terrorists would use weapons of mass victimization, multiple attack locations, asymmetrical tactics that could wreak havoc on our economic, social, and political stability. Let me reiterate. These cargoes have the potential to be used as weapons of mass victimization.

The potential effects of a human-initiated release of the radiation contained in these shipments include massive public health impacts, cascading response demands on the emergency response infrastructure, severe impacts on the social fabric of the country, economic impacts that could dwarf those seen by September 11, and severe stigmatization of the communities where release would occur. Remember that for radiological dispersion to occur, only two components are needed. The first is explosives or a physical release mechanism. The second is radiological materials. Clearly, with these shipments and their cargoes, we only need to add the first.

It is also important to recognize that these shipments are an attractive target for a variety of terrorist organizations. For example, because of the connection between some cargoes and our military infrastructure, there exists the potential for retaliation attacks from international groups. Likewise, attacks on energy-related targets are not uncommon internationally and were of real concern at a recent G8 meeting held in Detroit. The shipments may also attract considerable attention from domestic groups, who have already demonstrated their abilities with a 1986 attempt to derail a train carrying spent nuclear fuel just outside of Minneapolis.

No matter the origin of the adversaries, I would ask you to think of the impact of the attack on the long-term viability of the energy industry and the negative economic impacts on the commodities markets if an attack was to be perpetrated. The effects of September 11 may pale in comparison.

America is not immune to external or internal attacks. But the primary reason why these shipments will be a target is their symbolic value to terrorists. What does this mean? Just as the World Trade Center was not just a building, an attack against these waste shipments is not just an inconsequential incident probability to be explained away by statistics. To understand these facts, we should not forget that these shipments are radioactive and the general public fears this fact.

Secondly, the cargoes are dangerous, not only in a symbolic sense, but they represent a potentially viable weapon of mass radiological contamination.

Third, the whole shipment effort has the potential to create a mass counterculture-based revolutionary opposition movement.

Several examples of attack scenarios should help illustrate what is at stake. They are exemplars of asymmetrical tactics that could be used by terrorists.

The first is a capture and breach scenario. If the transportation vehicle and cargo were to be captured, it would be susceptible to the application of explosives and/or a human-engineering breach.

Secondly, we should consider a transportation infrastructure attack. The huge variety of topography and the enormous number of tunnels, bridges, and interchanges that would be traversed in the nationwide shipment of these materials need to be considered.

Third, we must address the risk of an attack using current generation weapons, weapons like readily available anti-tank missiles, like armor-piercing weapons, and the emerging category of weapons that are able to penetrate and/or destroy these cargoes or at least their containers.

Knowing how to attack a shipment is not enough. We should consider if a terrorist group could locate these cargoes. Potential shipment saboteurs and attackers will be presented with what is called a target-rich environment, due to the frequent and persistent shipping pattern, as well as the physical size and unique configuration of the shipment containers.

Clearly, the shipments will not be as safe and secure during transit as they are where they now reside. They will become a symbolic target, face a variety of adversaries, both foreign and domestic, be subject to asymmetrical tactics, and have the potential to be used as a weapon of mass radiological contamination. In short, moving them increases our risk of terrorist attack. It does not decrease the risk.

The alternative available to you today and in the next weeks is far easier and more logical than going forward with the Yucca Mountain proposal. If allowed to be stored at their existing facility for 50 to 100 years, these wastes will become less viable as a weapon. Thus, one option is to make the DOE shelter them in place.

Terrorism is a viable threat to nuclear waste shipments. The engineered controls put into the shipment containers are not equal to the challenge of asymmetrical terrorist tactics and motivated adversaries willing to commit what they consider altruistic suicide in the name of their cause.

The multiple attacks on September 11 changed how we live. In this instance, to counteract the enduring threat posed to our way of life, we must reconsider the logic of the Yucca Mountain pro-

posal. Allowing the DOE and NRC to proceed is tantamount to endorsing bureaucratic indifference of unimaginable consequences. Please, not on this watch and not with these dangerous cargoes.

Mr. Chairman, members, thank you for the opportunity to testify.

[The prepared statement of Dr. Ballard follows:]

PREPARED STATEMENT OF JAMES DAVID BALLARD, PH.D., ASSISTANT PROFESSOR OF CRIMINAL JUSTICE, GRAND VALLEY STATE UNIVERSITY, GRAND RAPIDS, MI

Mr. Chairman and Members of the Committee, my name is Dr. James David Ballard. I am an Assistant Professor of Criminal Justice at Grand Valley State University in Grand Rapids, Michigan where I teach a variety of courses on terrorism, research methods, criminology, and criminal justice. I am a sociologist and my training at the University of Nevada, Las Vegas was in political sociology, deviance, and criminology.

Currently, around the world research is being done on the potential for attacks against nuclear facilities and radioactive waste shipments. I am involved in one such working group. This international effort includes a number of researchers from Stanford University, experts tied to various government agencies, and is being funded by a grant from the North Atlantic Treaty Organization [NATO].

For the last seven years, I have studied the risk of terrorism attacks on nuclear waste shipments to the proposed Yucca Mountain storage facility. In particular, I study the changing nature of terrorism and the terrorist tactics that could be employed against nuclear waste shipments. I appreciate the opportunity to provide this body with some information on the potential of terrorism attacks against the shipments of spent nuclear fuel [SNF] and high-level radioactive wastes [HLRW] that could be made to the proposed Yucca Mountain facility.

INTRODUCTION

Several factors are important to recognize when considering the potential of terrorism against nuclear waste shipments to the Yucca Mountain facility. The proposed shipments to the Yucca Mountain facility will come from energy, research, and defense related facilities. These shipments will traverse the roadways, rail corridors, and shipping lanes of America and require decades of effort to transfer from their existing safe and secure facilities and to the proposed repository.

This process could happen under a variety of circumstances. For example, it could start once the Yucca Mountain facility is licensed for use by the Nuclear Regulatory Commission [NRC]. If that process is completed, and the decision then passes expected legal challenges, the Department of Energy [DOE] would then have to finalize the planning for the construction of the Yucca Mountain repository, construct a huge fleet of shipment containers, and only then would the proposed facility be ready to accept shipments from around the country. Other possibilities exist, but what matters is that you have a chance to influence the eventual outcome. Understanding terrorism as a risk to these shipments may help that policy decision.

Most experts would agree that removing such highly radioactive cargoes from the confines of their existing safe and secure facilities and exposing them to the dangers inherent in the massive transportation effort necessary to move them to Nevada is not an optimal safety and security risk reduction strategy. For example, two significant and unique risks would arise when removing these cargoes from their existing facilities and the subsequent transportation effort: Transportation accidents and in-transit terrorism attacks. The discussion that follows is focused around several of the most common questions surrounding the risk posed by these shipments with respect to in-transit terrorism attacks.

IS TERRORISM A THREAT TO THESE SHIPMENTS?

When we ask the question is terrorism a threat to these shipments, the answer is a definitive yes. The attacks of September 11, 2001 demonstrated that terrorists continue to develop an interest in weapons of mass victimization and have seemingly perfected the use of asymmetrical tactics that can wreak havoc on the economic, social, and political stability of our nation with a single act of terror. Subsequent investigations of the infrastructure behind these particular attacks revealed an active interest by al Qaeda and others in the development of nuclear weapons of mass destruction and radiological weapons of mass contamination. The latter category is where the risks lie for shipments of radioactive wastes like SNF and HWRW to the proposed Yucca Mountain facility.

What is being transported sounds benign when it is labeled "waste products" or "spent fuel rods," but terrorists and counter terrorism experts recognize these cargoes for what they could become: Potential weapons of mass radiological contamination. Each of these shipments represents a huge inventory of highly radioactive materials including such cargoes as pressurized fuel assemblies, transuranic wastes, and surplus weapon grade plutonium. If these materials were to be deliberately released into the environment during transit, they would create potentially massive public health impacts, cascading response demands on the emergency response infrastructure of the United States, severe impacts on the social fabric of this country, economic impacts that could dwarf those seen from the September 11, 2001 attacks, and severe radiological contamination based stigmatization of the communities where the release occurs.

Obviously, a human initiated release from any one of these shipments has the potential to contaminate the local community where an incident occurs with radiation. To avoid long-term national level dislocation of vital services that such an attack could induce, and to counteract potential negative human health consequences that would occur from such a deliberate exposure to these radioactive cargoes, would require immediate intervention, extensive environmental remediation, and would ultimately require an unprecedented national response equal or greater than that mounted to counteract the September 11, 2001 attacks.

Nuclear and radiological terrorism encompass two large categories of weapons. The first category is related to bombs that create a nuclear reaction and involve a massive explosion, radiation dispersion, and widespread destruction of property. The materials in SNF and HLRW cargoes will not be equal to these types of weapons in terms of overall effect, but they can be weaponized and thus fall into the second category of radiological weapons. The weaponization process using radioactive source materials like SNF and HLRW is referred to as a radiological dispersion device. The human initiated release of these particular radioactive cargoes would constitute a potential large-scale radiological dispersion incident.

For radiological dispersion to occur, two components are needed: (1) explosives or a physical release mechanism and (2) radioactive source materials. The larger the inventory of source materials, and the more dangerous the inventory of radionuclides, the greater the impact of dispersion into the environment an incident would have. SNF and HLRW shipments clearly have the potential for use as radiological dispersion devices under certain circumstances. These circumstances depend on a variety of factors and several are noted in the discussion below.

WHY TARGET THESE SHIPMENTS AND NOT OTHER HAZARDOUS MATERIALS, RADIOACTIVE CARGOES, OR RADIOACTIVE SOURCES?

Several factors would make these shipments prime targets for a terrorist attack and attract the attention of potential adversaries. These include both factors that may attract international groups and those that may inspire domestic groups to commit an act of violence against the shipment. After noting these factors, it will be argued that another more important factor has been neglected in the discussion of safety and security; that is the symbolic value of the attack against radioactive waste shipments and disposition of the cargoes thereafter.

First, it is important to recognize that these shipments might be an attractive target for international groups. They will represent an easily identifiable target, one that is predictable, and one that because of the longevity of the shipping campaign will allow for detailed planning and support from transnational sources. Because of the connection between the cargoes and our military infrastructure, there also exists the potential for retaliation attacks. Likewise, attacks on energy infrastructure have been a concern of terrorist experts for decades and were the discussion topic de jour for a recent G8 Energy Ministers meeting in Detroit. Also, anyone attacking these cargoes would be able to create an enormous economic impact by the introduction of "event risk" into the energy industry and its related commodities markets. These and many other factors all raise the international terrorism risk profile for the agencies and industries wishing to transport shipments of highly radioactive wastes, especially on the scale proposed for the Yucca facility.

The shipments may also attract considerable attention from domestic groups willing to perpetrate violence to press their political and social agendas. These domestic terrorists could be motivated by a variety of factors. For example, they could be opposed to the forced acceptance of energy wastes into their state. Deeply held distrust of the DOE and its motives with respect to nuclear wastes may inspire individuals to commit violence against SNF and HLRW shipments.

Domestic groups could also be motivated to commit violent acts in opposition to the shipments and nuclear facilities by using a variety of tactics. One example that

is illustrative of the potential for attacks was a 1972 hijack incident where the perpetrator threatened to crash an airplane into a research facility at Oak Ridge, Tennessee.

Additionally, potential domestic adversaries could include radical groups similar in philosophy to the Earth First and Sagebrush Rebellion movements. Such groups, and those who would emerge over the lifespan of the proposed project, could represent as large a threat as a well-financed international terrorist organization.

Domestic groups may have different motives than international terrorists, but we must recognize that America is not immune to internal attacks, even potential devastating attacks using mass radiological contamination tactics. After all, we have already witnessed a 1986 domestic terrorist incident where a group was willing to remove a rail section in front of a train carrying SNF at a location just outside of Minneapolis, Minnesota. While not successful, this was an organized attempt to derail the radioactive cargo and draw attention to the groups" opposition to the shipment of nuclear wastes.

Make no mistake, interest in radiological terrorism is not only on the terrorists' radar, but should be on policy makers' radar as well, since counter terrorist experts recognize that the future is not without serious risk of such attacks. While noting which groups could mount an attack is one way to begin to identify the risks these shipments pose, this exercise misses one of the most important aspects of why these shipments will become targets. The primary reason why SNF and HLRW shipments could become targets is their symbolic value to terrorists. The next section addresses this critical issue.

WHAT IS THE LINK BETWEEN SYMBOLIC VALUE AND TERRORISM ATTACKS AGAINST NUCLEAR WASTE SHIPMENTS?

Terrorism is generally defined in terms of the tactics used in the attacks, by use of a typology of potential adversaries, and/or within the confines of criminal law. Another way of understanding terrorism is to focus on why certain targets are more attractive than others.

For example, why was the World Trade Center the target of repeated attacks? To answer that question we must understand that these buildings represented more than just steel and concrete. To the terrorists that attacked the complex in February 1993 and again in September 2001, this office and commercial complex represented American economic strength. These attacks were against the core values of this society and the financial force behind American global economic dominance. They were not merely attacks against buildings, nor were the buildings just a target for random violence. The attacks meant something and were designed to convey a message to America and the world community.

So, could an attack against SNF and HLRW shipments be seen as such a symbolic act? Absolutely. To examine this idea, it is important to note several relative features that will help in an understanding of the symbolic value of these shipments.

First, at a most basic level, we should not forget that these shipments are radioactive and the general public fears this fact. The cultural conditioning represented by such historical facts as the decades long Cold War doctrine of mutual assured destruction, and the images of mass victimization and destruction documented after the use of nuclear weapons during WW II, has contributed to a generalized and specific anxiety about radioactivity and all things nuclear.

These historical facts are coupled with a generalized public distrust of the DOE and its management of the nation's nuclear weapons arsenal, the by-products of the weaponization of the atom, and what some consider the trivializing attitude taken by the energy industry and this federal agency when it comes to the safety and security of the public health, environment, and economic well being of the nation. Critics would point out that this is, after all, the same federal agency that was responsible for unethical medical tests on humans to determine the health effects of radiation and it is the agency most responsible for the serious mismanagement of such radioactive sites as Hanford, Washington and Rocky Flats, Colorado.

Regardless of the actual health hazards posed by these shipments, any incident involving these cargoes would elicit a public response of fear, panic, and distrust of any authority figure wishing to explain the health science of radioactivity over the reality of the public perception of the risks they were exposed to during a contamination event. The symbolic value of an attack against highly radioactive waste shipments should not be underestimated, since such perceptions are very real in their adverse political, economic, and social consequences.

Secondly, the cargoes are dangerous. The DOE itself reports that truck and rail casks will carry inventories of between hundreds of thousands to millions of curies respectively. Thus, they are not only dangerous in a symbolic manner, they rep-

resent a potential weapon of mass radiological contamination. A weapon that if used would create a backlash against the continued use of nuclear power in America, a backlash against federal agencies and their efforts at transporting these materials, and a backlash against anyone in charge at the time of the attack, and responsible for protecting public health and welfare against such actions.

For example, imagine if you will how an attack, successful or not, would threaten all nuclear power and research, create an immediate stoppage of shipments and cause an extensive investigation into safety and security procedures. Additionally, it would be a publicity disaster of unimaginable proportions for those charged with the moral, legal, and ethical responsibility of protecting the public.

A proactive search for a more viable and safe alternative, like a 50-100 year term strategy of sheltering the wastes in place at their existing storage facilities, would allow the public to gain a semblance of acceptance for DOE actions and thus reduce the potential impact of this particular symbolic effect. The current DOE efforts to push ahead with the Yucca Mountain proposal, without completing the scientific study of the proposed repository, can only fuel fear of the DOE and increase the symbolic impact of this type of attack. Likewise, the failure by the NRC and DOE to adjust to the new reality of terrorism may have an equal or greater devastating consequence.

Lastly, the whole shipment effort has the potential to create a mass counter culture based revolutionary opposition movement similar to that seen in recent years regarding the negative effects of globalization. Here, public safety and security experts saw the banding together of dissimilar groups like anarchists, labor advocates, and human rights activists to symbolically fight what they may consider the negative aspects of globalization.

This is an illustrative model for future large-scale opposition groups who will oppose the shipments to the proposed Yucca facility. The result of this social development is that America will be facing what has already transpired in Germany and other industrial nations: Widespread anti nuclear protests from well-organized and highly motivated protest groups. These shipments have the symbolic value of sparking such protests and these in turn increase the risks of an attack when transporting the materials, not necessarily by the groups themselves, but by others and within the context of their protests.

The symbolic nature of terrorism is multifaceted and difficult to codify into risk assessment methodologies, especially when those methods do not account for asymmetrical situations that could lead to an increased risk of an attack. Likewise, it is difficult to assess the risk of attacks when the DOE and NRC consider few, if any, non-traditional terrorist tactics that may form the basis of a human initiated mass contamination event using radioactive wastes. The connection between symbolic events and waste shipments is examined in the next section of this testimony.

WHAT TYPES OF SYMBOLIC OR EVERYDAY SITUATIONS COULD BE ENVISIONED AND COULD THEY BE A THREAT TO SHIPMENT SECURITY?

One symbolic issue not necessarily recognized in shipment planning, and that is subject to change over time as America becomes more populated, is that of geographic location. The attack location plays an important symbolic part in the identification and assessment of situational terrorism risks for SNF and HLRW shipments from the existing production and storage sites and to the proposed repository. Examples include:

1. Highly populated urban locations, especially large downtown office buildings, shopping districts, hotel complexes, convention centers, and specialized tourism areas are a different area of concern. These locations are different from other populated areas since urban attacks pose a different level of logistical challenge to the first responder community. Urban attacks may also create an initial higher public relations profile for the terrorist cause because of their proximity to a more intense concentration of media outlets.

2. Locations of special events such as the Olympics, the Super Bowl, and other major sporting events, major international trade shows or conventions, and national political party conventions are examples of other types of situational events that will offer attractive symbolic target opportunities. These events have a symbolic value that could potentially draw an adversary because of the potential media coverage and/or because of the adversary's ability to communicate a message by attacking a particular type of event.

3. Suburban locations near residences and difficult-to-evacuate facilities such as schools, hospitals, airports, shopping malls, industrial plants, amusement parks, sports stadiums, race tracks, and concert halls. The symbolic value of these targets and the motivation to perpetrate an attack in close proximity to these types of areas

differs from that found in other areas. For example, a terrorist could choose to perpetrate an attack on these geographic areas to create a highly disruptive mass evacuation event.

4. Rural locations near environmentally sensitive activities and resources such as farms, ranches, surface and underground water supplies, resorts, wildlife refuges, parks, and other public recreation facilities. Such areas have a different symbolic factor than that posed by other geographic areas, and the aggravated use of that value depends on the motives of the adversary.

While location and situational factors are important, the outcome of a human initiated mass radiological contamination event can vary, depending on a number of variables. These factors could include the motivation of the adversary, the type of attack, the weaponry used, and other salient variables. Proactive terrorist risk assessment methodologies would account for such variations in tactics and recognize the variability of the symbolic value a terrorist could attach to such tactical considerations.

For example, when considering these shipments and the contemporary terrorism threat potential, it is important to consider a range of terrorist attack outcomes such as:

1. Attacks designed to induce a breach of the cask where the contents are damaged, where the various radioactive cargoes to be transported are released into the environment, and where the effects of radiation emissions as a result of the loss of shielding could be a danger to human health.

2. Attacks can also yield a result where the cask is damaged, but with no large-scale release of radioactive materials. This could result in a measurable radiation emission from loss of shielding, but not a radiological dispersion equal to that from a full breach.

3. An attack could also yield a cask, the transportation vehicle, or the transportation infrastructure being damaged during the attack, but because of the engineered controls and physical design of the cask, the shipment would suffer no release and no loss of shielding. The recovery effort for such an incident would be delicate since there would exist a potential loss of containment and/or shielding, but in general this would be a less risky situation than that posed by a full or partial breach of the shielding.

4. The fourth category is where the cask is undamaged and the attack fails to yield any chance, or actuality, of a radiological dispersion. Under this scenario the actual attempt itself would have symbolic ramifications as noted above.

Considering the range of outcomes of an attack against these shipments by use of such a typology is a critical omission in current analytical and methodological assessment models being used by the DOE, NRC, and various agencies and contractors who are assessing the security of these shipments. In the next section specific types of attack scenarios are discussed to help illustrate the evolving nature of the vulnerability of these shipments and how transportation planners who focus only on past experiences with shipments, and not on the future risk realities that these shipments will face, underestimate the impact of the changing face of terrorism.

WHAT TYPES OF ATTACKS ARE VIABLE AGAINST THESE SHIPMENTS?

The attack scenarios presented below are composites of more detailed work presented by Nevada and various academic experts from around the world. They represent several of the many varieties of in-transit terrorism tactics that have yet to be studied in any meaningful way as very real and probable transportation events during the lifespan of the proposed shipment effort. They also represent one way to understand the risks these shipments pose, since they are exemplars of asymmetrical tactics not addressed by DOE/NRC regulation and/or security practice in the American radioactive waste transportation industry.

The first is a capture and breach scenario. If the transportation vehicle and cargo were to be captured and placed in an immobile state by any number of means, it would be susceptible to the application of explosives and/or a human engineered breach.

Traditionally, most regulatory and security tactics focus on denial of the opportunity to capture and transport the radioactive cargoes thereafter, but this is an altogether different tactic and requires different responses.

Success by the terrorists at fielding a capture and breach tactic would depend on how long the incident response would take and how effective the terrorists could be at holding off local emergency responders. Thus, depending on their success, the cargo could become a radiological dispersion device if the attackers were to breach cargo shielding and release the radioactive contents into the environment wherever the location of the incident.

Several relative capture and breach factors not currently anticipated, or underestimated, by waste shipment risk analysis and security practice, include the presence of pressurized cargoes and the potential radiological dispersion effect of internal cask gasses, the preexisting physical degradation of the fuel pellets in SNF cargoes that could increase the amount of respiratable particles subject to dispersion, and the potential to further degrade the integrity of the cargoes as a result of a co-existent fire resulting from the terrorist attack, and thus increasing the radioactive dispersion plume.

The capture and breach scenario may represent one variety of a maximum severe incident and could result in a release of radioactive cargo not anticipated by current regulations and/or cask design specifications. Compounding the analysis of this scenario would be such variables as the type of cargoes, the preexisting integrity of the cargoes, and the potential for a co-existent fire that may increase the distribution of the plume after an incident would transpire.

A transportation infrastructure attack scenario would likewise represent a risk to these cargoes. The huge variety of topography, and the enormous range of infrastructure components that would be traversed in the nationwide shipment of SNF and HLRW present unique challenges to Yucca Mountain transportation safety and security planners. For example, a deliberate collapse attack on a radioactive waste shipment in a tunnel could expose the cargo to risks of an impact breach, a crush breach, and/or a fire related incident sufficient to cause a failure of the controls engineered into the physical design of the casks that would eventually be used to move these cargoes. Likewise, an attack that took place on a bridge and in proximity to populated areas (e.g., the Hudson, Delaware, etc.) may also pose unique security challenges.

The transportation infrastructure breach is likewise a type of asymmetrical scenario that may represent a maximum severe incident and could potentially result in a release of radioactive cargo not anticipated by current regulations and/or cask design specifications.

Another scenario example is that of a remote attack using current generation weapons. If the transportation vehicle and its cargo were to become vulnerable to line of sight or direct attack tactics and weapons (e.g., readily available anti-tank missiles, stolen military armor piercing weapons, and/or one of an emerging generation of munitions with sufficient penetrating power), an adversary could use existing regulatory protocols like the disabling device on these vehicles, and/or in conjunction with geographically disadvantageous locations, to isolate the moving target, fix that target, and attack the vehicle from a distance of upwards of 3000 meters.

Remote attacks using such weapons as the Milan or TOW II missiles are a type of scenario that may represent a maximum severe incident and could potentially realize a release of the radioactive cargo not anticipated by current regulations and/or cask design specifications. This type of attack scenario will evolve over time and as increasingly more sophisticated weapons become available on the black market.

WHY REPOSITORY SHIPMENTS ARE MORE VULNERABLE TO ATTACK THAN FIXED SITE LOCATIONS

Once repository shipments begin, saboteurs and attackers will be presented with what is called a "target rich" environment. This tactically advantageous environment will provide them the opportunity to plan and execute a terrorist attack, using features of the proposed transportation effort to their advantage. The shipments will not be as secure as they would be if stored at nuclear power plants or DOE facilities, since it would be impossible to recreate the same level of safety and security used in these facilities. In fact, these waste shipments will be more vulnerable than if they were left where they currently are. They will become a symbolic target, face a variety of adversaries both foreign and domestic, and have the potential to be used as weapons of mass radiological contamination.

The overall time and effort necessary to transport the materials across the country is an advantage to terrorists. The choice of a single centralized repository that is located far from the majority of production sites is another advantage, since these shipments will need to travel long distances. Such sustained transportation efforts will produce easily identifiable and predictable shipment characteristics such as set times of day when a shipment is most likely to pass an attack location and large numbers of shipments along identifiable routes from which adversaries could pick and choose their targets.

Such a massive shipment effort also affords the terrorist multiple and simultaneous attack opportunities. After September 11, 2001 it is hard to disregard the potential for large-scale suicide based terrorist attacks transpiring in different locations at the same time and focused on the same type of symbolic target. The num-

bers of shipments (be they in the form of the DOE's mostly rail plan, the mixed rail/highway plan, or the primary highway shipment plan) will increase the likelihood of an adversary being able to acquire the target (shipment) and thereafter execute an attack on one or more of the many highway, railway, or waterway shipments that will transpire.

Massive numbers of shipments, predictable schedules, identifiable cargoes, and the overall length of the transportation routes, are all factors that add additional risks to the proposed Yucca Mountain program. The additional miles equal many more insecure areas and lower the potential for appropriate security defenses that can be planned and executed. Moving these materials out of their current safe and secure locations decreases the potential defense options available to counter terrorism planners, since the ability to secure tens of thousands of miles of roadways, railways, and waterways at the same level as that available at a power plant would be nearly impossible to achieve.

The policy alternative available to you today is far easier and more logical than adding more targets for terrorists to attack across the span of America's transportation infrastructure. From a strictly security and safety standpoint, these materials are better off where they sit, behind the security of walls and fences, protected by trained and professional plant security, and secured by regulations and procedures that have been designed to protect fixed site locations where nuclear wastes are stored.

If allowed to be sheltered in place at those facilities for 50 to 100 years, these wastes will become less and less toxic. That means that their radioactive inventory will become less of a risk to move, and the symbolic value of an attack will be reduced. We are in an enduring period of threat by terrorists and since this nation will not soon be abandoning its use of nuclear energy, allowing these cargoes to be sheltered in place is a viable alternative.

CONCLUDING REMARKS

Terrorism is a viable threat to nuclear waste shipments and the engineered controls put into the shipment casks are not equal to the challenge of asymmetrical tactics and motivated adversaries willing to commit what they consider altruistic suicide in the name of a cause. Current regulations, practice, and engineering do not account for the potential of 21st century terrorism and emerging modifications in terrorism tactics and philosophy.

Terrorism is changing, and to counteract the enduring threat posed to our way of life, we must reconsider our existing and future tactics and security arrangements. Until a safe and secure transportation plan capable of protecting the public interest can not only be articulated but battle tested, a plan that accounts for the radical change in terrorism illustrated by the September 11, 2001 attacks, we should stop the forward movement of this risky process.

Without due consideration and contingencies for the emerging asymmetrical terrorism tactics, it is folly to proceed with the Yucca Mountain project. Likewise, allowing the DOE and NRC to proceed without due consideration of the actual risks posed by terrorism is tantamount to endorsing bureaucratic indifference of unimaginable consequences.

I urge this body to solicit testimony not only on the historical safety and security records of these agencies, but to seek out the actual plans that have been developed to face the world we live in today, a world where large groups of well trained and highly motivated adversaries are willing to commit mass suicide to achieve an objective. A world where the unwritten prohibitions against mass murder by terrorist attack has not only been replaced, but what has been embraced in its place is a world where the terrorists are rewarded for mass victimization.

While no assurances can be made for the future, one thing is certain—if we offer an attractive target, someone will make an attempt to attack it. Do not allow the nation's nuclear waste products to become the golden carrot for would be terrorists. Nuclear waste shipments will be targets and unlike other targets, these shipments will have sufficient symbolic value to attract well-motivated and dangerous adversaries. Do not give them the easy opportunity to prove us unprepared once again.

Mr. Chairman and Members of the Committee, thank you for the opportunity to testify and answer questions today.

The CHAIRMAN. Thank you very much.

Next we'll hear from Dr. Victor Gilinsky, who is a former member of the U.S. Nuclear Regulatory Commission and is now a consultant.

Go right ahead, Dr. Gilinsky.

STATEMENT OF VICTOR GILINSKY, Ph.D., FORMER COMMISSIONER, NUCLEAR REGULATORY COMMISSION

Dr. GILINSKY. Thank you, Mr. Chairman. I am Victor Gilinsky. I am an energy consultant and a former NRC commissioner. I've been engaged by Nevada to help out on Yucca Mountain issues.

I'd like a few minutes to concentrate on the two issues that I think are most important for your upcoming vote. The first is the relation of Yucca Mountain to the future of nuclear power in the United States. Some people think that is the real issue and a reason for approving the project no matter what. I'd like to persuade you that nuclear power is not at stake in this vote.

My second point concerns the validity of the assurances that you've received that the project is based on sound science. Here I want to underline the importance of the reservations of the nuclear waste technical review board.

To consider the first point, what Yucca Mountain means for nuclear power, we can learn something from history. You know, the Government's plan in the early 1970's for long-term waste management was for what we would now call "monitored retrievable storage." The Government moved away from that plan and adopted the current deep geologic permanent repository concept primarily because this was thought at the time necessary to protect the nuclear industry's immediate future.

To fight off court challenges at the time by environmental opponents, it was thought essential by top officials, top nuclear officials, to be able to say there was a permanent solution to the nuclear waste problem. And so in this way, without much further thought, the Government lashed itself to the concept of permanent disposal. And this concept then took on a life of its own. Because permanent disposal entails or carries with it the possibility of irretrievable and irremediable error, the whole area became enmeshed in controversy, which continues.

Now, I bring this up because the current effort to stampede the Nation into Yucca Mountain continues to be premised on the mistaken assumption that the future of nuclear power in this country depends on this project. It does not. The truth is that Yucca Mountain is not needed to continue or even expand nuclear power use. There is ample opportunity to expand existing NRC-approved onsite storage. In time the spent fuel casks should be collected at locations specifically dedicated to spent fuel storage. But the important thing is that there is time to do this and to do a good a responsible job in terms of safety and security and to do it at far lower cost than would be done at Yucca Mountain.

And also do not think that if we go forward with Yucca Mountain this is going to be a plus for the nuclear industry. It's more likely to be a continuing source of contention that will spill over into other aspects of nuclear power, contentions over safety, over the environment, over Federal preemption, over licensing shortcuts, over transportation, and over its huge and growing expense.

DOE actually brags about the money spent so far in researching this site, as if to say billions of dollars can't be wrong. This brings me to the issue of sound science.

Now, proponents obviously accept the assurances; opponents don't accept the assurances. But significantly everyone agrees that

you have to be convinced that the project is based on sound science in order to approve it.

So now consider what the real experts, the members of the nuclear waste technical review boards say about it. As you know, the board has termed the technical basis for DOE's repository performance estimates as "weak to moderate." That's not a very good grade and not a very good report.

Among other things, the board has criticized lack of critical corrosion data on the metal waste containers that would be deposited in the repository. Now that's especially important as DOE relies almost entirely on the integrity of the waste containers to meet NRC's licensing standards. More generally, the board has made clear that categories of technical work that should have been done by DOE before site selection have not been done.

Now, I've said the board members are experts. More importantly, they are your experts, your technical watchdogs. Congress created the board in 1987, and the law says, "to evaluate the technical and scientific validity of activities undertaken by the Secretary." In this sea of controversy, they are just about the only ones you can rely on for highly competent and impartial advice. If the board doesn't give this project its strong endorsement for sound science, how can Congress do so? This question is especially important concerning the suitability of the site, that is, the site apart from the waste container and the engineered barriers.

I know that DOE says this site has been studied to death. But DOE never evaluated the site against its own geologic criteria, even though it is required to do so by the waste act. NRC is not going to do this either. It has other responsibilities.

By default, therefore, if you go forward, you will not just be endorsing a site suitability finding by the Energy Department or have the consolation of knowing that if you do go forward this will be checked by NRC. You will be making the technical evaluation of the site suitability yourselves, which, it seems to me, makes the cautionary message of the technical review board all the more critical.

We know that DOE is not remotely ready to file an NRC application soon after your approval, as is required by law. It seems to me this is not the time to give the department a green light. It would reinforce the wrong kind of behavior. This is the time to rethink the present course.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Gilinsky follows:]

PREPARED STATEMENT OF VICTOR GILINSKY, PH.D., FORMER COMMISSIONER, NUCLEAR REGULATORY COMMISSION

Mr. Chairman, Members of the Committee:

I am Victor Gilinsky. I am an energy consultant and have been engaged by the State of Nevada to assist on Yucca Mountain issues. I am here to present my views on the Senate Joint Resolution to approve Yucca Mountain as the site for a national high-level nuclear waste repository.

My involvement with nuclear power and nuclear waste issues is long-standing. I served two terms as a Commissioner with the U.S. Nuclear Regulatory Commission (NRC), having been appointed by President Ford and re-appointed by President Carter. Prior to the NRC, I was head of the Physical Sciences Department at the Rand Corporation in California. In the early 1970s, I was on the planning staff of the NRC's predecessor agency, the Atomic Energy Commission.

THE ISSUE IS NOT NUCLEAR POWER'S FUTURE

At that time the government's plan for long-term storage of nuclear waste was what would now be called monitored retrievable storage. After the reorganization of nuclear agencies in 1975, the government abandoned this approach and adopted the permanent geologic repository concept. This was done not to protect public safety in the distant future, but to protect the licensing of nuclear plants against then-ongoing court challenges by environmental activists and other opponents. The supporters of nuclear power thought it was essential for the industry's immediate future to be able to say the nuclear waste problem was solved permanently. In this way, without much consideration of its wisdom or thought to the difficulty of actually carrying it out, the government lashed itself to this concept and its long-term obligations. Because permanent, deep geologic disposal of nuclear waste carries with it the possibility of irretrievable and irremediable error, the subject quickly became enmeshed in controversy that continues to this day.

I mention this because the current effort to stampede the nation into adopting Yucca Mountain as the site for a deep geologic repository continues to be premised on the mistaken assumption that the immediate future of nuclear power in this country depends on bringing this project to fruition. This view was expressed by the Wall Street Journal's editorial page: "The real debate here," the Journal said, "is less about Yucca than it is about nuclear power," and has been echoed by several other major newspapers. The truth is that Yucca Mountain is not needed to continue, or even expand, nuclear power use. In fact, there is ample opportunity to expand existing, NRC-approved, on-site storage. In time, we should collect the spent fuel casks at locations dedicated to long-term spent fuel storage. But the important thing now is to recognize that there is no immediate crisis, that there is time to do this and to do a good and responsible job in terms of safety and security, and to do it at a much lower cost to ratepayers than Yucca Mountain represents.

Yucca Mountain is not likely be a boon to nuclear power, as some industry people seem to think it will be. Indeed, Yucca Mountain is much more likely to become an unhelpful and continuing reminder of nuclear power's history of contentions—over safety, over the environment, over federal preemption, over licensing short-cuts, over transportation, and over expense.

THE PROJECT HAS TAKEN ON A LIFE OF ITS OWN

The expense associated with Yucca Mountain is already huge, and continues to grow—approaching as much as $100 billion. Like other projects that don't meet a pressing need or have a definite measure of performance, it has taken on a life of its own—it is propelled by public money, supported by interested lobbies, and protected by a shifting array of arguments. These arguments don't, however, stand up to serious examination. You should not accept them as a basis for approval.

YUCCA MOUNTAIN IS NOT THE ANSWER TO CURRENT CONCERNS OVER SPENT FUEL SECURITY

The most egregious of the pro-Yucca arguments has to do with spent fuel security—egregious because it exploits public fears in the wake of September 11th. People have been given the idea that spent fuel from around the country will be moved quickly to Yucca Mountain where it will be placed deep underground. The mantra is "better one site than 131." But even if Yucca Mountain opened on schedule, according to the Department's projections, it would be several decades before the spent fuel could be shipped to Nevada, and probably decades more before the fuel actually went underground. And this scenario plays out even if we never license another nuclear plant. If we do license more nuclear power plants (which is in large part the point of opening a spent fuel repository), we will have lots of spent fuel in storage at reactor sites indefinitely. Because of the built-in delays involved, Yucca Mountain is not the answer to the current spent fuel security problem. The best thing we can do right now in this regard is to get the spent fuel at the reactor sites promptly moved into secure storage casks in a protected area at the reactor site. Such casks have already been licensed by the NRC and are in use at several sites.

APPEAL TO NATIONAL SECURITY IS QUITE A STRETCH

DOE also diverts attention from the important long-term Yucca Mountain issues with the claim that Yucca Mountain is important to our national security. The claim is that without Yucca Mountain our nuclear Navy operations could be constrained and U.S. nonproliferation policy could be undermined. First, let's face it; Naval operations are not going to be constrained no matter what happens at Yucca Mountain. That's a hollow argument. Second, DOE has the nonproliferation argument back-

wards. The proposed U.S.-Russian plutonium-recycling program to which DOE refers—the waste from which DOE wants to put in Yucca Mountain—would in my view raise the risks of proliferation and nuclear terrorism by encouraging the commercial use of plutonium.

Aside from the deficiency of these DOE arguments, there is something basically worrisome about the lopsided appeal to national security interests in support of Yucca Mountain. Is the Department merely distracting attention from the problems of the site's geology? Or is it setting the predicate for future national security exemptions from safety and environmental requirements?

DOE DID NOT APPLY ITS OWN GEOLOGIC SITE CRITERIA

The site obviously has problems, the chief one being lots more water than anyone expected. (I was myself surprised to find water dripping on my head in the test cavity in the center of the Mountain.) Water promotes corrosion and movement of radioactive material and so its presence in a repository is a serious drawback. The current design concept now includes titanium drip shields—in effect, titanium umbrellas—over the waste packages to be placed in the Yucca Mountain tunnels. But the water problems don't end there. The 15 years of geologic investigation and the several billions that DOE spent don't make this a good site. The bottom line is that the site didn't pass DOE's own geologic selection criteria—DOE never risked applying them. In fact, in December 2001, shortly before it forwarded the site recommendation to the president, DOE threw out the set of geologic criteria it had adopted as a formal rule in 1984. In its place, DOE then adopted a new rule that made site geology irrelevant if the metal container encasing the waste was good enough.

DOE SITE SELECTION DID NOT COMPLY WITH THE ACT

This action was at odds with DOE's responsibilities under the Nuclear Waste Policy Act. The Act tells DOE to do two separate things—(1) select a suitable site, and (2) make sure it can be licensed by NRC for its intended purpose. First, DOE was to recommend or reject Yucca Mountain, with geologic considerations to be the primary criteria. DOE sloughed off this responsibility and decided all it had to do was satisfy NRC's licensing limit on potential radiation doses to the nearby human population. But NRC's licensing rule doesn't have any separate requirement for effectiveness of geologic barriers. In short, DOE avoided the Act's demand for an answer to the question of site suitability by "deferring" to NRC, but NRC will not answer the question either. This cannot be what Congress intended.

It now appears that DOE's waste bureaucracy has rationalized its failure to comply with the Act's tough geologic requirements on their view that Congress already selected Yucca Mountain back in 1987. Congress was not, however, lowering the geologic standards in selecting Yucca Mountain for characterization. Indeed, that was also DOE's reading of the 1987 Amendment to the Act up until about 1996. Since DOE has now abandoned its geologic criteria, Congress is now being asked not merely to ratify a DOE site suitability decision, but instead to make one itself in view of DOE's default. Under this approach, a site suitability analysis and recommendation, as contemplated in the Act, will never be made. Congress should not allow this and should insist that DOE comply with the Act.

IF DOE WILL RELY MAINLY ON ITS MIRACLE METAL CONTAINER—WHY THEN YUCCA MOUNTAIN?

As it is, DOE plans to get around Yucca Mountain's geologic deficiencies with its "miracle metal" container (to use the Nuclear Energy Institute's appellation), which is purported to meet NRC's licensing standards all by itself. If we are to suppose this is true, and therefore the repository site doesn't need favorable natural characteristics, why then should such a repository be in Nevada as opposed to anywhere else? Why not store the miracle containers at or near existing reactor sites and eliminate the risk of transporting high-level radioactive waste by truck, rail and barge thousands of miles across the country?

CONGRESS SHOULD RELY ON NWTRB REGARDING "SOUND SCIENCE" ASSURANCES

A phrase that appears over and over in documents in support of putting the waste in Yucca Mountain is "sound science." We are assured that the project is based on "sound science." Significantly, the Secretary of Energy has said he would not have recommended the site were he not convinced that it was based on "sound science." That says this body, the United States Senate, should not be approving the site if you are not similarly convinced.

So now consider what the real experts—the members of the U.S. Nuclear Waste Technical Review Board—have said. If there are any heroes in this struggle, they are the Board members and their Chairman. They have carried out their responsibilities competently and even-handedly in difficult circumstances and have expressed themselves clearly and precisely. In the din of exaggeration on all sides it is possible to miss the vital importance of their message. You will hear from them directly tomorrow, but we should listen today to what they have already said.

NUCLEAR WASTE TECHNICAL REVIEW BOARD: TECHNICAL BASIS IS "WEAK TO MODERATE"

The Board has termed the technical basis for DOE's repository performance estimates as "weak to moderate"—not an encouraging evaluation. The Board has criticized the lack of critical corrosion data on the metal waste containers to support DOE's basic design concept. That's especially important as DOE relies almost entirely on the integrity of the metal waste containers to meet NRC's licensing standard. As one of the Board members said, "We are betting the performance of the systems on the long term performance of these effectively new materials."

Parenthetically, earlier this year a steel pressure vessel at an Ohio nuclear plant was found to be severely and dangerously corroded, to the point that a serious accident was barely averted. I mention this only because the metals involved and their environment were much better known than those planned for use in Yucca Mountain, and yet the corrosion came as a great surprise. In short, the lack of corrosion data the Board points to is a serious deficiency.

In March the Board wrote DOE expressing concern that important water flow processes around Yucca Mountain "remain poorly understood" and should be studied. DOE wrote back with the bureaucratic equivalent of "don't call us, we'll call you." It wasn't the response of an agency dedicated to assuring a firm project basis in sound science. In a more general comment, at last week's meeting of the Technical Review Board, the Board chairman said very simply and clearly that technical work that should have been done before site selection has not been done.

The Board members are not only experts; they are your experts, your technical watchdogs. Congress created the Board in 1987 to "evaluate the technical and scientific validity of activities undertaken by the Secretary." In this sea of controversy, they are the ones you appointed and can rely on for highly competent and impartial advice. If the Board doesn't give this project its strong endorsement for "sound science," how can Congress do so?

TIME TO STOP TO THINK

One thing is clear. DOE is not remotely ready to comply with the law's requirement to file an NRC license application 90 days after Congressional approval. DOE is talking about applying to NRC for a license in 2004, and there are some suggestions that it will be even later. They say they are keeping all options open—that it may be a high temperature repository or it may be a low temperature repository. That's another way of saying they don't even have a design. The trouble is, one concept may require a much larger repository than the other, and so the cost is up in the air, too.

The project doesn't make sense in terms of expense, security, or safety, or even in terms of the future of nuclear power. This is not the time to give the Department a green light. This is the time to rethink the present course.

The CHAIRMAN. Thank you very much. Appreciate your testimony.

Our next witness is the Honorable Rocky Anderson, who is mayor of Salt Lake City, Utah.

We're very pleased to have you here, Mr. Mayor.

STATEMENT OF ROSS C. "ROCKY" ANDERSON, MAYOR, SALT LAKE CITY, UT

Mr. ANDERSON. Thank you, Mr. Chairman, members of the committee. I certainly appreciate the opportunity to comment on the wholly inadequate proposal to transport deadly nuclear waste and the most deadly material known to man today across country for storage at Yucca Mountain and the shortsighted national nuclear policy that has led to this proposal.

The people of Salt Lake City are intimately familiar with the tragic politics of nuclear exploitation. Tens of thousands of Utah downwinders and downwinders across America have suffered and died and continue to suffer and die as the result of nuclear weapons testing in Nevada during the Cold War. And now a coalition of electric utilities is seeking to exploit the impoverished Goshute Indian tribe to create a purported temporary storage site for spent nuclear fuel rods just 70 miles from Salt Lake City.

From experience, we know that the Yucca Mountain proposal would put most Americans, including all the citizens of Salt Lake City, at tremendous risk, by creating tens of thousands of highly lethal dirty bombs and shipping them through large metropolitan areas and 43 States on a daily basis.

Now, the issue has recently arisen as to how many shipments this would really be, and Senator Thomas mentioned just a moment ago that DOE is now saying it would be 175 shipments per year. This has been truly a moving target in terms of DOE's analysis. In a review of department oversight from the Office of the Secretary, Department of Transportation, just within the last 4 months, they note there that according to DOE forecasts, there would be nearly 1,700 shipments by the year 2015, ten times as many as now DOE is asserting.

To make matters worse, the Yucca Mountain project would not be a long-term solution to the problem of nuclear waste, as contemplated by the 1982 act. The project only further accommodates the irresponsible actions of our Nation's nuclear industry, facilitating the production of even more nuclear waste, without addressing the fundamental issue of how to deal with the ever increasing amounts of these deadly substances.

A detailed transportation plan for shipping nuclear waste to Yucca Mountain has not yet been developed and not one actual full-size transportation cask in use has been physically tested to withstand plausible accident or terrorism scenarios. Without adequate research as to the safety of transporting this waste, without details of where and how it will travel, the American public, our representatives in Congress, and our Federal regulatory agencies are being asked to sign off on one of the most expensive projects and perhaps the most dangerous project in the history of the United States. Catastrophic loss of life could accompany a single major accident or terrorist strike in a metropolitan area, such as Chicago, Atlanta, and St. Louis, or in a major watershed area like Salt Lake City's. Such a scenario is almost a certainty. Human error is inevitable.

Scientists predict as many as 340 transportation accidents and almost 2,400 incidents involving the waste during the transport period. These numbers do not include the risks of terrorism, a very real possibility even before the September 11, 2001, terrorist attacks. A single terrorist attack, which could be carried out with far less planning and resources than the September 11 attacks, could result in thousands of cancer fatalities and cost upwards of $17 billion simply to clean up and respond to.

Protecting the Salt Lake, 2002, Winter Olympic Games for less than 2 weeks in a relatively constrained geographical area was a monumental task, requiring over 15,000 law enforcement officers

and costing over $310 million. Adequately protecting tens of thousands of highly lethal shipments of nuclear waste as they travel thousands of miles through dozens of major cities over a period of 38 years will be impossible.

With tragic ramifications, our Federal Government has failed in the past to responsibly deal with major terrorism-related security concerns. We implore you to acknowledge the horrendous terrorism-related security risks entailed in transporting by rail and truck highly lethal spent nuclear fuel and to assume the responsibility that is yours to protect the people of this country, including later generations, and to protect our economy from those risks.

Perhaps the most astounding fact about all the transportation risks inherent in the Yucca Mountain proposal is that they serve no fundamental long-term purpose. The safety of communities where nuclear waste is generated will not be significantly increased. Plants will still produce waste on site and will still be just as likely to fail in generation and storage operations. They will also remain just as likely targets of terrorist attack, as they are today.

There are no plans for the storage of waste after the year 2036, when Yucca Mountain will be at capacity. Therefore, after creating all of the significant risks to millions of Americans, resulting from the Yucca Mountain project, we will not be able to say that we have solved the long-term problem of nuclear waste storage. We will only have facilitated the continuation and exacerbation of a dangerous situation that has no foreseeable solution short of vastly reducing or eliminating the production of nuclear waste.

There is a better approach.

First, nuclear fuel should be stored where it is produced until a comprehensive, safe, and permanent solution to the entire storage and transportation problem is found. This cannot be characterized as a "not in my back yard" argument. And to characterize the position of Utahans and Nevadans as simply a "not in my back yard" argument epitomizes the crass hypocrisy of the industries and communities that have welcomed inexpensive nuclear power at their doorsteps, but now refuse to take responsibility for it in their back yards.

Utilities proposing temporary storage of nuclear fuel at the Goshute Reservation or Salt Lake City have represented that these lethal materials can be safely stored in above-ground casks. If that is true, the materials can be stored in those casks where the materials are produced while Congress plans for an effective long-term solution to nuclear waste in America.

Second, we must decommission nuclear powerplants at least until reprocessing or some other technology eliminates the problems of nuclear waste. Only 20 percent of electricity generated in the United States comes from nuclear power. We can and should make investments in construction and alternative general technologies that will make up for the energy generated by nuclear powerplants.

We know that reversing the momentum behind the Yucca Mountain proposal will not be easy. It will take political courage. It will take an honest admission of failure, and it will take a return to integrity in the process, but it is the only way to take real steps toward reaching a permanent solution to the long-term problems of

nuclear waste in America. Together we can make the hard decisions and take a leadership role in global environmental responsibility. While seeking to make good on broken promises of the past regarding the safe permanent storage of nuclear waste, Congress can finally set right our nation's nuclear policy for the long-term benefit of our country's public health, safety, and security.

Thank you, Mr. Chairman.

[The prepared statement of Mayor Anderson follows:]

PREPARED STATEMENT OF ROSS C. "ROCKY" ANDERSON, MAYOR, SALT LAKE CITY, UT

I am Ross Anderson, Mayor of Salt Lake City, Utah. I appreciate the opportunity to comment on the wholly inadequate proposal to transport deadly nuclear waste across country for storage at Yucca Mountain and the shortsighted national nuclear policy that has led to that proposal.

The people of Salt Lake City are intimately familiar with the tragic politics of nuclear exploitation. Thousands of Utah downwinders have suffered and died—and more continue to suffer and die—as the result of nuclear weapons testing in Nevada during the Cold War. Private companies target Utah as a prime dumping ground for so-called "low-level" radioactive wastes. Further, a coalition of electric utilities is seeking to exploit the impoverished Goshute Indian tribe to create a purported "temporary" storage site for spent nuclear fuel rods just 70 miles from Salt Lake City.

From experience, we know that the Yucca Mountain proposal would put most Americans, including all the citizens of Salt Lake City, at tremendous risk, by creating tens of thousands of highly lethal "dirty bombs" and shipping them through large metropolitan areas on a daily basis. To make matters worse, even if there were no serious risks from the transportation of this high-level nuclear waste, the Yucca Mountain project would not be a long-term solution to the problem of nuclear waste. The project only further accommodates the irresponsible actions of our nation's nuclear industry facilitating the production of even more nuclear waste and worsening our federal government's addiction to nuclear power, without addressing the fundamental issue of how to deal with the ever-increasing amounts of these deadly substances.

TRANSPORTATION RISKS

A detailed transportation plan for shipping nuclear waste to Yucca Mountain has not yet been developed, and not one transportation cask in use has been physically tested to withstand plausible accident or terrorism scenarios.[1] These facts illustrate the irresponsible and undemocratic manner in which this project is being developed. Without adequate research as to the safety of transporting this waste, without details of where and how it will travel, the American public, our representatives in Congress, and our federal regulatory agencies are being asked to sign off on one of the most expensive projects—and perhaps the most dangerous project—in the history of the United States.

If the Yucca Mountain proposal were approved, huge amounts of nuclear waste would be transported through Salt Lake City every day for many years. Virtually all of the major shipping routes to Yucca Mountain from the eastern U.S., both rail and highway, traverse Utah.[2] Salt Lake City will, by all estimations, see more traffic of nuclear waste than any other U.S. city except Las Vegas. Utah will be second only to Nevada in the number of high-level waste and spent nuclear fuel shipments routed through the state.[3]

Rail lines that may be used to transport spent fuel rods through Salt Lake City to Yucca Mountain lie 25 feet from residents" backyards. The trains travel within 100 feet of playgrounds. Six schools are within half a mile of transportation routes,

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[1] Resnikoff, Marvin. *The Next Nuclear Gamble.* New York: Council on Economic Priorities, 1983. Reference also: United States. Nuclear Regulatory Commission. *Discussion Draft: An Updated View of Spent Fuel Transportation Risk.* Office of Nuclear Material Safety and Safeguards: Washington, D.C., 2000. Reference also: Direct communication with Diane D'Arrigo. Nuclear Information and Resource Center, Washington, D.C., 13 August, 2001.

[2] United States Map of Probable Routes. Map. State of Nevada Agency for Nuclear Projects, 1995.

[3, 4] Clark County, Nevada. *Comments on Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain*, Nye County, Nevada. Clark County, Nevada. Clark County, Nevada, 1999.

well in range to receive measurable daily doses of radiation from incident-free transportation. Two interstate highways, the major arterials for truck transport from the east coast, run right through the heart of our city. Trains stopped at crossings and trucks stopped in traffic will sit only a few feet away from our citizens on a daily basis.

Scientists estimate that incident-free transportation, mostly by truck, will cause as many as 31 cancer fatalities nationwide.[3] This incident-free scenario assumes transportation utopia and does not take into account the Department of Energy estimates for transportation incidents and accidents.

Catastrophic loss of life could accompany a single major accident in a metropolitan area or in a major watershed area like Salt Lake City's. Such a scenario is almost a certainty. Human error is inevitable. Scientists predict as many as 340 transportation accidents and 2,395 incidents involving the waste during the transport period.[4] These numbers do not include the risks of terrorism—a very real possibility even before the September 11, 2001 terrorist attacks. A single terrorist attack, which could be carried out with far less planning and resources than the September 11th attacks, could result in thousands of cancer fatalities and cost up to $17 billion in adverse economic impacts.[5]

Protecting the Salt Lake 2002 Winter Olympic Games for less than two weeks, in a relatively constrained geographical area, was a monumental task, requiring over 15,000 law enforcement officers and costing over $310 million. Adequately protecting tens of thousands of highly lethal shipments of nuclear waste as they travel thousands of miles through dozens of major cities over a period of 38 years will be impossible.

With tragic ramifications, our federal government has failed in the past to responsibly deal with major terrorism-related security concerns. We implore you to acknowledge the horrendous terrorism-related security risks entailed in transporting, by rail and truck, highly lethal spent nuclear fuel and to assume the responsibility that is yours to protect the people of this country, including later generations—and to protect our economy—from those risks.

THE YUCCA MOUNTAIN PROPOSAL IS NOT A SOLUTION TO OUR LONG-TERM NUCLEAR FUEL STORAGE PROBLEMS

The most astounding fact about all the transportation risks inherent in the Yucca Mountain proposal is that they serve no fundamental long-term purpose. The safety of communities where nuclear waste is generated will not be significantly increased. Plants will still produce waste on site and will still be just as likely to fail in generation and storage operations. They will also remain just as likely targets of terrorist attack as they are today.

There are no plans for the storage of waste after 2036, when Yucca Mountain will be at capacity.[6] Therefore, after creating all of the significant risks to millions of Americans resulting from the Yucca Mountain project, we will not be able to say we have solved the long-term problem of nuclear waste storage. We will only have facilitated the continuation—and exacerbation—of a dangerous situation that has no foreseeable solution short of vastly reducing or eliminating the production of nuclear waste.

Congress has created a process with a foregone conclusion.[7] It has made promises to the nuclear utilities that it cannot keep and continues to appease the utilities that have profited while creating this enormous, dangerous dilemma for our nation. It is guaranteeing that an ever-growing amount of nuclear waste will be strewn across the United States, putting many generations of Americans at serious risk.

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[5] Marvin Resnikoff, Ph.D. "Testimony to the U.S. House of Representatives, Committee on Transportation and Infrastructure, Subcommittee on Highway and Transit, Subcommittee on Railroads," 25 April, 2002.

[6] Honorable Shelly Berkley, NV. "Opening Statement at the Joint Hearing on Transportation of Spent Rods to the Proposed Yucca Mountain Storage Facility, Subcommittee on Highways and Transit Subcommittee on Railroads," 25 April, 2002. Reference also: "Abraham: Yucca Not Enough For Waste." *Guardian Unlimited*, 17 May, 2002.

[7] Fueled by enthusiasm for cheap power generation, Congress set up the circumstances for us to push forward with nuclear power without stopping to consider its pitfalls. Indeed, the designated role of the first nuclear agency, the Atomic Energy Commission, rife with conflicts of interest between advocacy and regulation, set the stage for the reckless pursuit of nuclear power by our federal government. Ford, Daniel. *The Cult of the Atom: The Secret Papers of the Atomic Energy Commission.* New York: Simon and Schuster, 1982.

A BETTER, LONG-TERM APPROACH

There is a better approach. Instead of pursuing half-measures that put millions of Americans at risk, we can take effective steps now to accomplish permanent solutions, including the reduction of threats posed by the disposal of existing spent nuclear fuel and vastly curtailing the production of nuclear waste in the future.

First, nuclear fuel should be stored where it is produced until a comprehensive, safe, and permanent solution to the entire storage problem is found. While nuclear power advocates dismiss this plea of Nevadans and Utahns as a "Not-In-My-Backyard" argument, they epitomize the crass hypocrisy of the industries and communities that welcomed inexpensive nuclear power at their doorsteps but now refuse to take responsibility for it in their backyards. The utilities proposing "temporary" storage of nuclear fuel at the Goshute Reservation near Salt Lake City have represented that these lethal materials can be safely stored in above-ground casks. If that is true, the materials can be stored in those casks where the materials are produced while Congress plans for an effective, long-term solution to nuclear waste in America.

Second, we must decommission nuclear power plants, at least until reprocessing or some other technology eliminates the problems of nuclear waste. Only 20% of electricity generated in the U.S. comes from nuclear power.[8] We can and should make investments in conservation and alternative generation technologies that will make up for the energy generated by nuclear power plants. In the same way we led the atomic age, the United States has the opportunity to be a leader in conservation and alternative production technologies.

CONCLUSION

The people of Utah were lied to repeatedly when told that government plans were safe. We will not be lied to again. We will not allow Congress and the Department of Energy to treat Utah and Nevada as remote, disposable places, where the self-inflicted problems of the reckless nuclear power industry—and of a federal government that has been astoundingly irresponsible in its nuclear policy—can be conveniently dumped.

Reversing the momentum behind the Yucca Mountain proposal will not be easy. It will take political courage. It will take an honest admission of failure. It will take a return to integrity. But it is the only way to take real steps toward reaching a permanent solution to the long-term problems of nuclear waste in America. Together, we can make the hard decisions and take a leadership role in global environmental responsibility. While seeking to make good on broken promises of the past regarding the safe, permanent storage of nuclear waste, Congress can finally set right our nation's nuclear policy—for the long-term benefit of our country's public health, safety and security.

The CHAIRMAN. Thank you very much, Mr. Mayor.

Our next witness is Michael J. Ervin, Sr., who is the vice president of the Peace Officers Research Association of California, located in Sacramento, California.

Mr. Ervin, why don't you go right ahead.

STATEMENT OF MICHAEL J. ERVIN, SR., VICE PRESIDENT, PEACE OFFICERS RESEARCH ASSOCIATION OF CALIFORNIA

Mr. ERVIN. Thank you, Mr. Chairman, and good morning.

My name is Sergeant Mike Ervin. I live right outside of Los Angeles, and I'm a law enforcement officer with the city of Pomona Police Department in California. I have been a police officer for 22 years.

Before becoming a police officer, I was a professional truck driver. I drove tractor-trailers, either 48-foot-long single trailers or short doubles, on the interstates of southern California for 5 years and logged approximately a half a million miles.

[8] Recommendation by the Secretary of Energy Regarding the Suitability of the Yucca Mountain Site for a Repository Under the Nuclear Waste Policy Act of 1982. February 2002: 1.

I realize this hearing is about the proposal to transport and store nuclear waste and Yucca Mountain in Nevada. I have been asked to tell you what I know about truck driving and truck safety.

I am still licensed to drive tractor-trailers along with combination vehicles and even a bus. I take a written test every 4 years or so before my license expires. There is no requirement to take a road test. I have never hauled hazardous materials, although if I wanted to drive a combination vehicle carrying hazardous materials, I could. All I would have to do is take another written test. In California, that's all that is required for a truck driver to be licensed to drive a truck carrying hazardous materials is pass the written test and have a clean driving record.

As a truck driver and a police officer, I have seen a lot of truck crashes. I have concluded there are two elements to truck safety. The first is mechanical, the truck itself. It is important to understand that an 80,000 pound 18-wheeler is inherently dangerous. The fact is borne out by statistics. According to data from the National Highway Traffic Safety Administration, 457,000 large trucks were involved in traffic crashes in 2000.

There are a number of factors that make trucks so dangerous. The first is the weight of a truck. A heavy tractor-trailer tends to have a higher center of gravity because the extra weight is typically stacked vertically. The higher center of gravity increasing the risk of dangerous rollovers. Heavy tractor-trailers are likely to accelerate more slowly and have difficulty maintaining speeds on upgrades, increasing speed differentials with other traffic and increasing the risk of accidents.

If a truck is perfectly maintained, it will be a lot less—excuse me—it will be less likely to be involved in a crash. Some trucking companies do an excellent job of maintaining their trucks. They are checked daily and needed repairs are made immediately. However, I operate in the real world. And there are other truck companies that are not so scrupulous. They put off repairs because they are expensive. In addition, sometimes with even the best-maintained trucks, mechanical things do go wrong. The way I see it, the only way to have a perfectly maintained truck is if God came down himself and turned the wrenches.

What does this mean? It means that when brakes are in need of adjustments and pumped, a great heavy truck barreling down a highway may need hundreds more feet to stop. It means that the steering of those heavy trucks, which is always difficult, will be more so. It means that sharp turns made to avoid smaller vehicles that are too close will result in rollovers. I think of a tractor-trailer rig as a missile. The question is, Is it under control or out of control?

These are all factors that this committee should take into account when considering any proposal to transport nuclear waste on public highways.

A second element of truck safety is the human element. Again, there are many very good, experienced, responsible drivers who work for trucking companies which are very strict about limiting the hours that the drivers are on the road and which they insist that they get enough rest. Some of these companies don't even put sleepers on their cabs, because they want the drivers to get out of

their trucks and sleep in hotels. And truck drivers often feel that they must keep moving in order to make enough money to support themselves. They cannot afford to stop by the side of the road and rest when they are tired. These tired truck drivers make the roads unsafe for all of us.

Long-haul truck driving is extremely stressful and tiring. You must—have to monitor your speed, make sure you keep a safe distance from cars in front of you, and adjust for any wind, rain, or bumps in the road, and all with the knowledge that you are the heaviest vehicle out there. That is a huge obligation. You always have to think about what could go wrong, and what would you do if it actually happened?

Besides truck drivers, there are other human elements that make the roads dangerous. Trucks share the roads with automobile drivers. Most automobile drivers are not trained to deal with trucks that take up most of the lane. They are not aware that they should stay out of our blind spots.

There are automobile drivers who can just be careless and some who are just plain weird. I can remember a number of instances where I was driving along, tired, fighting wind, when a car would pull along right beside me so the driver could look into my cab. He would stay with me, very close, peering, and it was very nerve wracking, to say the least. The fact is that all truck drivers run into strange people on the road. Dealing with them is part of the job. But it makes truck driving more dangerous. And if you throw in the congestion of traffic conditions, poor roads, inclement weather, it seems almost impossible for a truck accident not to occur.

I feel that truck drive—excuse me—I feel that truck driving is a profession. A driver must be licensed. And I personally felt a great responsibility to everyone on the road. I felt that while I was driving everyone on the road was depending on me to do my job faithfully and carefully. If I drove past my skills or beyond my truck's capacity, the results could be disastrous.

I understand that trucks in the question would—excuse me—I understand that the trucks in question would be typically 80,000-pound tractor-trailers. But the heavier trucks may be used as well. Everything I have said to you today is about mechanical and human elements of driving heavy trucks. Even more important, if the truck gets heavier, more accidents will occur.

The University of Michigan Transportation Research Institute found that a strong statistical link that some truck configurations between higher weight and greater risk—with higher weights and greater risk for fatalities. If weights go from—when weights went from 65,000 to 80,000 pounds, the risk of accidents involving a fatality went up 50 percent. Just imagine the fatality rate of 120,000 pounds or more.

In conclusion, Mr. Chairman, there are hundreds of thousands of truck crashes every year in this country. In the real world, there's no such thing as a perfect truck, a perfect road, or a perfect weather condition. Even if there were, you will still always have the human element. You can have the best trained truck drivers, but if they are tired, you can never predict how the truck and its driver will interact with motorists.

Thank you very much.

[The prepared statement of Mr. Ervin follows:]

PREPARED STATEMENT OF MICHAEL J. ERVIN, SR., VICE PRESIDENT, PEACE OFFICERS RESEARCH ASSOCIATION OF CALIFORNIA

Thank you, Mr. Chairman. My name is Sergeant Mike Ervin. I live right outside of Los Angeles. I am a police officer with the Pomona, California Police Department. I have been a police officer for 22 years.

Before becoming a police officer I was a professional truck driver. I drove tractor trailers—either 48-foot-long single trailers or short double trailers—on the interstates in Southern California for five years and logged about half a million miles.

I realize that this hearing is about the proposal to transport and store nuclear waste at Yucca Mountain in Nevada. I have been asked to tell you what I know about truck driving and truck safety.

When I was 23, I became a police officer. I had always wanted to be one, and thought that I had better do it when I could. I am still licensed to drive trucks though. I can drive Class I or combination vehicles or a bus. I take a written test every four years or so, before my license expires. There is no requirement that I take a road test. I have never hauled hazardous materials, although if I wanted to drive a combination vehicle carrying hazardous materials, I could. All I would have to do is to take another written test. In California, that is all that is required for a truck driver to be licensed to drive a truck carrying hazardous materials—pass a written test and a have clean driving record.

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If a truck is perfectly maintained it will be a lot less likely to be involved in a crash. Some trucking companies do an excellent job of maintaining their trucks. The trucks are checked thoroughly every night and needed repairs are made immediately. However, I have to operate in the real world. And there are other trucking companies that are not so scrupulous. They put off some repairs because they are expensive. In addition, sometimes with even the best-maintained trucks, mechanical things go wrong. The way I see it, the only way to have a perfectly maintained truck is if God turns all the wrenches.

What does this mean? It means that when brakes that need adjustment are pumped, that great big heavy truck barreling down the highway may need hundreds of more feet to stop. It means that steering those heavy trucks, which is always difficult, will be more so. It means that a sharp turn, made to avoid a too close motorist, will result in a rollover. I think of a tractor-trailer rig as a missile. The question is, is it under control or out of control?

These are all factors that this Committee should take into account when considering any proposal to transport nuclear waste on public highways.

The second element to truck safety is the human element. Again, there are many very good, experienced, responsible drivers who work for trucking companies which are very strict about limiting the hours that their drivers are on the road, and which insist that they get enough rest. Some of these companies do not put sleepers in their cabs because they do not want their drivers sleeping in their trucks. They give them hotel vouchers—they want them sleeping in beds and getting a good night's rest. But again, there are other trucking companies that are not so careful. And truck drivers often feel that they must keep moving in order to make enough money to support themselves. They cannot afford to stop by the side of the road to rest when they are tired. These tired truck drivers make the roads unsafe for all of us.

Long haul truck driving is extremely stressful and tiring. You have to monitor your speed, make sure you keep a safe distance from the car in front of you, and adjust for any wind or rain or bumps in the road, all with the knowledge that you are the heaviest vehicle out there. That is a huge obligation. You always have to think about what could go wrong and what you would do if it actually happened.

Besides truck drivers, there are other human elements that make the road dangerous. Trucks must share the roads with automobile drivers. Most auto drivers are not trained to deal with trucks that take up most of a lane. They are not as aware as we would like them to be of the "no-zone" area around a truck where they are hidden from a truck driver's view. There are automobile drivers who can be careless, and some that are just plain weird. I can remember a number of instances where I was driving along, tired, fighting the wind, when a car would pull along right beside me so that the driver could peer into my cab. He would stay with me, very close, peering. It was nerve wracking. The fact is, all truck drivers run into strange people on the road. Dealing with them is part of the job. But, it makes truck driving more dangerous, and if you throw in congested traffic conditions, poor roads, inclement weather, it seems almost impossible for truck accidents not to occur.

I feel that truck driving is a profession. A driver must be licensed, and I personally felt a great responsibility to everyone on the road. I felt that while I was driving, everyone on the road with me was depending on me to do my job faithfully and carefully. If I drove past my skill level or beyond my truck's capacity, the result would be disaster.

I understand that the trucks in question would be typical 80,000-pound tractor-trailers, but that heavier trucks may be used, as well. Everything I have said here today about the mechanical and human elements of driving heavy trucks is even more important as trucks get heavier. The University of Michigan Transportation Research Institute found that there is a strong statistical link within the same truck configuration between higher weights and a greater risk of fatalities. As weights go from 65,000 to 80,000 pounds the risk of an accident involving a fatality goes up 50%.[1] Just imagine the fatality rate at 120,000 pounds or more.

In conclusion, Mr. Chairman, there are hundreds of thousands of truck crashes every year in this country. In the real world, there is no such thing as a perfect truck, a perfect road and perfect weather conditions. Even if there were, you will always have the human element. You can have the best-trained truck drivers, but they may be tired. And you can never predict how the truck and its driver will interact with the motorist.

I am happy to answer any questions.

The CHAIRMAN. Thank you very much, Mr. Ervin.

And our final witness on this panel is Dr. Stephen Prescott, who is the executive director of the Huntsman Cancer Institute in Salt Lake City, Utah.

Dr. Prescott, why don't you go right ahead.

STATEMENT BY STEPHEN M. PRESCOTT, M.D., EXECUTIVE DIRECTOR, HUNTSMAN CANCER INSTITUTE, SALT LAKE CITY, UT

Dr. PRESCOTT. Mr. Chairman and members and guests. I'm a physician and medical scientist. It is in these roles that I appear today.

At the Huntsman Cancer Institute we conduct research into the causes of cancer. We work to prevent cancer. And we treat cancer patients. Most of the patients we serve are from Utah. Many are from Nevada or other neighboring States, including Idaho, Wyoming, Colorado, Arizona, and even New Mexico.

Every day we see patients who come from families who have borne the burden of environmental exposure to radiation, exposure that resulted from Federal policy. This began in the 1950's with the atmospheric testing of nuclear devices at the Nevada test site, the location now proposed for the storage of spent nuclear fuel and high-level radioactive waste. Citizens of Nevada were exposed to this fallout, and because of the typical weather patterns, individuals in Utah, Arizona, and New Mexico were as well.

[1] U.S. DOT Comprehensive Truck Size and Weight Study, Phase 1, Working Paper 1 & 2, 1995, P. 37.

One of our cancer patients recently told me a horrifying story. As children in southern Utah, he and his brothers would take a Geiger counter out into the pasture of their farm to find the areas that gave the loudest response. Why did their parents allow this behavior that now appalls us? It wasn't because of disinterest in the well-being of their children, but because those parents had been reassured that there was no danger.

As illustrated by the experience of these downwinders, the residents of the intermountain west already have been asked to stand in harm's way with respect to nuclear exposure more than the other citizens of the United States. And yet there's another historical example.

During the same time period, it was deemed important to have large stockpiles of uranium, and our region—the same one I mentioned—was a key area for mining and refining uranium ore. For many years I've kept this photograph of a man who had worked as a uranium miner. He gave me this photograph when he was my patient while I was an intern at the Veterans Administration Hospital in Salt Lake City. I would talk with him every evening when my rounds were done, because he had no family and he was lonely and he knew he was dying, and I couldn't stop it. He was dying from metastatic lung cancer, a type that is caused by the radon gas that he breathed in the uranium mines. He died, alone, in the Salt Lake VA Hospital.

This is another example of how some individuals in the intermountain west were exposed to radiation that caused cancer and took their lives. They were assured that the mines and refineries were safe.

Now the citizens of the same region are being asked to assume the risk of a third round of radiation exposure. We are told again that the risk will be low. But will an unanticipated accident during the transportation cause my neighbors to develop lung cancer, leukemia, bone tumors? What suffering will come this time to the people of Utah, Nevada, Colorado, Arizona, New Mexico? Will my colleagues and I be able to stop their premature deaths?

I recognize that there are difficult questions to answer regarding nuclear waste. My purpose today is to emphasize that there are serious consequences if we err on the side of not enough safety.

In the course of this public debate, I've heard it claimed that the risk from radiation has been overstated. We should be clear. Decades of medical research showed exposure to radiation causes many types of cancer. Whether an individual will develop cancer is hard to predict, because the risk depends on the type of radiation, the amount received, and how quickly it is received. But we know that high-level waste, as we're discussing here, is much more dangerous than low-level waste. We must be certain that precautions are in place to prevent the release of stored material, either rapidly, as might happen in a natural disaster, like an earthquake, or gradually, as would happen if the design did not prevent the leakage. Likewise, the procedures for transporting high-level waste must prevent sudden release, which could cause severe radiation exposure if it were to occur in a populated area.

In conclusion, I plead with you today to not repeat the mistakes of the past. Please do not create a situation in which my successor

will be sitting in front of your successors reporting on an excess of cancer deaths in Utah, in Nevada, and Colorado, because there were accidents during the transport of this material to Yucca Mountain or Skull Valley or because the protocol had an unanticipated flaw. None of us will be here to answer for our mistakes, because cancer isn't apparent until years after the radiation exposure. But posterity will not let us escape the responsibility today to ensure that we have done everything feasible to protect our neighbors.

Thank you.

[The prepared statement of Dr. Prescott follows:]

PREPARED STATEMENT OF STEPHEN M. PRESCOTT, M.D., EXECUTIVE DIRECTOR, HUNTSMAN CANCER INSTITUTE, SALT LAKE CITY, UT

Mr. Chairman, Members of the Committee, and Guests: My name is Stephen Prescott. I am the Executive Director of the Huntsman Cancer Institute in Salt Lake City, Utah. I am a physician and a medical scientist and it is in these roles that I appear today. At the Huntsman Cancer Institute we conduct research into the causes of cancer, we work to prevent cancer, and we treat cancer patients. Most of the patients we serve are from Utah, or Nevada, or our other neighboring states. Every day we see patients who come from families who have borne the burden of environmental exposure to radiation—exposure that resulted from federal policy. This began in the 1950s with the atmospheric testing of nuclear devices at the Nevada Test Site—the location now proposed for storage of spent nuclear fuel and high level radioactive waste. Citizens of Nevada were exposed to this fallout and, because of the typical weather patterns, individuals in Utah, Arizona, and New Mexico were as well.

One of our cancer patients recently told me a horrifying story; as children in Southern Utah he and his brothers would take a Geiger counter out into the pasture on their farm to find the areas that gave the loudest response. Why did their parents allow behavior that now appalls us? Not because of disinterest in the well-being of their children, but because they had been reassured that there was no danger.

As illustrated by the experience of the Downwinders, the residents of the intermountain west already have been asked to stand in harm's way, with respect to nuclear exposure, more than other citizens of the United States. And yet, there is another historical example. During the same time period, it was deemed important to have large stockpiles of uranium, and our region was a key area for mining and refining uranium ore. For many years I have kept this photograph of a man who had worked as a uranium miner. He gave me this photograph when he was my patient while I was in intern at the VA Hospital in Salt Lake City. I would talk with him every evening when my rounds were done because he had no family to visit him; he was lonely and he knew that he was dying. And I couldn't stop that. He was dying from metastatic lung cancer—a type that is caused by the radon gas he breathed in uranium mines. He died, alone, in the VA hospital.

This is another example of how some individuals in the intermountain west were exposed to radiation that caused cancer. They were assured that the mines and refineries were safe. Now the citizens of the same region are being asked to assume the risk of a third round of radiation exposure. We are told, again, that the risk will be low. But, will an unanticipated accident during the transportation cause my neighbors to develop lung cancer? Leukemia? Bone tumors? What suffering will come again to the people of Utah? Nevada? Colorado? Arizona? New Mexico? Will my colleagues and I be able to stop their premature deaths?

I recognize that there are difficult questions to answer regarding nuclear waste. My purpose today is to emphasize that there are serious consequences if we err on the side of not enough safety. In the course of this public debate I've heard it claimed that the risk from radiation has been overstated. We should be clear: decades of medical research show that exposure to radiation causes many types of cancer. Whether an individual will develop cancer is hard to predict because the risk depends on the type of radiation, the amount received, and how quickly it happens. Thus, high-level waste is more dangerous than low-level. We need to be certain that precautions are in place to prevent the release of the stored material either rapidly, as might happen in a natural disaster like an earthquake, or gradually, as would happen if the design did not prevent leakage. Likewise, the procedures for trans-

porting high-level waste must prevent sudden release, which could cause severe radiation exposure if it were to occur in a populated area.

In conclusion, I plead with you today to not repeat the mistakes of the past. Please do not create a situation in which my successor will be sitting in front of your successors reporting on an excess of cancer deaths in Utah and Nevada and Colorado because there were accidents during the transport of this material to Yucca Mountain or Skull Valley. Or, because the storage protocol had an unanticipated flaw. None of us will be here to answer for our mistakes because cancer isn't apparent until years after the radiation exposure. But posterity will not let us escape the responsibility today to insure that we have done everything feasible to protect our neighbors. Thank you.

The CHAIRMAN. Well, thank all of you very much.

Let me take the first round here, and we'll take about 6 minutes each to ask questions.

First, Mr. Halstead, as I understand your testimony, you cite a whole series of inadequacies and failures to properly plan for safety in connection with the transportation. But is it your view that if the proper precautions were taken and if the proper planning were to occur, that nuclear waste could be transported safely, or is it your view that that is not something that's achievable?

Mr. HALSTEAD. Well, Mr. Chairman, over the past almost 14 years now that I've worked for the State of Nevada, the State of Nevada has made consistently constructive recommendations to the Department of Energy on the types of accident prevention and accident mitigation programs that the Department of Energy should adopt. And certainly it is possible to reduce both the probability and the consequences of accidents through proper planning. And the Department of Energy should be doing that.

Nonetheless, it is important to know that even if all the recommendations that the State of Nevada has made were adopted, there would still be a residual risk of accidents involving release of radioactive materials. And it would behoove us to always be honest with the public.

I think it's a difficult situation for the Department of Energy that they cannot stand before the public and say, "We have adopted the best available control technologies. We have adopted the best engineering practices." And in particular one issue alone affects radiological risk. And that is the amount of cooling time before the spent fuel has been shipped.

It will sound ironic, but one of the few areas of this life that I am aware of where procrastination enhances safety actually has to do with the amount of cooling time that the spent nuclear fuel at reactors stays on site before it is shipped off site. And I state this in my testimony. That basically if you—at the 40- or 50-year storage level, you get a 90 to 95 percent reduction in the radiological hazard, because the short-lived radionuclides, particularly Strontium 90 and Cesium 137 have relatively short half lives, compared to some of the things we worry about, like the long-uranium and trans-uranic and plutonium isotopes. So the single most important thing we can do for safety is to ship the oldest fuel first and not ship any waste until it's been stored for 40 or 50 years. And this was the original assumption when the Department of Energy issued its environmental impact statement in favor geologic disposal in 1980.

And so, first of all there are things we can do to make the transportation system safer in terms of preventing accidents.

Secondly, we can reduce the radiologic hazard by not shipping waste until it has been stored for 4 to 5 decades.

Third, there is still the area of terrorism risk, which I think everyone is more aware of now than they were before, but it's important to note that the State of Nevada brought the terrorism risk to the attention of Nuclear Regulatory Commission in June 1999, taking the same approach, saying what we know now about the consequences of a successful terrorist attack means that we should immediately strengthen the what are called safeguards and physical protection regulations.

And then secondly, we need to do more scientific research on what the consequences of a release would actually be. It's in this latter area of protecting shipments from becoming dirty bombs that I am most pessimistic about our ability to actually protect the public health and safety.

But in the first two areas, the areas of shaping up the transportation system to prevent accidents, yes, there are many things we can do. And secondly, we can reduce the radiological hazard by extended cooling time.

The CHAIRMAN. Let me ask, Dr. Gilinsky, one of the concerns that you—as I understand your position on this, you believe that a preferable solution to the problem of all of this nuclear waste having been produced, the preferable solution to putting it in a permanent repository would be to put it in what you call monitored retrievable storage at various locations.

Now, is what the Goshute tribe planning to do, or what is being discussed there, one of these, because as I understand the mayor of Salt Lake City's testimony, he believes that a very objectionable proposal? What are your thoughts as to if we pick a variety of places for monitored retrievable storage, don't we buy a whole series of safety problems in shipping the waste to that as well?

Dr. GILINSKY. Well, first, the proposal in Utah, I'm not familiar with it, and I can't speak to that one. I do think that we will in time want to collect the waste at more central locations. I think it makes sense in deciding where those are to minimize the amount of transportation rather than maximize it, as this proposal would do.

I didn't say anything about transportation in my comments, but however you look at it and however you evaluate it, I think everyone has to conclude that it's the weakest link in the system of waste management. So however you——

The CHAIRMAN. Transportation is the weakest link—is that what you're saying?

Dr. GILINSKY. I would think so, yes. And so however you organize your management system, I would think you would want to minimize that aspect of it rather than maximize it.

I mean, most of our plants are in the East. The Yucca Mountain of course is way in the West. So what we're doing is just maximizing the amount of transportation. And that it seems to me doesn't make a lot of sense. There's going to be a certain amount of it certainly.

The CHAIRMAN. Let me just ask one additional question. Then I'll defer to Senator Craig.

Mr. Anderson, your position is that you oppose the repository, the establishment of the repository or the approval of the site for the repository, but you really do believe we should go ahead and decommission the existing nuclear powerplants and recognize that this is not a safe way to be producing power, and until we come up with a different and adequate solution to the waste problem, we shouldn't be using nuclear power. Is that an accurate paraphrase of your position?

Mr. ANDERSON. Absolutely. And I might also say, there was a comment earlier by Senator Murkowski that—because Governor Guinn or other people from Nevada weren't on this panel that apparently they weren't opposing this. Governor Guinn has provided very compelling comments to the House committee in this regard in terms of both the science of the site and the transportation difficulties. And I think there are very significant issues going to the very bad science between the siting decision to this point, the transportation safety issues—not only is it the weakest link, but the science hasn't even been done. There haven't been actual tests as to the casks. And the third thing that Congress needs to get a hold of is that ultimate question of what are the long-term solutions to this problem?

I think in 1982, when Congress was looking to determine what one place would be the final repository—we now know that Yucca Mountain would be at capacity by the year 2036, and we're going to continue to have all of these problems.

The CHAIRMAN. Let me defer to Senator Craig.

Senator CRAIG. Mr. Chairman, thank you very much. Gentlemen, thank you all for your testimony. I too am not here to question your sincerity or your knowledge. I have looked at this issue, debated it, studied it for over a decade now, and probably Dr. Gilinsky and I have been more involved in it over a longer period of time than most.

I see you were testifying back in 1982, Doctor, and I'd like to quote some of your testimony at that time, because obviously you were thinking then about the need for a more permanent repository. The question is here, what about the interim? And this is a speech that you gave as a member of the commission in 1982.

You said, "We have seen that there is essentially no practical limit to the amount of spent fuel that can be stored at most reactor sites. This does not mean, however, that it would be a good idea to leave it there." And I think some of your comments today reflect that concern.

A lot of folks think you can just leave it where it is—and I've heard that said reflectively today by several—even though the sites were temporary in the beginning, designed for only temporary storage, until such time as we, the country, not private sector individuals, determined a permanent solution to the nuclear high-level waste stream coming off from especially commercial reactors at that time, but also public purposes of the Federal Government.

You went on to say, "There has been a lot of exaggeration of the dangers of commercial spent fuel storage and disposal."

I don't see anything contradictory in that statement, but I think way back then you and I and others were involved. I was a freshman congressman or a sophomore congressman in the early 1980's,

looked at it and voted. So this is not a rush to judgment or this is not a last-minute debate, or I believe, Doctor, you referenced the word "current effort to stampede." We have been at this effort *ad nauseam*, since 1982, when you first became involved. I see no stampede today. I see time lines and decisions to be made, pro or con. And you know and I know that decisions are triggered by law, and these are not efforts at stampeding anybody.

Now the Senate by law has a responsibility to make a determination whether to move a step further and allow the Nuclear Regulatory Commission, which you once served on, to make a determination as to whether DOE was correct in its assumption, its scientific studies.

So I can't argue stampede. I do believe that's a bit of false imagery. We're all entitled to our own language. But you've been involved in this too long to suggest that it's a stampede. A snail's pace or a desert tortoise's trot, possibly.

Now you can comment to that, if you wish, but I only make comment on it, because I think you and I go back too long to suggest that we are rushing to a decision. The decision we are about today we determined several years ago. We would be on a time line to make that decision, based on an act of Congress and the findings of the EPA and DOE. That would be my only comment to your testimony.

We have an interesting reflection today. I was at the hearing the other day and anticipated that we would have Nevada and Nevada citizens here. And, of course, that's not the case today. And I understand the politics of this and that we're really in the business of trying to generate as much fear as is possible on the issue of transportation, even though we have nothing to do with it at this moment. Transportation is being looked at and will be looked at in a much higher degree if the Nuclear Regulatory Commission makes decisions.

But, mayor, I guess I'm a little concerned about some of the language you used. We politicians love to use fear. It's a great motivating factor. I'm surprised that in fear of a terrorist attack and the world focused on Salt Lake, you did not cancel the Olympic Games. Everybody said that was the ultimate target. And yet I would think that citizens of your area were very fearful that they might come under attack. And yet I didn't hear you speak out in the cancellation of those games. And frankly I'm glad you didn't. You're to be congratulated for a marvelous production.

But the world was focused and every television camera in the world was there, and it was the ultimate target. And yet fear did not stop you from allowing the games to go forward. And I know that we invested a good deal in them, and I voted for that.

And so, in other words, we could prepare against fear, and we could most importantly prepare against a terrorist attack, which we did in Salt Lake. And as a result of, I think, the $310 million you're speaking to, we survived and the world and the country and Utah are prouder for it. I won't suggest the profits made or the monies recognized. That's neither here nor there. But this is something to be said, that if this Senate decides to go forward with allowing the Nuclear Regulatory Commission to determine that the soonest possible date for movement of any material would be

around 2010, now I would suggest to any of you on this dais today who are using 9/11 to heighten your argument of fear and terrorism, if this country doesn't have its act together by 2010 on the issue of terrorism, then maybe your arguments will be relevant. Certainly your arguments to engender alertness and preparedness and reexamination are extremely valuable.

But I must tell you, and I look at the State of Maryland, with 1,160 metric tons of high-level waste stored in a temporary facility on everybody's map today, including probably most terrorists, Michigan, with 1,862 metric tons of waste temporarily stored in a static or a known location, seems like it's a much more reasonable target than a mobile target. And then I guess we could say Wisconsin, with 1,146 metric tons of high-level waste stored, California with 2,457, all of it in temporary storage, both pools and dry casks. Now, if the terrorist world believes that this is a right approach toward intimidating American citizens, then my guess is they know where every one of those locations is today. I cannot understand how you would suggest that that is not a level of high vulnerability.

I know what your task is today. I understand it. But to prejudge how we're going to mow the lawn before we've even poured the concrete to build the structure is in itself a fascination. It seems to me that fear is the element you tried to generate today, not the logic, the reality, or the application of good science and a country dedicated to solving a problem, because we proved in Salt Lake, mayor, that if we are dedicated to doing something, we can get it done and you can profit by it. And so can we and the world.

It would have been a shame, out of fear, to deny the world, our country, and Salt Lake an opportunity to have the winter games of 2002. Thank you for not succumbing to fear.

Dr. GILINSKY. May I say a word, Senator?

The CHAIRMAN. Did any witness wish to respond? If so, go ahead.

Dr. GILINSKY. I certainly would like to, Mr. Chairman, Senator.

Senator Craig, your reference to my speech years ago gives me the opportunity to say that I supported this concept at that time.

Senator CRAIG. I didn't go that far. I wanted you to say that.

Dr. GILINSKY. And which I had omitted in my remarks and had forgotten to mention. So what I'm saying is pretty much what I was saying back then.

Senator CRAIG. Yes.

Dr. GILINSKY. I had questions about the permanent repository disposal concept. And I thought we ought to go to a system of management where we continue to monitor the waste. I think DOE itself is having second thoughts about the disposal concept and is now talking about possibly keeping Yucca Mountain, if it is approved, open up to 300 years. And I think really that's saying forever. So they're really talking about a monitor retrieval system at Yucca Mountain, but a thousand feet down. It's a sort of a mixture of the old concept and the new concept. I think it's just an outdated relic of earlier thinking.

In reference to your point about stampede, we know that DOE is not ready to file an application within 90 days, as required by law. And yet they're talking about filing an application in 2004. They're not just going to miss this by a few days. They're going to

miss this by years. So what's the hurry? So I think stampede really is an appropriate word.

You mentioned that after all this is all going to be reviewed by NRC. Certain aspects of it will be, but not the basic site suitability determination that by law DOE is required to make. And they interpreted the law that way for many years, up to about 1996, and said so, that they had two responsibilities. One was site suitability, which was quite apart from the man-made structures and the container. And the other is to meet NRC's licensing requirements. Now they've dropped that first requirement and just said, "We're just going to meet NRC's licensing requirements." So there's a gap here. And I frankly can't see how you can let them get away with this.

Senator CRAIG. Well, 1990, we hadn't put EPA into it pre-1996, had we?

Dr. GILINSKY. No.

Senator CRAIG. No. And that did change the dynamics of the effort at Yucca Mountain.

Dr. GILINSKY. But it didn't change the standards for site suitability. There are still two jobs.

Senator CRAIG. We raised it to a 10,000-year standard, did we not?

Dr. GILINSKY. It's one aspect of it. There's the licensing aspect.

Senator CRAIG. But we did change it.

Dr. GILINSKY. You did change it, but you didn't relieve them of that other responsibility.

Senator CRAIG. I see what you're saying.

Dr. GILINSKY. And let me just go to one other point, which is the mention of the word "temporary." Now, as if somehow this is something terrible, you know, because these were intended to be temporary storage facilities at the reactors. Now, in fact, they were intended to be even more temporary than they are. Originally, we intended to reprocess all the fuel. And we were——

Senator CRAIG. I didn't go that far. I studied them very closely.

Dr. GILINSKY. Well, we both go back a long way. But we were just going to have the fuel there, you know, 1 to 3 years and then ship it off to reprocessing. We've learned something. And to say that this is—it wasn't meant to be this way 34 years——

Senator CRAIG. Don't use those words, Doctor, 'cause I don't want to engender fear of the current situation.

Dr. GILINSKY. I don't know if you've read the recommendations of the Secretary of Energy.

Senator CRAIG. I have.

Dr. GILINSKY. But he is engendering fear. He has put stuff in there that I was just absolutely amazed. He lists all the cities that are within 75 miles of a reactor. He says these things are decaying. They could go into waterways. I haven't heard or seen stuff like this in the Union of Concerned Scientists. And then he says——

Senator CRAIG. Well, you should listen to some of the testimony before this committee, then.

Dr. GILINSKY. Well, maybe. But then he says once you get it into a truck and you take it over to Nevada, even if the container fails, even if everything fails, nothing is going to leak because this is ceramic. So somehow the ceramic sitting at the reactor site is vulner-

able, but the ceramic sitting—the same piece of material sitting in Yucca Mountain isn't going to do anything. There's a real disconnect here. And if there's fear mongering, I think they've been engaged in.

But the thing I wanted to say about the temporary, we shouldn't let all errors of the past become hereditary. We can learn some things. And if we've changed our mind and the thing of it makes sense, if we have a new way that makes sense, let's do it.

The CHAIRMAN. Thank you.

Any other response? Yes.

Mr. ANDERSON. If I may, yes.

And, Senator Craig, I absolutely agree with you that it was important to this country and I think the peace-loving people throughout the world to move forward with the Olympics even in view of the events of September 11. I advocated that. And following the Olympics, I've spoken a number of times about how moving forward with our lives and holding these kinds of events, especially where we bring people together from throughout the world in celebration and peace, that that in itself is a triumph over terrorism.

But to characterize the presentations today as somehow fear mongering I think is an absolute mischaracterization. We are attempting to point out some of the massive security risks. I think you don't defeat terrorism by simply saying that there may be risk, but we're going to march merrily along and ignore those risks. And I felt that it was also important to talk about solutions. And I ended my remarks by discussing the need to, number one, come up with a good, long-term solution, as I think Congress intended in 1982.

But we're facing very different circumstances now. We have 131 storage sites throughout this country that will still be targets. As soon as Yucca Mountain goes into operation, if that in fact occurs, we're not going to be getting rid of these materials from these sites all at once. In fact, we're only going to have about a net depletion at these sites of about a thousand tons per year. Three thousand tons will be shipped each year. Two thousand new tons are projected to be produced. And we'll have 64,000 tons in place in the year 2010 or 2011, when these shipments commence. So these sites are still going to have these materials. We'll still have 103—at least at present we have 103 nuclear plants in 66 locations that will still be prime targets and still will be vulnerable to the same kinds of accidents and the human error and the technological problems that we already know about.

So I think the three things that Congress must take a hold of, and I would submit that it's Congress's responsibility, not something you delegate to NRC, is that you make sure the science is good. And again, I would refer to Governor Guinn's testimony before the House committee—and I hope that's been submitted to this committee—where he references a new report, a peer review report commissioned by the DOE, that excoriates—those were his words—the scientific work of the Department of Energy in connection with Yucca Mountain.

Secondly, that there be an insistence that actual tests on actual casks being utilized be performed and that these casks meet plausible terrorist acts and scenarios; that's not been done. And I think

Martin Resnikof's analogy to what happened in 1970 when NRC—who apparently someone on this committee wanted to delegate this authority to—NRC said, with regard to the shipment by air of plutonium, that drop tests of 30 feet were sufficient.

And when the attorney general of New York made its case, NRC argued against New York's position, and it took Congress taking that decision away from the NRC—I think that's exactly what Congress ought to be doing today, demanding that actual tests be done on the very casks that are used.

And then third, there will be no security. We're being absolutely foolhardy to move forward with any of this without a long-term final solution. And that means conservation. That means other technology that's not going to continue us on this disastrous course.

Thank you.

Senator CRAIG. Gentlemen, thank you. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Reid.

Senator REID. Thank you, Mr. Chairman.

People would like this hearing to be Nevada complaining about Yucca Mountain. And we could do that. And we've done it for years. But it's time the American people heard that this is not a problem that relates to Nevada. It's a problem that relates to our country. And that's why this panel of witnesses has been put together, and you've done on outstanding job.

Now, for anyone to suggest that John Ensign, Harry Reid, and especially Kenny Guinn, Governor of Nevada, does not oppose nuclear waste is a dream that someone has. What good would a hearing do for Ensign and I to be down there and Governor Guinn to come and say we don't want nuclear waste? None. We've been doing it for 20 years. But what has developed now is a picture of what will happen if nuclear waste is attempted to be transported in this country. And that's why the Nuclear Energy Institute and these other people, who have this fetish to transport nuclear waste are upset about this panel that we've got here.

Now, mayor, thank you very much for being here. I think it says it all, on the piece of paper that you have, introducing your testimony, which shows a cowboy on a horse, and it shows a nuclear bomb going off with the mushroom cloud. And this was from an Atomic Energy Commission booklet, 1957, Atomic Tests in Nevada. And under it, under this cartoon-like figure, and it turned out to be a real cruel cartoon, are the words, "There is no danger." That's what we're hearing.

We heard it with the above-ground nuclear tests—and that's what this illustrated—when we have people who are still dying, as Dr. Prescott has said, from these tests that took place in Nevada.

You know, I used to watch them go off. And I was lucky, because they always made sure the wind did not blow toward Las Vegas. It blew toward Lincoln County, Nevada, and into southern Utah, where people are now dead and are dying. So anyone who suggests that the Federal Government has this under control is walking in dreamland.

I wanted to go through the résumés of each of you here. Everyone within the sound of my voice should understand that the panel

of witnesses here is above reproach. No one can touch their veracity, their educational, or professional backgrounds. Every one of you. Now, some of you have been hired by the State of Nevada. So what?

We know that—I say this to you, Mr. Halstead, and I think you did a good job answering this already—the increase in shipments and the distance covered and the number of vehicles on the road, does that effect the risk of an accident? I mean, does it take much of a mathematician to figure that out?

Mr. HALSTEAD. No, Senator, it doesn't. And, in fact, many people would be surprised to find that, to begin with, the past statistical accident record of the industry is pretty average. And that's why, when we project their past accident rate forward with the large increase in shipment miles, that we get the numbers of projections of about 150 to as high as 400 accidents over the shipments that are being proposed.

The bottom line is that the Department of Energy, once they reach their full level of operations, would be shipping as much waste every year for certainly 24 years as they have shipped in the entire past 40 years. And the shipment distance would increase from about five to six hundred miles in the past to well over 2,000—about 2200 miles on average, creating more opportunities for equipment failure and human error.

Senator REID. And as Michael Ervin has said, he's a police officer and has been for several decades, but he could go out tomorrow, jump in a truck, and whip it through the country hauling nuclear waste or hazardous waste. Now, as alert as you appear, I think that you have—some of your driving skills, you may have to brush up on them a little bit; isn't that right?

Mr. ERVIN. Yes, Senator. Those are what I would consider perishable skills. The longer you're away from the business, the lower your skill level becomes. So you have to go out and restart again and practice.

Senator REID. I drove a truck, but a small one, that hauled oil, gas in it. And I was taught that you could drive as safely as you wanted, but the concern you had was with other people. And it's the same with driving one of these big trucks, isn't it?

Mr. ERVIN. Very much so. In fact, I was blessed and fortunate enough to learn from my father, who drove for 45 years. And the big thing he taught me was not only to take care of yourself, but you need to predict what the people around you are going to do.

And his favorite term was, "If you think it's crazy or stupid for them to do, they'll probably do it, so be prepared for it."

And he was right more times than not.

Senator REID. Dr. Ballard—again, we have a panel here of witnesses who are extremely well qualified. Dr. Ballard is no exception to that.

Secretary Abraham testified that the EIS considered the probability of a worst-case scenario to be 2.8 in 10 million per year over 24 years. In addition, the new threat post-September 11 has reflected that nuclear waste shipments could become targets for terrorists. In your opinion, how do these changes affect these safety projections, and do these projections still reflect the risk realistically?

Dr. BALLARD. Senator, thank you for having me here today. I have several comments that I'd like to bring to that particular point.

Senator REID. Your professional academic life is terrorism, isn't that right?

Dr. BALLARD. Yes, sir. I teach a variety of classes of terrorism, both domestic and international. I have spent the last seven years studying this area exclusively. My training is in political sociology, deviance, and criminology, though I teach in a criminal justice department, where I train police officers for their future careers.

This particular issue has been one that's motivated me to become an academic. It seems like we're having a convention of former truck drivers here, 'cause in a former life, in southern California, I have driven a truck myself too.

The answer to your question is very complex, but I have three points that I'd like to make. And I hope that they can get to some of the misperceptions I think that people may have about the risk of terrorism and the reason why somebody like myself, who's an academic of the terrorist tactics that could be used, would be testifying.

First of all, I want to talk about the current threat environment. Yes, it has been heightened since September 11, but that is only true in the United States. Around the world, people are very concerned about attacks against nuclear facilities. This is an important point I'll get to in a moment. But as we've seen in the recent G8 meeting attended by Spencer Abraham, this concern is not just in the United States.

We've seen mass protest in Germany and other countries that indicate what might happen after a large-scale shipment program could begin. We also do not hear very much in the United States about those attacks that are being perpetrated in places like Russia—in the former Soviet Union—pardon me—and the newly independent States. Have to get the acronyms right.

There's a researcher named Lyudmilla Zaitseva at Stanford, who has documented 16 attacks against these type of facilities in the year 2000. I haven't talked to her recently about her newest research. The point of that is terrorists and those who would perpetuate mass violence are interested in radiological targets. That's what we should be discussing here today.

There's also a process that's being more and more understood by the academic community. And this is a diffusion of tactics. If we have a successful terrorist attack, using an airplane, for example, to take down a building, other people are going to become interested in it. We have to be proactive, to stop that diffusion of tactics. So we have to start planning for these events much before there will be any other consideration. And part of that is a transportation issue. Part of that is a security issue. Part of it is a national security issue. All of those come to bear on this particular topic.

Secondly, I spoke in my written comments about the symbolic value of these targets. These targets will be different than the shipments that are being made now. They'll be different because it's a large-scale planned campaign of federalization program that may be opposed by domestic groups because of its connection to military targets; it may be opposed by international groups. We have to be

forward thinking in this process. And we have to address those potential risks.

Lastly, because this is an energy committee, I will defer to some of the economic literature and talk about the event risk that this particular shipment program poses to the energy industry and the energy commodities market. It's very interesting to me to hear people not address those issues.

If there was a single terrorist attack or major accident involving these materials, it would have a significant impact on these industries and the commodities market. They call that event risk these days. So after September 11 we saw a significant impact into the financial markets. The same would be true in the event of a terrorist attack.

I hope that answers your question, sir.

The CHAIRMAN. Thank you very much.

Senator ENSIGN. Thank you, Mr. Chairman. And once again thank you very much for holding this hearing and allowing a little different side than I think most senators have been exposed to on the whole issue of storing nuclear waste and transporting nuclear waste.

As Senator Reid mentioned, one of the reasons that we wanted the panel made up of different people today was that Nevada's side has been told. We have been telling it from every angle that we can tell it from and why we think that Yucca Mountain is a bad idea. But unfortunately people seem to have already made up their mind in a lot of cases. And so we didn't want to take why just Yucca Mountain is a bad idea.

We want to also discuss why transportation is a bad idea, because then it impacts individual people in their own cities and towns across the country. And I think that it's very important as a national issue for these—the dangers—not to use fear, but for the dangers, the real dangers, to be explored, so that if we do currently as we are currently transporting nuclear waste, we need to explore those dangers and to try to correct them, to try to make it safer for the transportation that we're currently doing.

All of us looked at September 11. And the reason I disagree with Senator—the Senator from Idaho and his characterization about fear is that—is that September 11 changed everything in this country. We need to look at everything differently. We need to look at the way that all of our security of all of our capital complex is different today, post September 11. And we need, I think, to look at the transportation of nuclear waste. As Dr. Ballard has talked about, these are huge targets. And so we need to think, I think, in different ways than we have thought about in the past.

I want to explore a few of the areas that have been talked about. Senator Thomas, when he first opened his—or the one comment that he made was the 175 shipments that have been—that are going to be made. And I've heard that and I've heard that and I've heard that. And Dr. Gilinsky and I think Mr. Halstead, in your testimony, between the two of you, the Department of Energy—and I'd like to submit for the record the Department of Energy in their final EIS, on page J10 and page J11, those two pages, really point out—first of all, that they only did the final EIS on 77 of the sites, if I'm correct. Is that correct, Mr. Halstead?

Mr. HALSTEAD. That's correct, Senator.

Senator ENSIGN. And there's 131 sites total?

Mr. HALSTEAD. That's right.

Senator ENSIGN. Under their lowest case scenario, they're talking about between—and if it's mostly rail—and that would be the lowest, lowest number that we have—under their lowest case scenario, over the 23 years, they're looking at about 10,600 shipments. Is that number correct to you?

Mr. HALSTEAD. That's correct.

Senator ENSIGN. This is all documented according to the DOE. Well, divide 10,600 by 23 years. I'm not exactly a mathematician, but I think that that's close to 500 per year. So—and that's on their lowest case scenario, with just 77 of the sites. So when somebody says 175 shipments per year——

Mr. HALSTEAD. Big shipments.

Senator ENSIGN. Yeah. They're going to be a lot bigger shipments than the ones they're talking about.

Mr. HALSTEAD. Might I add to that, Senator Ensign, that what is unfortunately not made clear to the reader—and I have my document open also to page J11, because that's perhaps the most important page in the whole environmental impact statement for transportation—they forget to mention that in order to make that low case mostly rail work, they have to make 1,600 barge shipments and they have to make 600 to 800 heavy haul truck shipments just on the reactor end alone. And then, since they haven't put forward a route for a railroad in Nevada, the possibility would certainly be there that they would have to move each of those rail casks onto a heavy haul truck, which because they would be separately permitted, would have to be counted as a separate shipment. And that adds another 9,600 shipments. So that's why in my statement I added the more appropriate numbers. In order to make this mostly rail program work, you have to add a bunch of shipments that the Department of Energy has conveniently omitted from the table, which even in itself shows much larger numbers than the Secretary has been quoting publicly.

Senator ENSIGN. Right. And once again that's only 77 sites, correct?

Mr. HALSTEAD. That's right.

Senator ENSIGN. Which is amazing to me that they only covered 77 sites and forgot that there were—everybody's been talking about the 131 sites. So I thought that was important to get on the record.

Dr. Gilinsky, you mentioned something about viability of nuclear power. And I hear a lot that the reason that people want to build Yucca Mountain is they think that it will make nuclear power more viable. You mentioned on-site dry cask storage cost, transportation risks, and some of those kind of things. Can you just explore that a little more, as far as the viability of nuclear power, of putting $60 billion-plus into Yucca Mountain and what that does to the possible cost of nuclear power in the future and we know the politics of transporting this waste.

Dr. GILINSKY. Well, the cost of this project is already estimated by DOE to be $60 billion. And that has been growing rather rapidly. So to put a $100 billion label on it I think wouldn't be appropriate—wouldn't be inappropriate.

Somehow or other the people who are most involved with nuclear power have convinced themselves that the thing that's holding up public approval, which is usually the phrase, to an expansion of nuclear power is the lack of a permanent repository. I think this is a complete misreading of what their problems are and what the pros and cons of nuclear power are and what the future of it will turn on. I think mostly it will turn on the quality of the generators, the economics and the safety of the generating plants.

But somehow they have convinced themselves of this, and they think this is the be all and end all. And I think that Washington lobbyists have not done them a favor in convincing them of this. And so this to me is the driving consideration.

I've talked to people in the Department of Energy. They're not personally concerned about the safety of the waste sites as they are now. They think the public out there is concerned. And so we must do this in order to convince the public to have more nuclear power.

Well, this—even if it were true, I think it's not a good reason to spend public money this way. But I don't think it's right. And we have a system that works. The on-site storage is there. It's NRC approved. We can store fuel this way for many years, decades. And as I said, in time we'll want to collect, not because it isn't safe to be at those sites. But I think you want fuel generally to be in the hands of people whose principal business that is to limit the distraction of the—for the operators. But that's a matter of degree. And I think we have plenty of time to do it and to do a good and responsible job.

I did want to make just one comment going back to your transportation comment. And that is I haven't myself gotten into this subject, but I have done a little arithmetic here while everybody was talking. And if you divide the 2,000 tons per year by 175, you get about 11. And that's 11 tons of spent fuel per shipment. And that implies cask weight several times that. So we're talking about tens of tons per shipment. I'm not aware that DOE has vehicles that can handle this at least at the present time. So that's a question I think that they ought to be asked.

Senator ENSIGN. Mr. Chairman, if I may just follow up with one other question for Mr. Gilinsky, because I thought this was maybe the most important part of your testimony. It's something that I've been emphasizing that we have time. The point about Yucca Mountain, the point about a nuclear waste repository is we have time. And as a matter of fact, what I thought about your testimony is taking time actually improves the situation, because of the cooling time. The radioactive nucleotides that actually decrease their toxicity over 40 to 50 years.

Waiting 40 to 50 years is actually a benefit scientifically. Not emotionally, not fear mongering, but from a scientific basis, it would actually be better, even if you were going to build Yucca Mountain, to do it 40 to 50 years from now, to ship that stuff and to bring it to the site. I thought that was very important.

Do you care to comment further?

Dr. GILINSKY. I agree with that, Senator. And, in fact, DOE's plans—they talk about two possibilities, a hot repository, which was their original plan, and the waste board raised a lot of ques-

tions about that—the technical review board. And so they're now thinking about a cool repository.

Now, if you go to a cool repository, when they bring the stuff to Yucca Mountain, they're going to have to leave it on the surface for decades before they put it down there. So they're talking about collecting it and then leaving it on the surface. I mean, they will reconfigure it and change it from this kind of cask to that kind of cask and so on. But they're basically going to have to leave it on the surface, because they can't put it down right away.

And this is why it's also extremely misleading that they've been putting out this idea, one is better than 131, as if all of a sudden we've had this terrorist attack, people are worried, and they're sort of suggesting, and a lot of editorial writers have bought this message, that we're going to collect this stuff really fast, get it out of all these sites, put it in one place and underground, and isn't that better?

Well, "A," it's not going to get collected for decades and then very likely it's going to sit—I mean, if we go forward with this proposal, it's going to sit on the surface there, and there will still be lots of waste at those sites. So I think this is not a good idea.

Senator REID. Mr. Chairman, I know that you have—like all of us——

The CHAIRMAN. Go ahead. We still have time if you have an additional question.

Senator REID. We have a vote at 11:30.

I want to say this, Mr. Chairman. First of all, I am grateful to you and your staff for allowing us to have this hearing. You could have jammed this through, as happens a lot of times in Congress.

I want to say this. My friends came earlier, who are in support of Yucca Mountain, and in effect bad-mouthed this hearing. I'm disappointed they didn't stay for the hearing. They may have learned something.

Here on this panel we have two Ph.Ds, one of the foremost medical doctors in the country, people who are experienced—one is a mayor of a major city in Utah—we have an eminent panel of witnesses here. And I'm so disappointed with people who come in and smear mud all over this hearing and then leave. I think that's not the right way to go.

The situation is this. We don't like Yucca Mountain. Of course, we don't like Yucca Mountain. But the fact of the matter is the people of this country are going to react just like the people in Germany that Dr. Ballard talked about. They have dropped their plans in Germany to transport, to have a repository, 'cause why? They can't move it. We are never going to haul nuclear waste in America. Understand that.

Now, it doesn't matter what—they can say, "Okay, we're going to haul it to Yucca Mountain in 2010." It will never ever happen. Believe me.

They are not going to allow nuclear waste to be transported in this country unless there are some changes made in procedures. You can't haul these trucks up and down the highways and rail. We have evil people in this country today who are looking for targets of opportunity. That's what we've been told here today. If fear

has been generated today, it's the right thing to do. People should be concerned about what's taking place.

The Department of Energy, led by the Secretary of Energy, who is from the State of Michigan, who was in love with nuclear waste when he was in the Senate—he's still in love with nuclear waste—gave some very bad advice to a President who I'm convinced wanted to do the right thing. He didn't do the right thing, and I won't go into how I feel about that.

But we have a situation here that we at least have been able to let the people of this country know by people who have qualifications about what's about to happen to this country, and it's too bad.

The CHAIRMAN. Senator Ensign, did you have any final question?

Senator ENSIGN. I don't, Mr. Chairman, other than just to say thank you. I think it—I agree with Senator Reid. It is a shame that actually all the Senators to the committee on such an important issue—I mean, we're not talking about a $100 million program; we're talking a $60 to $100 billion program that is of such import that it really is a shame that the rest of the Senators were not here to hear this, because I think that if an objective listener were listening to the testimony here, what Secretary Abraham did, just the going back and forth of all the facts, if anybody was objective on this, I think that it—the evidence is so clear against Yucca Mountain, it amazes me that people are still wanting to go forward with it.

Thank you.

The CHAIRMAN. Well, thank you. Tomorrow we have our final hearing on this issue with the various boards and oversight organizations that have been looking into this. And so we will convene again tomorrow.

Thanks to all the witnesses. I think it was good testimony.

The WITNESSES. Thank you, Mr. Chairman.

[Whereupon, at 11:20 a.m., the hearing was recessed, to be reconvened on May 23, 2002.]

YUCCA MOUNTAIN DEPOSITORY DEVELOPMENT

THURSDAY, MAY 23, 2002

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:33 a.m., in room SH–216, Hart Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. We will call the hearing to order. The committee meets this morning for the last of three hearings on S.J. Res. 34, which is a joint resolution approving the site at Yucca Mountain, Nevada, for the development of the nuclear waste repository.

The question posed to us by the joint resolution is whether Congress should allow the Secretary of Energy to apply to the Nuclear Regulatory Commission for a license to build a nuclear waste repository at Yucca Mountain. Last week we heard the Secretary of Energy explain that we should. Yesterday, we heard spokesmen for the State of Nevada explain why we should not. And today, we will hear from the agencies charged with regulating or overseeing the repository program.

Our first panel will consist of the Nuclear Regulatory Commission, which will be responsible for deciding whether to authorize construction of a repository, if Congress approves the President's site recommendation.

Following the panel made up of the Commissioners, we will hear from a second panel consisting of Dr. Jared Cohon, who is the Chairman of the Nuclear Waste Technical Review Board, which was established to provide independent experts, scientific and technical advice about the program to the Secretary of Energy and the Congress.

Second on this panel is the Honorable Jeffrey R. Holmstead, who is the Assistant Administrator for Air and Radiation at the Environmental Protection Agency, which is responsible for setting radiation protection standards for the repository.

Third on the second panel is Ms. Gary Jones, the Director of the Natural Resources and Environment Team of the General Accounting Office, which monitors the nuclear waste program for Congress.

And finally on that panel is Mr. Robert Card, who is the Under Secretary of Energy.

Before we hear from these two panels, however, we want to hear from Jim Hall on behalf of the Transportation Safety Coalition. Mr. Hall was originally invited to testify yesterday with Nevada's other witnesses, but was unable to be here yesterday. So, we have agreed to hear from him first this morning.

As at the prior two hearings, we have again invited Senators Reid and Ensign to sit with the committee this morning, and ask questions if they desire to do so.

I see my ranking member, Senator Murkowski, just arriving. Let me see if he has any opening statement before we turn to Mr. Hall for his testimony.

[A prepared statement from Senator Reid follows:]

PREPARED STATEMENT OF HON. HARRY REID, U.S. SENATOR FROM NEVADA

I want to thank you Chairman Bingaman and Senator Murkowski for allowing me the opportunity to participate in this hearing and for understanding the importance of this issue to me and to my state, and really to almost every state.

The resolution this committee is considering refers to the President's recommendation of Yucca Mountain, Nevada as the site for disposal of high-level radioactive waste.

But this limited description fails to take into account the full implications of developing a repository there (or anywhere else) namely, that before dumping the nation's nuclear waste on Nevada, it has to be shipped through 43 states, including the states most members of this committee represent.

Today we are going to hear from witnesses who will tell us about the risks the Department of Energy's program will entail—these include risks in Nevada and more importantly, risks all over the country where this waste will be shipped.

The Secretary said it best last week when he acknowledged that the Department of Energy has only had preliminary thoughts about a transportation plan for this waste. That's like someone building a hospital with no doctors.

So while there are many fundamental problems with the site itself and concerns about the process that led to the President's recommendation of the site, I want to first address the dangers of transporting massive amounts of deadly nuclear waste along the nation's major highways, railroad tracks and waterways.

Bush plan for moving thousands of tons of deadly high-level radioactive waste requires 100,000 shipments by truck, 20,000 by train and perhaps thousands more by barge over 40 years.

This idea would be risky at any time, but after September 11, 2001 it is just unthinkable.

The long term radiation contained in each shipment is 240 times radiation released by the Hiroshima bomb.

Shipments will pass by homes, schools, parks, churches, offices.

Shipments jeopardize the safety, health, environment and the lives of many people who live in cities and towns all over the country.

We know there will be hundreds of accidents involving shipments of nuclear waste.

It's not a question of if, but when and where and how severe will these accidents be. And an accident involving a container of deadly nuclear waste is no routine fender-bender. A collision or fire involving a 25-ton payload of nuclear waste could kill thousands.

Yet, the Department of Energy despite knowing there will be accidents recommended this plan without developing a plan for the shipments.

In addition, DOE has failed to provide the millions of people who live near the proposed routes the information they need to understand the risk their families face.

Deadly accidents are not the only concern. Shipping nuclear waste across the country increases our vulnerability to terrorist attack, by adding hundreds of thousands of targets for terrorists to attack with a missile or to hijack or to sabotage.

So transporting deadly nuclear waste is dangerous and it's a risk our country shouldn't take.

The nuclear power industry and some of its backers suggest it would be better to have nuclear waste at a single site instead of scattered around the country. But this is a false promise, because the nation's nuclear waste will never be consolidated at a single site.

It will continue to be at every one of the operating reactor sites. Spent nuclear fuel rods are so hot and radioactive that they have to be stored at the nuclear reactor site in a cooling pond for 5 years before they can be moved. So developing Yucca Mountain would add to the number of sites with nuclear waste, not reduce it.

There are also risks about Yucca Mountain itself and hundreds of unanswered questions about whether it can be a safe storage facility.

Independent federal experts agree that the science done on Yucca Mountain is incomplete.

> The General Accounting Office, a credible independent agency, chastised the Secretary of Energy for making a decision on Yucca Mountain when almost 300 important scientific tests remain incomplete.
>
> The experts at the Nuclear Waste Technical Review Board, another independent agency, concluded that the technical basis for Yucca Mountain is weak to moderate.
>
> The Inspector General at the Department of Energy found the that law firm they hired was working for the nuclear power industry at the same time.

There is an alternative. We can safely leave the waste on site, where it will be any way as new waste is added to the existing waste. It will be safe there while we develop the technology for reprocessing or safe disposal without shipping 100,000 nuclear dirty bombs through your states.

Again, I want to thank you for the opportunity to discuss this important issue.

STATEMENT OF HON. FRANK H., MURKOWSKI, U.S. SENATOR FROM ALASKA

Senator MURKOWSKI. Thank you, Senator Bingaman. I had the pleasure of making sure these hearings started on time when I was chairman. I am glad to see that you are continuing the effort. I am pleased to see that we have a witness from Nevada this morning.

It looks like we have a pretty good list of witnesses representing the Nuclear Regulatory Commission, the Waste Technical Review Board, the Government Accounting Agency, Department of Energy, and the Environmental Protection Agency.

I am sure we are going to get some objective views on this. And I am also pleased to note that evidently the Honorable Robert Card is here from the Department of Energy, and I hope that he will feel free to jump in at any time to respond to questions or comments from both witnesses or members. I think he is very knowledgeable.

As we know, we have had 20 years of study on this, over $4 billion invested in determining whether this site is scientifically and technically suitable for the development of a repository.

For those of you who say we are moving too fast, why, I am not sure that I would agree. This is a decision that has been made after 24 years of study by some of the world's best scientists, not that there are not other scientists out there that would disagree. But, at some point in time, you have to reach a decision. You can not vacillate forever, and then you have to be held accountable for that decision. So I am confident that the work done today by the Department of Energy, while it will continue, at least we are in a position now to move on, make recommendations and so forth, relative to the scientific investigations and analysis that will continue, of course, for the life of the repository.

I personally believe that at some date that repository will be used for reprocessing of the waste which is what the French have done, what the Japanese are proceeding with, and I think is the appropriate way to proceed. But evidently, we are not quite there yet.

We have got a realization that the $4 billion is not Federal dollars. Those are the dollars that have been paid into this by the rate payers. Now that money was paid in exchange for an obligation to take the nuclear waste. Remember, that was due in 1998. So far, no waste has been removed, despite the fact that the nuclear waste fund is now in excess of $17 billion.

If the spent fuel is not taken soon, we are told at least one reactor will shut down, Prairie Island in Minnesota. And I do not think that we can afford to sacrifice nuclear power, not in Minnesota or anywhere else.

We have got 1,860 tons in California, 2,300 tons in New York, 5,800 tons in Illinois, and the recognition that the nuclear industry is still 20 percent of our power generation.

We also have a responsibility to clean up our Cold War legacy and the Department of Energy weapons sites. Well, have them all over the United States. They have to be cleaned up. And to accomplish cleanup, waste must be removed. Sites like Rocky Flats in Colorado, Hanford in Washington, and Savannah River in South Carolina.

It is rather ironic that those who are concerned about transportation, they want it out of their States, but they do not recognize the reality to get it out of their State—it is not going to disappear. It has got to be moved. So for a variety of reasons, all based on sound science, we must proceed to affirm the President's site designation of Yucca Mountain as our Nation's central remote nuclear waste repository. This is a decision before the committee, and what we will have to vote on the 5th of June.

So, I look forward to proceeding, Mr. Chairman. I wish our witnesses a good day.

The CHAIRMAN. All right. Thank you very much.

Let me also just advise for anybody watching that we do have all of the testimonies at these hearings on our web site at energy.senate.gov.

So, Mr. Hall, please go right ahead.

STATEMENT OF JIM HALL, FORMER CHAIRMAN, NATIONAL TRANSPORTATION SAFETY BOARD, ON BEHALF OF THE TRANSPORTATION SAFETY COALITION

Mr. HALL. Thank you, Mr. Chairman and Senators.

My name is Jim Hall. For almost 7 years I served as Chairman of the National Transportation Safety Board. I previously served as a member of Governor Ned McWherter's cabinet and director of the Tennessee State Planning Office, where I worked on spent nuclear fuel transportation and storage issues. I also directed the State's oversight of DOE operations during the cleanup and restructuring of the Oak Ridge National Nuclear Weapons Complex. I currently serve on the National Academy of Engineering's committee on combating terrorism.

Mr. Chairman, I should state that at the outset that I am not anti-nuclear. My house gets electricity from a nuclear powerplant that I see from a nearby ridge. I have no position on whether or not Yucca Mountain is a safe site for nuclear waste.

I am here today representing the Transportation Safety Coalition, an ad hoc group of organizations concerned about the trans-

portation of nuclear waste on America's roads, rails, and waterways. This is not solely an issue that affects the citizens of the State of Nevada, but all Americans, because shipments of nuclear waste would travel through 44 States, affecting over 200 million people.

I want the committee to know exactly why I joined this effort. I joined for three reasons. First, in my role at the NTSB, I became all too familiar with the human and economic toll caused by air, rail, truck, and marine accidents. Since September 11, we have learned that we must protect our Nation's transportation system from intentional acts, as well.

Second, from my work with the State of Tennessee, I know that the Department of Energy operations need careful oversight to ensure that safety is considered at all levels of an operation. The Oak Ridge cleanup will cost taxpayers over $6.5 billion, and could have been avoided if a plan for safe disposal had been in place when testing began.

Finally, Mr. Chairman, I hope that my entrance into this discussion will raise the level of discussion on transportation safety issues surrounding this important decision.

As you evaluate legislation for a nuclear waste repository, you are considering a proposal for which there is no transportation plan. As the Secretary of Energy told you last week, and I quote his words, "The Department of Energy is just beginning to formulate its preliminary thoughts about a transportation plan."

There is no plan, or even answers to basic questions. There is no post 9/11 risk assessment, no finalized modes and routes, no full scale test of the shipping containers.

The Department of Energy has spent approximately $7 billion to study Yucca Mountain, but they have spent less that $200 million over 20 years on transportation of nuclear material.

Based on my review of the relevant materials and discussions with other experts in the field, it appears clear to me that much more work needs to be done. The proposal to send tens of thousands of shipments of high-level nuclear waste across country by truck, rail, and barge, will be, I believe, the biggest transportation safety decision made by this Congress in the next 50 years.

The Department of Energy has not yet designated routes or modes of transportation. The DOE does not even support the use of dedicated trains, which would greatly enhance safety and security, in my opinion. We do not know what criteria the DOE will use to weigh safety against the cost of different transportation modes.

According to a letter to Congress from the NRC, there have been no full scale tests on the casks that will be carrying high-level nuclear waste. According to news reports, terrorists have identified nuclear materials as their target of choice. And we do not know if the casks can withstand explosives or a missile.

I know, from my work at the National Transportation Safety Board, that safe vehicles undergo vigorous tests for crash worthiness, structural integrity, and engineering reliability. Congress should demand vigorous tests on full scale shipping casks.

A transportation plan for nuclear waste shipments should have a zero accident goal. The zero accident goal would reflect a culture

in which safety is paramount and drives all aspects of the transportation system.

Instead, the DOE estimates there will be over 66 truck accidents and 10 rail accidents over the first 24 years. Whatever the number, the fact is that one accident resulting in radioactive release will have long-term, devastating results.

In the months following September 11, nearly every Federal agency has been engaged in evaluating the preparedness to deal with terrorist attacks and adopting measures to counter this new threat. Congress has approved billions of dollars for protecting Federal facilities from terrorist attacks, and is considering legislation to adapt the country's public health, emergency preparedness and response system to new threats. These ongoing efforts to protect citizens and infrastructure from terrorist acts, even those we have not yet been able to confirm. In contrast, we know that transporting nuclear waste is a hazard, and we need a full risk assessment of transporting nuclear waste.

The DOE's proposal for transporting large amounts of high-level nuclear waste over long distances many times every year is a dramatic increase in the amount of waste we have moved in the past. The number of things that can go wrong will increase significantly.

History has shown us, time and time again, that if the essential elements of a safety plan are not put into place before an activity begins, the momentum of the activity overcomes safety considerations. Congress has the obligation to protect the public safety of the American people.

The members of this committee are very familiar with the record of Federal agencies to respond to mandates once appropriations have been made and projects are underway. It is essential, I believe, to the American people that Congress is satisfied with a transportation plan before proceeding with the Yucca Mountain project.

Thank you very much, and I thank the members of the committee for their attention.

[The prepared statement of Mr. Hall follows:]

PREPARED STATEMENT OF JIM HALL, FORMER CHAIRMAN, NATIONAL TRANSPORTATION SAFETY BOARD

Members of the Committee: My name is Jim Hall, and for more than seven years I served as Chairman of the National Transportation Safety Board (NTSB). In that capacity, I acted as the "eyes and ears" of the American people at transportation accidents across the country and around the world. Since leaving the National Transportation Safety Board in January of 2001, I have continued to work on transportation safety issues and serve as a strategic counselor in transportation safety and crisis management. In addition, I currently serve on the National Academy of Engineering's Committee on Combating Terrorism. This project is aimed at helping the Federal Government, and more specifically the Executive Office of the President, effectively use the nation's and the world's scientific and technical community in a timely response to the threat of catastrophic terrorism. The specific audience for the study will be the Office of Homeland Security, federal and state legislators, and state and local government officials responsible for mitigating terrorist threats.

Prior to coming to Washington, I served as a member of Governor Ned McWherter's cabinet and director of the Tennessee State Planning Office. In that role, I was deeply involved with spent nuclear fuel transportation and storage issues while Tennessee was being considered a potential host state for Department of Energy's (DOE) proposed Monitored Retrievable Storage Facility. Additionally, I directed the State's oversight of DOE operations at Oak Ridge during the cleanup and restructuring of the national nuclear weapons complex. I also directed Tennessee's

participation in the Southern States Energy Board Advisory Committee on Transportation of High-Level Radioactive Material and in the Southeast Compact Commission for Low-Level Radioactive Waste Management.

I am here today representing the Transportation Safety Coalition, a group of organizations concerned about the safety of transporting dangerous nuclear waste on America's roads, railroads, and waterways. The coalition is composed of environmental, public health, and safety organizations, including the American Public Health Association, the Environmental Working Group, the National Environmental Trust, Physicians for Social Responsibility, U.S. Public Information Research Groups, and the Nevada Agency for Nuclear Projects. This coalition has come together to inform policy makers and the public on the dangers of proceeding with a nuclear waste repository without a thorough risk assessment of transporting nuclear waste.

DOE HAS NO TRANSPORTATION PLAN

As the Chairman of the National Transportation Safety Board, I saw the results of a failure to adequately build a safety culture into transportation systems. I also saw how hard it can be for government bureaucracies to change directions to respond to new safety concerns. The National Transportation Safety Board's Strategic Plan states that it is often difficult for Federal, State and local agencies to "recognize and acknowledge when their safety regulations or programs are ineffective."

From my work with the State of Tennessee, I know firsthand about the failure to build a safety culture into the planning stage of an operation. The DOE's activities at the Oak Ridge National Laboratory site have contaminated soil, groundwater and rivers, even drinking water sources, as a result of leaks, spills, and past waste disposal practices. The resulting cleanup will cost taxpayers over $6.5 billion and could have been avoided if a plan for safe disposal had been in place when testing began.

What I find most shocking about the Yucca Mountain Project is that DOE has no plan to transport spent nuclear fuel to its proposed repository. Secretary Abraham testified last week that the DOE is "just beginning to formulate its preliminary thoughts about a transportation plan."

In fact, DOE's spending history suggests that transportation planning has never been a high priority. The Department has spent 7 billion dollars looking into Yucca Mountain's geology, but less than 200 million dollars on transportation of nuclear waste. That works out to less than 10 million dollars a year for the last twenty years. This is a fundamental flaw in the Department's approach. While some might have accepted this approach before 9/11, no one should now. Failing to plan for the safe and secure transport of nuclear waste is irresponsible.

We should not move ahead with this project without a plan for the most critical element of the project, the element that affects more people directly than any other element—that is the lesson of September 11th. The issue of safe transportation cannot be separated from the issue before Congress today, that of deciding whether or not to override Governor Guinn's veto and move ahead with a Yucca Mountain site license. The Nuclear Regulatory Commission, which will evaluate the DOE's work on Yucca Mountain, has no authority to require a transportation plan before deciding on a site license. Only Congress can demand that the DOE develop a credible, safety-based transportation plan.

Today, we all live under the constant threat of terrorism. It is reckless and irresponsible to move ahead without a transportation plan. Congress must immediately demand a detailed transportation plan that protects our citizens before it considers a vote on this project.

TRANSPORTATION MODE AND ROUTES

Secretary Abraham testified last week that DOE has made no decisions on the mode or mechanism of transport. DOE's Final Environmental Impact Statement (FEIS) simply predicts the maximum number of shipments that would occur under two scenarios: (1) shipments mostly by truck, and (2) shipments mostly by rail, which would require barge shipments from some reactors to rail lines.

DOE's stated preference is to ship spent nuclear fuel mainly by rail. The rail industry concurs that safety and security are maximized by rail transport; however the Association of American Railroads testified to Congress that "the safest possible method of transporting spent nuclear fuel is through the use of dedicated trains." DOE has not committed to using dedicated trains.In fact the Department appears to be resistant to the idea because it is cheaper to ship nuclear waste on a train that can also take on other types of cargo. Yet it appears there would be greater safety and security risks if the DOE does not use dedicated trains. A transportation

plan should outline how the DOE will weigh safety against economic concerns. We don't know how the DOE is going to develop its transportation plan, and we don't know whether in fact it will rely on rail as its primary transportation mode.

Construction of a rail line to Yucca Mountain would be the largest new rail construction undertaking in America since World War I and cost 1.5 billion dollars or more. If there is no rail spur to Yucca Mountain, then high-level nuclear waste must be trucked. Without a new rail line to Yucca Mountain, large rail casks would have to move long distances on public highways by heavy haul trucks through the country's fastest growing urban area. In this scenario the waste would have to be transferred three times, increasing the risk and the exposure to the general public.

The United States is undergoing a major demographic shift involving migration from rural areas to urban areas, meaning that both the population of urban areas and the size of urban areas will dramatically increase over the next ten to twenty years. Many of the interstate highways near urban areas already experience significant rush-hour congestion, which is expected to increase as the number of drivers increases. These interstates—such as I-75 through Atlanta, I-95 through Connecticut and New York, and I-24 through Nashville—are the routes that will most likely be used for truck shipments of nuclear waste. Nowhere in DOE's materials was I able to locate any use of projected traffic patterns, demographics, or highway expansion, which should be a critical element of a transportation plan. A route that might take a commuter—or a truck carrying nuclear waste—15 minutes today may take over an hour in future conditions, and transportation planning must include this kind of forward thinking.

It is worth noting here that even if shipments were to begin today, there are more than 200 million Americans living in the 700-plus counties that are traversed by DOE's potential roads and rail-lines. This population is only going to grow, and grow quickly, during the 24 years DOE needs to move nuclear waste across the country.

The DOE does not account for the fact that while nuclear waste shipments begin at scattered locations around the country, these shipments will begin to converge along certain routes as they near the proposed repository site. In these areas, nuclear waste shipments will become everyday occurrences, and the routes will become well known. This raises two concerns. First, risk is not constant across the country but may be higher along routes that converge near the repository, and a transportation plan should consider this. Second, in the past the DOE has usually been able to transport nuclear waste in relative secrecy. The proposed movement of 77,000 tons of nuclear waste is unprecedented, and in certain parts of the country, shipments will be frequent and predictable. We know that nuclear waste is an attractive target for terrorists—I have heard that al Qaeda has identified nuclear material as its target of choice—and it is unlikely that the DOE will be able to maintain a low profile for these shipments throughout the 24 years of shipments.

SHIPMENT CASKS

No government agency has demonstrated the safety of the casks that will be used to transport spent nuclear fuel under conditions that would be encountered in an accident or terrorist attack. Neither the Department of Transportation nor the Nuclear Regulatory Commission (NRC) has tested the truck or rail waste containers, which is why I have called for immediate full scale testing of the shipping casks. Before transportation vehicles are allowed to carry passengers, the vehicles undergo vigorous tests for crash-worthiness, structural integrity and engineering reliability. The only tests that have been done on these casks to date were conducted on small-scale models or simulated with computer programs. These tests are no substitute for full-scale testing of the actual casks that will be used for transporting waste. This is especially true given the fact that these canisters, if breached in an accident or terrorist attack, could spread radioactive waste across many square miles and endangering the health of thousands of people.

Full-scale testing of truck and rail casks would provide cask designers, regulators, and policy makers with the information necessary to determine whether the casks could withstand such damage, and what corrective actions, if any, need to be taken. The experts I have consulted tell me that full-scale physical tests should include, at a minimum, the following elements: meaningful stakeholder participation in the development of testing protocols and the selection of test facilities and personnel; full-scale sequential testing (drop, fire, puncture, and water immersion) on a single example of each new truck and rail cask type; and physical testing of casks against currently available armor-piercing weapons and other explosive devices.

THE HUMAN FACTOR

Rather than setting a goal of zero accidents and zero releases, the DOE estimates that there will be over 66 truck accidents and 10 rail accidents over the first 24 years of transportation to a repository. Based on information from the DOE and the department's past performance, other experts are estimating that there will be more than 150 truck or 360 rail accidents over 38 years. Whatever the number, the fact is that one accident resulting in radioactive release will have long-term devastating results.

A transportation plan for nuclear waste shipments should have a zero-accident goal. The zero-accident goal would reflect a culture in which safety is paramount and drives all aspects of the transportation system. The goal encourages a culture of safety. The FAA and individual airline companies have set a goal of zero accidents and zero fatalities. The DuPont Corporation, with a 99.1 percent safety record, has set a zero tolerance policy for accidents and employee injuries. The company noted that if we all accepted 99.1 percent in other aspects of our lives, we would then accept:

- 4,500 incorrect surgical operations each year;
- 18 unsafe landings at O'Hare Airport in Chicago each day; and
- 150,000 pieces of mail lost each hour.

A transportation plan should include a careful look at all the human factors that contribute to risk in transporting nuclear waste. Over 80% and possibly up to 90% of all transportation accidents are caused by human error. In investigating the causes of accidents, the National Transportation Safety Board examines such human factors as operating practices and procedures; training; duty/rest cycles; fatigue; workload; control/display systems; crew coordination; situational awareness; and decision-making. These are all elements that should be in a transportation plan to ensure a culture of safety.

September 11th and the anthrax mail incident have highlighted the importance of having a well-articulated communications system in place before it might become necessary to use such a system. But even before last fall, past incidents had already taught us that a strategy for crisis communication is essential. One of the most striking failures during the Three Mile Island incident was the series of miscommunications between plant operators, federal agencies, local officials, the press and the public. The widespread public panic that followed the first announcement of problems with the nuclear reactor has generally been blamed on poor communications, and the incident itself was in part caused by communication problems. It will be a huge, but critical, undertaking to develop a nationwide communications system as part of a nuclear waste transportation plan.

FULL RISK ASSESSMENT

In the months following September 11th, nearly every federal agency has been engaged in evaluating their preparedness to deal with terrorist attacks and adopting measures to counter this new threat. Congress has approved billions of dollars for protecting federal facilities from terrorist attacks and is considering legislation to adapt the country's public health, emergency preparedness, and response systems to new threats (H.R. 3555). In 1998, federal agencies were directed to conduct vulnerability assessments of critical infrastructure (PDD 63). These ongoing efforts aim to protect citizens and infrastructure from terrorist acts, even those we have not yet confronted. In contrast, we already know that terrorists view nuclear material as the target of choice, and yet safeguarding the transportation of nuclear waste—a known hazard—has not received the same level of scrutiny.

The issues I have just raised must be addressed before the DOE can tell us where, how and for how long shipments will occur. To address these issues, the Department must make some difficult decisions and initiate long-range planning. The DOE's decisions must be safety-driven, and safety-driven decisions are often not the most economical. The process by which the DOE makes these choices must be transparent and based on a system-wide risk analysis. What does that entail? In general terms, DOE must perform a comprehensive risk assessment that considers current and future conditions; identifies known hazards and anticipates unknown hazards; analyzes where, how, and how much the public may be at risk; and estimates how much each alternative—including security—will cost. It is essential that state and local officials, particularly transportation experts and emergency response providers, are involved in the risk assessment process. This risk assessment will provide the information needed to decide whether the unprecedented nationwide mobilization of spent nuclear fuel can be done safely and securely.

CONCLUSION

Secretary Abraham admitted last week that no decision on routes or transportation modes has been made, and that any suggestion to this effect is "completely fictitious." He further stated that those decisions can't be made until the "DOE has the opportunity to work with affected States, local governments, and other entities on how to proceed."

I couldn't agree more with the Secretary, but I disagree that this work can wait until after a site is designated. The Secretary argues that because the DOE has shipped nuclear materials before, there is a record of safety. But I can assure you as someone intimately familiar with transportation in this country that we have never shipped waste in the vast quantities or with the frequency that the DOE is proposing now. Before Yucca Mountain is approved Congress should demand that DOE conduct a full risk assessment of transporting nuclear waste.

My testimony is no different than what Secretary Abraham told the Committee last week with regard to the DOE's plan for transporting nuclear waste. There is no plan for shipping nuclear waste to Yucca Mountain. The potential consequences of an accident or terrorist attack on a nuclear waste shipment would be devastating, and the American people need to understand that their highways, their communities, and their neighborhoods are the sites for potential releases of this high level waste.

History has shown us time and time again that if the essential elements of a safety plan are not put into place before an activity begins, the momentum of the activity overtakes safety considerations. We all have an obligation to ensure that everything that can be done is being done to protect the American people. I believe every member of Congress will fulfill their obligation by requiring DOE to develop a transportation plan with a full risk assessment before any repository site is approved.

The CHAIRMAN. Well, thank you very much.

Let me start with a few questions. As I understand your statement, your testimony, your position is that there has not been near enough work done related to transportation issues in connection with Yucca Mountain, but that you are not saying that those issues—that there is anything that necessarily leads us to conclude those issues can not be adequately dealt with. Is that right?

Mr. HALL. Well, Mr. Chairman, I look at this as two different decisions that this Congress has to make. One decision, obviously, is the designation of a permanent repository, and the decisions—you know, the questions, that need to be asked, and the decision that needs to made associated with that site, wherever it is.

The other decision, obviously, is the safe transport of the waste from over 70 different locations around the United States to wherever that permanent repository is. There has been an expenditure of over $7 billion, and a great deal of work that has been done on one of those decisions.

The second decision, as I pointed out in my testimony, over 20 years, less—about $200 million has been spent on that decision. It would appear to me, however, that that decision is probably the most important decision to the constituents in the 50 States of the United States, because these materials are going to be transported through their homes, their communities, their neighborhoods. And, therefore, Congress needs to be sure that this material can be transported safely, before it makes a decision on a final site for this material.

The CHAIRMAN. What is your view? My impression, though, has always been that the Nuclear Regulatory Commission has authority to set requirements that have to be met related to transportation and to the adequacy of the shipping casks being used, and any other aspect of the project—the transportation aspects of the project that concern them, they can set those requirements and can

condition a license on the meeting of those requirements. Is that wrong?

Mr. HALL. Well, I would like to submit, for the record, a letter that was given to me that was sent to Senator Durbin on May 10, 2002 in which one of the questions was, "What role would your energy play regarding transportation of spent fuel if Congress approves Yucca Mountain?"

And the response was, "If DOE takes custody of the spent fuel at the licensee's site, DOE regulations would control the actual spent fuel shipment." But, I think the important point here——

The CHAIRMAN. This is from the Nuclear Regulatory Commission to Senator Durbin?

Mr. HALL. Yes, sir, and I will submit that for the record.

The important point to me, Mr. Chairman, I believe, is that after 9/11, a risk assessment should take place; a risk assessment that would identify what can go wrong, what is the likelihood of it, and what are the consequences. And then Congress should make a decision on exactly who should set up the regulatory scheme for the transport of this material, because it possibly might be—it should be the responsibility of the United States military to handle the transport of this material.

The CHAIRMAN. So, your view is that since 9/11 occurred, or as a result of 9/11 having occurred, the Secretary should not have gone forward with a recommendation to the President. The Secretary of Energy should not have done that until he did this risk assessment, is that right?

Mr. HALL. Well, my position, sir, is that I would certainly not speak for the Secretary. I would certainly recommend, from my background at the NTSB and in Tennessee with the Oak Ridge facility, that I would like to recommend to Congress that I think it is your responsibility to ensure that there is a transportation plan in place that satisfies the members of Congress for the safe handling and the transport through the neighborhoods and homes of their constituents prior to approving this decision.

The CHAIRMAN. Well, you understand, I'm sure, the legal framework in which this is coming before the Congress, in that when the Secretary of Energy made his recommendation to the President, the President had a limited period of time in which to rule on that. Then the Governor in Nevada had an opportunity, again a limited period of time, in which to veto it. And now Congress has a limited period of time in which to override that veto. And it is your recommendation to Congress that we not override that veto, and that we essentially terminate work on the project until this issue is adequately dealt with?

Mr. HALL. Sir, I do not know all the options that might be available to the Congress in this situation, but I do strongly feel that a transportation plan is an essential ingredient to making the decision to transport this waste to a final repository.

The CHAIRMAN. All right. Thank you very much.

Senator Campbell.

STATEMENT OF HON. BEN NIGHTHORSE CAMPBELL, U.S. SENATOR FROM COLORADO

Senator CAMPBELL. Thanks, Mr. Chairman. Sorry I could not have attended yesterday. I had to chair another hearing for Senator Inouye, who is gone. But, I was particularly interested in hearing Jim Hall's testimony.

I have not been a big supporter of the moving of this waste, as you probably know, Jim. And I think you pointed to one of the main reasons, and that is the transportation problem. I've mentioned two or three times our concerns in Colorado. And I have read all of the testimony of today, and I noticed in the Department of Transportation's testimony, they talk about using beltways, when available, and that the, you know, Governors can recommend designated routes and so on, but that is not an iron-clad way of dealing with it, I don't think, because most towns in the West do not have beltways, and the Governors do not have the authority to overrule the Federal agencies, as you probably know.

And, so, we get down, you know, to really a question of what is the safest thing to do? It seems to me we have got three problems when we talk about transporting. You mentioned the opportunity of targets for terrorists. I was just musing about that. If you leave it where it is, they have an opportunity at the location where it is. If you move it, they have a second opportunity, and that opportunity is where it is and en route. And if you put it in Nevada, you have a third opportunity for terrorists, and one is where it is now, one is en route, and where you are going to put it, because it is not going to be done overnight. It is going to take long time to transport all that stuff.

So it seems to me, if you are dealing with the opportunity for terrorists, they have got three opportunities, if we move it, instead of one opportunity. I think that is wrong to do that.

I also read some of the tests. I did not bring them with me so I can not repeat them exactly, but the tests of how these casks were dropped on a hard surface, on a six-inch stake from a certain number of feet. I forgot the number of feet, if it was 50, 60, or something of that nature, but living in a State where it is nothing to have automobiles sometimes fall 800 or 1,000 feet off some of those cliffs that they have missed the road. It seems to me that that is not an ironclad test as to whether that thing is going to break.

And I read about how it was subjected to an amount of heat. Well, let me tell you, if steel beams can melt in the 9/11 catastrophe in New York, that thing is sure going to melt under less heat. If you get enough heat, anything will melt. And I do not know where that leaves those pellets, frankly, if that does melt. And I have heard, a number of times, that diesel fuel in itself will fuel a fire hotter than this container can withstand.

And when you talk about impact, there was also a study done on the impact of a moving impact to an immovable object, but I don't think there are any studies the other way around dealing with ballistics, at least not that I know of. Maybe it does.

So it seems to me that there is so much based on hypothetical scenarios that we do not know, I just have to tell you I think it is safer leaving it all where it is. And I know that I come from a

State that wants to get rid of it, and I get some criticism because of it, but it just seems to me that we are dealing with so much unknown that we ought to know a lot more.

And my big concern, of course, is that I—part of the transportation that would go through Colorado is on I-25, that goes through Denver and down the Glenwood Canyon. Even if you could re-route it around Denver, there is no other route to get over the Continental Divide that is four-lane, except I-25, that goes through a lot of towns, but there is a railroad, as you know, that goes right beside the highway.

Whether you ship it by railroad or ship it by truck, you have got the same problem. And one is on one side of the river, if you have ever been there, and the other is on the other side of one of the tributaries that goes into the Rio Grande. If something happened there, and it seems to me that it certainly is in the realm of possibility, considering we average eight to ten trucks per year that crash going down that I-25 west side of the Continental Divide, that water goes into Nevada, goes into California, goes into Mexico, and our international compacts. I cannot imagine the catastrophic results if that water is contaminated for millions and millions of people downstream.

I do not really have any questions, Mr. Chairman, but I do want to throw that out, because I think I have learned a lot from Jim's testimony. Thank you.

The CHAIRMAN. Thank you.

Senator Thomas.

Senator THOMAS. Thank you for being here. It is correct, then, that you have no opinion on the siting issue.

Mr. HALL. No, sir.

Senator THOMAS. That is what this hearing is about, as you know, is siting. What—do you not think—as the chairman pointed out, we have a sequence of determining the site, and then the obligation to determine the transportation requirements. Does that not seem reasonable? Why do you suggest that the Congress is going to ignore transportation requirements just because we already have a site?

Mr. HALL. Well, sir, it is just my personal opinion. Let me say my opinion, in regard to the site, I have no opinion as to where the site should be. I do have a very strong opinion that I attempted to express, that I felt that it would be in the wisdom of Congress to ensure that there is the ability to safely transport this.

Senator THOMAS. That is what I am asking you. Why do you think that the Congress will not do that?

Mr. HALL. My experience, sir, with—I think the Congress will exercise, obviously, the responsibilities. However, I have seen in my experience, both at the Federal level and State level, that many times agencies that have split authorities, given the emphasis to do one thing—we had a discussion, if you remember, with the Federal Aviation Administration during my tenure at the NTSB——

Senator THOMAS. Could you kind of come to the——

Mr. HALL. Over there is a divided authority in regard to safety versus the promotion of aviation.

Senator THOMAS. My question is what makes you think that we are not going to address the safety transportation issue?

Mr. HALL. My experience in government.

Senator THOMAS. I see. And you were there for how long?

Mr. HALL. I was with the National Transportation Safety Board for over 7 years, and the State of Tennessee over 7 years.

Senator THOMAS. We have been transporting nuclear materials for 30 years, over 16 million miles, and you do not have a safety arrangement from the Transportation Board? What did you do during that 10 years?

Mr. HALL. What, sir?

Senator THOMAS. Well, we have been doing this—this is not the first nuclear waste that we have transported. We are transporting it right now.

Mr. HALL. Well, I did not—I certainly did not——

Senator THOMAS [continuing]. And you have been on the Transportation Board who was responsible for the safety on transportation.

Mr. HALL. Yes, sir, the National Transportation Safety Board is empowered by Congress for the investigation of transportation accidents—all aviation accidents and major transportation accidents in other modes. We do look at accidents of hazardous materials.

The point in my testimony is there has been transport of hazardous materials and some radioactive materials. I am very familiar with that, and very familiar from my experience with the State of Tennessee. But you were talking——

Senator THOMAS. Have there been any real serious problems with that?

Mr. HALL. There have been accidents and incidents——

Senator THOMAS. Have there been any accidents that have been nuclear?

Mr. HALL [continuing]. But none that have resulted, that I am aware of, in any releases to this point, sir, but we are talking about the volume and distances that have never been looked at before. And we are discussing this issue post 9/11.

Senator THOMAS. Oh, I understand. And the Congress is aware of 9/11. I am a little offended that you say, "Well, you are not going to look at the transportation." The obligation of these hearings is the site. And that is what is being done. Are you a paid consultant for the State of Nevada?

Mr. HALL. Yes, sir.

Senator THOMAS. Okay. So you are representing the point of view of the State of Nevada.

Mr. HALL. I am representing my own point of view, sir.

Senator THOMAS. I see.

Mr. HALL. I am a representative and safety consultant, and transportation consultant for a number of clients, as I expressed in my opening testimony. I chose to get involved in this issue because of my experience at the NTSB, at Oak Ridge, and also because I did not think adequate attention was being given to the transportation safety issues. And I thought that by my participation and the possible potential, I understood, of others to attack my participation, it would at least serve to raise the level of issue of the Transportation Safety Plan, which I think does not exist.

Senator THOMAS. I see. I guess I am just interested that you served on the board responsible for that for 10 years, and you act as if there has never been——

Mr. HALL. No, sir. We did not have a regulatory responsibility.

Senator THOMAS. It is the safety board, is it not?

Mr. HALL. The safety board has a responsibility to make recommendations out of major transportation accidents.

Senator THOMAS. And it is your view, then, that probably once the site is done, there will be no more talk about transportation from the Congress.

Mr. HALL. My concern is that if you look at the past 20 years, that some $7 billion has been spent on the site, less that $200 million over 20 years in trying to look at very serious safety issues.

When I was at the State of Tennessee, there was discussions at that time that there was no way that this material was going to be transported any other way than dedicated trains.

You fast forward now and there is the discussion of not only putting this on our highways, but putting it on our waterways, as well. And I think, post 9/11, again, and I know the members of Congress much more than any other Americans are aware of 9/11——

Senator THOMAS. Waterways to Yucca Mountain?

Mr. HALL. What, sir?

Senator THOMAS. Waterways to Yucca Mountain?

Mr. HALL. No, barging from some of the 70 sites.

Senator THOMAS. I see. It is a little hard to barge to Yucca. But, in any event, I guess I am just kind of disappointed in the way you picked out one thing and suggest that despite 35 years of transportation of nuclear power without any notable incidents that the DOE is not going to take a look at the transportation, I think that is wrong, sir. They will look at it, and that will be the second phase to understand whether that is safe or not. Thank you.

The CHAIRMAN. Senator Burns.

STATEMENT OF HON. CONRAD BURNS, U.S. SENATOR FROM MONTANA

Senator BURNS. Good to see you, Jim. I had not seen you for a while.

Mr. HALL. Nice to see you, Senator.

Senator BURNS. We are still having wrecks.

[Laughter.]

Senator BURNS. Let the public be reminded the only thing that we got in that hole out there in Yucca Mountain, Nevada, is $7 billion. And we still have not resolved this thing. And let us also quiet the nerves of the American people that nuclear waste is being transported on waterways, and on land, surface transportation all over the world.

If we want anyone to be responsible, then we should take a very close look on how it is being done in Europe. I have been in both of those reprocessing plants, have taken a look at their transportation. They have not had one loss of life, and some of that waste comes as far into France as far away as Japan. So it is on our high seas. I have seen these rods—stood within 10 feet of them with only ten feet of water between you. How it is unloaded; how it is handled; how it is reprocessed; and how the waste that is leftover

is vitrified and stored. All that process and that technology was developed, for the most part, here in the United States of America. And yet, we go through this exercise like we are doing something here that is going to make those folks or those animals or whatever, on or near Yucca Mountain, or on or near a nuclear site glow at night, when we should be taking a look at common sense and the tools and technology that we have to deal with the challenge of nuclear waste.

It defies common sense to me that the experience that we have had in the generation of power using nuclear fuels, the record that they have. Some folks point to Three-Mile Island. Who died? Did the system work? Did we learn from that accident up there that there are some weak points? But, those weak points held up, but we found out things and we learned things, and we changed our method of dealing with it in the correct way. We put emotion into it and hearsay, and misinformation to the point where we can not make a solid, sound, political or common sense decision on how to deal with nuclear waste produced from making power for this country. That simply defies common sense.

And I know we all have our interests and we still have to do business in this 17 square miles of logic-free environment, and try to come to some conclusion on how to solve this challenge. It is not a problem. Problems are challenges, and they are opportunities, but it gets in the way—of all the rhetoric that is flying around here, it gets in the way of making a solid, sound decision.

So, I have studied it. I have been around this thing—I have been on this committee for 13 years now—13 years. I can remember when the estimated cost was, what, around $2.5 or $3 billion, Mr. Chairman? Something like that.

The CHAIRMAN. I am sure it was.

Senator BURNS. And we ripped right by it, folks. I mean, it is just like trying to buy a house within 4 miles of where we sit. You can go past that peg of what you want to get for a house so fast it will make your head swim. And we still have not resolved the question that is at hand.

So, I am going to continue to read and to watch, and Jim, I appreciate your testimony, and I appreciate your written testimony. And I know you kind of have a handle on that. But, it is also transported all over this world, and there has not been an accident there either.

So we are doing something right. That is not to say that questions should not be asked. And some of the doubts that you have or some of the weakness that you see is valuable to us. So we appreciate you coming today and bringing those up. They will be studied and looked at, because we do want to make a prudent decision. But keep in mind, folks, we have been doing this for 35 years. And the only people who got reckless about it were the folks that paid the price, and we know where that is. It is not here, and it is not in Europe. And 80 percent of the power that is being produced for the country of France is being produced by nuclear fission. So thank you for coming today. I appreciate that.

Mr. HALL. Thank you, Senator.

The CHAIRMAN. Senator Ensign.

Senator ENSIGN. Thank you, Mr. Chairman.

I want to clear up just a couple of things. First of all, the Senator from Wyoming, when he was talking about the barges, that is according to the DOE. That is one of the possibles. If they go with mostly train scenarios, they have to go with barges. To get it from the sites to Yucca Mountain, and that is where—Mr. Hall, I think that that is where your comments came about the barge scenarios, and the potential for a terrorist attack.

I want to get back to the 9/11 comment. People have talked about doing this thing for years and years and we thought about high rises or skyscrapers for years, we did not think about a missile—an airplane used as a missile going into those, and forming the kinds of devastation that happened in New York City.

And not to use fear, but I think that when we are talking about some of the deadliest substances known to the planet, we need to look at worst-case scenarios. We need to study that, and I think that that is what you are talking about. Could you comment—I do not know how familiar you are with the train accident last year in Baltimore, the Baltimore Tunnel fire—just on some of the temperatures maybe and the canisters and if those have been studied, and would these things withstand some of the temperatures that were reached in the Baltimore Tunnel fire?

Mr. HALL. Well, thank you very much, Senator. And let me say that I am sorry that the gentleman I have a great deal of respect for, Senator Burns, has left, but my purpose here is to raise what I think are issues that are important issues to this Committee. And I would not be here for any other reason. I think it is a fact that many people are concerned. I live in Tennessee. The TVA is—20, 25 percent of the power, the power for my home is generated nuclear.

But there is a concern. We saw that in the reaction after the Three Mile Island incident. And not to take those things into consideration when we are talking about the amount of waste and the distance that we are talking about transporting this, that is the issue that I am trying to raise, and I certainly hope I am doing it responsibly.

In regard to the accident in Baltimore, that occurred after my term at the NTSB. However, I am familiar with the accident. There is an ongoing investigation being conducted by the National Transportation Safety Board. I am told from the reports I have read, that the temperatures were in excess of 1500 degrees. As you know, there was a study done by the State of Nevada looking at the economic and human consequences had that train, obviously, been one of the trains carrying this type of material. And I do not think that that is irresponsible at all.

I think that is what any Senator here, if the material was going to their State, would be doing, wanting to be sure that this is being handle safely, because although it is coming from 70 different locations, there is—that material is going to accumulate in large quantity at several Western States and eventually in the State of Nevada. So looking, obviously, at the amount of material and the amount of responsibility, it is extremely important.

I have asked Dr. Merritt Berkey who was a fire and explosive expert at the National Transportation Safety Board, to look at some of these issues and to provide his opinion for this committee's eval-

uation. And I hope that if it is permissible with the chairman, that Dr. Berkey's comments, as soon as he has them prepared, could be submitted to the committee for its record.

The CHAIRMAN. We will be glad to consider those comments, if we receive them in time to do so.

Mr. HALL. Okay, Mr. Chairman. But those types of—I have seen, regrettably, many, many situations—as you know, our cockpit voice recorders and flight date recorders are built to withstand tremendous impact forces and heat. And yet, we have had accidents while I have been at the Board during my tenure in which we basically lost the use of those recorders because of many—usually because of the fire.

So that is certainly a very important part of a risk assessment that needs to be done.

Senator ENSIGN. Well—and correct me if I am wrong. But I think losing information in a flight date recorder is not nearly as serious as, obviously, you know, having a leak. And I think that the point of them going on barges or the point of these things happening in a major city is just the idea that, even if you are not concerned that—because they are in a pellet form or whatever, the release of radiation, I think we do have to—if you are not concerned about the health consequences, we do have to consider the economic consequences if nothing else.

I mean, the reputation, if this happened, that we had a radiation leak in a tourist destination or in a business area or something like that and you are shutting down commerce because nobody is going to want to go to that area, and they have to seal the area off because of—to make sure that there is no radiation there, we know what happens with these places when they seal it off, and how long it takes the government to certify that an area was radiation-free, and the public perception.

We saw from 9/11 how nobody wanted to fly for a while. They slowly came back, but a lot of economic damage was done at the time. And that, I think, is part of the study that needs to be done when we are talking about the transportation.

I, frankly, think it is irresponsible for the Congress to go ahead with building Yucca Mountain when we do not have these answers done. And I appreciate you being here today and raising some of these questions for us.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Reid.

Senator REID. Thank you very much, Mr. Chairman.

I want to follow up on the last statement Senator Ensign made. Just being logical, I understand Senator Thomas—my staff told me Senator Thomas said that transportation is going to be the second phase of the nuclear waste program. Is that your understanding?

Mr. HALL. Well, it is—yes, sir.

Senator REID. Now, if we cannot—if we find that transportation cannot be done safely, does it not seem to you that we would be better off finding out if we can do the transportation before you spend $100 billion? That is the latest figures we have on the program out there.

Mr. HALL. Senator, what I was trying to respectfully say to Senator Thomas is that my experience with government and well-intentioned government employees and a very well-intentioned Congress—and I point to the example of ValuJet, where a government policy was made to try to accelerate the entrance of low-cost airlines into the market without thoroughly and clearly thinking out, you know, the regulatory and safety responsibility in advance. It can end up with consequences that, obviously, no one on this committee or anyone else could have intended.

The most important part of this decision is not the site. The most important part of this decision is the safe transport of this material to the site. And I think, quite respectfully, that in this situation the cart is before the horse in the fact that we must know—the Congress must know and be satisfied that this material can be transported safely before it makes a decision on a final site for the material.

Senator REID. The State of Nevada has for almost 20 years been attempting to show, and I think it has been proven conclusively in the minds of many that Yucca Mountain is not a place that you should store nuclear waste. But that issue is no longer important to the Congress. And what Senator Ensign and I have been trying to do with the hearing we had yesterday and through other witnesses is show that the transportation is not a Nevada problem. Nuclear waste is not suddenly going to show up at Yucca Mountain some morning, "Oh, we have 40,000 tons or 70,000 tons. I wonder how that—that is nice. I am glad it is here."

The fact of the matter is it is going to have to come in thousands of different truckloads and hundreds and hundreds if not thousands of trainloads. And as we learned yesterday, using one transportation scenario, it will have to have thousands of barge trips before it can get to where it is. And it would seem to me that common sense would indicate that before you have a siting decision, you should decide if there is any way of putting the stuff there, before you site it. But we have not done it that way. And I think it is really wrong, and I do not think it takes a degree in calculus to figure that out.

Mr. HALL. Well——

Senator REID. So I appreciate your testimony.

Mr. HALL. I appreciate that, Senator. Obviously, in aviation, we are sure that we have redundant systems and an airplane is very well tested before we put passengers on it.

Senator CAMPBELL. Mr. Chairman, may I ask one more question of this witness?

The CHAIRMAN. Certainly. Go right ahead, Senator Campbell.

Senator CAMPBELL. Senator Thomas's comment about barges not going to Nevada I think is well taken. But where are some of the places where barges might be used? Do they just come across the Great Lakes, for instance, or——

Mr. HALL. Senator Campbell, I know that I only have a Tennessee public school education, which I am very proud of, but even I know that there are not barges to Yucca Mountain. But I was referring to the EIS study in which it relates—and I do not know specifically. There was some transport, I think, up in the northeast and other areas where at present the only way that——

Senator CAMPBELL. Well, then let me ask something else, because I consider you pretty much of an expert on transportation because of your background. Does that mean that there is a possibility that these containers could be loaded and unloaded three times? For instance, it has to come from somewhere, and could then have to be put on a barge, and then taken off the barge and put back on something else, trucks or trains.

Mr. HALL. Senator——

Senator CAMPBELL. Is that correct?

Mr. HALL. Yes, sir. And the thing that concerns me and the reason I have asked for the full-scale testing is that is just one part of it. You know, we had many failures in our pipeline system in the United States as a result of a phenomena called "railroading."

We were making what we thought were good steel pipe to the specifications that were required. They were being put and placed on railroad cars and being shipped to their destinations. Some 10, 15, 20 years later, we began finding leaks and ruptures that were then discovered later to become a phenomena of the transportation of this particular container.

Senator CAMPBELL. Okay.

Mr. HALL. So the handling of the specifications obviously for the container itself, what it can do in terms of accidents or intentional terrorist attacks is important. Looking at the human factors issues in regard to the handling of the cask is going to be extremely important; and testing, obviously, what impact the transportation is going to have on the container itself.

All of these are issues that again—and I understand that there is a difference of opinion here possibly. But I think the responsible—my personal opinion is that the responsible thing to do is to know that this material can be safely transported before a decision is made that you are going to start a site and set it in motion.

Senator CAMPBELL. Well, I happen to have gotten through—I got through college by driving an 18-wheeler. I think I am still the only member of the Senate that still has a CDL. And as I remember from those years when I did drive, the biggest amount of damage was never in transport; it was in loading and unloading. If we broke something or did something, it was almost always when we were loading or unloading it.

But it also brings up another question. And that is that when you are transporting by truck, there are all kinds of regulations now with the Department of Transportation for truckers, such as hours of service, as an example. As you know, they can only drive a certain number of hours, and then they have to park those things for a certain number of hours. You know that.

It would seem to me that we have a whole bunch of other problems. I mean, what truck stop wants nuclear waste parked in his backyard with a bunch of other trucks? Nobody is going to want to.

And in addition to that, some of the regulations now say that you cannot be over 100 feet from the cab of your trucker if you—when you are parked, as you probably know. And that is under the guidelines for any hazardous waste, not just nuclear, but hazardous waste. They cannot even leave the darn tractor to go to the bathroom if it is over 100 feet from the terminal.

And it seems to me there are all kinds of things that have not been well thought out on the transportation issue.

Mr. HALL. Well, Senator, I hesitate to comment on the transportation plan because my feeling is, after reading the material, I came to the same conclusion that Secretary Abraham had last week. There is no plan.

Senator CAMPBELL. Yes.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

We appreciate your testimony very much, Mr. Hall. Why do we not——

Mr. HALL. Mr. Chairman, let me just personally thank you. I apologize to the committee that I was unable to be here; I had a commitment that I could not break. And I appreciate your willingness to let me appear this morning.

The CHAIRMAN. Well, we understood that. I think you have given useful testimony and we appreciate you coming today.

Mr. HALL. Thank you, sir.

The CHAIRMAN. Our next witnesses are four of the members from the Nuclear Regulatory Commission: Richard Meserve, Greta Joy Dicus, Nils Diaz and Ed McGaffigan. Thank you all for being here.

[Pause.]

Mr. MESERVE. Thank you very much, Senator. We are very pleased to join you this morning.

The CHAIRMAN. All right. Why do we not start with you, Mr. Meserve? And then if the other members have statements, we are glad to hear from them, too.

STATEMENT OF RICHARD A. MESERVE, CHAIRMAN, NUCLEAR REGULATORY COMMISSION; ACCOMPANIED BY GRETA JOY DICUS, COMMISSIONER; NILS J. DIAZ, COMMISSIONER; AND EDWARD McGAFFIGAN, JR., COMMISSIONER

Dr. MESERVE. Mr. Chairman, members of the committee, the Commission is pleased to join you today to testify on behalf of the Nuclear Regulatory Commission's regulatory oversight role in the U.S. program for management and disposal of high-level radioactive waste and spent nuclear fuel.

I am joined, as you indicated, by Commissioners Dicus, Diaz and McGaffigan. Commissioner Merrifield, who is the fifth member of the Commission, regrets that he is unable to attend the hearing. Prior to receiving the invitation, he had scheduled visits to two nuclear power stations, and had already coordinated the visits with another Federal agency.

I have a prepared statement I have submitted for the record, but I would like to just briefly summarize a few points.

The Commission believes that a permanent geologic repository can provide the appropriate means for the United States to manage spent nuclear fuel and other high-level radioactive wastes in a safe manner. We also believe that public health and safety, the environment, and the common defense and security can be protected by deep underground disposal of these wastes. However, the Commission takes no position on whether such a repository should be located at Yucca Mountain, Nevada. Our views on that question

must be shaped by the results of the congressionally mandated licensing process.

The Nuclear Waste Policy Act provides that it is the NRC's responsibility to establish licensing criteria for a potential repository, to provide preliminary views on the sufficiency of certain DOE information collected during site characterization, and to comment, along with other Federal agencies, on the Environmental Impact Statement prepared by DOE for Yucca Mountain. It is also the Commission's obligation to be prepared to make a fair, informed, and timely licensing decision, if the Congress should approve the President's recommendation.

If the President's recommendation is accepted by the Congress, it represents a determination that the Department of Energy may apply to the NRC for construction authorization.

I would like to point out that if that is the case, several important steps must be taken before the Commission can decide whether to authorize construction. First, DOE must submit a high-quality application. Second, staff at the NRC must conduct an independent safety review and issue a safety evaluation report. Third, we must conduct a full and fair public hearing on the DOE application. Only after these steps are complete will NRC be in a position to determine whether the DOE's license application complies with the NRC's regulations. Our decision will be based on the information before us at that time.

Federal regulation of spent fuel transportation safety is shared by the U.S. Department of Transportation and the NRC. DOT regulates the transport of all hazardous materials, including spent fuel, and has established regulations for shippers and carriers regarding radiological controls, hazard communication, training, and other aspects. For its part, NRC establishes design standards for the casks used to transport licensed spent fuel, and reviews and certifies cask designs prior to their use. Further, cask design, fabrication, use and maintenance activities must be conducted under an NRC-approved Quality Assurance program.

NRC also conducts an inspection and enforcement program, and reviews and approves physical security plans for spent fuel shipments.

NRC has reviewed and certified a number of package designs intended to be used for transport of spent fuel to a repository, and has additional designs under review.

We believe the safety protection provided by the current transportation regulatory system is well established. Nonetheless, we continually examine the transportation safety program.

Mr. Chairman, this completes my statement. My colleagues and I will be pleased to answer any questions that you or other members may have. Thank you.

The CHAIRMAN. Thank you very much.

[The prepared statement of Mr. Meserve follows:]

PREPARED STATEMENT OF RICHARD A. MESERVE, CHAIRMAN, NUCLEAR REGULATORY COMMISSION

Mr. Chairman, members of the Committee, I am pleased to join you to testify on behalf of the Nuclear Regulatory Commission (NRC) concerning the NRC's regulatory oversight role in the U.S. program for management and disposal of high-level radioactive waste and spent nuclear fuel.

The Commission has long believed that a permanent geologic repository can provide the appropriate means for the United States to manage spent nuclear fuel and other high-level radioactive waste in a safe manner. We also believe that public health and safety, the environment, and the common defense and security can be protected by deep underground disposal of these wastes. However, the Commission takes no position on whether such a repository should be located at Yucca Mountain, Nevada. Our views on that question must be shaped by the results of the Congressionally mandated licensing process.

Congress provided in the Nuclear Waste Policy Act of 1982 (NWPA) and the Energy Policy Act of 1992 that the NRC would serve as an independent regulator to ensure that any repository adequately protects the public health and safety and the environment. I am pleased to state that the NRC has consistently met the obligations established by these Acts. We are now in the midst of preparations for an important transition—from the pre-licensing role defined for NRC in statute, to the role of regulator and licensing authority—if a decision is made to authorize the Department of Energy (DOE) to submit a license application for Yucca Mountain.

THE PRESIDENT'S RECOMMENDATION

As you know, on February 15 of this year, President Bush accepted the Secretary of Energy's recommendation that the Yucca Mountain site be developed as a potential repository for the disposal of high-level nuclear wastes and spent nuclear fuel. If the Congress approves a resolution of siting approval, the President's recommendation becomes a final decision and DOE could then apply to the NRC for construction authorization. If DOE does so, several important steps must be taken before the Commission can decide whether to authorize construction of a potential repository at Yucca Mountain. First, DOE must submit a high-quality application. Second, staff at the NRC must conduct an independent safety review and issue a safety evaluation report. Third, we must conduct a full and fair public hearing on the DOE application. Only after these steps are complete will NRC be in a position to determine whether the DOE's license application complies with NRC regulations. Our decision will be based on the information before us at that time.

The Nuclear Waste Policy Act provides that it is NRC's responsibility to establish licensing criteria for a potential repository, to provide our preliminary views on the sufficiency of certain DOE information collected during site characterization, and to comment, along with other federal agencies, on the Environmental Impact Statement prepared by DOE for Yucca Mountain. It is also the Commission's obligation to be prepared to make a fair, informed, and timely licensing decision, if the Congress should approve the President's recommendation. I will discuss each of these activities in turn.

THE REGULATORY FRAMEWORK

Under the Energy Policy Act of 1992, the Environmental Protection Agency (EPA) was directed to establish dose-based environmental standards for Yucca Mountain. Congress required EPA to base these standards on the recommendations of the National Academy of Sciences. The NRC was directed to modify its regulations to be consistent with final EPA standards within one year of their issuance. Because of the short period given to NRC to issue final implementing regulations, the Commission initiated its own rulemaking in parallel with that of the EPA.

Immediately upon publishing our proposed regulations at 10 C.F.R. Part 63 for public comment in February 1999, our staff embarked on a series of public meetings to encourage involvement by members of the public in Nevada. From these meetings, together with written submittals, we received more than 1000 comments on our proposed criteria. The Commission carefully considered and analyzed these comments, and last November promulgated the health and safety regulations that will guide any licensing decision on Yucca Mountain. Our regulations are consistent with the health and safety standards established by the EPA. We are confident that any repository that can be shown by DOE to comply with these demanding standards and regulations will protect the people living near the proposed repository today and in the future.

DOE'S COLLECTION OF INFORMATION

In forwarding his recommendation to the President, Secretary Abraham included the Commission's preliminary comments on DOE's examination of Yucca Mountain. As required by the NWPA, our comments addressed ". . . the extent to which the at-depth site characterization analysis and waste form proposal . . . seem to be sufficient for inclusion in [a license application to the NRC]." 42 U.S.C. § 10134(a)(1)(E). In offering these comments, the NRC drew no conclusions about the

suitability of the Yucca Mountain site. Rather, we commented on whether sufficient information will exist to begin a potential licensing review, if the President's recommendation becomes a final decision and if DOE submits an application. To evaluate the adequacy of DOE's information for this purpose, the NRC staff reviewed all major program documents for Yucca Mountain, as well as the available supporting technical documents. Our staff's reviews of DOE's program documents and technical material were performed over many years of extensive pre-licensing interactions with DOE staff and various stakeholders, including the State of Nevada, Indian Tribes, affected units of local government, representatives of the nuclear industry, and interested members of the public.

Based on our technical reviews and pre-licensing interactions, we believe that sufficient information can be available at the time of a license application. The DOE and NRC have reached and documented numerous agreements regarding additional information that will be needed for a licensing review. Approximately two-thirds of these agreements call for DOE to document the bases for assumptions or conclusions. The remainder oblige DOE to perform specific tests or analyses, to document prior tests or studies, or to provide other information. As DOE completes the actions necessary to fulfill these agreements, NRC will review the results promptly and notify DOE of our findings. Based on these agreements, we are confident that DOE can assemble the information necessary for an application that NRC can accept for review.

It is important to note that NRC is as concerned about the quality of documentation supporting the recommendation of the Yucca Mountain site as about the quantity of information. Over the course of our pre-licensing interactions we have discussed with DOE the need to verify the quality of the documents it has generated to support the site recommendation. We are aware that DOE performed extensive reviews of this documentation, including dedicated reviews to determine the root causes of any errors. We acknowledge DOE's intention to qualify all data, software, and models fully if they are to be used to support a license application. Quality management continues to be a challenging program area for DOE, one which the NRC staff routinely monitors.

DOE'S FINAL ENVIRONMENT IMPACT STATEMENT

As required by the NWPA, Secretary Abraham included a final Environmental Impact Statement (EIS) with his recommendation to the President along with the comments agencies provided on the final EIS, including those of NRC. Our comments were developed on the basis of reviews of DOE's draft EIS for Yucca Mountain, the supplement to the draft EIS and the final EIS. Like the sufficiency comments I discussed earlier, our reviews were supported and informed by extensive pre-licensing interactions with DOE, the State of Nevada, Indian Tribes, affected units of local government, representatives of the nuclear industry, and interested members of the public.

As a result of our reviews, we believe that the final EIS contains sufficient information about the environmental impacts of the proposed action to provide a foundation for a site recommendation. The analyses provided in the EIS appear to bound appropriately the range of environmental impacts. We expect that DOE's commitment to refine the repository design and define transportation modes and routes will allow for more precise estimates of impacts and possibly result in future revisions to the National Environmental Policy Act analyses. We expect that any such additional reviews will be completed in support of a license application. If the President's recommendation becomes a final decision, NRC will, of course, continue interactions with DOE and other interested stakeholders, to resolve outstanding technical and environmental issues, as needed.

NRC PREPARATIONS FOR LICENSING

As part of our overall pre-licensing strategy, our staff has applied the experience gained in the reviews of DOE documents and pre-licensing interactions to the preparation of a Yucca Mountain review plan that will eventually guide the NRC's review of any license application. The NRC staff recently published a draft of the review plan which is on our website for public comment. This week, members of our technical staff are conducting public information meetings in Nevada to seek public input on our draft review plan. As our preparation for possible licensing progresses, NRC will continue to conduct public technical exchanges between members of the NRC and DOE technical staffs and with NRC's Advisory Committee on Nuclear Waste.

In addition, our Atomic Safety and Licensing Board Panel has begun to evaluate hearing-related aspects, including location, and the development of the automation

tools necessary to meet the time restrictions imposed by the Nuclear Waste Policy Act. These activities include development of an electronic hearing docket to expedite a possible hearing and completion of an Internet-based Licensing Support Network (LSN) that will provide access to all the key documents. Noting delays in entering key licensing documents due to security concerns after the events of September 11, it is important that DOE, which is the stakeholder with the most documents, enters its documents into the system as soon as possible. The NRC staff also is working to provide guidance to DOE on developing an electronic High Level Waste repository license application. In late June, NRC will conduct a public meeting with DOE on this issue in Las Vegas.

SAFETY AND SECURITY OF SPENT FUEL TRANSPORTATION

The Commission believes that the spent nuclear fuel and high-level radioactive waste stored at multiple sites can be safely and securely transported to a single location for geologic disposal.

Responsibility for federal regulation of spent fuel transportation safety is shared by the U.S. Department of Transportation (DOT) and the NRC. DOT regulates the transport of all hazardous materials, including spent fuel, and has established regulations for shippers and carriers regarding radiological controls, hazard communication, training, and other aspects. For its part, NRC establishes design standards for the casks used to transport licensed spent fuel, and reviews and certifies cask designs prior to their use. Further, cask design, fabrication, use and maintenance activities must be conducted under an NRC-approved Quality Assurance program.

NRC also conducts an inspection and enforcement program, and reviews and approves physical security plans for spent fuel shipments. These plans provide information on how shippers and carriers comply with NRC spent fuel shipment protection requirements, including advance notification of each shipment to Governors' designees, the establishment of redundant communication capability with the shipment vehicle, the arrangement of law enforcement contacts along the route, and provision of shipment escorts.

The Nuclear Waste Policy Act requires DOE to utilize NRC-certified casks for spent fuel shipments to a repository, follow NRC's advance notification requirements, and to provide emergency response training along shipment routes. NRC has reviewed and certified a number of package designs intended to be used for transport of spent fuel to a repository, and has additional designs under review.

The NRC believes the safety protection provided by the current transportation regulatory system is well established. Nonetheless, we continually examine the transportation safety program. In FY 2000, NRC re-evaluated its generic assessment of spent fuel transportation risks to account for the fuel, cask and shipment characteristics likely to be encountered in future repository shipping campaigns. Over two years ago, NRC began the Package Performance Study to study cask performance under severe impact and fire accident conditions. The study plan calls for full-scale testing of a cask to confirm computer models of cask response to severe accident conditions. NRC is also supporting a study by the National Academies' Board on Radioactive Waste Management that will examine radioactive material transportation, with a primary focus on spent fuel transport safety. As a part of its evaluation, the NRC staff is analyzing appropriate national transportation accidents, such as the 2001 train accident in Baltimore, Maryland, to determine if lessons learned from that event should be included in our transportation requirements or analyses. The results of our confirmatory analytical studies, the significant history of safe shipments, the rigor of our pre-certification design reviews, and our inspections form the basis for our confidence that spent fuel can be shipped safely today and in the future. Finally, NRC is sponsoring a study to update its evaluation of cask response to acts of sabotage. NRC plans to utilize the results of these studies as input into its comprehensive review of security in light of the events of September 11. These studies should be available at the time possible licensing is being considered.

CONCLUSION

The Commission believes that deep geologic disposal is appropriate for high-level radioactive wastes and spent nuclear fuel and that such wastes can be safely and securely transported to a disposal location. We take no position, however, on whether the site recommendation for a Yucca Mountain repository should be approved. Our role is to put in place a licensing system that will ensure adequate protection of public health and safety and the environment and to review and evaluate any license application submitted, to ensure its compliance with regulatory require-

ments. As I believe this statement makes clear, we take that obligation very seriously.

I will be pleased to answer any questions you may have.

The CHAIRMAN. Do any of you have other statements you want to make before we do questions?

[No response.]

The CHAIRMAN. Okay. Let me go right to the issue that Mr. Hall raised in his testimony just a minute ago. That is the question of whether or not the NRC can insist that a safe transportation plan be presented before you issue a license to use this facility. I mean, I am a little confused. We have a split of responsibility here between the Department of Transportation and the NRC and the DOE.

And I guess where I come out on it is: Regardless of the split of jurisdiction here, I would like to know whether the NRC believes it can refuse to issue a license until it is satisfied that a safe transportation plan has been developed?

Dr. MESERVE. Well, let me give you my understanding of the way in which we would approach that issue. As part of the requirements of the National Environmental Policy Act, the Department of Energy is required to prepare an environmental impact statement that analyzes all of the possible impacts of the decision that would be before us. And then we have to review that and be satisfied with it. That impact statement has to include transportation as a component.

We have commented on the environmental impact statement that DOE has prepared at this juncture to say that we expect that there will be further development of the transportation plan and that will be reflected in supplementation of the environmental impact statement that has been produced to date.

And we have to be satisfied with that environmental impact statement so that we can rely on it as part of our licensing decision.

So the short answer to your question is: Yes, we will be looking at transportation safety as part of our process.

As I indicated in my statement, we also have to license the casks that would be used for the transport of the spent fuel. We would have regulatory requirements that we would impose and do impose to assure that these casks are suitable for that use. So we have multiple levers by which we get at the transportation issue.

The CHAIRMAN. One of the concerns that I believe Mr. Hall raised, and I believe Senator Campbell also alluded to it here, is the question of whether the NRC would require full-scale testing of these shipping casks; the concern being, I gather, that they have gone through some testing, but it is not adequate considering the risks involved.

What is your view on that? I mean, will you make that decision as to how full-scale the testing will be as you go along, or do you plan—have you made that decision as a sort of generic decision, or what is your view?

Dr. MESERVE. We have licensed casks, as I indicated in my testimony. And we have not required full-scale testing of the casks. We do have stringent requirements that the licensees have to demonstrate that the casks satisfy. And the way they try to dem-

onstrate that those requirements can be met is by smaller scale testing, sometimes of components, and a computer analysis of the engineering associated with the casks.

These are relatively simple engineering structures, and they are ones that are susceptible to that kind of analysis in that there are reliable computer codes that can be used to assess the situation. And we know how the performance of the casks would scale with size, so the measurement of effects on a smaller scale model are sufficient, we believe, to be able to assess the effects of an accident on a larger cask.

All of that being said, we recognize that there is a concern. We have undertaken what we call a package performance study that was started and that we will be continuing in which we do contemplate some full-scale testing of casks in order to verify that the analytical methods that I have described and the testing methods that we have described are accurate.

The CHAIRMAN. So I guess the answer is that you will conduct the full-scale testing that you think is necessary in order to satisfy you that these casks can withstand whatever they encounter.

Dr. MESERVE. That is our plan.

The CHAIRMAN. Okay. We have this issue that the law requires, as I understand it, that the Department of—if we go ahead and override the veto of the Governor of Nevada, if the Congress were to do that, then the law contemplates that the Department of Energy would file an application within 90 days, I believe is what the law says.

And Secretary Abraham told us last week that the Department of Energy will not be prepared to file an application before 2004. What is your understanding about this 90-day provision that is in the Nuclear Waste Policy Act? What happens if you wind up getting an application in 2004 instead of in the 90 days provided for in the law?

Dr. MESERVE. Well, let me say that there is a 90-day provision in the statute as you have indicated. It is my understanding that the Department of Energy construes that as a permissive and an enabling authority within which to file the application.

We do understand that the Department intends to file an application if permission is given in the 2004 period. From the Commission's point of view, we believe that that time before the filing is going to be important because there are issues, some of which have been raised here today, that we believe should be addressed and should be part of a license application.

And so we are looking for a high-quality application that will provide the foundation for us to be able to conduct the necessary and thorough review. And it is going to take some time for the Department of Energy to pull that information together.

So as a policy matter, we think that we are all served by there being a high-quality application. We are expecting to receive such an application in 2004 and we will docket it if it is a complete one.

The CHAIRMAN. Let me ask one other question. Mr. Gilinsky yesterday, Victor Gilinsky, who previously served on your Commission, testified that the NRC's licensing rule does not have any separate requirement for effectiveness of geologic barriers. I just wonder what your view on that is. Is that true? What is your read on that?

Dr. MESERVE. Let me say that I think that Mr. Gilinsky's testimony may reflect some misunderstanding of both the statute and of our regulatory requirements, in that the statute requires a consideration of both natural and engineered barriers, as do our regulatory requirements. This reflects a general philosophy that we would apply of defense in depth. We look for a variety of different means to assure that the regulatory requirements can be satisfied.

And that would include both natural and engineered barriers. We would anticipate that any Department of Energy application for the site would reflect the effectiveness of various of these barriers.

We do not have separate requirements for each of the barriers. That, of course, is consistent with the advice that the Department of Energy and we received from the National Academy of Sciences that the system should be viewed as an integrated whole and that all of the barriers should work synergistically with each other, and that we should see the integrated picture rather than looking at each barrier in isolation.

The CHAIRMAN. Let me ask probably the bottom-line question for the committee and for the Congress here: Do you see any reason why Congress should not allow the DOE to go ahead and file an application?

Dr. MESERVE. Well, we have indicated that the final environmental impact statement, we thought, was sufficient to allow a site recommendation. We are not aware of anything that would foreclose the—either decision that the Congress might make in this matter.

I do not want to be seen as pre-judging how we would respond to an application. All of that work remains in front of us.

The CHAIRMAN. Thank you very much.

Senator Campbell.

Senator CAMPBELL. Mr. Meserve, who does the actual testing of containers, as an example? Does your agency do that, or is that hired out to private contractors, or who does it?

Dr. MESERVE. Typically—well, let me express how I understand it to work, and let me say that I will supplement my response for the record if I have anything wrong.

The requirements are ones that we establish as part of the process, and an applicant seeking to have a cask certified will submit information to us that will include the test results and the analysis.

The NRC staff will then undertake its own review, an independent review of the cask design using the tools that are available to it. Typically, in this process, the applicant would provide the scale model tests.

We have the authority to undertake independent scale-model testing. We would probably—if we were to do that, we would not do it ourselves. We would probably hire an independent contractor to do that work.

Senator CAMPBELL. Okay.

Mr. MCGAFFIGAN. It would probably be one of the National Laboratories.

Senator CAMPBELL. One of the National Labs, okay.

Mr. MCGAFFIGAN. And our intent would be——

Senator CAMPBELL. The computer analysis that you spoke of, some of the preliminary testing, was that also done by the National Laboratories?

Mr. MCGAFFIGAN. The package performance study, if we go to full-scale testing, the intent is to—the tests would be done at Sandia, I believe. Sandia did the full-scale tests back in the 1980's.

Senator CAMPBELL. Sandia. Okay.

Thank you, Mr. Chairman. It just seems to me that when we talk about the billions of dollars we have spent and billions of more dollars we are going to spend, that we ought to—I do not know. Maybe I have something wrong here. But it seems to me that all of that complete testing ought be done before, not after the fact.

What if we spend billions more and find out that it is—through some strange way that they are not as indestructible as we would like them to be? I mean, where does that leave us? That is a rhetorical question, I guess. You do not have to answer it.

But I think we are making a big mistake in not doing the complete testing before we spend any more money on the development. But I just wanted to make that statement.

Thank you, Mr. Chairman.

The CHAIRMAN. Senator Carper.

Senator CARPER. Yes. Let me yield to Senator Ensign. He has been waiting.

The CHAIRMAN. Senator Ensign.

Senator ENSIGN. Thank you, Senator.

I thought that was interesting, what you just said. You said that "We are planning on going ahead with full-scale testing," but then you said "if."

Mr. MCGAFFIGAN. I did not mean to contradict the chairman. We do—the "if" is subject to congressional appropriations. Our intent is to ask for money in the fiscal year 2004 budget for the conduct of a full-scale test. We have said that in a letter to Senator Reid dated the 24th of April. But we do not want to presume on the congressional appropriations process. Hopefully, you will——

Senator ENSIGN. Do you think that—without full-scale testing, do you think that you can ensure that these transport canisters will be safe?

Dr. MESERVE. Let me say in response to that, that we have been licensing the canisters. We think we have been responsible in licensing these transportation packages, based on the information that is available to us.

Senator ENSIGN. Okay. Could the ones—those current ones that are licensed, could those have withstood—if one of those would have been exposed to the fires in the Baltimore Tunnel, could they have withstood the heat from that, or would they have actually been breached?

Dr. MESERVE. Well, let me say that part of the package performance study is to look at the performance of the casks in what we call severe accidents. There has been a preliminary analysis that has been conducted by the staff based on assumptions about the conditions that existed in the Baltimore fire, as to the temperatures, temperature profile over time, duration of the fire, which do indicate that the cask that they analyzed would survive. There

would be no failure of the welds. In fact, there would not have been any melting of the fuel.

But let me emphasize, it is a preliminary analysis, and I would not want you to rely on that. We are going to continue to look at these sorts of issues very carefully as part of our package performance study.

Senator ENSIGN. When you are dealing with testing—because I think this is absolutely critical to the safety, when you are dealing with the testing. because I do not think that, you know, when they were—and I keep going back to 9/11. When they were thinking about building skyscrapers, I do not think that they foresaw the idea of terrorists taking planes into the World Trade Center, and the unusual circumstances.

And it would seem to me that testing should take in not normal, every-day circumstances, but worst-case scenarios especially because we are dealing now with the most—if not the most, certainly one of the most deadly substances on the planet, and that we have to do everything possible, full-scale testing.

And I agree with Senator Campbell. I think it is putting the cart before the horse. I think it is ridiculous that we are going forward with this thing before we know that we can address these problems.

And I guess what I want is that your assurances that you will not license the site if you cannot get these things tested to make sure that we are protecting the citizens of America, because you are the ones responsible for the testing.

Will you guarantee this committee and this Senate and the people of America that you will not license the site if you cannot guarantee the safe transportation?

Dr. MESERVE. Well, let me say that we are going to comply with every element of the statute as to what conditions and circumstances under which we should allow the licensing of the site to occur. Part of that process does require a full evaluation, as I have indicated, of the transportation issues as part of the assessment.

We also have an obligation to assure the public health and safety in the context of the certification of casks. And we take that obligation very seriously. And we will be satisfied, before we certify the casks, that they meet the necessary requirements.

You mentioned 9/11. This is an area in which there is continuing examination by the Commission of the possible vulnerability of all elements of our nuclear enterprise. That work is continuing. But in the period since 9/11, we have augmented the security that exists at various of our facilities including the transport of nuclear materials. But that work is also going to continue. And that may be manifested in some further requirements down the road.

Senator ENSIGN. Let me rephrase the question, then. You know, can you—well, will you guarantee the American people that you will not license the site if, for instance, things that are commonly available to terrorists, if deployed against these canisters, that they will breach these canisters—will you guarantee and will you promise us that, that you will not license the site if that is the case?

Dr. MESERVE. Well, I think there is a separate question about licensing the site versus certification of canisters. And we certainly

are examining all of those, the nature of the requirements that should be imposed on the certification of canisters. And included in that evaluation is certainly going to be the issue of dealing with possible terrorist attacks that might occur on canisters, and what kinds of requirements, if any, that we should add to the current requirements to deal with the terrorist threat.

We are in an evolving situation where we are all learning about the nature of this threat, and it does require very thorough consideration and careful consideration, which we have undertaken. But in the interim, we have taken steps to assure that these materials can be safely transported, and we are going to continue that work.

Senator ENSIGN. Well, I mean—and we obviously are transporting nuclear waste today.

Dr. MESERVE. That is correct.

Senator ENSIGN. And I guess what we have to determine and what I am trying to get you to say, basically, is that your responsibility is to the safety of the American people, to make sure that those things, if they are being transported through major cities, on waterways, where the public is in potentially in danger, that it is your responsibility to make sure that those things are licensed, that something, obviously, with every possible scenario that we can think of, that they cannot be breached.

And from what I understand, one of these things during transport—if they are surrounded by concrete, they will not. But during transport, one of these things can be breached by a TOW Missile. Have you seen the testing that has been done on some of that?

Dr. MESERVE. I am aware of some testing some years ago, in which a particular cask was subject to a TOW Missile attack, and there was a penetration of the cask. The significance of that is something that is—well, it was obviously an unfortunate event.

Whether that would have resulted in a significant release of material or of hazard to the public is yet another matter.

But we are aware of the fact that the nature of the tactics that might be used by terrorists, the nature of equipment that might be available to them, is something that is changing, and we need to consider these matters as we undertake our obligation to assure the protection of the public health and safety in the usage of the casks. And we will do that.

Senator ENSIGN. The last concern I want to raise to you is that Israel is—probably there is no country more concerned about their own safety and their own prevention of terrorist attacks than the state of Israel. But yet, even today, I guess, there was a bomb put on a fuel container there that they tried to do everything they could to prevent something like that from happening.

So I guess my charge would be to you, because you have such an awesome responsibility for making sure that the American people are safe, that whatever you think that you have done so far, you know, post-9/11, we have to rethink and rethink and rethink, and re-cross every "t" and re-dot every "i," and do every kind of full-scale testing that you can possibly do.

And I would think that if Congress does not give you the type of resources to do the testing, we would be irresponsible.

But I still think, Mr. Chairman, we are completely irresponsible in going ahead with Yucca Mountain without doing this testing ahead of time.

Thank you very much.

The CHAIRMAN. Thank you.

Mr. MCGAFFIGAN. Mr. Chairman.

The CHAIRMAN. Yes, sir.

Mr. MCGAFFIGAN. Could I just make one comment with regard to the transportation issue?

The CHAIRMAN. Yes.

Mr. MCGAFFIGAN. In the security issue in particular, we need to look at the security of our facilities—of our transportation casks against reasonable threats.

But if a terrorist gets a TOW Missile, which I hope is not widely available in America, there are targets available to them where, instead of getting possible radiological consequences that might cause cancer sometime down the road, where they can get guaranteed large, tens of thousands of deaths potentially.

There was an article in the *Washington Post* a few months ago about taking the chlorine tanks out of the Blue Plains facility, which is not far from this site, when they discovered, without the use of TOW Missiles, that they had too much chlorine there and if a terrorist had attacked at that site, there would have been very large numbers of deaths in Washington.

So you have to put the radiological consequences of an attack—we have these massive containers that, unlike other things, actually can do pretty well against a TOW Missile. You have hazardous materials in the transportation system daily in this country that are, you know, no-risk opportunities for terrorists.

So putting some of this in context, I think, is very important.

Senator ENSIGN. Well, the reason I brought that up, Mr. Chairman——

The CHAIRMAN. Senator Carper is about to sprint out of here to preside.

Senator ENSIGN. Okay. I am sorry.

The CHAIRMAN. Let me just give him a couple of minutes to say what he has to, and then we can ask additional questions. Go ahead.

Senator CARPER. Mr. Chairman, thank you for that because I have an 11 o'clock start. I appreciate your indulgence.

Let me just ask two quick questions. One, in your view, what are the greatest risks that are posed to us as a people by the transportation of these materials? If they are indeed transported some years down the road, what is the greatest threat that we face? What are you doing about it? What do we need to do about it?

Dr. MESERVE. Well, let me say I think as to the transport of the material, that we have a record in which for commercial waste that they have gone nearly one million miles of transport without a radiological release. We cannot prevent the possibility that there will be ordinary traffic accidents that occur. If there were such an accident, we try to assure that there will not be a breach of a cask that would result in a radiological release. And that has been the focus of our requirements. And we have been successful in over one million miles of transport.

We are going to continue that effort and expand it to make sure that we are dealing adequately with the terrorist threat that might be posed to these sorts of packages. And that is part of what our package performance study is intended to do, is to make sure we understand the severe events to which these sorts of casks might be confronted and to satisfy ourselves that they could survive those events adequately.

Dr. DIAZ. Senator, if I might——

Senator CARPER. The second half of my question is: What do we need to do? What do we need to do about it? I think you may have telegraphed the pitch by talking about an appropriation for 2004.

Dr. MESERVE. That is correct.

Senator CARPER. What do we need to do in the Congress to help avert a catastrophe?

Dr. MESERVE. Well, I know Dr. Diaz wants to respond, but let me just say quickly on that, I think that we will be seeking funds to support the kinds of full-scale testing that has been discussed here this morning, and to do other aspects of the package performance study. And I think that we would encourage you to review such a request favorably.

Senator CARPER. All right. Thank you.

Yes, sir.

Dr. MESERVE. Dr. Diaz.

Dr. DIAZ. Yes, I just wanted to say, Senator, that a catastrophe where significant life would be lost involving a transportation accident, is very difficult to imagine. Fundamentally, not only is the—not only are the casks very robust, but the amount of material in the casks that would potentially leak is, in our analysis, most of the time, not likely to result in immediate deaths or significant problems except for those who would be located right by the cask.

Our concern, the Commission's, is always public health and safety. And so we look at the consequences very carefully. And we really do not see tremendous catastrophic results or disasters occurring from accidents with the casks.

Yes, there is the potential of breaching the cask. There is a potential of radiation. Radiation is a very strange fellow. It is easily detectable. It can easily be measured. And in this country, we always have been and we always will be ready to take protective measures for our people. So it is not that something happens, and you have all of these immediate casualties.

The American people are protected by many layers, we are one of those layers. And we do not see this tremendous catastrophic disasters occurring from a cask being breached.

Senator CARPER. All right. Thank you, sir.

Mr. Chairman, I have a couple of other questions. I am not going to ask them now, but I am interested in knowing how some other countries are handling the transportation of their high-level nuclear and radioactive waste.

And the other thing I wanted to ask for you input on—and I will do this or ask for something in writing. But I have just an inquiry with respect to the future likelihood of our ability to reprocess this fuel, to recycle it, to reduce the amount of space that it takes up in the future.

Dr. MESERVE. We would be happy to respond to those, for the record.

Senator CARPER. Thank you very much.

And I thank my colleagues, as well.

The CHAIRMAN. Thank you very much.

Let me go ahead. Senator Campbell indicated he had another question or two.

Senator CAMPBELL. I think they answered most of my questions, Mr. Chairman. I do not think anybody can absolutely guarantee total and absolute safety under all conditions. My gosh, we kill 55,000 people a year on American highways with accidents. And I do not think that that is in the mix.

But I also do not think that there is anything known to man that cannot be cut into or destroyed, and I do not mean with a TOW Missile. I mean with a—my gosh, anybody, good guys and bad guys, can buy a cutting torch that will melt steel at any local hardware store. So I think that ought to be in the mix, too, that that is—that they can be penetrated, I think. But the danger of how far it leaks and so on, I think Dr. Diaz, he addressed that a little bit.

But I had one question, but I think I will just go ahead and submit that in writing because I am going to have to leave in a minute, too. But thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator CAMPBELL. And I thank this panel.

The CHAIRMAN. Thank you very much.

Senator Ensign, did you have additional questions?

Senator ENSIGN. Yes, just briefly in that I just wanted to go back to when you are talking, and I agree with you, that there are a lot of things that we need to restudy. We need to make our current facilities, nuclear facilities, safer. We need to put more security into those.

And, Dr. Diaz, the point that you made about that if there is a leak that, you know, the possibility of mass deaths is very low and all of that, when you are talking about radiation, you are talking about fear. Okay? And sometimes it is irrational fear, but fear nonetheless.

We all know of the device called an MRI. It is very, very commonly known to us as magnetic resonance imaging. The original name of that NMR. It contained the word "nuclear." Anytime you use the word "nuclear," people are fearful. Nobody would have gone in for an NMR. They go in commonly for MRIs. They are the same exact technology, but because it evokes fear, that people become necessarily irrational.

Terrorists play on people's fears. The reason that the terrorists—we know in our intelligence gathering that is why they are looking for nuclear types of targets is because they know that people are irrational with when it comes to any kind of radiation, anything to do with any kind of nuclear thing.

So that is one of the big reasons, is that—it is that we know that these things are going to be targets, much more than a chlorine tank is a target, even though a chlorine tank may do more damage, that people are much more afraid of a radiation leak than they are of chlorine leaks even though chlorine does much more damage.

Mr. MCGAFFIGAN. That may speak to the American educational system and perhaps the terrorists' educational system.

Dr. DIAZ. Senator——

Senator ENSIGN. Right. But we all know up here. And, Mr. Chairman, we have learned very, very, very, very clearly in our dealings up here that perception is reality.

The CHAIRMAN. Yes.

Senator ENSIGN. And that is people's perception.

Mr. MCGAFFIGAN. You work in a very high radiation environment. Last year, my son was a page in the Senate for Senator Warner, and I took my MicroR meter around the Capitol and got measurements in the 20 to 30 MicroR per hour range. You also travel a lot by air, and every time you go home to Nevada, you get about 4 millirems round trip so we may want to monitor you. You may be a radiation worker.

[Laughter.]

Senator ENSIGN. I am going to start wearing a lead apron.

[Laughter.]

Dr. DIAZ. Mr. Chairman, I just wanted to add that I think the point is very well taken, and that is one of the things that I think and believe is our responsibility; that is to allay unnecessary fears. Our concern is always with respect to public health and safety, Unnecessary fears might actually detract from our society and might not let us use every useful thing that is possible, whether it is chemical or whatever it is. To allay unnecessary fear is certainly part of our responsibilities. And we take that very seriously, sir.

The CHAIRMAN. All right. Well, thank you all very much. I think it has been useful testimony. We appreciate it.

Dr. MESERVE. Thank you.

The CHAIRMAN. And we will go to the final panel. We have Dr. Jared Cohon, the Chair of the Nuclear Waste Technical Review Board; Ms. Gary Jones, the Director of the Natural Resources and Environment Team at the General Accounting Office; the Honorable Jeffrey Holmstead, Assistant Administrator for Air and Radiation at the EPA; and the Honorable Robert Card, who is the Under Secretary for the Department of Energy.

Thank you all very much for being here.

[Pause.]

The CHAIRMAN. Dr. Cohon, please go ahead and begin.

Dr. COHON. Thank you very much, Mr. Chairman.

The CHAIRMAN. Let me just, before you start, indicate that I understand this may be your last appearance before the committee, and we should take the opportunity to thank you for your many years of service on the Board, and particularly the last five during which you have been the Chair of the Board.

Dr. COHON. Thank you very much, Mr. Chairman. I appreciate it.

The CHAIRMAN. You have done an excellent job, and we appreciate it very much. So go ahead with your testimony.

STATEMENT OF JARED L. COHON, CHAIRMAN, NUCLEAR WASTE TECHNICAL REVIEW BOARD

Dr. COHON. Thank you. In fact, as the Chairman knows, I am one of only ten members of the Board, and I am pleased that two of the other members could be with us today. I would like to introduce them very briefly and ask them to rise as I do so.

Debra Knopman is a senior scientist at RAND Corporation. And Richard Parizek is a professor of hydrogeology at Penn State University.

As the chairman noted at the beginning of the hearing, our Board was created by Congress in the 1987 amendments to the Nuclear Waste Policy Act. And you did so specifically to create a body that would provide to you independent technical review of the DOE's work related to Yucca Mountain and the management of high-level nuclear waste.

Based on that, we did a review and, Mr. Chairman, I would like to summarize my testimony and ask that the full text be included in the record.

The CHAIRMAN. We will include each of the witnesses' full testimony, and please do summarize your points.

Dr. COHON. Thank you.

As part of that ongoing independent technical review that we provide, we notified the Secretary in December 2001 that we would be issuing our comments with regard to the site recommendation that we knew was forthcoming.

That was contained in a letter on January 24 of this year, which was conveyed both to the Secretary and to Congress. I would like to just point out to you some of the key points in that letter. Based on our review of all of the relevant work that DOE had done to that point, the Board's view is that, when that work is taken as a whole, the technical basis for the DOE's repository performance estimates is weak to moderate at this time.

The Board concurs with the consensus of the international scientific community that deep geologic disposal is technically feasible at a suitable site. The Board, however, makes no judgment on the suitability of Yucca Mountain itself. We believe and we are very clear in understanding the mandate that Congress gave us, which is to provide technical insight and technical review and not to make policy decisions of that sort. We defer to the policy-making process which is to say Congress now, on the suitability of Yucca Mountain.

At this point, the Board found no individual technical or scientific factor that would automatically eliminate Yucca Mountain from consideration. The Board considers this minimum threshold to be a necessary, but by itself not a sufficient technical condition, for a positive determination of site suitability.

The DOE's performance estimates are based on a complicated and large model called "Total System Performance Assessment," or TSPA for short. There are many uncertainties due to gaps in data and basic understanding as it relates to this model and its use. This creates limited confidence for the Board in the current performance estimates, which are a product of this TSPA model.

The Board made several recommendations in its January letter that, if implemented fully, would likely improve the Board's view

of the technical basis for DOE's performance assessments. Just to highlight some of those recommendations that we made, we strongly recommend that DOE continue a vigorous scientific investigation so as to increase basic understanding of the potential behavior of the proposed repository system.

We note that high temperatures in the DOE's base case design increase uncertainties and, therefore, decrease confidence in the performance of waste package materials which are a key part of the system. Adopting a low-temperature design might reduce uncertainties; we do not know. But in any event, we strongly recommend that the DOE do a full and objective comparison of both high temperature designs and low temperature designs.

Among the other recommendations we made was urging DOE to identify, quantify and communicate clearly the uncertainties associated with their estimates of performance. We point out the importance of DOE identifying other data or other arguments they could use to buttress their performance estimates other than TSPA. And we point out the importance of defense in depth.

I should emphasize, Mr. Chairman, that even if all of these recommendations are in fact pursued, one cannot predict whether performance estimates would be better or worse after implementing these recommendations.

Finally, Mr. Chairman, your letter conveyed a question seeking the Board's view on whether sufficient technical information is or will be available to the NRC to enable it to assess the safety and environmental impact of a repository at Yucca Mountain. I would like to respond to that question now in full.

The NRC issued a sufficiency statement on this subject in November 2001. The NRC and the DOE have agreed on a list of key technical issues that need to be addressed in the DOE's license application. The NRC, and not our Board, will judge whether or not DOE's efforts to resolve these issues are, in fact, adequate.

However, the Board believes that given the significant uncertainties associated with the DOE's current performance estimates, addressing all of the key technical issues in the 2004 time frame that has been discussed will be an ambitious undertaking.

Finally, in closing, let me just note: The Board is certainly aware and the chairman and the other members of this committee are as well, that it is not possible to avoid all technical uncertainty associated with Yucca Mountain or any other potential repository site.

It is up to policy makers to decide how much uncertainty is acceptable at the time that you make your decision.

That concludes my statement. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

[The prepared statement of Dr. Cohon follows:]

PREPARED STATEMENT OF JARED L. COHON, CHAIRMAN, NUCLEAR WASTE TECHNICAL REVIEW BOARD

Good morning, Mr. Chairman and members of the Committee. I am Jared Cohon, Chairman of the Nuclear Waste Technical Review Board. All members of the Board are appointed by the President and serve on a part-time basis. In my case, I also am president of Carnegie Mellon University in Pittsburgh, Pennsylvania.

I am pleased to be here today to present the Board's technical and scientific evaluation of the Department of Energy's work related to the recommendation of a site at Yucca Mountain in Nevada as the location of a permanent repository for spent nuclear fuel and high-level radioactive waste and to respond to questions posed by

the Committee in its invitation letter. We hope that the Committee and other policymakers will find the Board's testimony useful as you consider the various issues that will affect a decision on whether to proceed with repository development. With your permission, Mr. Chairman, I will summarize the Board's findings, and I request that my full statement and the Board's January 24, 2002, letter report to Congress and the Secretary of Energy be included in the hearing record.

As you know, Mr. Chairman, Congress created the Board in the 1987 amendments to the Nuclear Waste Policy Act. Congress charged the Board with performing an ongoing independent evaluation of the technical and scientific validity of activities undertaken by the Secretary of Energy related to disposing of spent nuclear fuel and high-level radioactive waste. The Board also reviews the DOE's activities related to transporting and packaging such waste. Since the Board was established, its primary focus has been the DOE's efforts to characterize a site at Yucca Mountain in Nevada to determine its suitability as the location of a potential repository.

Early last year, Secretary of Energy Spencer Abraham indicated that he would make a decision at the end of 2001 on whether to recommend the Yucca Mountain site for repository development. As the Secretary's decision approached, the Board decided it was important to comment to the Secretary and Congress, within the context of the Board's ongoing evaluation of the technical and scientific validity of DOE activities, on the DOE's work related to a site recommendation. So, in November 2001, the Board met to review comprehensively the DOE's efforts in this area. In December 2001, the Board sent a letter to the Secretary indicating that the Board would provide its comments within a few weeks. The Board conveyed those comments in a letter, which included attachments with supporting details, that was sent to Congress and the Secretary on January 24, 2002.

I will now summarize the Board's review procedures and the results of the Board's evaluation. Questions posed by the Committee in its invitation letter are addressed in the context of the Board's evaluation.

The Board's evaluation of the DOE's work represents the collective judgment of its members and was based on the following:

- The results of the Board's ongoing review of the DOE's Yucca Mountain technical and scientific investigations since the Board's inception;
- An evaluation of the DOE's work on the natural and engineered components of the proposed repository system, using a list of technical questions identified by the Board;
- A comprehensive Board review of draft and final documents supplied by the DOE through mid-November 2001;
- Field observations by Board members at Yucca Mountain and related sites.

To focus its review, the Board considered the following 10 questions for components of the repository system:

1. Do the models used to generate input to the total system performance assessment (TSPA) and the representations of processes and linkages or relationships among processes within TSPA have a sound basis?
2. Have uncertainties and conservatisms in the analyses been identified, quantified, and described accurately and meaningfully?
3. Have sufficient data and observations been gathered using appropriate methodologies?
4. Have assumptions and expert judgments, including bounding estimates, been documented and justified?
5. Have model predictions been verified or tested?
6. Have available data that could challenge prevailing interpretations been collected and evaluated?
7. Have alternative conceptual models and model abstractions been evaluated, and have the bases for accepting preferred models been documented?
8. Are the bases for extrapolating data over long times or distances scientifically valid?
9. Can the repository and waste package designs be implemented so that the engineered and natural barriers perform as expected?
10. To the extent practical, have other lines of evidence, derived independently of performance assessments, been used to evaluate confidence in model estimates?

In evaluating the DOE's work related to individual natural and engineered components of the proposed repository system, the Board found varying degrees of strength and weakness. For example, the Board considers the DOE's estimates of the probabilities of volcanic events and earthquakes at Yucca Mountain strengths and the lack of data related to corrosion of materials proposed for the waste packages under conditions that would likely be present in the repository and the very short experience with these materials weaknesses.

This kind of variability is not surprising, given that the Yucca Mountain project is a complex, and, in many respects, a first-of-a-kind undertaking. An important conclusion in the Board's January letter is that when the DOE's technical and scientific work is taken as a whole, the Board's view is that the technical basis for the DOE's repository performance estimates is weak to moderate at this time. However, if all the recommendations in the Board's January 24, 2002, letter report* are implemented and no surprises are found, the Board's view of the technical basis would likely improve. The predicted repository performance, however, might be either better or worse, depending on what is discovered.

The Board concurs with the consensus within the international scientific community that deep geologic disposal is technically feasible at a suitable site. However, the Board made no judgment in its January letter on the question of whether the Yucca Mountain site should be recommended or approved for repository development. Those judgments, which involve a number of public-policy considerations as well as an assessment of how much technical uncertainty is acceptable at various decision points, go beyond the Board's congressionally established mandate.

Let me explain in a little more detail, Mr. Chairman, the basis for the Board's conclusion on performance estimates. The DOE uses a complex, integrated performance assessment model to project repository system performance. Performance assessment is a useful tool because it assesses how well the repository system as a whole, not just the site or the engineered components, might perform. However, gaps in data and basic understanding cause important uncertainties in the concepts and assumptions on which the DOE's performance estimates are now based. Therefore, while no individual technical or scientific factor has been identified that would automatically eliminate Yucca Mountain from consideration at this point, the Board has limited confidence in current performance estimates generated by the DOE's performance assessment model.

But first let me expand a bit on the comment I just made that at this point, no individual technical or scientific factor has been identified that would automatically eliminate Yucca Mountain from consideration. The Board considers this minimum threshold finding to be a necessary, but by itself not a sufficient, condition for a positive determination of site suitability.

How can confidence in the DOE's performance estimates be increased? As noted in the Board's January letter report, the Board believes that a fundamental understanding of the potential behavior of a proposed repository system is very important. Therefore, if policy-makers decide to approve the Yucca Mountain site, the Board strongly recommends that, in addition to demonstrating regulatory compliance, the DOE continue a vigorous, well-integrated scientific investigation to increase its fundamental understanding of the potential behavior of the repository system. Increased understanding could show that components of the repository system perform better than or not as well as the DOE's performance assessment model now projects. In either case, making performance projections more realistic and characterizing the full range of uncertainty could improve the DOE's performance estimates.

The DOE's estimates of repository performance currently rely heavily on engineered components of the repository system, making corrosion of the waste package very important.

As the Board has mentioned in many of its previous reports and letters, we believe that high temperatures in the DOE's base-case repository design increase uncertainties and decrease confidence in the performance of waste package materials. Confidence in projections of waste package and repository performance potentially could increase if the DOE adopts a low-temperature repository design. However, the Board continues to believe that the DOE should complete a full and objective comparison of high- and low-temperature repository designs before it selects a final repository design concept.

Over the last several years, the Board has made several other recommendations that could improve the DOE's projections of repository performance. For example, the Board recommended that the DOE identify, quantify, and communicate clearly the extent of the uncertainty associated with its performance estimates. The Board also recommended that the DOE use additional lines of evidence and argument to supplement the results of its performance assessment. Moreover, the DOE could strengthen its arguments about how multiple barriers in its proposed repository system provide "defense-in-depth" (or redundancy). Although the DOE has made progress in each of these areas, more work is needed.

Other actions that might be considered if policy-makers approve the Yucca Mountain site include systematically integrating new data and analyses produced by ongoing scientific and engineering investigations; monitoring repository performance

* The letter has been retained in committee files.

before, during, and after waste emplacement; developing a strategy for modifying or stopping repository development if potentially significant unforeseen circumstances are encountered; and continuing external review of the DOE's technical and scientific activities.

Mr. Chairman, your letter of invitation asked what the Board's views are on whether sufficient technical information is or will be available to the Nuclear Regulatory Commission to enable it to assess the safety and environmental impact of a repository at Yucca Mountain.

This is the Board's answer to that question. The NRC issued the following statement in November 2001, "The NRC believes that sufficient at-depth site characterization analysis and waste form proposal information, although not available now, will be available at the time of a potential license application such that development of an acceptable license application is achievable." The NRC and the DOE have agreed on a list of "key technical issues" (KTI) that need to be addressed in the DOE's license application. The NRC, not the Board, will judge the adequacy of the DOE's efforts to resolve these issues for a license application. However, the Board believes that given the significant uncertainties associated with the DOE's current performance estimates, addressing all of the KTI's in the 2004 time frame that has been discussed will be an ambitious undertaking.

Mr. Chairman, let me close by observing that eliminating all uncertainty associated with estimates of repository performance would never be possible at any repository site. Policy-makers will decide how much scientific uncertainty is acceptable at the time various decisions are made on site recommendation or repository development. The Board hopes that the information provided in this testimony and in its letter report to Congress and the Secretary will be useful to policy-makers faced with making these important decisions.

Thank you for the opportunity to present the Board's views. I will be happy to respond to additional questions from the Committee.

The CHAIRMAN. Ms. Jones, why don't you go right ahead?

STATEMENT OF MS. GARY JONES, DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT, GENERAL ACCOUNTING OFFICE

Ms. JONES. Thank you, Mr. Chairman.

We are pleased to be here today to discuss DOE's project to develop a nuclear waste repository at Yucca Mountain, Nevada.

This morning I would like to focus on three points. First, DOE has a significant amount of work ahead to prepare to submit an acceptable license application to NRC. Second, DOE is unlikely to achieve its goal of opening a repository by 2010. And third, DOE needs to reestablish a cost and schedule baseline for the project and use that baseline as one of the basic tools to manage the project.

The President's recommendation of the Yucca Mountain site to the Congress on February 15th triggered specific statutory time frames for the next step in the repository project. For example, if the Congress enacts legislation overriding the State's disapproval. The Nuclear Waste Policy Act requires DOE to then submit a license application within 90 days. However, DOE's managing contractor concluded that DOE would not be in a position to submit the application to NRC until January 2006 or about four years from now. This conclusion was based on a September 2001 detailed reassessment of the work required to submit a license application that would be acceptable to NRC.

DOE did not accept this schedule and directed the contractor to shorten the time to a license application to December 2004 or about 2½ years from now.

One of the key factors that drive DOE's ability to submit an acceptable license application is satisfactory completion of the 293

agreements with NRC under which DOE agreed to collect more scientific data and/or improve its technical assessment of that data.

These agreements generally relate to uncertainties about three aspects of the long-term performance of the proposed repository: One, the expected lifetime of engineered barriers particularly the waste containers; two, the physical properties of the Yucca Mountain site; and three, supporting information for the mathematical models used to evaluate the performance of the planned repository.

Minimizing uncertainties about the waste containers is especially critical because DOE's estimates of the repository system's performance depend heavily on the waste containers, in addition to the natural features of the site. According to NRC, as of March 4, 2002, DOE had satisfactorily completed work on 38 of these agreements and could resolve another 22 by September 30 of this year.

DOE is also continuing to address similar technical issues raised by the Board. As Dr. Cohon has testified, the Board's most recent report in January concluded that when DOE's technical and scientific work is taken as a whole, the technical basis for DOE's repository performance estimates is weak to moderate at this time. The Board added that gaps in data and basic understanding cause important uncertainties in the concepts and assumptions on which DOE's performance estimates are now based.

With regard to opening the repository, it is unlikely that DOE can meet its goal of opening the repository in 2010. According to program estimates, 7 years would be needed after license application until the facility was operational, 3 years to obtain a license, and 4 years to construct the facility.

Depending on the license application date, this would extend the opening date until about 2012 or 2013. However, even these time frames may be questionable. A repository at Yucca Mountain would be a first-of-a-kind facility, meaning that any scheduled projections might be optimistic. The contractor's reassessment statement that the proposed schedule to reach license application did not include any cost or schedule contingencies.

Further, a contractor who independently reviewed the Nuclear Waste Program reported that the 4-year construction period was too optimistic and recommended that the construction phase be extended by a year and a half.

Finally, unless the program receives the funding level assumed, the budget might become the determining factor when DOE will be able to accept wastes.

DOE currently does not have a reliable estimate of when and at what cost a license application can be submitted, including the late 2004 date, or when a repository can be opened. This is because DOE stopped using its cost and schedule baselines to manage the site investigation in 1997.

Further, DOE has accepted only the fiscal year 2002 portion of the baseline its contractor proposed. And DOE is currently reviewing the contractor's plan for submitting a license application to NRC by December 2004.

Our December 2001 report recommended that DOE reestablish a baseline for the repository program that accounts for the outstanding technical work needed to prepare an acceptable license application and the estimated cost and schedule to achieve this milestone

and use that baseline to manage the program. This would help to ensure that when changes occur, such as adding or modifying technical work, or unanticipated funding shortfalls, alternative courses of action can be assessed on the basis of each action's potential effect on the baseline. DOE has told us that the new baseline will be established by September 2002.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

[The prepared statement of Ms. Jones follows:]

PREPARED STATEMENT OF MS. GARY JONES, DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT, GENERAL ACCOUNTING OFFICE

Mr. Chairman and Members of the Subcommittee: We are pleased to be here today to discuss the Department of Energy's (DOE) project to develop a nuclear waste repository. As required by law, DOE has been investigating a site at Yucca Mountain, Nevada, to determine its suitability for disposing of highly radioactive wastes in a mined geologic repository. On February 14, 2002, the secretary of energy recommended to the president approval of this site for the development of a nuclear waste repository. The next day, the president recommended approval of the site to the Congress. The president's recommendation began a statutory review process for the approval or disapproval of the site, including action by the state of Nevada, the Congress, DOE, and the Nuclear Regulatory Commission (NRC) within specified time frames. If the site is approved, DOE must apply to NRC for authorization (a license) to construct a repository. If the site is not approved for a license application, or if NRC denies a license to construct a repository, the administration and the Congress will have to consider other options for the long-term management of existing and future nuclear wastes.

Our testimony, which is based on our recent report on the Yucca Mountain Repository Project,[1] addresses (1) DOE's readiness to submit a license application within the statutory time frame, (2) the extent to which DOE can meet its goal of opening a repository at Yucca Mountain in 2010, and (3) the extent to which DOE is managing the project consistent with applicable departmental procedures.

SUMMARY

DOE is not prepared to submit an acceptable license application to NRC within the statutory limits that would take effect if the site is approved. The president's recommendation of the Yucca Mountain site to the Congress triggered specific statutory time frames for the next steps in the repository project. Nevada, which had 60 days from February 15 to disapprove the site, did so on April 8. The Congress now has 90 days (of continuous session) from that date in which to enact legislation overriding the state's disapproval. On May 8, the House of Representatives passed a joint resolution approving the site for a repository. If the Senate also passes this resolution—resulting in final approval of the site—the Nuclear Waste Policy Act requires DOE to then submit a license application to NRC within 90 days of the effective date of the legislation. Thus, the process gives DOE about 5 to 8 months from the date of the president's recommendation to submit the license application. However, a September 2001 detailed assessment of the repository program by DOE's managing contractor concluded that DOE would not be ready to submit a license application that would be acceptable to NRC until January 2006. DOE did not accept the contractor's proposed new schedule and directed the contractor to develop a proposal to shorten the time to a license application to December 2004, or about 19 months from now. The contractor has now developed such a proposal, which is under review within DOE. Moreover, while a site recommendation and a license application are separate processes, essentially the same data are needed for both. Waiting until DOE was closer to having the additional information needed to support an acceptable license application would have put DOE in a better position to submit the application within the time frames set out in the law, and to respond to questions and challenges that may emanate from the statutory review process subsequent to the president's recommendation.

DOE is unlikely to achieve its goal of opening a repository at Yucca Mountain by 2010. On the basis of DOE's managing contractor's September 2001 reassessment,

[1] U.S. General Accounting Office, *Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project*, GAO-02-191 (Washington, D.C.: Dec. 21, 2001).

sufficient time would not be available for DOE to obtain a license from NRC and construct enough of the repository to open it in 2010. Even under the more recent proposal to submit a license application as early as December 2004, it is questionable whether DOE could open the repository in 2010. A key factor in the future licensing and construction of a repository is whether DOE will be able to obtain the increases in annual funding that would be required to open the repository by 2010. Because of the uncertainty of meeting the 2010 goal, DOE is exploring alternative approaches, such as developing surface facilities for storing waste at the site until sufficient underground disposal facilities can be constructed. Had DOE elected to defer a site recommendation until it was closer to having an acceptable license application, it could have ensured that the site recommendation was based on the approach to developing a repository that it intends to follow. This would have enabled DOE to develop an estimated schedule to design and build the preferred approach and to estimate its cost, including the annual funding requirements, as part of the information on which to make a site recommendation.

DOE currently does not have a reliable estimate of when, and at what cost, a license application can be submitted or a repository can be opened because DOE stopped using its cost and schedule baselines to manage the site investigation in 1997. DOE needs to reestablish a baseline for the repository program that accounts for the outstanding technical work needed to prepare an acceptable license application and the estimated schedule and cost to achieve this milestone. In conjunction, DOE needs to use the baseline as a tool for managing the program, in accordance with the department's policies and procedures for managing major projects. Therefore, our December 2001 report recommended that the secretary of energy reestablish the baseline through the submission of a license application and follow the department's management requirements, including a formal procedure for changing program milestones. According to DOE, it is currently in the process of establishing a new baseline for the nuclear waste program.

BACKGROUND

Recognizing the critical need to address the issue of nuclear waste disposal, the Congress enacted the Nuclear Waste Policy Act of 1982 to establish a comprehensive policy and program for the safe, permanent disposal of commercial spent fuel and other highly radioactive wastes in one or more mined geologic repositories. The act created the Office of Civilian Radioactive Waste Management within DOE to manage its nuclear waste program. Amendments to the act in 1987 directed DOE to investigate only the Yucca Mountain site.

The Nuclear Waste Policy Act also set out important and complementary roles for other federal agencies:

- The Environmental Protection Agency (EPA) was required to establish health and safety standards for the disposal of wastes in repositories. EPA issued standards for the Yucca Mountain site in June 2001 that require a high probability of safety for at least 10,000 years.[2]
- NRC is responsible for licensing and regulating repositories to ensure their compliance with EPA's standards. One prerequisite to the secretary's recommendation was obtaining NRC's preliminary comments on the sufficiency of DOE's site investigation for the purpose of a license application. NRC provided these comments on November 13, 2001. If the site is approved, then NRC, upon accepting a license application from DOE, has 3 to 4 years to review the application and decide whether to issue a license to construct, and then to operate, a repository at the site.[3]
- The Nuclear Waste Technical Review Board (the board) reviews the technical and scientific validity of DOE's activities associated with investigating the site and packaging and transporting wastes. The board must report its findings and recommendations to the Congress and the secretary of energy at least twice each year, but DOE is not required to implement these recommendations.

DOE has designated the nuclear waste program, including the site investigation, as a "major" program that is subject to senior management's attention and to its agency-wide guidelines for managing such programs and projects. The guidelines require the development of a cost and schedule baseline, a system for managing changes to the baseline, and independent cost and schedule reviews. DOE is using

[2] The Energy Policy Act of 1992 required EPA to establish specific health and safety standards for a repository at Yucca Mountain.

[3] The acceptance of a license application is not the same as approving an application. A decision to approve or disapprove any application would be made by NRC following extensive review and testing.

a management contractor to carry out the work on the program. The contractor develops and maintains the baseline, but senior DOE managers must approve significant changes to cost or schedule estimates. In February 2001, DOE hired Bechtel SAIC Company, LLC (Bechtel), to manage the program and required the contractor to reassess the remaining technical work and the estimated schedule and cost to complete this work.

DOE WILL NOT BE READY TO SUBMIT A LICENSE APPLICATION WITHIN THE STATUTORY TIME FRAME

DOE is not prepared to submit an acceptable license application to NRC within the statutory limits that would take effect if the site were approved. Specifically, DOE has entered into 293 agreements with NRC to gather and/or analyze additional technical information in preparation for a license application that NRC would accept. DOE is also continuing to address technical issues raised by the board. In September 2001, Bechtel concluded, after reassessing the remaining technical work, that DOE would not be ready to submit an acceptable license application to NRC until January 2006. DOE did not accept the 2006 date. Instead, it directed the contractor to prepare a new plan for submitting a license application to NRC by December 2004. DOE's current plan is that, by the end of September 2002, Bechtel will develop, and DOE will review and approve, a new technical, cost, and schedule baseline for submitting a license application to NRC in December 2004.

Moreover, while a site recommendation and a license application are separate processes, DOE will need to use essentially the same data for both.[4] Also, the act states that the president's recommendation to the Congress is that he considers the site qualified for an application to NRC for a license. The president's recommendation also triggers an express statutory time frame that requires DOE to submit a license application to NRC within about 5 to 8 months.

DOE LACKS INFORMATION FOR A LICENSE APPLICATION

The 293 agreements that DOE and NRC have negotiated address areas of study within the program where NRC's staff has determined that DOE needs to collect more scientific data and/or improve its technical assessment of the data. According to NRC, as of March 2002, DOE had satisfactorily completed work on 38 of these agreements and could resolve another 22 agreements by September 30 of this year. These 293 agreements generally relate to uncertainties about three aspects of the long-term performance of the proposed repository: (1) the expected lifetime of engineered barriers, particularly the waste containers; (2) the physical properties of the Yucca Mountain site; and (3) the supporting information for the mathematical models used to evaluate the performance of the planned repository at the site.

The uncertainties related to engineered barriers revolve around the longevity of the waste containers that would be used to isolate the wastes. DOE currently expects that these containers would isolate the wastes from the environment for more than 10,000 years. Minimizing uncertainties about the container materials and the predicted performance of the waste containers over this long time period is especially critical because DOE's estimates of the repository system's performance depend heavily on the waste containers, in addition to the natural features of the site, to meet NRC's licensing regulations and EPA's health and safety standards

The uncertainties related to the physical characteristics of the site center on how the combination of heat, water, and chemical processes caused by the presence of nuclear waste in the repository would affect the flow of water through the repository.

The NRC staff's concerns about DOE's mathematical models for assessing the performance of the repository primarily relate to validating the models; that is, presenting information to provide confidence that the models are valid for their intended use and verifying the information used in the models. Performance assessment is an analytical method that relies on computers to operate mathematical models to assess the performance of the repository against EPA's health and safety standards, NRC's licensing regulations, and DOE's guidelines for determining if the Yucca Mountain site is suitable for a repository. DOE uses the data collected during site characterization activities to model how a repository's natural and engineered features would perform at the site.

According to DOE, the additional technical work surrounding the 293 agreements with NRC's staff is an insignificant addition to the extensive amount of technical

[4] See *General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories; Yucca Mountain Site Suitability Guidelines* (preamble), 66 Fed. Reg. 57298, 57322 (Nov. 14, 2001).

work already completed—including some 600 papers cited in one of its recently published reports and a substantial body of published analytic literature. DOE does not expect the results of the additional work to change its current performance assessment of a repository at Yucca Mountain.

From NRC's perspective, however, the agreements provided the basis for it to give DOE its preliminary comments on the sufficiency of DOE's investigation of the Yucca Mountain site for inclusion in a future license application. In a November 13, 2001, letter to the under secretary of energy, the Chairman of the NRC commented that:

> [a]lthough significant additional work is needed prior to the submission of a possible license application, we believe that agreements reached between DOE and NRC staff regarding the collection of additional information provide the basis for concluding that development of an acceptable license application is achievable.

The board has also consistently raised issues and concerns over DOE's understanding of the expected lifetime of the waste containers, the significance of the uncertainties involved in the modeling of the scientific data, and the need for an evaluation and comparison of a repository design having a higher temperature with a design having a lower temperature. The board continues to reiterate these concerns in its reports. For example, in its most recent report to the Congress and the secretary of energy, issued on January 24, 2002, the board concluded that, when DOE's technical and scientific work is taken as a whole, the technical basis for DOE's repository performance estimates is "weak to moderate" at this time. The board added that gaps in data and basic understanding cause important uncertainties in the concepts and assumptions on which DOE's performance estimates are now based; providing the board with limited confidence in current performance estimates generated by DOE performance assessment model.

As recently as May 2001, DOE projected that it could submit a license application to NRC in 2003. It now appears, however, that DOE may not complete all of the additional technical work that it has agreed to do to prepare an acceptable license application until January 2006. In September 2001, Bechtel completed, at DOE's direction, a detailed reassessment in an effort to reestablish a cost and schedule baseline. Bechtel estimated that DOE could complete the outstanding technical work agreed to with NRC and submit a license application in January 2006. This date, according to the contractor, was due to the cumulative effect of funding reductions in recent years that had produced a ". . . growing bow wave of incomplete work that is being pushed into the future. Moreover, the contractor's report said, the proposed schedule did not include any cost and schedule contingencies. The contractor's estimate was based on guidance from DOE that, in part, directed the contractor to assume annual funding for the nuclear waste program of $410 million in fiscal year 2002, $455 million in fiscal year 2003, and $465 million in fiscal year 2004 and thereafter.[5] DOE did not accept this estimate because, according to program officials, the estimate would extend the date for submitting a license application too far into the future. Instead, DOE accepted only the fiscal year 2002 portion of Bechtel's detailed work plan and directed the contractor to prepare a new plan for submitting a license application to NRC by December 2004. Bechtel has prepared such a plan and the plan is under review by DOE. Although we have not reviewed the entire plan, we note that the plan (1) assumes that the program receives the $525 million in funds requested by the Administration for fiscal year 2003, which would be more than $100 million above the funds provided for fiscal year 2002, and (2) work on 10 of the department's 293 agreements with NRC would not be complete by the target license application date of December 2004.

ESSENTIALLY THE SAME INFORMATION IS NEEDED FOR A SITE RECOMMENDATION AND A LICENSE APPLICATION

Under the Nuclear Waste Policy Act, DOE's site characterization activities are to provide information necessary to evaluate the Yucca Mountain site's suitability for submitting a license application to NRC for placing a repository at the site. In implementing the act, DOE's guidelines provide that the site will be suitable as a waste repository if the site is likely to meet the radiation protection standards that NRC would use to reach a licensing decision on the proposed repository. Thus, as stated in the preamble (introduction) to DOE's guidelines, DOE expects to use essentially the same data for the site recommendation and the license application.

[5] DOE's budget request for fiscal year 2003 is about $527 million, or $72 million more than assumed in Bechtel's reassessment. The preliminary amounts for fiscal years 2004 and 2005 are $538 million and $550 million, respectively.

In addition, the act specifies that, having received a site recommendation from the secretary, the president shall submit a recommendation of the site to the Congress if the president considers the site qualified for a license application. Under the process laid out in the Nuclear Waste Policy Act, once the secretary makes a site recommendation, there is no time limit under which the president must act on the secretary's recommendation. However, when the president recommended, on February 15, that the Congress approve the site, specific statutory time frames were triggered for the next steps in the process. Figure 1 shows the approximate statutory time needed between a site recommendation and submission of a license application and the additional time needed for DOE to meet the conditions for an acceptable license application. The figure assumes that the Congress overrides the state's disapproval of April 8, 2002. As shown in the figure, Nevada had 60 days—until April 16—to disapprove the site. The Congress now has 90 days (of continuous session) from that date in which to enact legislation overriding the state's disapproval. If the Congress overrides the state's disapproval and the site designation takes effect, the next step is for the secretary to submit a license application to NRC within 90 days after the site designation is effective. In total, these statutory time frames provide about 150 to 240 days, or about 5 to 8 months, from the time the president makes a recommendation to DOE's submittal of a license application. On the basis of Bechtel's September 2001 and current program reassessments, however, DOE would not be ready to submit a license application to NRC until January 2006 or December 2004, respectively.

DOE IS UNLIKELY TO OPEN A REPOSITORY IN 2010 AS PLANNED

DOE states that it may be able to open a repository at Yucca Mountain in 2010. The department has based this expectation on submitting an acceptable license application to NRC in 2003, receiving NRC's authorization to construct a repository in 2006, and constructing essential surface and underground facilities by 2010. However, Bechtel, in its September 2001 proposal for reestablishing technical, schedule, and cost baselines for the program, concluded that January 2006 is a more realistic date for submitting a license application. Because DOE objected to this proposed schedule, the contractor has now proposed a plan for submitting the application in December 2004. Because of uncertainty over when DOE may be able to open the repository, the department is exploring alternatives that might still permit it to begin accepting commercial spent fuel in 2010.

EXTENSION OF LICENSE APPLICATION DATE WILL LIKELY POSTPONE 2010 REPOSITORY GOAL

An extension of the license application date to December 2004 or January 2006 would likely preclude DOE from achieving its long-standing goal of opening a repository in 2010. According to DOE's May 2001 report on the program's estimated cost, after submitting a license application in 2003, DOE estimates that it could receive an authorization to construct the repository in 2006 and complete the construction of enough surface and underground facilities to open the repository in 2010, or 7 years after submitting the license application. This 7-year estimate from submittal of the license application to the initial construction and operation of the repository assumes that NRC would grant an authorization to construct the facility in 3 years, followed by 4 years of construction. Assuming these same estimates of time, submitting a license application in the December 2004 to January 2006 time frame would extend the opening date for the repository until 2012 or 2013.

Furthermore, opening the repository in 2012 or 2013 may be questionable for several reasons. First, a repository at Yucca Mountain would be a first-of-a-kind facility, meaning that any schedule projections may be optimistic. DOE has deferred its original target date for opening a repository from 1998 to 2003 to 2010. Second, although the Nuclear Waste Policy Act states that NRC has 3 years to decide on a construction license, a fourth year may be added if NRC certifies that it is necessary. Third, the 4-year construction time period that DOE's current schedule allows may be too short. For example, a contractor hired by DOE to independently review the estimated costs and schedule for the nuclear waste program reported that the 4-year construction period was too optimistic and recommended that the construction phase be extended by a year-and-a-half.[6] Bechtel anticipates a 5-year period of construction between the receipt of a construction authorization from NRC

[6] U.S. Department of Energy, *Independent Cost Estimate Review of the Civilian Radioactive Waste Management Program, 2001 Total System Life Cycle Cost* (Washington, D.C.: Jan. 2001).

and the opening of the repository. A 4-year licensing period followed by 5 years of initial construction could extend the repository opening until about 2014 or 2015.

Finally, these simple projections do not account for any other factors that could adversely affect this 7- to 9-year schedule for licensing, constructing, and opening the repository. Annual appropriations for the program in recent years have been less than $400 million. In contrast, according to DOE, it needs between $750 million and $1.5 billion in annual appropriations during most of the 7- to 9-year licensing and construction period in order to open the repository on that schedule. In its August 2001 report on alternative means for financing and managing the program, DOE stated that unless the program's funding is increased, the budget might become the "determining factor" whether DOE will be able to accept wastes in 2010.[7]

In part, DOE's desire to meet the 2010 goal is linked to the court decisions that DOE—under the Nuclear Waste Policy Act and as implemented by DOE's contracts with owners of commercial spent fuel—is obligated to begin accepting spent fuel from contract holders not later than January 31, 1998, or be held liable for damages. Courts are currently assessing the amount of damages that DOE must pay to holders of spent fuel disposal contracts. Estimates of potential damages for the estimated 12-year delay from 1998 to 2010 range widely from the department's estimate of about $2 billion to $3 billion to the nuclear industry's estimate of at least $50 billion. The damage estimates are based, in part, on the expectation that DOE would begin accepting spent fuel from contract holders in 2010. The actual damages could be higher or lower, depending on when DOE begins accepting spent fuel.

DOE IS REVIEWING ALTERNATIVE WAYS TO ACCEPT WASTES IN 2010

Because of the uncertainty of achieving the 2010 goal for opening the Yucca Mountain repository, DOE is examining alternative approaches that would permit it to meet the goal. For example, in a May 2001 report, DOE examined approaches that might permit it to begin accepting wastes at the repository site in 2010 while spreading out the construction of repository facilities over a longer time period. The report recommended storing wastes on the surface until the capacity to move wastes into the repository has been increased. Relatively modest-sized initial surface facilities to handle wastes could be expanded later to handle larger volumes of waste. Such an approach, according to the report, would permit partial construction and limited waste emplacement in the repository, at lower than earlier estimated annual costs, in advance of the more costly construction of the facility as originally planned. Also, by implementing a modular approach, DOE would be capable of accepting wastes at the repository earlier than if it constructed the repository described in the documents that the secretary used to support a site recommendation.

DOE has also contracted with the National Research Council to provide recommendations on design and operating strategies for developing a geologic repository in stages, which is to include reviewing DOE's modular approach. The council is addressing such issues as the (1) technical, policy, and societal objectives and risks for developing a staged repository; (2) effects of developing a staged repository on the safety and security of the facility and the effects on the cost and public acceptance of such a facility; and (3) strategies for developing a staged system, including the design, construction, operation, and closing of such a facility. In March 2002, the council published an interim report on the study in which it addresses a conceptual framework for a generic repository program. The Council plans to issue a final report this fall, in which it intends to provide specific suggestions for incorporating additional elements of staged repository development into DOE's repository program.

DOE'S CURRENT LICENSE APPLICATION MILESTONE DATE IS NOT SUPPORTED BY THE PROGRAM'S BASELINE

As of December 2001, DOE expected to submit the application to NRC in 2003.[8] This date reflects a delay in the license application milestone date last approved by DOE in March 1997 that targeted March 2002 for submitting a license application. The 2003 date was not formally approved by DOE's senior managers or incorporated into the program's cost and schedule baseline, as required by the management procedures that were in effect for the program. At least three extensions for the license application date have been proposed and used by DOE in program documents, but none of these proposals have been approved as required. As a result, DOE does not

[7] U.S. Department of Energy, *Alternative Means of Financing and Managing the Civilian Radioactive Waste Management Program*, DOE/RW-0546 (Washington, D.C.: Aug. 2001).

[8] DOE's 2003 budget request states that DOE now expects to submit the license application between October and December 2004.

have a baseline estimate of the program's schedule and cost—including the late 2004 date in its fiscal year 2003 budget request—that is based on all the work that it expects to complete through the submission of a license application.

DOE's guidance for managing major programs and projects requires, among other things, that senior managers establish a baseline for managing the program or project. The baseline describes the program's mission—in this case, the safe disposal of highly radioactive waste in a geologic repository—and the expected technical requirements, schedule, and cost to complete the program. Procedures for controlling changes to an approved baseline are designed to ensure that program managers consider the expected effects of adding, deleting, or modifying technical work, as well as the effects of unanticipated events, such as funding shortfalls, on the project's mission and baseline. In this way, alternative courses of action can be assessed on the basis of each action's potential effect on the baseline. DOE's procedures for managing the nuclear waste program require that program managers revise the baseline, as appropriate, to reflect any significant changes to the program.

After March 1997, according to DOE officials, they did not always follow these control procedures to account for proposed changes to the program's baseline, including the changes proposed to extend the date for license application. According to these same officials, they stopped following the control procedures because the secretary of energy did not approve proposed extensions to the license application milestone. As a result, the official baseline did not accurately reflect the program's cost and schedule to complete the remaining work necessary to submit a license application.

In November 1999, the Yucca Mountain site investigation office proposed extending the license application milestone date by 10 months, from March to December 2002, to compensate for a $57.8 million drop in funding for fiscal year 2000. A proposed extension in the license application milestone required the approval of both the director of the nuclear waste program and the secretary of energy. Neither of these officials approved this proposed change nor was the baseline revised to reflect this change even though the director subsequently began reporting the December 2002 date in quarterly performance reports to the deputy secretary of energy. The site investigation office subsequently proposed two other extensions of the license application milestone, neither of which was approved by the program's director or the secretary of energy or incorporated into the baseline for the program. Nevertheless, DOE began to use the proposed, but unapproved, milestone dates in both internal and external reports and communications, such as in congressional testimony delivered in May 2001.

Because senior managers did not approve these proposed changes for incorporation into the baseline for the program, program managers did not adjust the program's cost and schedule baseline. By not accounting for these and other changes to the program's technical work, milestone dates, and estimated costs in the program's baseline since March 1997, DOE has not had baseline estimates of all of the technical work that it expected to complete through submission of a license application and the estimated schedule and cost to complete this work. This condition includes the cost and schedule information contained in DOE's budget request for fiscal year 2003.

When DOE hired Bechtel to manage the nuclear waste program, one of the contractor's first assignments was to document the remaining technical work that had to be completed to support the submission of a license application to NRC and to estimate the time and cost to complete this work. The contractor's revised, unofficial baseline for the program shows that it will take until January 2006 to complete essential technical work and submit an acceptable license application. Also, DOE had estimated that completing the remaining technical work would add about $1.4 billion to the cumulative cost of the program, bringing the total cost of the Yucca Mountain project's portion of the nuclear waste program to $5.5 billion.[9] As noted earlier, DOE accepted only the fiscal year 2002 portion of the proposed baseline and then directed the contractor to prepare a plan for submitting a license application to NRC by December 2004. The resulting plan is now under review within DOE.

Because of these management weaknesses, we recommended in our December 2001 report that the secretary of energy reestablish the baseline through the submission of a license application and follow the department's management requirements, including a formal procedure for changing program milestones. According to DOE, it is currently in the process of establishing a new baseline for the nuclear waste program.

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[9] DOE estimated that the program cost $4.1 billion, on the basis of year-of-expenditure dollars from the program's inception in 1983 through March 2002. The $5.5 billion estimate for the license application is based on year-of-expenditure dollars from 1983 through January 2006.

Mr. Chairman, this concludes our prepared statement. We would be happy to respond to any questions that you or members of the subcommittee may have.

The CHAIRMAN. Mr. Holmstead, please go right ahead.

STATEMENT OF JEFFREY R. HOLMSTEAD, ASSISTANT ADMINISTRATOR FOR AIR AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY

Mr. HOLMSTEAD. Thank you. My name is Jeffrey Holmstead, and I currently serve as the Assistant Administrator for Air and Radiation at the United States Environmental Protection Agency.

I am pleased to be here today to discuss EPA's role in setting standards for the proposed repository at Yucca Mountain. As you have already heard this morning, EPA's responsibilities with respect to the proposed repository are described in the Nuclear Waste Policy Act and also in the Energy Policy Act of 1992.

These statutes assign EPA the task of developing public health and environmental radiation protection standards for the repository. These same statutes assign other roles and responsibilities to other governmental entities. The Department of Energy has the responsibility to determine whether the site is suitable for a repository. The Nuclear Regulatory Commission has the responsibility to review DOE's application for a license for the repository. And, of course, Congress has the responsibility for final approval for the Yucca Mountain repository.

EPA issued its final standards for the Yucca Mountain site on June 13, 2001. These standards were developed after extensive consultation with DOE, NRC, the Office of Science and Technology Policy, and they were the subject of significant public comment. DOE, by law, must address these standards in its license application.

NRC may issue a license only if it determines that DOE has demonstrated that the repository will comply with all the provisions of the EPA standards. EPA believes that disposal in compliance with the EPA standards will be protective of public health and the environment.

Under EPA's standards, DOE must demonstrate compliance with three separate provisions: First, an individual protection standard; second, a human intrusion standard; and third, standards that are specifically intended to protect groundwater as a natural resource.

The so-called individual protection standard is the core element of EPA's regulation. It is the most basic measure of how well the repository will operate. To meet this standard, DOE must demonstrate that the "Reasonably Maximally Exposed Individual," which we refer to as the RMEI, will not incur an annual dose of radiation above 15 millirem, from all exposure pathways combined. The RMEI—that is the reasonably maximally exposed individual—is a typical person whose location and lifestyle would place him or her among the most highly, but not necessarily the highest, exposed members of the population. Although the NAS recommended using a "critical group" approach, it has agreed that EPA's approach was "broadly consistent" with its recommendation.

EPA's view is that, by meeting the standard for the RMEI, the vast majority of the population will be protected. This approach is preferable to hypothesizing unrealistic scenarios to protect those

whose lifestyles might lead to unusually high exposures, and is consistent with the NAS recommendation to use "cautious, but reasonable" assumptions.

The second standard, the Human Intrusion Standard, accounts for the possibility that future human activity could compromise the integrity of the repository sometime over the next 10,000 years and cause releases of radioactive material. The NAS found that there is no credible means of predicting whether, when, or how often such an intrusion might occur at Yucca Mountain, so analyzing a simple event to determine how well the repository responds would be appropriate. In accordance with the NAS recommendation, EPA's Human Intrusion Standard requires DOE to meet the same RMEI standard as in the individual-protection analysis.

Perhaps most importantly, EPA adopted a separate groundwater protection standard because it is long-standing Agency policy to protect groundwater as a natural resource, particularly when that resource is a significant current or a likely future source of drinking water.

EPA believes that ground water should be protected to ensure that the Nation's drinking water resources do not present adverse health risks and are preserved for present and future generations. This is particularly important in arid regions, such as southern Nevada, where ground water is precious, and cleaning up the aquifer would be challenging and costly. Therefore, EPA's standards require DOE to demonstrate that ground water will not be radioactively contaminated above certain standards, which are consistent with EPA's radiation standards for drinking water.

EPA does not believe that an all pathway exposure standard with groundwater as one pathway among several, provides adequate public health protection against groundwater contamination since groundwater is, in fact, the principal exposure pathway.

Although EPA's statutory role was complete with the issuance of its final standards, it continues to be involved in many of the ongoing activities of other agencies. First, EPA is defending its standard in court against challenges brought by several parties. EPA has also reviewed and provided comment on NRC's licensing requirements for the Yucca Mountain repository. We have also provided comments on DOE's site evaluation guidelines, and DOE's Draft, Supplemental, and Final Environmental Impact Statements.

EPA is currently reviewing NRC's draft Yucca Mountain Review Plan, and plans to comment throughout the licensing process as appropriate. EPA also expects to review DOE's evolving plans for transportation, although the selection of transportation modes and routes is DOE's responsibility with oversight from NRC and the Department of Transportation.

Finally, EPA continues to receive and respond to questions from the public, not only about EPA's own standards, but on the other repository-related activities listed above.

Thank you again for the opportunity to appear today before the Committee to present the EPA's views. This concludes my prepared statement.

The CHAIRMAN. Thank you very much.

[The prepared statement of Mr. Holmstead follows:]

PREPARED STATEMENT OF JEFFREY R. HOLMSTEAD, ASSISTANT ADMINISTRATOR FOR AIR AND RADIATION, ENVIRONMENTAL PROTECTION AGENCY

Mr. Chairman and Members of the Committee: Good morning. My name is Jeffrey Holmstead and I currently serve as the Assistant Administrator for Air and Radiation at the U.S. Environmental Protection Agency (EPA). I am pleased to be here today to discuss EPA's role in setting public health and environmental radiation protection standards for the proposed spent nuclear fuel and high-level radioactive waste repository at Yucca Mountain, Nevada. I appreciate this opportunity to discuss EPA's responsibilities related to this important national project.

INTRODUCTION

EPA's roles and responsibilities in the federal government's establishment of a repository for spent nuclear fuel and high-level radioactive waste are described generally in the Nuclear Waste Policy Act, and more specifically for the Yucca Mountain site in the Energy Policy Act of 1992. These statutes assign EPA the task of developing public health and environmental radiation protection standards for the repository. These same statutes assign other roles and responsibilities to other governmental entities. The Department of Energy (DOE) has the responsibility to determine whether the site is suitable for a repository; The Nuclear Regulatory Commission (NRC) has the responsibility to review DOE's application for a license for the repository; and Congress has the responsibility for final approval or denial of DOE's suitability recommendation. EPA issued its final standards for the Yucca Mountain repository on June 13, 2001 (40 CFR 197). These standards were developed through extensive consultation with DOE, NRC, the Office of Science and Technology Policy, and were the subject of significant public comment. DOE must address these standards in its license application. NRC may issue a license only if it determines that DOE demonstrates a reasonable expectation that the repository will comply with all provisions of the EPA standards. EPA believes that disposal in compliance with the EPA standards will be fully protective of public health and the environment. In fact, EPA's standards are both implementable and among the most stringent in the world.

NAS REPORT

The Energy Policy Act of 1992 also directed EPA to contract with the National Academy of Sciences to provide findings and recommendations on reasonable public health and safety standards for establishing a repository for spent nuclear fuel and high-level radioactive waste. NAS issued its report in 1995. I will refer to the NAS report as I discuss the EPA standards further. NAS has provided formal comments to EPA stating that our standards for Yucca Mountain are generally consistent with the NAS recommendations.

OVERVIEW OF EPA STANDARDS

Under EPA's standards, DOE must demonstrate a reasonable expectation of compliance with three separate provisions: an individual-protection standard, a human intrusion standard, and standards that are specifically intended to protect ground water as a natural resource.

The Individual Protection Standard is the core element of EPA's regulation. It is the most basic measure of how well the repository will operate. To meet this standard, DOE must demonstrate a reasonable expectation that the "Reasonably Maximally Exposed Individual," or RMEI, will not incur an annual dose of radiation above 15 millirem, from all exposure pathways combined. The RMEI is a typical individual whose location and lifestyle would place him among the most highly, but not necessarily the highest, exposed members of the population. (Although NAS recommended using a "critical group" approach, it agreed that EPA's approach was "broadly consistent" with its recommendation.) EPA's view is that, by meeting the standard for the RMEI, public health and safety, including the health and safety of those living in the immediate vicinity of Yucca Mountain, will be protected now and for future generations. This approach is preferable to postulating unrealistic scenarios to protect hypothetical individuals for whom lifestyles could be constructed that might lead to unusually high exposures, and thus is consistent with the NAS recommendation to use "cautious, but reasonable" assumptions.

The Human Intrusion Standard accounts for the possibility that future human activity could compromise the integrity of the repository and cause releases of radioactive material. NAS found that there is no credible means of predicting whether, when, or how often such an intrusion might occur at Yucca Mountain, so analyzing a simple event to determine how well the repository responds would be appropriate.

In accordance with the NAS recommendation, EPA's Human Intrusion Standards requires DOE to meet the same RMEI standard as in the individual-protection analysis.

EPA adopted separate ground-water protection standards because it is long-standing Agency policy to protect ground water as a natural resource, especially when that resource is a source of drinking water. EPA believes that ground water should be protected to ensure that the Nation's drinking water resources do not present adverse health risks and are preserved for present and future generations. This is particularly important in arid regions, such as southern Nevada, where ground water is precious, and cleaning up the aquifer would be challenging and costly. Therefore, EPA's standards require DOE to demonstrate that ground water will not be radioactively contaminated above certain standards, which are consistent with EPA's radiation standards for drinking water.

To determine the location where the three basic provisions of EPA's disposal standards must be met, EPA's standards set the point of compliance south of the repository at the Nevada Test Site boundary, about 18 kilometers (11 miles) from the repository. EPA used regional ground water flow patterns, current population patterns, and near-term local plans, to identify this location and to calculate potential exposure scenarios. EPA's standards apply at the location outside this boundary where radionuclide concentrations in ground water could be highest.

DOE must demonstrate compliance with each of these provisions for a period of not less than 10,000 years after disposal. In addition, EPA's standard requires that DOE include analyses showing the performance of the repository after 10,000 years in its Environmental Impact Statement, so that the public will have the full record before it.

Finally, although DOE must demonstrate compliance with these standards to the NRC, EPA recognizes that absolute proof in the conventional sense will be impossible to attain for analyses extending ten thousand years into the future. Therefore, EPA requires that DOE demonstrate a "reasonable expectation" that the standards will be met. This standard should not be construed as requiring a less rigorous or scientific process. It is simply a recognition that there will inevitably be significant uncertainties in projecting the performance of natural and engineered systems over very long time periods, and that these uncertainties must be understood and managed accordingly.

EPA'S ROLE NOW THAT THE STANDARD IS COMPLETE

Although EPA's statutory role was complete with the issuance of its final standards, it continues to be involved in many of the ongoing activities of other agencies. First, EPA is defending its standard in court against challenges brought by several parties. EPA has also reviewed and provided comment on NRC's licensing requirements for the Yucca Mountain repository, DOE's site evaluation guidelines, and DOE's Draft, Supplemental, and Final Environmental Impact Statements. EPA is currently reviewing NRC's draft Yucca Mountain Review Plan, and plans to comment as appropriate. EPA also expects to review DOE's evolving plans for transportation, though the selection of transportation modes and routes is DOE's responsibility. Finally, EPA continues to receive and respond to questions from the public, not only on EPA's standards, but on the other repository-related activities listed above.

Thank you again for the opportunity to appear today before the Subcommittee to present the EPA's views. This concludes my prepared statement. I would be happy to address any questions that you may have.

The CHAIRMAN. Secretary Card, why don't you go right ahead.

STATEMENT OF ROBERT CARD, UNDER SECRETARY, DEPARTMENT OF ENERGY

Mr. CARD. Sure. Good morning, Mr. Chairman. I am Robert Card, Under Secretary of Energy.

As you know, Secretary Spencer Abraham testified before this committee last Thursday. I would ask the committee to refer to his written and oral statements and decision document which laid out the scientific basis for DOE's recommendation and the other compelling reasons to support this project.

Rather than repeat his testimony, I want to emphasize three points. First, what is this vote about? The Department's position on

the vote facing the Senate is as follows: A "yes" vote is simply a decision to allow the expert and independent Nuclear Regulatory Commission to have the opportunity to rule on the safety on the Department's license application. If we fail to pass the rigorous and open review by the NRC, then no repository will be built.

A "no" vote will indicate that the Senate either rejects more than two decades of national policy on creating deep geologic repository, or that this site policy is so hopelessly flawed that the NRC should be prohibited from ruling on its safety.

A "no" vote is not a vote to delay or review or modify the proposal. Rather, a "no" vote terminates this entire process in its tracks, demobilizes the Yucca Mountain project and leaves DOE without congressional authorization to pursue any other path forward.

Secondly, transportation: A "yes" vote, in DOE's interpretation, allows the DOE under NRC and other regulations to expand on its already substantial and successful shipping campaign to develop and implement a sophisticated shipping system to transport this material.

A "no" vote does not stop either the substantial shipping taking place today or whatever makeshift and ad hoc shipping system that may arise from the actions and decisions of individual States and utilities to respond to the problem of managing would-be orphaned waste located at 131 sites in 39 States.

Thirdly, on capacity: While Congress has chosen to initially limit the capacity at Yucca Mountain to 70,000 metric tons, there is adequate potential capacity at the site for all of the high-level waste likely to be generated by all—and I repeat, "all"—of the current waste sources, even assuming reasonable life extensions for the current fleet of nuclear powerplants.

Thank you.

The CHAIRMAN. Well, thank you all for your testimony.

Let me ask a few questions, and then defer to my colleagues here.

Dr. Cohon, as I understand your position, the position the Technical Review Board, you have—you believe or the Board believes that the Department of Energy has yet to make a convincing case that nuclear waste can safely be buried at Yucca Mountain. But you have not found any reason that would justify Congress terminating the project at this point.

You believe that DOE may yet find a convincing case or yet may make a convincing case to the Nuclear Regulatory Commission. Is that a fair summary of where you come out on this, or not?

Dr. COHON. It is not unfair, but I cannot give you a clear yes. I would like to qualify it a bit, if you do not mind, which I am sure you expected.

The CHAIRMAN. Yes.

Dr. COHON. We do not use the word "convincing." We talk about both the strength of the case and that is what led to the phrase "weak to moderate."

And we also talk about confidence. We think that is actually a very key concept, both in a technical sense for the Board and for policy makers. On that score, we say our confidence is low, or low to moderate—I do not want to misquote myself from our letter—

with regard to the technical basis for the estimates that DOE has offered.

The other part of your question with regard to whether we have ruled out or—I forgot exactly your wording—but basically whether there are any clearly disqualifying factors, on that score we have said no, we have not seen any. No factor that, when taken by itself, would clearly rule out Yucca Mountain as a suitable repository. This does not exclude, however, a combination of factors that policy makers, you, might find that taken together would lead you to conclude the site was not suitable. So, I hope that that nuance is understood.

The CHAIRMAN. Let me ask if you looked into this issue related to safe transportation to the site. Mr. Hall's testimony this morning and some of the testimony yesterday went to the point that Congress should not allow DOE to continue down this road of developing this site or preparing an application to get a license to develop this site until we are persuaded that a safe system of transportation is developed.

Did you look at that? Is that something that the Board has a view on?

Dr. COHON. Transportation is certainly within the Board's purview as laid out by Congress. However, the Board is basically reactive to DOE. That is, our role is to review work that DOE has done. And as you know, to date DOE's focus, quite appropriately we believe, has been on the site and less so on the transportation system or plan.

We have reviewed what DOE has done to date. We have also reviewed other statements with regard to the safety of transportation, for example, NRC's statements on the record and find nothing there for us to disagree with.

The CHAIRMAN. Okay. Let me ask: Secretary Card, what is your response to the position that Mr. Hall stated which is that you folks at DOE should be required to give us a plan for how this waste could be safely transported to the site before we make any decision to allow you to go ahead and prepare an application to license this site?

Mr. CARD. Well, first, let me give a general answer and then I will go into specifics. I want to repeat in the general answer that transportation is not an issue that is unique to this decision before the Senate.

Waste is shipped today and we believe more will be shipped in the future should the Senate vote in favor of this project. Or should the Senate not vote in favor of this project, there are 131 communities in 39 States and utilities that will seek alternate methods to deal with the problem of what could become orphaned waste at that time.

Responding, though, specifically, I would cite the track record where we have already shipped, made approximately half of the shipments anticipated in this country, over the last 40 years safely. Europe has already shipped a comparable volume of waste safely, as you have heard from other members and witnesses, and overseas and with all other modes.

And to say that we do not have a plan, I would be interested to know what they felt a plan would look like. The environmental im-

pact statement has fully analyzed a variety of routes and options for transportation. You have heard that there is a regulatory infrastructure in place. We have just recently started up a comparable transportation system for WIPP, and it has already safely ensured the shipment of over 800 shipments, which is 20 percent of the estimated 4,000 shipments for Yucca Mountain.

So I think we feel very comfortable with transportation. There is obviously a lot of work to do with communities about siting and their community preferences for how this would be handled. But I would reject the notion that we do not have a plan or that we have not thought about this issue.

The CHAIRMAN. Okay. Mr. Holmstead, EPA established radiation protection standards for the WIPP project in my State, the Waste Isolation Pilot Plant, back in 1998 and certified that WIPP would meet those standards. How do the standards that you have come up with for Yucca Mountain compare to those WIPP standards?

Mr. HOLMSTEAD. The standards for the two different repositories are essentially the same. They are—I think the key parts that people have focused on appropriately are the total allowable exposure which is 15 millirem. That is exactly the same. The 10,000-year time frame is also the same, and as is the idea that we would need a separate groundwater protection standard. So in that respect, they are exactly the same.

We have also used the concept that we should be addressing the—we should be effectively evaluating these standards at the point at which we can possibly foresee any human habitation.

With respect to the site in your State, I believe that that location is something like about 3 kilometers from the actual repository. In the Nevada site, that is slightly farther away because this site is on the Nevada test range, as you know, where we think it is highly unlikely there would be any human habitation. And so the compliance point is slightly farther away. I think it is about 18 kilometers.

But in all key respects, they are exactly the same.

The CHAIRMAN. Okay. Dr. Cohon, let me ask you one other question here. Are you familiar with the international peer review of Yucca Mountain that was performed by the International Atomic Energy Agency and the Organization for Economic Cooperation and Development?

Dr. COHON. Yes, sir.

The CHAIRMAN. That review concluded that, while DOE needs to do more to increase confidence in its performance assessment, overall DOE has provided an adequate basis for the site recommendation decision. How does the evaluation of your technical review board jibe with this international peer review's assessment?

Dr. COHON. We actually agree much more than your question implies. And I think the level of agreement depends also on how one interprets the statements by that peer review panel.

A key point on which we agree—and I think it is the central point made by that peer review panel—is that the total system performance assessment as a tool is a good one for estimating performance at Yucca Mountain. That was their key point.

Whether or not the technical basis, that is, the results of applying that tool, is strong enough and provides sufficient confidence to

support a decision about Yucca Mountain, that is something that we have spoken about. I do not know that the peer review really spoke to that.

If they believe—well, we are on record as saying, and I have repeated it today, in our view, that technical basis is weak to moderate. And we have relatively low confidence.

But again, with regard to the use of such a tool, we agree with the peer review panel. It is completely appropriate.

The CHAIRMAN. Okay.

Senator Craig.

Senator CRAIG. Thank you very much, Mr. Chairman. I apologize for not being here for everyone's testimony. I have been to the last couple of hearings, but there was another one this morning that I needed to participate in.

Secretary Card, let me focus on you for all of my questions, and I will read the rest of your testimony. And I say that to all of the panelists, because I did have a question, as it related to the testimony of Mr. Hill, but I—or Hall, but I think that has been answered.

I think the chairman asked that question, as it related to a criticism leveled at the Secretary for not having a plan and the reality of when plans come and how they get handled. And so, instead of asking that question, Bob, let me ask this question and go back to your experience at Rocky Flats, because I think that is important for the record to understand that the DOE has been in the business of moving high-level and low-level waste or materials around this country for a good, long while.

And, of course, you came to us from Rocky Flats, where you were involved in a major cleanup of that facility. It is probably one of those areas of EM or Environmental Management that we like to point out as a success story, as it relates to how it was operated and the cleanup process that you were very much involved in.

You have been handed a map, which was provided to Congress during a briefing last month, on the status of the Rock Flats cleanup. What this chart shows—I wish I had a blowup for the audience and for the committee—is the many off-site shipments that have been and will be necessary in the completing of the cleanup of Rocky Flats.

What this map demonstrates to me is the necessary role of nuclear waste transportation and how it is played out and continues to be played out in DOE's Environmental Management Program, because part of the argument here is "Leave it in place, leave it in place, leave it in place." And if you are going to clean up, you cannot leave things in place. And we have known that throughout time and with the EM Program we have had going through DOE.

I see by the WIPP figures—and that is the Waste Isolation Pilot Project that the chairman referred to in his State at Carlsbad and, of course, I have focused on that for years, because of the low-level transuranic waste moving now from Idaho's INEEL to WIPP some 279 shipments as of May 20.

But in Rocky Flats—let us talk about the map in front of you. And I think the chairman and Senator Ensign have that map. In the Rocky Flats Environmental Technology Site, some 514 shipments have gone to WIPP, alone. And by definition of WIPP's capa-

bilities, that is low-level. But there are shipments to Hanford and shipments to Envirocare in Utah and Nevada Test Site and Lawrence Livermore and Los Alamos and Pantex and Oak Ridge and Savannah, and some of that was high-level.

Could you bring us up to speed, with your experience there, how all of that transportation plan was developed and when that plan came to place, how it was managed, how it is managed, the security involved in it, and which came first—the idea of cleanup and the cleanup plan, or the transportation plan—and how all of that fits together? Because part of the criticism here is the plan before the licensing, if you will. And yet, I see those kinds of things going hand-in-glove.

Most importantly, while I do not, in any way, belittle concern over transportation, I have known the issue well enough over the years not to fear it, but I think, for the record, it is important to demonstrate, as I think you can, where we are going, what we have been doing, and what we can do, as it relates to transportation of waste.

Mr. CARD. Sure. Well, as you point out, there—hundreds to thousands of shipments have taken place from Rocky Flats; everything from final weapons components to weapons parts to transuranic waste, low-level waste, mixed waste, hazardous waste, et cetera. It would probably be most instructive, and to the point of your question, to focus on the Rocky Flats to WIPP example.

WIPP, as you know, is the first geologic repository. We already have one in this country. The WIPP site was selected before there was the Transportation Plan that has been referred to here. That Transportation Plan— I think that project was selected in 1988 time frame—I mean, there were studies done in the eighties on it. Transportation, and many of items that are being discussed here at this hearing by the various witnesses, were largely done in the last 2 or 3 years of that project. And the kind of work done is that the first responders were trained; in the States, the governors were provided the opportunity to designate routes.

I remember, in Colorado, where I was at the time, that was an interesting process, as people realized just how much stuff is moving through their State, regardless of whether there is a WIPP or not a WIPP. And that, interestingly, became the focus of the issue.

The same sorts of Armageddon results were predicted for the WIPP system. We have completed—successfully completed, as mentioned before, 800 shipments so far. And for Rocky Flats, of course, the decision was made by President Clinton to shut down Rocky Flats. I do not think anything was thought of transportation at the time that decision was made. And I do not think that it necessarily needed to be.

Senator CRAIG. And the shutdown was not for a purpose of just locking the doors. It was for a purpose of shutdown and cleanup. Was it not?

Mr. CARD. Right. It was basically load the site up into drums and containers, and ship it to all of these locations that you have discussed. That is, in essence, what the project is.

We had to develop the transportation strategies to deal with that. And, again, they worked out successfully without a single significant transportation incident in all of that experience.

So, it seems to me a bit "chicken and eggs." Since we have an extensive amount of shipping already in the United States and worldwide, you would have to argue, we must either have a system, or we are all derelict in some way now, whether or not there is a Yucca Mountain.

It would seem appropriate, the norm of the commercial industry, where I came from, is you pick where you want something to go, and then you figure out how to get it there. And I do not know how you would come up with a siting decision, if you had to evaluate every conceivable transportation route for every conceivable place this stuff might go, before you picked anywhere for it to go. And so, we do not think this is out of step at all.

Again, the kind of work that needs to be done, as we already have a shipping system, is largely routing, responder training along new routes—there is already responder training on existing routes—giving stakeholders, Governors and others the opportunity to comment on routing, time of day, other things that they're concerned about, and building a system like we have at WIPP, which I think the Western States and Southern States, through which transuranic shipments are made, are pretty darned happy with.

Senator CRAIG. Well, thank you very much. I think you have expressed well my concerns and the fact that we have substantial quantities of material moving now, both in the high-level and low-level category, and that they do not move at random. They move with plan and organization and designed containers and all of that.

I have watched, Mr. Chairman, with great interest, the protocol involved in the movement of substantial quantities of transuranic out of Idaho to your State, and the containers, the trucks, the designs, the GPS, the strategies of walk-through, all of it over time, to see a highly sophisticated system in place that clearly has gone without incident. And that is to the credit of the plan and the organization, the protocol and the execution of it.

Bob, thank you very much.

Mr. Chairman, thank you.

The CHAIRMAN. Senator Ensign.

Senator ENSIGN. Thank you, Mr. Chairman.

I want to focus a little bit on the—Dr. Cohon, the high temperature versus low temperature. Could you just briefly describe the difference between a high temperature versus low temperature inside Yucca Mountain?

Dr. COHON. Certainly. First, let me explain why the board has focused on this and paid so much attention to it. A key element of the repository system and its projected performance is the performance of the waste packages within which the waste would be placed. Those packages are made out of a thicker alloy that seems to be very tough and corrosion resistant. Just how it performs will depend very much on the kind of environment it sees inside the tunnels, such as the temperature and moisture and the chemistry of the water or water vapor.

Therefore, the temperature is directly important, in terms of influencing the corrosion behavior of the waste. It is additionally important in influencing how water moves through the mountain; that is, if the repository is above boiling, that suggests that water

will be in the form of steam and will move and be mobilized away from the tunnels where the waste is.

Temperature, in this sense, is a complicating factor; that is, it makes it harder to predict how water will move, how much water will be present, and how the metals will perform.

The CHAIRMAN. Could you just describe the design, just in simple lay——

Dr. COHON. Yes. I am sorry.

Senator ENSIGN [continuing]. Person's terms, the difference between high temperature and low temperature.

Dr. COHON. That was a very long preface. I apologize for that.

Senator ENSIGN. No problem.

Dr. COHON. I will do so, but I will invite Secretary Card to correct or to add.

The thing about the design, which includes the temperature, is how densely placed the waste is, as well as the age of waste, and therefore, its temperature when it is placed inside the mountain. But the most important thing is the spacing. When it is close together, you get higher temperatures. When it is farther apart, you get relatively lower temperatures.

The two choices here, though—you can look at many others—DOE could look at many others—are the so-called base-case design, where it is estimated that the packages will see temperatures of up to 160 degrees centigrade, and then cooling over time, versus the cooler operating mode, where the temperatures would be maintained below, I believe, 85 degrees centigrade. Is that right?

Senator ENSIGN. One of the reasons I asked the question is because yesterday Victor Gilinsky talked about—and I do not know if he was exactly talking about the high temperature versus the low temperature inside the mountain, but he commented that in the first 40 to 50 years, these nuclear waste rods cool during that period of time, because some of the nucleotides have shorter half-lives, and some of the ones that generate a lot of the heat have shorter half-lives. And if it was going to be a low temperature, one of the things that you could do is, if you do not ship it for 40 to 50 years, or if you keep it above ground for 40 to 50 years, obviously, you do not have to put these things as far apart. Is that correct?

Dr. COHON. That is correct.

Senator ENSIGN. The reason that I wanted to follow that up, Ms. Jones, is—the GAO has commented a lot about the costs of the project. You said, when was it, back in 1997 that the DOE quit using their—I do not remember the exact term—cost baseline of how they were evaluating the project, and you want them—you have encouraged them to go back to using or to come up with a cost baseline.

Ms. JONES. That is correct, Senator.

Senator ENSIGN. I think that the important part of this is that right now the latest cost estimate was about $58 billion. And that is dramatically increased from 1995, when it was somewhere in the thirties, mid $30 billion range. Two years later, it was—or a few years later, it was in the mid $40 billion range. And now we are at—a couple of years after that, we are in the high $50 billion range.

The low temperature dramatically increases the cost. Is that my understanding? DOE can comment, if that is not the case. It would seem—obviously, common sense to make—to be common sense if you have to go to the low temperature design, the costs would dramatically increase.

Mr. CARD. Okay. Well, first of all, I will answer that question, but I would like to point out that the Nuclear Waste Fund, funded by the rate payers of one of the lowest cost power sources in the country, is adequate to construct this project.

DOE conducted a formal and published periodic review of the fund in May 2001 and certified the fund adequacy.

Senator ENSIGN. Does that include the total life cycle?

Mr. CARD. Yes, it does.

Senator ENSIGN. And transportation?

Mr. CARD. Yes, it does. And, now, let me respond to your specific question.

Senator ENSIGN. Before you go off of there, at what cost estimate does that work out?

Mr. CARD. I believe that was at $56 billion.

Senator ENSIGN. $56 billion. What if it goes to $75 billion or $100 billion?

Mr. CARD. Well, I do not want to speculate. I would be glad to provide you a series of curves on the record, if you would like; however——

Senator ENSIGN. Well, the reason I ask that is because if it is in the mid-$30 billions, just in 1995, and then it went to the mid-$40 billions in the later nineties, and now in 2001 it is at $58 billion, I mean, how accurate are our estimates? I mean, it does not sound to me like they are going to be that accurate.

Mr. CARD. Can I answer that? I am comfortable that the cost estimates are conservative. We experienced the same issues at WIPP. In the planning stages, a number of conservatisms were introduced to—to know, everybody got to pick their favorite conservatism, and they were all added together.

I am confident these costs can actually be reduced, not increased, from the repository. Of course, if you went to a cold design—and by the way, DOE continues to carry the cold design option, and we will until it is apparent that that is not necessary anymore. Obviously, the costs would be greater, but I am not prepared——

Senator ENSIGN. Do you have any estimate of those costs?

Mr. CARD. Well, I am not prepared to say they would be greater than $56 billion, because I personally—I have managed projects, personally, at this scale before. And based on the reviews I have done over the last year, since I have been confirmed, I am not convinced that the costs are $56 billion to start with.

Senator ENSIGN. Okay. Were the people at DOE comfortable, in 1995, with the cost estimates?

Mr. CARD. I was not here on the project in 1995.

Senator ENSIGN. You imagine they were probably pretty comfortable with them, though.

Mr. CARD. I cannot speak for them.

Senator ENSIGN. They probably would not have put them out if they were not comfortable with them, would be my guess.

Mr. CARD. That would be your presumption. I don't know.

Senator ENSIGN. That would be, I think, a pretty good presumption. Probably, in 1999, they were comfortable with the mid-$40 billions on a cost estimate. You do not usually put out numbers that you are not comfortable with. I mean, you usually are—you know, because nobody likes to come back and say, "Why are your numbers so bad?" I mean, nobody likes to experience that. And, frankly, the numbers have been horrendous. And I would be curious to see what they are in another two years from now, especially if we have to go with the cool temperatures.

The bottom line, to me, is that this thing has just been—the costs are just so outrageous. The most expensive construction project in the history of the world. And for what—for something that I believe is completely unnecessary, because onsite dry cask storage has been shown to be effective. And I would like to see us put more of that money, instead of building Yucca Mountain, into the research in some of these alternatives of recycling and some of the modern technologies. That is my own personal—as a policy maker up here, where I would rather see the money go.

Ms. Jones, would you like to comment on the costs? I know that GAO is—that is part of the responsibility.

Ms. JONES. The one comment I would like to make on the costs, Senator, is that in the bottoms-up approach that the contractor took as the basis for their report at the end of 2001, that estimated license application in 2006, there were no contingencies built into that, either for cost or schedule.

Now the contractor is trying to compress that time frame down to 2004. There is still no cost or schedule contingencies. So, I think that is very, very risky for a first-of-kind project, when you are in the design phase and you are still doing research.

Senator ENSIGN. So, based on what Mr. Card has said, I mean, how confident are you in those numbers?

Ms. JONES. I think I would like to wait and see DOE's approval of Bechtel's proposal, and see if they are going to be adding contingency factors in. If they do add contingency factors in, I would imagine that it is going to increase the costs.

Senator ENSIGN. Okay. Thank you, Mr. Chairman.

Mr. CARD. Mr. Chairman, can I just make a comment on that?

The CHAIRMAN. Go right ahead.

Mr. CARD. As I have said, I believe we can meet the schedules for 2004 for the license application, and 2010 for the initial operations. And I would just pose two rhetorical questions for this issue.

Regarding the start date and costs. For what predicted start date does the Senate think is so late that they should kill this project now and switch to an, as yet, unbounded alternative that has not had anywhere near the study, consideration and investment as this project?

And second, what body of evidence does the Senate think would be appropriate to have accumulated before making such a momentous decision on either schedule or costs?

And I would assert, from DOE's position, that we have an adequate handle on the schedule and costs to move forward at this point.

The CHAIRMAN. Okay. Any other comment from any of the witnesses? If not, why do we not conclude the hearing? I think the testimony has been useful.

And let me mention, there are four additional statements we will include in the record.* One is a letter from Charles Groat, the Director of the U.S. Geological Survey to Robert Card, dated October 4, 2001, related to the geology of the Yucca Mountain site.

Second is a statement from Ellen Engleman, the Administrator of Research and Special Programs Administration at the U.S. Department of Transportation, related to the safe transportation of nuclear waste.

Third is a statement from Allan Rutter, who is the Administrator of the Federal Railroad Administration in the Department of Transportation, related to the transportation of nuclear waste by rail.

And fourth is a statement from the National Association of Regulatory Utility Commissioners in support of the President's recommendation of Yucca Mountain as a site.

That will conclude the hearing, and we will adjourn.

[Whereupon, at 11:52 a.m., the hearing was adjourned.]

* Can be found in the appendix.

APPENDIXES

APPENDIX I

Responses to Additional Questions

RESPONSES OF SECRETARY ABRAHAM TO QUESTIONS FROM SENATOR LANDRIEU

TRANSPORTATION OF TRANSURANIC WASTE TO WIPP

Question 1. Mr. Secretary, there were many concerns raised during the approval process of the Waste Isolation Pilot Plant (WIPP) regarding the safe transportation of transuranic waste from our national weapons complex to New Mexico—could you tell me how that program has progressed so far in terms of transportation issues?

Answer. The Waste Isolation Pilot Plant (WIPP) is recognized for the extensive safety programs incorporated into every aspect of this facility's operation, including the safety of the system used to transport transuranic waste over our highways to WIPP. As of the end of May 2002, the Department has made about 870 shipments, constituting 1.7 million miles, without a safety incident. This record represents one of the safest hazardous materials transportation systems on the Nation's highways today.

This safety record is the result of a multi-faceted approach to the transportation of transuranic waste to WIPP. DOE developed transportation protocols to provide for the safe and uneventful transportation of waste to WIPP. The protocols establish organizational responsibilities, carrier responsibilities, shipment schedules, route maps, emergency plans and contacts, communication strategies, packaging information, and agreements that will be followed over the course of a shipping campaign.

Transuranic waste is transported in Nuclear Regulatory Commission (NRC)-certified transportation containers, TRUPACT-IIs. The transportation routes to WIPP have been negotiated with States and tribal governments in accordance with guidelines established by the U.S. Department of Transportation for the movement of radioactive material.

The ultimate safety of the transportation system resides with the people who move the waste to WIPP. WIPP has contracted with two carriers that provide dedicated drivers and trucks to transport TRU waste to WIPP. Prior to hiring a driver, each carrier performs a background check to ensure applicants have no criminal history and have a good driving record; the New Mexico State Police performs an independent check as well. In addition, each WIPP driver must attend the same emergency response courses offered to firefighters, law enforcement personnel, and the ambulance crews and other emergency response personnel along the WIPP transportation routes. They are among the safest, most highly trained drivers on America's highways. The trucks are also inspected by Commercial Vehicle Safety Alliance (CVSA)-certified State inspectors, and periodic audits are performed on the contract carriers. All WIPP waste shipments receive a CVSA Level VI Enhanced inspection (the most rigorous) at the point of origin and are defect-free prior to dispatch. Some States elect to perform re-inspections at their ports-of-entry.

The WIPP Land Withdrawal Act requires that DOE "provide advance notification to states and Indian tribes through whose jurisdiction the Secretary plans to transport transuranic waste to or from WIPP." The Department met this requirement by developing a transportation tracking and communications system to be used for shipments of radioactive materials and high-visibility shipping campaigns, as specified by DOE. The Transportation Tracking and Communications (TRANSCOM) satellite tracking system, which is also accessible to States, has been in operation since 1989.

Communication between the TRANSCOM Control Center and WIPP drivers provides a constant source of information about changing weather conditions or any ab-

normal event that might occur. Safe parking areas are designated for use during inclement weather. Tractors are also equipped with backup communication capabilities. Emergency responders along the WIPP routes are trained to respond quickly and effectively to accidents. DOE also coordinates with the States on emergency response plans and procedures as part of the transportation planning process.

APPROVING THE SITE AT YUCCA MOUNTAIN

Question 2. Though the recent U.S. General Accounting Report (GAO) report focused on the next step in Nuclear Waste Policy Act (NWPA) that is the licensing process vs. the current step we are here to discuss (site recommendation)—do you anticipate any potential show-stoppers in the 293 items as identified in the report?

Answer. No, these are not showstoppers. These are technical studies and steps on the way to licensing. They are a checklist of items agreed to by the Nuclear Regulatory Commission (NRC) and the Department of Energy (DOE) to provide additional information related to nine key technical issues. NRC has issued a sufficiency letter (required by the Nuclear Waste Policy Act) stating its belief that DOE has obtained or has agreed to obtain the additional information needed for a license application. In fact, NRC has already formally closed 44 issues and about a third of the total should be closed by the end of September. The remainder will be addressed by the time of license application, planned for the end of 2004.

RESPONSES OF SECRETARY ABRAHAM TO QUESTIONS FROM SENATOR THOMAS

RADIOACTIVE WASTE SHIPMENTS THROUGH WYOMING

Question 1. Could you tell me how many shipments will travel across Wyoming, say per week? Will it be by rail or truck?

Answeer. According to the Environmental Impact Statement for the Yucca Mountain repository, under the mostly rail scenario, 2-3 rail shipments per week (assuming 3 casks per train) and 3-4 truck shipments per month would travel across Wyoming.

Question 2. Will the Governor or appropriate state officials be notified upon each shipment?

Answer. The Department will provide advance notification in writing to the Governor or the Governor's designee. The notification will be postmarked at least seven days before the scheduled shipment. In addition to the required formal notification, the Department intends to provide oral or written notification to the Governor or designated point of contact so that the information is received at least seven working days prior to actual shipment.

Question 3. Approval of Yucca aside, how many shipments currently cross the State of Wyoming?

Answer. Since 1982, the Department of Energy has made 213 spent nuclear fuel cask-shipments by highway and 21 shipments by rail through the State of Wyoming. In addition, over the past 45 years, the Naval Nuclear Propulsion Program has safely shipped a total of 739 containers of spent nuclear fuel without injury to members of the public or harmful releases of radioactivity. These containers have traveled over 1.5 million miles with spent nuclear fuel sealed inside of them. About 450 of these containers have gone through Wyoming during those 45 years.

Question 4. Mr. Secretary, what commitment or assurances will you give me that your Department will work with the Delegation and our Governor to ensure that the people of Wyoming are fully informed as to the status of shipments within Wyoming's boarders?

Answer. The Department fully intends to work with the Governor and whomever else is designated regarding the status of radioactive shipments across and within Wyoming's borders. The Department expects to use an approach to interacting and communicating with States and Tribes similar to that used during the successful program for shipping radioactive waste to the Waste Isolation Pilot Plant in New Mexico.

RESPONSES OF SECRETARY ABRAHAM TO QUESTIONS FROM SENATOR BENNETT

PRIVATE FUEL STORAGE EFFORTS

Question 1. In your testimony you mentioned your concerns that private efforts, like the Goshute Indians in Utah, to store spent fuel were not in the best interest of our nation. Would you please clarify your remark?

Answer. As I have said previously, failure to proceed with a repository at Yucca Mountain likely will result in makeshift private alternatives for consolidated off-reactor site storage. As a result, spent fuel will end up being transported somewhere,

regardless of whether Yucca Mountain proceeds. That being the case, it seems preferable for spent fuel transportation to occur by the federal government in the structure specified by the Nuclear Waste Policy Act rather than pursuant to ad hoc private arrangements.

RESPONSES OF SECRETARY ABRAHAM TO QUESTIONS FROM SENATOR CRAIG

TRANSPORTATION OF NUCLEAR WASTE

Please provide responses to the following statements regarding transportation of nuclear waste, which were made by Jim Hall, Former Chairman of the National Transportation Safety Board, during the Committee's May 23 hearing:

Statement 1. "There is no plan, or even answers to basic questions."

Response. In point of fact, for over 30 years there have not only been plans for moving nuclear materials, but over that period we have successfully shipped nuclear waste without a single harmful release of radioactive materials. Over 2,700 shipments have occurred in this country, and over 70,000 metric tons have been transported in Europe. We know what has to be done to transport spent fuel in a safe manner, and we have established an impressive safety record.

If Congress designates the Yucca Mountain site, detailed planning for shipments—much of which is dependent on a site designation—will begin about five years before the shipments commence. This planning includes the finalization of shipping routes, the provision of funding for training of first responders, and other technical assistance. As an example, DOE has provided approximately $30 million in training along routes to prepare for the shipments of radioactive waste to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. Since 1988, WIPP has trained nearly 24,000 State and Tribal first responders and emergency medical personnel in 22 States.

Transportation to Yucca Mountain would not begin until 2010, and would last for 24 years. It is presumptuous to believe that there will be a single "Plan" that will address all aspects of transportation for the entire period. In conducting any transportation to Yucca Mountain, the Department expects to be responsive to evolving conditions, the changing needs of our stakeholders and customers, as well as advances in technology.

The Yucca Mountain final environmental impact statement (FEIS) evaluated the potential impacts of transportation of spent fuel to Yucca Mountain under a variety of possible scenarios under which we may operate, to ensure that these potential impacts are fully understood. It is the Department's intent to work with our stakeholders, including States, Tribes and utilities, to ensure that the spent fuel is transported in a safe and secure manner.

Statement 2. "The DOE does not even support the use of dedicated trains, which would greatly enhance safety and security, in my opinion."

Response. The Department does not oppose the use of dedicated trains, and has not yet made a determination whether it will require the use of dedicated trains for shipments to Yucca Mountain. The Department of Transportation has been tasked by Congress to evaluate the use of dedicated trains; they currently expect to complete this study later this year. DOE will review the results of this study, along with input from our stakeholders, prior to making any determination on the use of dedicated trains for the transport of spent nuclear fuel.

I would, however, like to re-emphasize my confidence in the safety of nuclear shipments. The Nation's outstanding and lengthy track record, the careful precautions taken, and the strict regulatory oversight to which these shipments are subject provide a sound basis for confidence in our ability to transport safely nuclear materials, either by the use of dedicated trains or in general freight.

Statement 3. "According to a letter to Congress from the NRC, there have been no full-scale tests on casks that will be carrying high-level nuclear waste."

Response. I believe the letter referred to in this statement was one of two pieces of correspondence that responded to a letter from Senator Reid dated March 12, 2002.

In this correspondence (Commission letter to Senator Reid, April 24, 2002), Chairman Meserve of the NRC also noted that "casks are not complicated structures and that the physics and mechanical properties of the casks under accident conditions can be accurately predicted by scale model testing and computer analysis." That letter went on to state that the NRC is "considering certain full-scale cask testing in order to contribute to public confidence in transportation casks," and conveyed the Commission's intent to "include a request for NRC's share of the funding" for full-scale tests in its 2004 budget request. The Department supports the NRC's effort on full scale testing.

NRC regulations require that cask designs be shown to perform radiological safety functions under normal and accident conditions of transport. These safety demonstrations can be done in several ways that include analysis and testing. Furthermore, testing may include full and part scale model tests, and component tests. For casks, which are robust and designed with large safety margins, a combination of computer analysis, component tests, and scale model tests are generally sufficient to demonstrate safety for NRC certification. Although full-scale testing of casks are not generally performed for NRC certification, studies performed for NRC in 1987 and 2000 (NUREG/CR-4829 and NUREG/CR-6672) have shown the adequacy of the NRC certification process.

Statement 4. ". . . the DOE estimates there will be over 66 truck accidents and 10 rail accidents over the first 24 years—Whatever the number, the fact is that one accident resulting in radioactive release will have long-term devastating results."

Response. All aspects of the Yucca Mountain project are being conducted with a view toward having zero accidents; transportation will be conducted in the same manner.

The above accident numbers were taken from the Yucca Mountain Final Environmental Impact Statement (FEIS), and are statistical projections of vehicle accidents, including minor collisions with other vehicles. The statistical projections do not mean that we expect these accidents to occur, or that they would result in any breach of a cask or release of material if they did occur. Furthermore, the FEIS transportation risk analysis used general transportation accident statistics. As such, the statistics used did not reflect the exemplary record of the movement of nuclear materials over the past 30 years. For example, the Department's recent WIPP transportation experience shows that over 800 shipments were moved safely over 850,000 miles.

Studies by the NRC have concluded there would be no release of radioactive materials in approximately 99.99% of all accidents. The comprehensive analysis in the FEIS indicates that even if there were a radioactive release, the results would not be considered "devastating" and would be easily mitigated.

In the Yucca Mountain FEIS, DOE described a maximum reasonably foreseeable accident for the mostly rail scenario that would involve a release of a fraction of the contents of a rail cask in an urban area under stable meteorological conditions. The accident scenario would have a likelihood of about 2.8 in 10 million, per year. In general however, in the highly unlikely event of a cask breach as a result of an accident, it is anticipated that the amount of radioactive material released would be small and the consequences easily mitigated. Please note that spent fuel is solid in form and cannot spill like a liquid. It is not flammable, and is not explosive.

Statement 5. "We know that transporting nuclear waste is a hazard, and we need a full risk assessment of transporting nuclear waste."

Response. DOE has performed an extensive assessment of the risks of shipping spent fuel and high-level radioactive waste to Yucca Mountain in the FEIS. The Department believes that the FEIS considered bounding scenarios that adequately envelop the risks of anticipated activities. As stated above, the transportation of spent nuclear fuel is not a new activity. The requirements for safe transport and the risks of transport are well understood.

Beyond the above, due to the events of September 11, 2001, DOE, NRC and other agencies are presently undertaking a top to bottom review of their nuclear security and safeguards practices, including those governing the transport of spent nuclear fuel and high-level radioactive waste. DOE stands ready to follow the NRC lead regarding any changes to NRC transport regulations that the NRC may implement as a result of its review.

I am confident that these reviews, and likely several that have not yet been conceived or initiated, will be completed and results implemented prior to any shipping of materials to a repository at Yucca Mountain. As has been stated in earlier testimony, the Department projects shipments to begin in 2010—8 years from now—which will allow for an exhaustive review of matters unique to these shipments.

RESPONSE OF CHAIRMAN MESERVE TO QUESTION FROM SENATOR LANDRIEU

Question. "Based on NBC's technical reviews and pre-licensing interactions with DOE, do you anticipate any key technical issues pertaining to:

a) expected lifetime of engineered barriers;

b) physical properties of site;

c) supporting information on mathematical models

to significantly delay DOE's license application to the NRC?"

Answer. If Congress approves the Yucca Mountain site, DOE has indicated that it expects to submit a license application in December 2004.

Although significant additional work is needed prior to the submission of a possible license application, we believe that the 293 agreements reached between DOE and NRC staff during public meetings regarding the collection of additional information provide the basis for concluding that development of an acceptable license application is achievable. Based on the existing schedule for addressing issues contained in these agreements, NRC does not expect a delay in the license application to result from DOE addressing these issues.

However, it should also be noted that DOE is exploring a flexible design concept to allow for the possibility of operating the repository over a range of thermal conditions. For example, if DOE were to adopt a lower temperature operating mode, NRC believes that additional information would be needed for a potential license application.

U.S. NUCLEAR WASTE TECHNICAL REVIEW BOARD,
Arlington, VA, May 31, 2002.

Hon. JEFF BINGAMAN,
Chairman, Committee on Energy and Natural Resources, U.S. Senate, Washington, DC.

DEAR SENATOR BINGAMAN: Thank you very much for the opportunity to present the views of the Nuclear Waste Technical Review Board at the hearing of the Committee on Enemy and Natural Resources on May 23, 2002. Following up on issues raised during the hearing, the Committee sent questions to the Board on May 29, 2002. Enclosed are the Board's responses to those questions.

As you know, the Board is charged by Congress with conducting an ongoing and independent review of the technical and scientific validity of activities undertaken by the Secretary of Energy associated with the management of the country's commercial spent nuclear fuel and defense high-level radioactive waste. The Board provides its technical views to help inform policy-makers as they deliberate on issues that face the Department of Energy related to nuclear waste disposal.

Please do not hesitate to contact me or have your staff contact Bill Barnard, the Board's executive director, if you have questions related to the Board's responses or any other issue related to the Board's technical and scientific review.

Sincerely,

JARED L. COHON,
Chairman.

RESPONSES TO QUESTIONS ASKED BY THE SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES

Question. Could you further explain what you meant in your testimony about "gaps in data and basic understanding cause important uncertainties in . . . DOE's performance estimates"?

Answer. Gaps in data and basic understanding exist in a number of areas including: the hydraulic properties of faults and other significant rock-mass discontinuities at Yucca Mountain; thermal, hydrologic, and mechanical characteristics of the repository rock formations (especially thermal conductivity); the properties of the in-drift environment; fundamental mechanisms underlying long-term corrosion and passive-film behavior; the chemical composition of salt solutions on the waste package surface that could promote corrosion; colloid formation and dissolution; modeling of rock-matrix diffusion and radionuclide transport in the drift shadow; oxidation-reduction conditions in the saturated zone; and consequences of igneous activity. Because of the cumulative effect of these and other uncertainties, the Board has limited confidence in current estimates of repository performance generated by the DOE's performance assessment model. Increased understanding in these key areas could show that components of the repository system perform better than or not as well as the DOE's performance assessment model now projects.

Question. Based on the International Atomic Energy Agency's (IAEA) assertion that the modeling already incorporates many conservatisms, do you believe that many of the uncertainties in the performance estimates may already be well within an acceptable risk range?

Answer. Although the IAEA peer review group pointed out a number of conservatisms, it also mentioned a number of potential non-conservatisms and areas where additional data are required to achieve an increased level of understanding and confidence. More specifically, in the Board's view, the DOE's current performance estimates for Yucca Mountain are based on a mix of conservative, realistic, and non-

conservative models and assumptions. This mix and the gaps in data and basic understanding, such as those mentioned above, make it very difficult to estimate what the "true" overall level of uncertainty is and whether or not this uncertainty lies within an acceptable range of risk. So that policy-makers can determine whether the risks and associated uncertainties are acceptable, the Board has recommended that meaningful quantification of conservatisms and uncertainties be a high priority for the DOE.

APPENDIX II

Additional Material Submitted for the Record

U.S. DEPARTMENT OF THE INTERIOR,
U.S. GEOLOGICAL SURVEY
OFFICE OF THE DIRECTOR,
Reston, VA, October 4, 2001.

Mr. ROBERT G. CARD,
Under Secretary, Energy, Science and Environment, U.S. Department of Energy, Washington, DC.

DEAR MR. CARD: This letter summarizes the position of the U.S. Geological Survey (USGS) relative to the current state of scientific knowledge about the Yucca Mountain site to help the Secretary of Energy decide whether to recommend the site for development as a spent nuclear fuel and high-level radioactive waste repository. The USGS is commenting within the scope of our Earth science expertise and is neutral regarding other information the Secretary may consider.

Earth scientists, many from the USGS, have long played an active role in studying the challenge of nuclear waste disposal. The conclusion drawn from these studies is that geologic disposal remains the only long-term approach for dealing with long-lived radioactive waste. Further, the USGS believes that the scientific work performed to date supports a decision to recommend Yucca Mountain for development as a nuclear waste repository. This position is based upon our understanding of the inherent natural attributes of the site as determined through extensive studies and takes into account the ability of the site to support waste retrieval long into the future. In addition to the positive attributes of the site, there is no feature or characteristic of the site that would preclude recommending the site. However, even after site recommendation, additional studies need to be performed, and there are some specific aspects of the proposed design that the USGS believes should be part of any final design.

Physical assets of the site include its relatively uncomplicated geology; the lack of economic mineral or energy deposits; the ease of excavating stable tunnels; the arid climate; the very low rate of infiltration of precipitation into the subsurface; the small percentage of infiltrating water that could actually seep into subsurface drifts (tunnels); and the free drainage, through fractures on the floor of the drifts, of any water that enters the tunnels. Additional positive attributes are the natural, passive ventilation of the mountain; the presence of an extremely thick unsaturated zone allowing the repository to be built far below the land surface and above the water table; and natural minerals known as zeolites which tend to retard the movement of certain radionuclides.

The Yucca Mountain site also has some characteristics that potentially may degrade repository performance and that consequently deserve scrutiny. If the President eventually designates Yucca Mountain, these attributes may require additional study and monitoring. During the preclosure period, critical surface facilities must be designed using state-of-the-art engineering practice to accommodate the potential for earthquakes. Whereas the engineering design is outside the scope of USGS studies, the USGS has confidence in the probabilistic earthquake hazard analyses upon which designs will be based. The potential for future volcanic activity has been extensively studied because of the presence of nearby volcanic features that are much younger than Yucca Mountain. The USGS concurs with expert panels that the probability of a repository-piercing eruption, including surface eruptions, is very low (on the order of 1.6×10^{-8}/year, or odds of 16 in a billion per year). However, other scientists believe that the probability may be perhaps ten times higher. Although this topic continues to be discussed, the total range of current probability estimates remains very low. Potential contamination of a deep, potable aquifer beneath the site is of concern because it is a valuable resource for the human and natural environment of this arid region. However, the USGS believes that the site characteristics

of an arid climate coupled with the hydrologic characteristics of the thick unsaturated zone will result in very limited contact of water and waste. Future climate change is inherently uncertain and can result in positive or negative effects on the proposed repository. Plausible limits on the future climate are based on records of climate change over the past one million years. Expected states range from present, and conditions to significantly cooler periods with double today's precipitation. It is likely that climate at Yucca Mountain in the next 10,000 years will be intermediate between the two extremes, that is, semi-arid. Finally, although the local geology of Yucca Mountain is relatively uncomplicated, the regional hydrologic system is complicated, particularly when future conditions are included. This complexity accounts in part for the unparalleled characterization effort expended at Yucca Mountain.

The discussion above is based upon the extensive studies conducted at Yucca Mountain. Nonetheless, it is practical and desirable to continue efforts to improve knowledge of the site, to reduce uncertainty, to apply new Earth science concepts as they develop, and to gather data to support refinements in repository plans.

As the final design of the repository is prepared, the USGS strongly supports the inclusion of three design considerations. First, maintaining the surrounding rock at a temperature less than boiling at all times will minimize potentially negative effects of the repository on the site's natural attributes and thereby lower uncertainty in its predicted performance. Second, forced and natural ventilation should be used to improve repository performance by towering temperature and removing substantial amounts of moisture from the mountain. Third, a period of retrievability and monitoring preserves the options of future generations to make alternative disposal choices.

Evaluation of any alternative for nuclear waste disposal is limited by our ability to make long-term predictions. The Department of Energy is proposing recommending the Yucca Mountain site in part because the results of the Total System Performance Assessment (TSPA) indicate that the amounts of radioactivity likely to be released from Yucca Mountain meet regulatory limits. The USGS recognizes the benefits of the TSPA modeling technique as an important evaluation tool, but the limits of quantitative prediction as embodied in the TSPA over such long time periods need to be recognized. This fact reinforces the importance of retrievability and monitoring as discussed above.

Additional confidence in the site's long-term ability to isolate waste from the biosphere can be attained through the examination of natural analogues and through geochemical studies. Studies of archeological and geological sites provide analogues for the potential of Yucca Mountain to isolate waste. Preservation of extremely fragile natural and human-made items for thousands to tens of thousands of years in caves, rock shelters, and fissures shows the potential to design and operate a repository successfully in the deep unsaturated zone of Yucca Mountain. Geochemical studies of calcite and opal in Yucca Mountain have shown unequivocal evidence that the water table has been below the proposed repository level for millions of years and that the effects of past climatic shifts are greatly attenuated at the proposed repository depth.

Recognizing that uncertainty in the future performance of the repository remains, the USGS endorses a stepwise decisionmaking process and phased implementation of the repository program. This approach allows for future decision-makers to select alternative options, if necessary, based upon additional information, different societal needs, or changing priorities.

A more detailed discussion of the above topics is attached to this letter. Please let me know if I can provide additional information.

Sincerely,

CHARLES G. GROAT,
Director.

[Enclosure.]

I. INTRODUCTION AND PURPOSE

The Secretary of Energy is considering the Yucca Mountain site for recommendation as a spent nuclear fuel and high-level radioactive waste repository. The Secretary's decision is based, in part, on the geologic and hydrologic nature of the site as determined through site characterization activities. The U.S. Geological Survey (USGS) has no regulatory or management mandates and provides impartial science that serves the needs of the Nation. It is appropriate, therefore, for the Director of the USGS to provide policy-relevant, yet policy-neutral, science-based, input to the Secretary of Energy to aid in his decision.

II. GEOLOGIC DISPOSAL CONCEPT

Earth scientists, many from the USGS, have long played an active role in the examination of the problem of high-level radioactive waste disposal. Since the 1970s, USGS researchers have published studies of the concept of geologic disposal. In 1978, for example, the USGS considered different rock types, the effect of the waste on the rocks, movement of contaminants through ground water, and containment of waste in a philosophical discussion of the problem. Subsequently, the USGS studied different potential repository rocks, proposed the concept of a repository above the water table in arid regions, and investigated the hydrology and geology of Yucca Mountain.

National panels (such as the National Academy of Sciences/National Research Council) and international groups (for example, the Nuclear Energy Agency) examined the concept of geologic disposal of long-lived radioactive wastes on a number of occasions. These panels have consistently endorsed geologic disposal as the only viable long-term solution to the problem of long-lived radioactive waste. Considering the state of knowledge today, the USGS is confident that acceptable geologic repositories can be constructed. However, it is important that a repository be developed in a stepwise manner, with wastes remaining retrievable for a substantial period, in order to confirm the geologic and hydrologic attributes of the site or permit the development of alternative solutions by future generations.

III. THE YUCCA MOUNTAIN SITE

A. Natural System

Studies of the natural system at Yucca Mountain have been of unprecedented extent and thoroughness. Here, we will try to put the natural system characterization efforts in the perspective of USGS studies and interpretations.

For more than 120 years, the USGS has provided scientific support to help resolve the Nation's complex natural resource problems. The USGS began applying that expertise to the Yucca Mountain region several decades before Congress selected the site for study as a potential repository location. Major geological and hydrological studies in southern Nye County were conducted by the USGS in support of national defense programs at the Nevada Test Site.

After the selection of Yucca Mountain for site characterization, USGS scientists worked with academic, national laboratory, and contractor geologists and hydrologists to compile a comprehensive description of the proposed repository site and its vicinity. The work included surface mapping, detailed stratigraphic measurements, studies of numerous soil pits and trenches, logging of hundreds of drill holes, observations in more than 10 kilometers (6 miles) of underground excavations, geophysical surveys, geochemical analyses, hydrologic tests, and studies of past climate records. The USGS stands firmly behind the quality of work that its scientists produced in the site characterization effort. Whereas scientific investigations commonly lead to additional possibilities for further work, the USGS is confident that the thoroughness of the work performed to date is sufficient to support a decision to proceed to the next step of repository site recommendation. At this time (October 2001), analysis of the extensive data by USGS scientists has found no feature or characteristic of the site that would preclude its designation as a repository site.

Site Attributes

Any potential repository site has attributes that are favorable for the isolation of waste as well as unfavorable. As site characterization proceeds, these attributes are studied exhaustively and the potentially negative attributes receive particular scrutiny. Yucca Mountain has been studied in this way and a number of site attributes, both positive and negative, have been documented. These are summarized below along with an explanation of why the negative attributes do not preclude a site recommendation decision at this time.

Positive Attributes. National screening programs conducted in the 1980s and site characterization studies have revealed a number of positive attributes of the natural system with regard to the siting of a potential geologic repository at Yucca Mountain. The local geology at Yucca Mountain is uncomplicated. Beds or layers of volcanic rocks of relatively uniform thicknesses dip gently to the east and are offset small amounts by northwesterly and northerly trending faults. The three dimensional geological framework of the mountain is well established by mapping, drilling, and underground exploration. In addition, the Yucca Mountain site has been thoroughly investigated for economic deposits that would be attractive for commercial mining and for energy resources, but there is no indication of either.

The volcanic tuffs at Yucca Mountain are suitable for underground construction, as shown by the relative ease with which exploratory tunnels, drifts, and alcoves

were excavated using tunnel boring machines and alpine miners. This feature is favorable both for worker safety during normal operations and for waste retrievability well into the future should that become necessary.

Yucca Mountain is located in an arid climate zone of the northern Mojave Desert and receives about 190 millimeters (7.5 inches) of precipitation per year. Potential evapotranspiration exceeds precipitation by about an order of magnitude. Consequently, net infiltration is very low, averaging about 5 millimeters (0.2 inches) per year above the potential repository area under current climatic conditions. Because of the capillary barrier that surrounds underground openings in unsaturated rock, the percentage of net infiltration that can enter drifts of the potential repository as seepage is small. Furthermore, the interconnected fracture network within the potential repository host rock (Topopah Spring welded unit) will allow free drainage of water that might enter an emplacement drift, thereby inhibiting ponding of water. In addition, the interconnected fracture network of the Topopah Spring welded unit facilitates natural, passive ventilation of the repository. Such long-term passive ventilation of the repository would be beneficial because of the potentially large amounts of heat and water vapor that could be removed by this natural process.

A fundamental attribute of Yucca Mountain is its location above an unsaturated zone that is among the thickest (500 to 800 meters or 1600 to 2600 feet) in the United States. This allows a repository to be situated at a significant vertical distance below the land surface and above the regional water table. Such a location in the unsaturated zone ensures that a repository is extremely unlikely to be flooded by ground water. This conclusion is supported by geochemical and mineralogic studies that indicate that the water table has remained well below the repository horizon for millions of years. Another significant attribute of the Yucca Mountain unsaturated zone is that the rocks of the Calico Hills Formation beneath the repository site contain zeolites that can significantly retard the transport of certain radionuclides. Finally, Yucca Mountain is located in a closed desert basin with no discharge beyond the regional drainage system or to the sea.

Negative Attributes. The principal objective of a geologic repository is to securely isolate nuclear waste from the biosphere (the environment and its inhabitants) to the greatest extent possible. In the previous section, we discussed natural attributes of the Yucca Mountain site that are favorable with respect to this goal; many of them are also referred to as "natural barriers" in Department of Energy (DOE) literature.

The Yucca Mountain site also has some characteristics that potentially may degrade repository performance and that consequently deserve scrutiny. If the President eventually designates Yucca Mountain, these attributes may require additional study and monitoring. These include: (1) earthquakes; (2) potential volcanic activity; (3) the existence of a large aquifer of potable water at depth beneath the repository; (4) future climate change effects; and (5) the regional complexity of the hydrogeologic system. Without minimizing the importance of these attributes, the USGS believes that they are understood well enough with respect to the potential performance of a repository to support a decision to take the next step in repository development. Our reasons follow.

The occurrence of earthquakes gives rise to strong ground motion and to surface faulting that primarily affects surface facilities. Critical operational facilities in the preclosure period, such as the waste-handling complex, can be designed to withstand earthquake ground motions following state-of-the-art engineering practice as applied to critical facilities. Whereas the engineering design is outside the scope of USGS studies, the probabilistic hazard analysis upon which designs will be based is supported by the USGS and follows internationally recognized state-of-the-art.

The potential for volcanic activity has been extensively studied using probabilistic hazard analysis. The USGS concurs with expert panels that the probability of a repository-piercing eruption, including surface eruptions, is very low (on the order of 1.6×10^{-8}/year, or odds of 16 in a billion per year). However, other scientists believe that the probability may be perhaps ten times higher. Although this topic continues to be discussed, the total range of current probability estimates remains very low.

The presence of a deep aquifer beneath the site is a primary reason for the two decades of efforts by scientists to characterize the geology, hydrology, geochemistry, and paleoclimate of the Yucca Mountain site. The aquifer is a valuable resource for this arid region. For reasons described in the final section of this paper, the USGS believes that the risk of possible contamination of ground water remains low. Nonetheless, this matter should continue to be evaluated and a monitoring program associated with repository construction should be designed with these concerns in mind.

A variety of paleontologic, geologic, and isotopic evidence indicates that the climate of the Yucca Mountain area changed cyclically in the past million years. During this time it varied from that of the present—mean annual precipitation and

temperature of about 190 millimeters (7.5 inches) and 19 degrees Celsius (67 degrees Fahrenheit)—to a few extremely cold and wet periods that may have had more than double modern precipitation and perhaps more than 11 degrees Celsius (20 degrees Fahrenheit) colder temperature. However, during most of the past million years, the region is believed to have had intermediate climates. Predicting future climate at Yucca Mountain from the geologic records is uncertain, but limits observed during the past one million years suggest that the climate is likely to be intermediate between the present and the extreme climate states during the next 10,000 years. Thus, the climate of the Yucca Mountain region would at such times be semi-arid, rather than arid, as it is today.

The present-day regional hydrogeologic system is complicated, and is compounded by the inclusion of future climate change effects (for example, precipitation). Understanding this complex system is important in predicting repository performance. However, a substantial amount is known about the system, enough to understand the potential for the site's attributes to isolate waste.

Continuing Studies

The development of a high-level waste repository is a first-of-a-kind endeavor. The challenge to predict the performance of a proposed repository at Yucca Mountain has resulted in extensive local and regional studies as summarized above. Over time, site knowledge has increased dramatically and uncertainty in prediction of the performance of the natural system has been reduced. Nonetheless, the USGS also supports continuing study and monitoring efforts to improve knowledge of the site, to further reduce uncertainty, to apply new earth science concepts as they develop, and to gather data to support refinements in repository plans.

B. Design and Engineering Considerations

Cool Repository

Engineered barriers can complement the natural barriers in isolating waste from the biosphere and can do much to offset uncertainties in characterizing the natural site conditions. One proposed engineering approach is to allow the rocks adjacent to the waste packages to exceed the boiling point of water, thus driving moisture away from the tunnels. The USGS supports a cooler operating regime (one in which the rock temperature never exceeds the boiling point of water) because of reduced impact on natural assets of the repository system and reduced uncertainties in predicting the repository system behavior. The USGS has consistently held this position for 23 years, since publication of USGS Circular 779, and continues to believe that the potential advantages of an above-boiling repository have not been sufficiently demonstrated to warrant changing our position.

Ventilation

In keeping with the USGS belief that the repository host rock temperature is kept below boiling, we support the proposed practice of using a combination of forced and natural ventilation of the drifts for the time necessary to prevent the drift wall temperatures from ever exceeding the boiling point of water. A substantial added benefit of drift ventilation is the removal of a large volume of rock moisture from the repository environs. This water must be replaced by infiltration following the end of ventilation before seepage into the drifts could occur. Thus, conditions for possible radionuclide transport could be delayed by hundreds to thousands of years. Again, this is a long-standing USGS position, held for 18 years, since publication of USGS Circular 903.

Retrievability and Monitoring

DOE proposes in the Yucca Mountain Preliminary Site Suitability Evaluation that the repository may remain open for as much as 325 years and will be designed to include waste package retrieval capabilities prior to closure. One of the advantages of locating a repository in the unsaturated zone is that it remains more accessible (e.g., for retrieval of waste) than a repository below the water table. A repository above the water table does not need to incorporate backfill in the waste-disposal drifts and will not flood after closure. As a result, extending the preclosure period may be economically feasible (as shown by DOE's consideration of a preclosure period exceeding proposed regulatory minimums) and retrievability after closure remains a possibility. The USGS remains supportive of repository designs that facilitate retrievability, as pointed out in USGS Circular 903.

The USGS also supports design elements that incorporate the ability to monitor key attributes of the site, including moisture movement through the unsaturated zone, temperature, and watertable levels. A comprehensive monitoring plan is strongly endorsed by the USGS as a means to continuously evaluate the site prior

to reaching a decision on closure. This will allow continuous validation and confidence building in the attributes of the natural system upon which the repository design is based. After waste emplacement, it is important to assure that the repository is functioning as expected and within accepted limits.

IV. RISK TO HUMANS AND THE ENVIRONMENT

The disposal of wastes produced by human activities has been an ongoing problem for societies throughout the world since the beginning of civilization. A new challenge arose following the Industrial Revolution with the need for industrial societies to dispose of increasing quantities of toxic solid and liquid chemical wastes. The problem of toxic-waste disposal acquired a new dimension with the advent of the nuclear age in 1945 and the subsequent need to dispose of accumulating quantities of long-lived radioactive wastes. The disposal of radioactive wastes requires that these materials be isolated from the biosphere for time periods necessary to protect the environment and to ensure human health and safety. The National Research Council, in a recent report ("Disposition of High-Level Waste and Spent Nuclear Fuel"), reiterated its belief, and that of all nations with nuclear power, that underground disposal of nuclear wastes in a geologic repository is the "only long-term solution available."

Radioactive-waste materials may reach the biosphere from a geologic repository by the mobilization and transport of radioactive substances by water moving through the repository system. Most proposed geologic repositories would be located below the water table where the wastes are in continuous contact with ground water. Yucca Mountain is an exception. Because of the thick unsaturated zone beneath this ridge, the waste can be emplaced several hundred meters (hundreds of feet) below the surface, yet also several hundred meters (hundreds of feet) above the water table. Because of the arid climate at Yucca Mountain and the hydrologic characteristics of the unsaturated rock mass in which the potential repository would be located, minimal quantities of ground water are expected to pass through the potential repository horizon under present-day conditions. Under expected future wetter climates, the natural attributes listed above in conjunction with the proposed engineered barriers should limit contact of waste with infiltrating water during the regulatory 10,000-year compliance period, and beyond.

The regulations that govern development of a potential Yucca Mountain repository require that the collective processes that may lead to release of radionuclides to the environment be evaluated using the Total System Performance Assessment (TSPA) methodology. TSPA is an internationally recognized tool not only for evaluating expected future repository-system performance but also for identifying additional data and information needs and for eliminating sites that may prove to be unsuitable for repository development. Although the USGS has not been involved directly in conducting the TSPA evaluations for the Yucca Mountain site, the earth-science investigations, data, and interpretations by the USGS have provided the fundamental scientific basis for these evaluations. The TSPA evaluations to date indicate that the radioactivity released to the environment from Yucca Mountain is likely to meet regulatory limits. The USGS recognizes the benefits of the TSPA modeling technique as an important evaluation tool, but the limits of quantitative prediction as embodied in the TSPA over such long time periods need to be recognized.

Additional confidence in the site's long-term ability to isolate waste from the biosphere can be attained through the examination of natural analogues and through geochemical studies. Fossils and archaeological finds in caves and in human-made openings in rock comprise natural analogues for the possible fate of waste emplaced in the thick unsaturated zone beneath Yucca Mountain. Throughout the southwestern United States packrat middens, delicate fossils readily dissolved by water, are found in caves, rock shelters, and fissures. These middens are as much as 40,000 years old. Spirit Cave, Nevada, is famous for its 9,000-year-old mummies. Even in humid climates, caves contain fragile items such as ice-age paintings, some as much as 32,000 years old. These paintings have survived, in over 150 caves in the presently sub-humid to humid climates of southern France and northern Spain, presumably owing to the tendency of infiltrating water to move around openings within the unsaturated zone. Detailed study of calcite and opal deposits in cavities within the exploratory drifts in Yucca Mountain has shown unequivocally that the water table has been below the proposed repository horizon for millions of years. Additionally, these studies indicate that the climatic shifts recorded at the surface were greatly attenuated at the level of the proposed repository.

Recognizing that uncertainty in the future performance of the repository remains, and that continuing monitoring and scientific work will enhance understanding of critical processes, the USGS endorses national (National Academy of Sciences/Na-

tional Research Council) and international (Nuclear Energy Agency) positions in favor of stepwise decisionmaking or phased development approaches. As stated by the Nuclear Energy Agency, a stepwise approach "leaves open the possibility of adaptation, in the light of scientific progress and social acceptability, over several decades, and does not exclude the possibility that other options could be developed at a later stage."

THE SECRETARY OF ENERGY,
WASHINGTON, DC, FEBRUARY 14, 2002.

THE PRESIDENT,
The White House, Washington, DC.

DEAR MR. PRESIDENT: I am transmitting herewith, in accordance with section 114(a)(1) of the Nuclear Waste Policy Act of 1982 (the "Act"), 42 U.S.C. 10134, my recommendation for your approval of the Yucca Mountain site for the development of a nuclear waste repository, along with a comprehensive statement of the basis of my recommendation. In making this recommendation, I have examined three considerations.

First, and most important, I have considered whether sound science supports the determination that the Yucca Mountain site is scientifically and technically suitable for the development of a repository. I am convinced that it does. This suitability determination provides the indispensable foundation for my recommendation. Irrespective of any other considerations, I could not and would not recommend the Yucca Mountain site without having first determined that a repository at Yucca Mountain will bring together the location, natural barriers, and design elements necessary to protect the health and safety of the public, including those Americans living in the immediate vicinity, now and long into the future.

The Department has engaged in over 20 years of scientific and technical investigation of the suitability of the Yucca Mountain site. As part of this investigation, some of the world's best scientists have been examining every aspect of the natural processes—past, present and future—that could affect the ability of a repository beneath Yucca Mountain to isolate radionuclides emitted from any spent fuel and radioactive waste disposed there. They have been conducting equally searching investigations into the processes that could affect the behavior of the engineered barriers that are expected to contribute to successful isolation of radionuclides. These investigations have run the gamut, from mapping the geologic features of the site, to studying the repository rock, to investigating whether and how water moves through the Yucca Mountain site.

To give just a few examples, Yucca Mountain scientists have: mapped geologic structures, including rock units, faults, fractures, and volcanic features; excavated more than 200 pits and trenches to remove rocks and other material for direct observation; drilled more than 450 boreholes; collected over 75,000 feet of core, and some 18,000 geologic and water samples; constructed six and one-half miles of tunnels to provide access to the rocks that would be used for the repository; mapped the geologic features exposed by the underground openings in the tunnels; conducted the largest known test in history to simulate heat effects of a repository, heating some seven million cubic feet of rock over its ambient temperature; tested mechanical, chemical, and hydrologic properties of rock samples; and examined over 13,000 engineered material samples to determine their corrosion resistance in a variety of environments.

The findings from these and numerous other studies have been used to expand our knowledge of the rocks beneath Yucca Mountain and the flow of water through these rocks, including amounts, pathways, and rates. Yucca Mountain scientists have used this vast reservoir of information to develop computer simulations that describe the natural features, events and processes that exist at Yucca Mountain and, in turn, have used these descriptions to develop the models to forecast how a repository will perform far into the future. Yucca Mountain scientists have followed a deliberately cautious approach to enhance confidence in any prediction of future performance.

The results of this investigation have been openly and thoroughly reviewed by the Department and oversight entities such as the Nuclear Regulatory Commission (NRC), the Nuclear Waste Technical Review Board, and the U.S. Geological Survey, as well as having been subjected to scientific peer reviews, including a review undertaken by the International Atomic Energy Agency. The Department also has made available the scientific materials and analyses used to prepare the technical evaluations of site suitability for public review by all interested parties. The results of this extensive investigation and the external technical reviews of this body of scientific work give me confidence for the conclusion, based on sound scientific prin-

ciples, that a repository at Yucca Mountain will be able to protect the health and safety of the public when evaluated against the radiological protection standards adopted by the Environmental Protection Agency and implemented by the NRC in accordance with Congressional direction in the Energy Policy Act of 1992.

Second, having found the site technically suitable, I am also convinced that there are compelling national interests that require development of a repository. In brief, the reasons are these:

- A repository is important to our national security. About 40% of our fleet's principal combat vessels, including submarines and aircraft carriers, are nuclear-powered. They must periodically be refueled and the spent fuel removed. This spent fuel is currently stored at surface facilities under temporary arrangements. A repository is necessary to assure a permanent disposition pathway for this material and thereby enhance the certainty of future naval operational capability.
- A repository is important to promote our non-proliferation objectives. The end of the Cold War has brought with it the welcome challenge of disposing of surplus weapons-grade plutonium as part of the process of decommissioning weapons we no longer need. A geological repository is an integral part of our disposition plans. Without it, our ability to meet our pledge to decommission our weapons could be placed in jeopardy, thereby jeopardizing the commitment of other nations, such as Russia, to decommission its own.
- A repository is important to our energy security. We must ensure that nuclear power, which provides 20% of the nation's electric power, remains an important part of our domestic energy production. Without the stabilizing effects of nuclear power, energy markets will become increasingly more exposed to price spikes and supply uncertainties, as we are forced to replace it with other energy sources to substitute for the almost five hours of electricity that nuclear power currently provides each day, on average, to each home, farm, factory and business in America. Nuclear power is also important to sustainable growth because it produces no controlled air pollutants, such as sulfur and particulates, or greenhouse gases. A repository at Yucca Mountain is indispensable to the maintenance and potential growth of this environmentally efficient source of energy.
- A repository is important to our homeland security. Spent nuclear fuel, high-level radioactive waste, and excess plutonium for which there is no complete disposal pathway without a repository are currently stored at over 131 sites in 39 States. More than 161 million Americans live within 75 miles of one or more of these sites. The facilities housing these materials were intended to do so on a temporary basis. They should be able to withstand current terrorist threats, but that may not remain the case in the future. These materials would be far better secured in a deep underground repository at Yucca Mountain, on federal land, far from population centers, that can withstand an attack well beyond any that is reasonably conceivable.
- And a repository is important to our efforts to protect the environment. It is past time for the federal government to implement an environmentally sound disposition plan for our defense wastes, which are located in Tennessee, Colorado, South Carolina, New Mexico, New York, Washington and Idaho. Among the wastes currently at these sites, approximately 100,000,000 gallons of high-level liquid waste are stored in, and in some instances have leaked from, temporary holding tanks. About 2,500 metric tons of solid un-reprocessed fuel from production and other reactors also are stored at these sites. It is also past time for the federal government to begin disposition of commercial spent fuel, a program that was to have begun in 1998. A repository is necessary for accomplishment of either of these objectives.

Third, I have considered carefully the primary arguments against locating a repository at Yucca Mountain. None of these arguments rises to a level that would outweigh the case for going forward. This is not to say that there have not been important concerns identified. I am confident, however, these concerns have been and will continue to be addressed in an appropriate manner.

In short, after months of study based on scientific and technical research unique in its scope and depth, and after reviewing the results of a public review process that went well beyond the requirements of the Act, I reached the conclusions described in the preceding paragraphs—namely, that technically and scientifically the Yucca Mountain site is fully suitable; that development of a repository at the Yucca Mountain site serves the national interest in numerous important ways; and that the arguments against its designation do not rise to a level that would outweigh the case for going forward. Not completing the site designation process and moving

forward to licensing the development of a repository, as Congress mandated almost 20 years ago, would be an irresponsible dereliction of duty.

Accordingly, I recommend the Yucca Mountain site for the development of a nuclear waste repository.

Respectfully,

SPENCER ABRAHAM.

RECOMMENDATION BY THE SECRETARY OF ENERGY REGARDING THE SUITABILITY OF THE YUCCA MOUNTAIN SITE FOR A REPOSITORY UNDER THE NUCLEAR WASTE POLICY ACT OF 1982

FEBRUARY 2002

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1. INTRODUCTION

For more than half a century, since nuclear science helped us win World War II and ring in the Atomic Age, scientists have known that the Nation would need a secure, permanent facility in which to dispose of radioactive wastes. Twenty years ago, when Congress adopted the Nuclear Waste Policy Act of 1982 (NWPA or "the Act"), it recognized the overwhelming consensus in the scientific community that the best option for such a facility would be a deep underground repository. Fifteen years ago, Congress directed the Secretary of Energy to investigate and recommend to the President whether such a repository could be located safely at Yucca Mountain, Nevada. Since then, our country has spent billions of dollars and millions of hours of research endeavoring to answer this question. I have carefully reviewed the product of this study. In my judgment, it constitutes sound science and shows that a safe repository can be sited there. I also believe that compelling national interests counsel in favor of proceeding with this project. Accordingly, consistent with my responsibilities under the NWPA, today I am recommending that Yucca Mountain be developed as the site for an underground repository for spent fuel and other radioactive wastes.[1]

The first consideration in my decision was whether the Yucca Mountain site will safeguard the health and safety of the people, in Nevada and across the country, and will be effective in containing at minimum risk the material it is designed to hold. Substantial evidence shows that it will. Yucca Mountain is far and away the most thoroughly researched site of its kind in the world. It is a geologically stable site, in a closed groundwater basin, isolated on thousands of acres of Federal land, and farther from any metropolitan area than the great majority of less secure, temporary nuclear waste storage sites that exist in the country today.

This point bears emphasis. We are not confronting a hypothetical problem. We have a staggering amount of radioactive waste in this country—nearly 100,000,000 gallons of high-level nuclear waste and more than 40,000 metric tons of spent nuclear fuel with more created every day. Our choice is not between, on the one hand, a disposal site with costs and risks held to a minimum, and, on the other, a magic disposal system with no costs or risks at all. Instead, the real choice is between a single secure site, deep under the ground at Yucca Mountain, or making do with what we have now or some variant of it—131 aging surface sites, scattered across 39 states. Every one of those sites was built on the assumption that it would be temporary. As time goes by, every one is closer to the limit of its safe life span. And every one is at least a potential security risk—safe for today, but a question mark in decades to come.

The Yucca Mountain facility is important to achieving a number of our national goals. It will promote our energy security, our national security, and safety in our homeland. It will help strengthen our economy and help us clean up the environment.

The benefits of nuclear power are with us every day. Twenty percent of our country's electricity comes from nuclear energy. To put it another way, the "average" home operates on nuclear-generated electricity for almost five hours a day. A government with a complacent, kick-the can-down-the-road nuclear waste disposal policy will sooner or later have to ask its citizens which five hours of electricity they would care to do without.

Regions that produce steel, automobiles, and durable goods rely in particular on nuclear power, which reduces the air pollution associated with fossil fuels—greenhouse gases, solid particulate matter, smog, and acid rain. But environmental concerns extend further. Most commercial spent fuel storage facilities are near large populations centers; in fact, more than 161 million Americans live within 75 miles of these facilities. These storage sites also tend to be near rivers, lakes, and seacoasts. Should a radioactive release occur from one of these older, less robust facilities, it could contaminate any of 20 major waterways, including the Mississippi River. Over 30 million Americans are served by these potentially at-risk water sources.

Our national security interests are likewise at stake. Forty percent of our warships, including many of the most strategic vessels in our Navy, are powered by nuclear fuel, which eventually becomes spent fuel. At the same time, the end of the Cold War has brought the welcome challenge to our Nation of disposing of surplus weapons-grade plutonium as part of the process of decommissioning our nuclear weapons. Regardless of whether this material is turned into reactor fuel or other-

[1] For purposes of this Recommendation, the terms "radioactive waste" and "waste" are used to cover high-level radioactive waste and spent nuclear fuel, as those terms are used in the Nuclear Waste Policy Act.

wise treated, an underground repository is an indispensable component in any plan for its complete disposition. An affirmative decision on Yucca Mountain is also likely to affect other nations' weapons decommissioning, since their willingness to proceed will depend on being satisfied that we are doing so. Moving forward with the repository will contribute to our global efforts to stem the proliferation of nuclear weapons in other ways, since it will encourage nations with weaker controls over their own materials to follow a similar path of permanent, underground disposal, thereby making it more difficult for these materials to fall into the wrong hands. By moving forward with Yucca Mountain, we will show leadership, set out a roadmap, and encourage other nations to follow it.

There will be those who say the problem of nuclear waste disposal generally, and Yucca Mountain in particular, needs more study. In fact, both issues have been studied for more than twice the amount of time it took to plan and complete the moon landing. My Recommendation today is consistent with the conclusion of the National Research Council of the National Academy of Sciences—a conclusion reached, not last week or last month, but 12 years ago. The Council noted "a worldwide scientific consensus that deep geological disposal, the approach being followed by the United States, is the best option for disposing of high-level radioactive waste."[2] Likewise, a broad spectrum of experts agrees that we now have enough information, including more than 20 years of researching Yucca Mountain specifically, to support a conclusion that such a repository can be safely located there.[3]

Nonetheless, should this site designation ultimately become effective, considerable additional study lies ahead. Before an ounce of spent fuel or radioactive waste could be sent to Yucca Mountain, indeed even before construction of the permanent facilities for emplacement of waste could begin there, the Department of Energy (DOE or "the Department") will be required to submit an application to the independent Nuclear Regulatory Commission (NRC). There, DOE would be required to make its case through a formal review process that will include public hearings and is expected to last at least three years. Only after that, if the license were granted, could construction begin. The DOE would also have to obtain an additional operating license, supported by evidence that public health and safety will be preserved, before any waste could actually be received.

In short, even if the Yucca Mountain Recommendation were accepted today, an estimated minimum of eight more years lies ahead before the site would become operational.

We have seen decades of study, and properly so for a decision of this importance, one with significant consequences for so many of our citizens. As necessary, many more years of study will be undertaken. But it is past time to stop sacrificing that which is forward-looking and prudent on the altar of a *status quo* we know ultimately will fail us. The *status quo* is not the best we can do for our energy future, our national security, our economy, our environment, and safety—and we are less safe every day as the clock runs down on dozens of older, temporary sites.

I recommend the deep underground site at Yucca Mountain, Nevada, for development as our Nation's first permanent facility for disposing of high-level nuclear waste.

2. BACKGROUND

2.1. History of the Yucca Mountain Project and the Nuclear Waste Policy Act

The need for a secure facility in which to dispose of radioactive wastes has been known in this country at least since World War II. As early as 1957, a National Academy of Sciences report to the Atomic Energy Commission suggested burying radioactive waste in geologic formations. Beginning in the 1970s, the United States and other countries evaluated many options for the safe and permanent disposal of radioactive waste, including deep seabed disposal, remote island siting, dry cask storage, disposal in the polar ice sheets, transmutation, and rocketing waste into orbit around the sun. After analyzing these options, disposal in a mined geologic repository emerged as the preferred long-term environmental solution for the manage-

[2] *Rethinking High-Level Radioactive Waste Disposal: A Position Statement of the Board on Radioactive Waste Management,* Washington, D.C., National Academy Press, 1990.

[3] Letter and attached report, Charles G. Groat, Director, U.S. Geologic Survey, to Robert G. Card, October 4, 2001 (hereafter USGS Letter & Report); Letter and attached report, Hans Riotte, NEA-IAEA Joint Secretariat, to Lake H. Barrett, November 2, 2001 (hereafter *NEA-IAEA Letter & Report*); Letter, Charles V. Shank, Director, Lawrence Berkeley National Laboratory, to Spencer Abraham, September 6, 200 (hereafter *Lawrence Berkeley National Laboratory Letter*).

ment of these wastes.[4] Congress recognized this consensus 20 years ago when it passed the Nuclear Waste Policy Act of 1982.

In the Act, Congress created a Federal obligation to accept civilian spent nuclear fuel and dispose of it in a geologic facility. Congress also designated the agencies responsible for implementing this policy and specified their roles. The Department of Energy must characterize, site, design, build, and manage a Federal waste repository. The Environmental Protection Agency (EPA) must set the public health standards for it. The Nuclear Regulatory Commission must license its construction, operation, and closure.

The Department of Energy began studying Yucca Mountain almost a quarter century ago. Even before Congress adopted the NWPA, the Department had begun national site screening research as part of the National Waste Terminal Storage program, which included examination of Federal sites that had previously been used for defense-related activities and were already potentially contaminated. Yucca Mountain was one such location, on and adjacent to the Nevada Test Site, which was then under consideration. Work began on the Yucca Mountain site in 1978. When the NWPA was passed, the Department was studying more than 25 sites around the country as potential repositories. The Act provided for the siting and development of two; Yucca Mountain was one of nine sites under consideration for the first repository program.

Following the provisions of the Act and the Department's siting Guidelines,[5] the Department prepared draft environmental assessments for the nine sites. Final environmental assessments were prepared for five of these, including Yucca Mountain. In 1986, the Department compared and ranked the sites under consideration for characterization. It did this by using a multi-attribute methodology—an accepted, formal scientific method used to help decision makers compare, on an equivalent basis, the many components that make up a complex decision. When all the components of the ranking decision were considered together, taking account of both preclosure and post-closure concerns, Yucca Mountain was the top-ranked site.[6] The Department examined a variety of ways of combining the components of the ranking scheme; this only confirmed the conclusion that Yucca Mountain came out in first place. The EPA also looked at the performance of a repository in unsaturated tuff. The EPA noted that in its modeling in support of development of the standards, unsaturated tuff was one of the two geologic media that appeared most capable of limiting releases of radionuclides in a manner that keeps expected doses to individuals low.[7]

In 1986, Secretary of Energy Herrington found three sites to be suitable for site characterization, and recommended the three, including Yucca Mountain, to President Reagan for detailed site characterization.[8] The Secretary also made a preliminary finding, based on Guidelines that did not require site characterization, that the three sites were suitable for development as repositories.[9]

The next year, Congress amended the NWPA, and selected Yucca Mountain as the single site to be characterized. It simultaneously directed the Department to cease activities at all other potential sites. Although it has been suggested that Congress's decision was made for purely political reasons, the record described above reveals that the Yucca Mountain site consistently ranked at or near the top of the sites evaluated well before Congress's action.

As previously noted, the National Research Council of the National Academy of Sciences concluded in 1990 (and reiterated last year) that there is "a worldwide scientific consensus that deep geological disposal, the approach being followed by the United States, is the best option for disposing of high-level radioactive waste."[10]

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[4] *Final Environmental Impact Statement for Management of Commercially Generated Radioactive Waste,* DOE/EIS0046. 1980.

[5] The Guidelines then in force were promulgated at 10 CFR part 960, General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories, 1984.

[6] *Recommendation by the Secretary of Energy of Candidate Sites for Site Characterization for the First Radioactive Waste Repository,* DOE/S-0048, May 1986.

[7] Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, Final Rule, 40 CFR Part 191, December 20, 1993.

[8] Letter, John S. Herrington, Secretary of Energy, to President Ronald Reagan, May 27, 1986, with attached report, *Recommendation by the Secretary of Energy of Candidate Sites for Site Characterization for the First Radioactive Waste Repository,* DOE/S-0048, May 1986.

[9] IBID.

[10] *Rethinking High-Level Radioactive Waste Disposal: A Position Statement of the Board on Radioactive Waste Management,* Washington, D.C., National Academy Press, 1990. And: *Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges,* Board on Radioactive Waste Management, Washington, D.C., National Academy Press, 2001.

Today, many national and international scientific experts and nuclear waste management professionals agree with DOE that there exists sufficient information to support a national decision on designation of the Yucca Mountain site.[11]

2.2. The Nuclear Waste Policy Act and the Responsibilities of the Department of Energy and the Secretary

Congress assigned to the Secretary of Energy the primary responsibility for implementing the national policy of developing a deep underground repository. The Secretary must determine whether to initiate the next step laid out in the NWPA—a recommendation to designate Yucca Mountain as the site for development as a permanent disposal facility. The criteria for this determination are described more fully in section 5. Briefly, I first must determine whether Yucca Mountain is in fact technically and scientifically suitable to be a repository. A favorable suitability determination is indispensable for a positive recommendation of the site to the President. Under additional criteria I have adopted above and beyond the statutory requirements, I have also sought to determine whether, when other relevant considerations are taken into account, recommending it is in the overall national interest and, if so, whether there are countervailing arguments so strong that I should nonetheless decline to make the Recommendation.

The Act contemplates several important stages in evaluating the site before a Secretarial recommendation is in order. It directs the Secretary to develop a site characterization plan, one that will help guide test programs for the collection of data to be used in evaluating the site. It directs the Secretary to conduct such characterization studies as may be necessary to evaluate the site's suitability. And it directs the Secretary to hold hearings in the vicinity of the prospective site to inform the residents and receive their comments. It is at the completion of these stages that the Act directs the Secretary, if he finds the site suitable, to determine whether to recommend it to the President for development as a permanent repository.

If the Secretary recommends to the President that Yucca Mountain be developed, he must include with the Recommendation, and make available to the public, a comprehensive statement of the basis for his determination.[12] If at any time the Secretary determines that Yucca Mountain is not a suitable site, he must report to Congress within six months his recommendations for further action to assure safe, permanent disposal of spent nuclear fuel and high-level radioactive waste.

Following a Recommendation by the Secretary, the President may recommend the Yucca Mountain site to Congress "if . . . [he] considers [it] qualified for application for a construction authorization. . . ."[13] If the President submits a recommendation to Congress, he must also submit a copy of the statement setting forth the basis for the Secretary's Recommendation.

A Presidential recommendation takes effect 60 days after submission unless Nevada forwards a notice of disapproval to the Congress. If Nevada submits such a notice, Congress has a limited time during which it may nevertheless give effect to the President's recommendation by passing, under expedited procedures, a joint resolution of siting approval. If the President's recommendation takes effect, the Act directs the Secretary to submit to the NRC a construction license application.

The NWPA by its terms contemplated that the entire process of siting, licensing, and constructing a repository would have been completed more than four years ago, by January 31, 1998. Accordingly, it required the Department to enter into contracts to begin accepting waste for disposal by that date.

3. DECISION

3.1. The Recommendation

After over 20 years of research and billions of dollars of carefully planned and reviewed scientific field work, the Department has found that a repository at Yucca Mountain brings together the location, natural barriers, and design elements most likely to protect the health and safety of the public, including those Americans living in the immediate vicinity, now and long into the future. It is therefore suitable, within the meaning of the NWPA, for development as a permanent nuclear waste and spent fuel repository.

After reviewing the extensive, indeed unprecedented, analysis the Department has undertaken, and in discharging the responsibilities made incumbent on the Secretary under the Act, I am recommending to the President that Yucca Mountain be

[11] *USGS Letter & Report, supra; NEA-IAEA Letter & Report, supra; Lawrence Berkeley National Laboratory Letter, supra.*

[12] This document together with accompanying materials comprises the recommendation and the comprehensive statement. The accompanying materials are described in footnote 26.

[13] NWPA section 114(a)(2)(A).

developed as the Nation's first permanent, deep underground repository for high-level radioactive waste. A decision to develop Yucca Mountain will be a critical step forward in addressing our Nation's energy future, our national defense, our safety at home, and protection for our economy and environment.

3.2. What This Recommendation Means, and What It Does Not Mean

Even after so many years of research, this Recommendation is a preliminary step. It does no more than start the formal safety evaluation process. Before a license is granted, much less before repository construction or waste emplacement may begin, many steps and many years still lie ahead. The DOE must submit an application for a construction license; defend it through formal review, including public hearings; and receive authorization from the NRC, which has the statutory responsibility to ensure that any repository built at Yucca Mountain meets stringent tests of health and safety. The NRC licensing process is expected to take a minimum of three years. Opposing viewpoints will have every opportunity to be heard. If the NRC grants this first license, it will only authorize initial construction. The DOE would then have to seek and obtain a second operating license from the NRC before any wastes could be received. The process altogether is expected to take a minimum of eight years.

The DOE would also be subject to NRC oversight as a condition of the operating license. Construction, licensing, and operation of the repository would also be subject to ongoing Congressional oversight.

At some future point, the repository is expected to close. EPA and NRC regulations require monitoring after the DOE receives a license amendment authorizing the closure, which would be from 50 to about 300 years after waste emplacement begins, or possibly longer.

The repository would also be designed, however, to be able to adapt to methods future generations might develop to manage high-level radioactive waste. Thus, even after completion of waste emplacement, the waste could be retrieved to take advantage of its economic value or usefulness to as yet undeveloped technologies.

Permanently closing the repository would require sealing all shafts, ramps, exploratory boreholes, and other underground openings connected to the surface. Such sealing would discourage human intrusion and prevent water from entering through these openings. DOE's site stewardship would include maintaining control of the area, monitoring and testing, and implementing security measures against vandalism and theft. In addition, a network of permanent monuments and markers would be erected around the site to alert future generations to the presence and nature of the buried waste.[14] Detailed public records held in multiple places would identify the location and layout of the repository and the nature and potential hazard of the waste it contains. The Federal Government would maintain control of the site for the indefinite future. Active security systems would prevent deliberate or inadvertent human intrusion and any other human activity that could adversely affect the performance of the repository.

4. DECISION DETERMINATION METHODOLOGY AND THE DECISION-MAKING PROCESS

I have considered many kinds of information in making my determination today. I have put on a hard hat, gone down into the Mountain, and spoken with many of the scientists and engineers working there. Of course my decision-making included a great deal more than that. I have also personally reviewed detailed summaries of the science and research undertaken by the Yucca Mountain Project since 1978. I relied upon review materials, program evaluations, and face-to-face briefings given by many individuals familiar with the Project, such as the acting program manager and program senior staff.

My consideration included: (a) the general background of the program, including the relevant legislative history; (b) the types, sources, and amounts of radioactive waste that would be disposed of at the site and their risk; (c) the extent of Federal responsibilities; (d) the criteria for a suitability decision, including the NWPA's provisions bearing on the basis for the Secretary's consideration; the regulatory structure, its substance, history, and issues; DOE's Yucca Mountain Suitability Guidelines promulgated under the NWPA;[15] the NRC licensing regulations,[16] and EPA

[14] During characterization of the Yucca Mountain site, Nye County began to develop its Early Warning Monitoring program and boreholes. These boreholes not only provide information about water movement in the area of the site, but also can serve as monitoring points should a repository be built at Yucca Mountain.

[15] 10 CFR Part 963, Yucca Mountain Site Suitability Guidelines, November 14, 2001.

[16] 10 CFR Part 63, Disposal of High-Level Radioactive Waste in a Geologic Repository at Yucca Mountain, Nevada, November 2, 2001.

radiation protection standards[17] as referenced in the Suitability Guidelines; (e) assessments of repository performance, including technical data and descriptions of how those data were gathered and evaluated; assessments of the effectiveness of natural and engineered barriers in meeting applicable radiation protection standards, and adjustments for uncertainties associated with each of these; (f) the Yucca Mountain Site Suitability Evaluation; (g) the views of members of the public, including those expressed at hearings and through written comments; (h) environmental, socioeconomic, and transportation issues; (1) program oversight history, technical issues, and responses, including the role and views of the NRC, the Nuclear Waste Technical Review Board, the General Accounting Office, the Inspector General, and the State of Nevada; and the role and views of the National Laboratories, the United States Geological Survey, and peer reviews; and (j) public policy impact.

I also requested an external review of program briefing materials. It was conducted by Dr. Chris Whipple, a member of the National Academy of Engineering and an experienced independent peer reviewer of programs for both the Waste Isolation Pilot Plant and the Yucca Mountain Project. Dr. Whipple previously had led a peer review team that critically analyzed Total System Performance Assessment (TSPA) work of the Yucca Mountain Project.

I also reviewed the comment summary documents from both the Environmental Impact Statement (EIS) and NWPA Section 114 site recommendation hearing process in order fully to take into account public views concerning a possible recommendation of the Yucca Mountain site. This review enabled me to evaluate scientific and research results in the context of both strongly held local concerns and issues of national importance. I took particular note of comments and concerns raised by the Governor of Nevada, governors of other states, state agencies, Native American tribes, and members of the public at large.

5. DECISION CRITERIA

My charge to make a recommendation to the President on this matter stems from the Nuclear Waste Policy Act of 1982. That statute directs the Secretary of Energy to determine "whether to recommend to the President that he approve [the Yucca Mountain] site for development of a repository."[18] The NWPA establishes certain guideposts along the way to making this determination, but it also gives the Secretary significant responsibility for deciding what the relevant considerations are to be.

Pursuant to that responsibility, I concluded that I should use three criteria in determining whether to recommend approval of the Yucca Mountain Project. First, is Yucca Mountain a scientifically and technically suitable site for a repository, i.e., a site that promises a reasonable expectation of public health and safety for disposal of spent nuclear fuel and high-level radioactive waste for the next 10,000 years? Second, are there compelling national interests that favor proceeding with the decision to site a repository there? And third, are there countervailing considerations that outweigh those interests?

The first of these criteria is expressly contemplated by the NWPA, although the NWPA also confers considerable discretion and responsibility on the Secretary in defining how to determine scientific and technical suitability and in making a judgment on the question. The two other criteria are not specified by the NWPA, but I am convinced that they are appropriate checks on a pure suitability-based decision.

5.1. Scientific and Technical Suitability

Under the NWPA, the first step in a Secretarial determination regarding Yucca Mountain is deciding whether it is scientifically and technically suitable as a repository site. Although the NWPA does not state explicitly that this is the initial step, the language and structure of the Act strongly suggest that this is so. Most significantly, section 114(a)(1) of the NWPA states that the Secretary's recommendation is to be made at the conclusion of site characterization.[19] Section 113, in turn, makes clear that the function of site characterization is to provide enough site-specific information to allow a decision on Yucca Mountain's scientific suitability.[20]

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[17] 540 CFR Part 197, Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada, June 13, 2001.

[18] NWPA section 114(a)(1).

[19] Ibid.

[20] This is apparent from two related provisions of section 113: section 113(c)(1), which states that, "The Secretary may conduct at the Yucca Mountain site only such site characterization activities as the Secretary considers necessary to provide the data required for evaluation of the

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As to what a determination of site suitability entails, the only real guidance the Act provides is that in several places it equates a favorable suitability judgment with a judgment that a repository could (1) be built at that site and (2) receive a construction authorization from the NRC.[21] This suggests that a determination that the site is suitable entails a judgment on my part that a repository at Yucca Mountain would likely be licensable by the NRC.

Beyond that, the NWPA largely leaves the question to the Secretary of Energy by charging him with establishing "criteria to be used to determine the suitability of . . . candidate site[s] for the location of a repository."[22] On November 14, 2001, following NRC's concurrence, the Department issued its final version of these criteria in a rule entitled, "Yucca Mountain Site Suitability Guidelines." I shall describe these in detail in the next section of this Recommendation, but outline them here. In brief, DOE's Guidelines envision that I may find the Yucca Mountain site suitable if I conclude that a repository constructed there is "likely" to meet extremely stringent radiation protection standards designed to protect public health and safety.[23] The EPA originally established these standards.[24] They are now also set out in NRC licensing rules.[25]

The EPA and NRC adopted the standards so as to assure that while the repository is receiving nuclear materials, any radiation doses to workers and members of the public in the vicinity of the site would be at safe levels, and that after the repository is sealed, radiation doses to those in the vicinity would be at safe levels for 10,000 years. These radiation protection levels are identical to those with which the DOE will have to demonstrate compliance to the satisfaction of the NRC in order to obtain a license to build the repository.

Using the Department's suitability Guidelines, I have concluded that Yucca Mountain is in fact suitable for a repository. The reasons for this conclusion are set out in section 7 of this Recommendation. However, I want to pause to make one thing clear at the outset. If for any reason I found that the site were not suitable or licensable, then, irrespective of any other consideration, I would not recommend it. Specifically, however much as I might believe that proceeding toward a repository would advance the national interest in other ways, those additional considerations could not properly influence, and have not influenced, my determination of suitability.

5.2. National Interest Considerations

Beyond scientific suitability, the NWPA is virtually silent on what other standard or standards the Secretary should apply in making a recommendation. It does direct me to consider certain matters. It requires that I consider the record of hearings conducted in the vicinity of Yucca Mountain, the site characterization record, and various other information I am directed to transmit to the President with my Recommendation.[26] 26 The Act does not, however, specify how I am to consider these

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suitability of such site for an application to be submitted to the Commission for a construction authorization for a repository at such site" (as well as for NEPA purposes); and its companion provision, section 113(c)(3), which states that, "If the Secretary at any time determines the Yucca Mountain site to be unsuitable for development as a repository, the Secretary shall . . . terminate all site characterization activities [there]."

[21] NWPA section 112(b)(1)(D)(ii); NWPA section 113(c)(1); NWPA section 113(c)(3).

[22] NWPA section 113(b)(1)(A)(iv). That section contemplates that these criteria are to be included in the first instance in the site characterization plan for each site and thereafter may be modified using the procedures of section 112(a).

[23] 10 CFR part 963.

[24] 40 CFR part 197.

[25] 10 CFR part 63.

[26] The statutorily required information is set out in Section 114(a)(1) of the NWPA, which states: Together with any recommendation of a site under this paragraph, the Secretary shall make available to the public, and submit to the President, a comprehensive statement of the basis of such recommendation, including the following:

(A) a description of the proposed repository, including preliminary engineering specifications for the facility;

(B) a description of the waste form or packaging proposed for use at such repository, and an explanation of the relationship between such waste form or packaging and the geologic medium of such site;

(C) a discussion of data, obtained in site characterization activities, relating to the safety of such site;

(D) a final environmental impact statement prepared for the Yucca Mountain site pursuant to subsection (f) and the National Environmental Policy Act of 1969 [42 U.S.C. 4321 et seq.], together with comments made concerning such environmental impact statement by the Secretary of the Interior, the Council on Environmental Quality, the Administrator, and the Commission, except that the Secretary shall not be required in any such environmental impact state-

various items or what standard I am to use in weighing them. And finally among the items it directs me to take into account is, "such other information as the Secretary considers appropriate."

The approach taken in the Act led me to conclude that, after completing the first step of reaching a judgment as to the scientific suitability of Yucca Mountain, if I concluded the site was scientifically suitable, I should also address a second matter: whether it is in the overall national interest to build a repository there. In considering that issue, I have addressed two further questions: are there compelling national interests favoring development of the site, and if so, are there countervailing considerations weighty enough to overcome the arguments for proceeding with development? Sections 8 and 9 of this Recommendation set forth my conclusions on these questions.

In my view, the statute's silence on the factors that go into the recommendation process makes it at a minimum ambiguous on whether I should conduct any inquiry beyond the question of scientific suitability. In light of that ambiguity, I have elected to construe the statute as allowing me, if I make a favorable suitability determination based on science, also to consider whether development of a repository at Yucca Mountain is in the national interest. For several reasons, I believe this is the better way to interpret the NWPA. First, given the significance of a siting decision and the nature of the officers involved, one would expect that even if a Cabinet Secretary were to find a site technically suitable for a repository, he should be able to take broader considerations into account in determining what recommendation to make to the President. A pure suitability-based decision risks taking insufficient heed of the views of the people, particularly in Nevada but in other parts of the country as well. Second, it is difficult to envision a Cabinet Secretary's making a recommendation without taking into account these broader considerations. Finally, it is plain that any conclusion on whether to recommend this site is likely to be reviewed by Congress. Since that review will inevitably focus on broader questions

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ment to consider the need for a repository, the alternatives to geological disposal, or alternative sites to the Yucca Mountain site;

(E) preliminary comments of the Commission concerning the extent to which the at-depth site characterization analysis and the waste form proposal for such site seem to be sufficient for inclusion in any application to be submitted by the Secretary for licensing of such site as a repository;

(F) the views and comments of the Governor and legislature of any State, or the governing body of any affected Indian tribe, as determined by the Secretary, together with the response of the Secretary to such views;

(G) such other information as the Secretary considers appropriate; and

(H) any impact report submitted under section 116(c)(2)(B) [42 U.S.C. 10136(c)(2)(B)] by the State of Nevada. This material is attached to this Recommendation, as follows:

- The description of the repository called for by section 114(a)(1)(A) is contained in Chapter 2 of the Yucca Mountain Science and Engineering Report (YMS&ER), Revision 1.
- The material relating to the waste form called for by section 114(a)(1)(B) is contained in Chapters 3 and 4 of the YMS&ER, Revision 1.
- The discussion of site characterization data called for by section 114(a)(1)(C) is contained in Chapter 4 of the YMS&ER, Revision 1.
- The EIS-related material called for by section 114(a)(1)(D) is contained in the *Final Environmental Impact Statement (EIS) for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* along with letters received from the Secretary of the Interior, the Chair of the Council on Environmental Quality, the Administrator of the Environmental Protection Agency, and the Chairman of the Nuclear Regulatory Commission (NRC), transmitting their respective comments on the final EIS.
- The information called for by section I114(a)(1)(E) is contained in a letter from NRC Chairman Meserve to Under Secretary Card, dated November 13, 2001.
- The information called for by section 114(a)(1)(F) is contained in Section 2 of two separate reports, the *Comment Summary Document and the Supplemental Comment Summary Document,* and in a separate document providing responses to comments from the Governor of Nevada sent to the Department after the public comment periods on a possible site recommendation closed.
- Section 114(a)(1)(G) provides for the inclusion of other information as the Secretary considers appropriate. The report, *Yucca Mountain Site Suitability Evaluation* (DOE/RW-0549, February 2002), has been included as other information. This report provides an evaluation of the suitability of the Yucca Mountain site against Departmental Guidelines setting forth the criteria and methodology to be used in determining the suitability of the Yucca Mountain site, pursuant to section 113(b)(1)(A)(iv). In addition, impact reports submitted by the various Nevada counties have been included as other information to be forwarded to the President. In transmitting these reports to the President, the Department is neither deciding on, nor endorsing, any specific impact assistance requested by the governmental entities in those reports.
- The State of Nevada submitted an impact report pursuant to section 114(a)(1)(H). In transmitting this report to the President, the Department is likewise neither deciding on, nor endorsing this report.

than the scientific and technical suitability of the site, it seems useful in the first instance for the Executive Branch to factor such considerations into its recommendation as well. I note, however, that if my interpretation of the statute in this regard is incorrect, and Congress has made a finding of suitability the sole determinant of whether to recommend Yucca Mountain, my Recommendation would be the same.

6. IS YUCCA MOUNTAIN SCIENTIFICALLY AND TECHNICALLY SUITABLE FOR DEVELOPMENT OF A REPOSITORY?

The Department of Energy has spent over two decades and billions of dollars on carefully planned and reviewed scientific fieldwork designed to help determine whether Yucca Mountain is a suitable site for a repository. The results of that work are summarized in the *Yucca Mountain Science and Engineering Report, Revision 1,* and evaluated in the Yucca Mountain Site Suitability Evaluation (YMSSE), which concludes, as set out in 10 CFR part 963, that Yucca Mountain is "likely" to meet the applicable radiation standards and thus to protect the health and safety of the public, including those living in the immediate vicinity now and thousands of years from now. I have carefully studied that evaluation and much of the material underlying it, and I believe it to be correct.

6.1. Framework for Suitability Determination

6.1.1. General Outline

The general outline of the analytic framework I have used to evaluate the scientific suitability of the site is set out in the Department's Yucca Mountain Site Suitability Guidelines, found at 10 CFR part 963.

The framework has three key features. First, the Guidelines divide the suitability inquiry into sub-inquiries concerning a "pre-closure" safety evaluation and a "post-closure" performance evaluation. The "pre-closure" evaluation involves assessing whether a repository at the site is likely to be able to operate safely while it is open and receiving wastes. The "post-closure" evaluation involves assessing whether the repository is likely to continue to isolate the materials for 10,000 years after it has been sealed, so as to prevent harmful releases of radionuclides.

Second, the Guidelines set out a method and criteria for conducting the pre-closure safety evaluation. The method is essentially the same as that used to evaluate the safety of other proposed nuclear facilities; it is not particularly novel and should be recognized by those familiar with safety assessments of existing facilities. This is because, while it is open and receiving nuclear materials, a repository at Yucca Mountain will not be very different, in terms of its functions and the activities expected to take place there, from many other modern facilities built to handle such materials. A pre-closure evaluation to assess the probable safety of such a facility entails considering its design, the nature of the substances it handles, and the kinds of activities and external events that might occur while it is receiving waste. It then uses known data to forecast the level of radioactivity to which workers and members of the public would be likely to be exposed as a result.

Third, the Guidelines set out a method and criteria for evaluating the post-closure performance of the repository. This is the most challenging aspect of evaluating Yucca Mountain's suitability, since it entails assessing the ability of the repository to isolate radioactive materials far into the future. The scientific consensus is, and the Guidelines specify, that this should be done using a "Total System Performance Assessment." This approach, which is similar to other efforts to forecast the behavior of complex systems over long periods of time, takes information derived from a multitude of experiments and known facts. It feeds that information into a series of models. These in turn are used to develop one overarching model of how well a repository at Yucca Mountain would be likely to perform in preventing the escape of radioactivity and radioactive materials. The model can then be used to forecast the levels of radioactivity to which people near the repository might be exposed 10,000 years or more after the repository is sealed.[27]

[27] The selection of the 10,000-year compliance period for the individual-protection standard involves both technical and policy considerations. EPA weighed both during the rulemaking for 40 CFR Part 197. EPA considered policy and technical factors, as well as the experience of other EPA and international programs. First, EPA evaluated the policies for managing risks from the disposal of both long lived, hazardous, nonradioactive materials and radioactive materials. Second, EPA evaluated consistency with both 40 CFR Part 191 and the issue of consistent time periods for the protection of groundwater resources and public health. Third, EPA considered the issue of uncertainty in predicting dose over the very long periods contemplated in the alternative of peak dose within the period of geologic stability. Finally, EPA reviewed the feasibility of implementing the alternative of peak risk within the period of geologic stability.

6.1.2. Radiation Protection Standards

A key question to be answered, as part of any suitability determination is, "What level of radiation exposure is acceptable?"

DOE's Site Suitability Guidelines use as their benchmark the levels the NRC has specified for purposes of deciding whether to license a repository at Yucca Mountain. The NRC, in turn, established these levels on the basis of radiation protection standards set by the EPA. The standards generally require that during pre-closure, the repository facilities, operations, and controls restrict radiation doses to less than 15 millirem a year[28] to a member of the public in its vicinity.[29] During post-closure, they generally require that the maximum radiation dose allowed to someone living in the vicinity of Yucca Mountain be no more than 15 millirem per year, and no more than four millirem per year from certain radionuclides in the groundwater.[30]

This level of radiation exposure is comparable to, or less than, ordinary variations in natural background radiation that people typically experience each year. It is also less than radiation levels to which Americans are exposed in the course of their everyday lives—in other words, radiation "doses" to which people generally give no thought at all.

To understand this, it is important to remember that radiation is part of the natural world and that we are exposed to it all the time. Every day we encounter radiation from space in the form of cosmic rays. Every day we are also exposed to terrestrial radiation, emitted from naturally radioactive substances in the earth's surface.

In addition to natural background radiation from these sources, people are exposed to radiation from other everyday sources. These include X-rays and other medical procedures, and consumer goods (e.g., television sets and smoke detectors).

Americans, on average, receive an annual radiation exposure of 360 millirem from their surroundings. The 15 millirem dose the EPA standard set as the acceptable

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As a result of these considerations, EPA established a 10,000-year compliance period with a quantitative limit and a requirement to calculate the peak dose, using performance assessments, if the peak dose occurs after 10,000 years. Under this approach, DOE must make the performance assessment results for the post-10,000-year period part of the public record by including them in the EIS for Yucca Mountain.

The relevance of a 10,000-year compliance period can also be understood by examining hazard indices that compare the potential risk of released radionuclides to other risks. One such analysis, presented in the *Final Environmental Impact Statement for the Management of Commercially Generated Radioactive Waste,* DOE/EIS-0046F, examined the relative amounts of water required to bring the concentration of a substance to allowable drinking water standards. The relative hazard for spent fuel compared to the toxicity of the ore used to produce the reactor fuel at one year after removal of the spent fuel from the reactor is about the same hazard as a rich mercury ore. The hazard index is about the same as average mercury ores at about 80 years. By 200 years the hazard index is about the same as average lead ore; by 1,000 years it is comparable to a silver ore. The relative hazard index is about the same as the uranium ore that it came from at 10,000 years. This is not to suggest that the wastes from spent fuel are not toxic. However, it is suggested that where concern for the toxicity of the ore bodies is not great, the spent fuel should cause no greater concern, particularly if placed within multiple engineered barriers in geologic formations, at least as, if not more, remote from the biosphere than these common ores.

[28] Risk to human beings from radiation is due to its ionizing effects. Radionuclides found in nature, commercial products, and nuclear waste emit ionizing radiation. The forms of ionizing radiation differ in their penetrating power or energy and in the manner in which they affect human tissue. Some ionizing radiation, known as alpha radiation, can be stopped by a sheet of paper, but may be very harmful if inhaled, ingested or otherwise admitted into the body. Long-lived radioactive elements, with atomic numbers higher than 92, such as plutonium, emit alpha radiation. Other ionizing radiation, known as beta radiation, can penetrate the skin and can cause serious effects if emitted from an inhaled or ingested radionuclide. The ionizing radiation with the greatest penetrating power is gamma radiation; it can penetrate and damage critical organs in the body. Fission products can emit both gamma and beta radiation depending on the radionuclides present. In high-level nuclear waste, beta and gamma radiation emitters, such as cesium and strontium, present the greatest hazard for the first 300 to 1,000 years, by which time they have decayed. After that time, the alpha-emitting radionuclides present the greatest hazard.

Radiation doses can be correlated to potential biologic effects and are measured in a unit called a rem. Doses are often expressed in terms of thousandths of a rem, or millirem (mrem); the internationally used unit is the Sievert (S), which is equivalent to 100 rem.

[29] The NRC regulations also require that the annual dose to workers there be less than 5 rem. See 10 CFR part 63, referencing 10 CFR part 20. This is the general standard for occupational exposure that applies in numerous other settings, such as operating nuclear facilities.

[30] During both pre- and post-closure, the NRC licensing rules, 10 CFR part 63, also contain a number of more particularized standards for specific situations. These are referenced in the results tables contained in the following sections. Pursuant to EPA's groundwater standard, 40 CFR part 197, they also contain concentration limits on certain kinds of radionuclides that may be present in the water, whether or not their presence is attributable to a potential repository. These are also referenced in the results tables.

annual exposure from the repository is thus slightly over four percent of what we receive every year right now.

Moreover, background radiation varies from one location to another due to many natural and man-made factors. At higher elevations, the atmosphere provides less protection from cosmic rays, so background radiation is higher. In the United States, this variation can be 50 or more millirem. Thus, if the repository generates radiation doses set as the benchmark in the Guidelines, the incremental radiation dose a person living in the vicinity of Yucca Mountain would receive from it would be about the same level of increase in radiation exposure as a person would experience as a result of moving from Philadelphia to Denver.

Ordinary air travel is another example. Flying at typical cross-country altitudes results in increased exposure of about one-half millirem per hour. If the Yucca Mountain repository generates radiation at the 15 millirem benchmark, it would increase the exposure of those living near it to about the same extent as if they took three round trip flights between the East Coast and Las Vegas.

Rocks and soil also affect natural background radiation, particularly if the rocks are igneous or the soils derived from igneous rock, which can contain radioactive potassium, thorium, or uranium. In these cases, the variation in the background radiation is frequently in the tens of millirem or higher. Wood contains virtually no naturally occurring radioactive substances that contribute to radiation exposures, but bricks and concrete made from crushed rock and soils often do. Living or working in structures made from these materials can also result in tens of millirem of increased exposure to radiation. Thus, if the repository generates radiation at the levels in the Guidelines' benchmark, it is likely to result in less additional exposure to a person living in its vicinity than if he moved from a wood house to a brick house.

Finally, it is noteworthy that the radiation protection standards referenced by the Guidelines are based on those selected by the NRC for licensing the repository. They in turn relied on the EPA rule establishing these as the appropriate standards for the site. The NRC and EPA acted pursuant to specific directives in the NWPA, in which Congress first assigned to the EPA the responsibility to set these standards, and later in the Energy Policy Act of 1992, which directed the EPA to act in conjunction with the National Academy of Sciences and develop a standard specifically for Yucca Mountain. The EPA carefully considered the question of how to do so. The 15 millirem per year standard is the same it has applied to the Waste Isolation Pilot Plant in New Mexico.[31] And it is well within the National Academy of Sciences-recommended range, a range developed in part by referring to guidelines from national and international advisory bodies and regulations in other developed countries.[32]

For all these reasons, there is every cause to believe that a repository that can meet the 15 millirem radiation protection standard will be fully protective of the health and safety of residents living in the vicinity of the repository.[33]

6.1.3. Underlying Hard Science

As explained in section 6.1.1, the Guidelines contemplate the use of models and analyses to project whether the repository will meet the 15 millirem dose standard.[34] To have confidence in the model results, however, it is important to understand the kind of science that went into constructing them.

For over 20 years, scientists have been investigating every aspect of the natural processes—past, present and future—that could affect the ability of a repository beneath Yucca Mountain to isolate radionuclides emitted from nuclear materials emplaced there. They have been conducting equally searching investigations into the processes that would allow them to understand the behavior of the engineered barriers—principally the waste "packages" (more nearly akin to vaults)—that are expected to contribute to successful waste isolation. These investigations have run the gamut, from mapping the geological features of the site, to studying the repository rock, to investigating whether and how water moves through the Mountain. To give just a few examples:

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[31] 40 CFR part 191.

[32] *Technical Bases for Yucca Mountain Standards,* National Academy of Sciences, National Research Council, 1995.

[33] As noted above, the EPA, in 40 CFR part 197, also established groundwater protection standards in the Yucca Mountain rule; these are compatible with drinking water standards applied elsewhere in the United States, and apply maximum contaminant levels, as well as a 4 mrem/yr dose standard.

[34] As well, of course, as the other radiation protection standards such as the groundwater standard.

At the surface of the repository:

- Yucca Mountain scientists have mapped geologic structures, including rock units, faults, fractures, and volcanic features. To do this, they have excavated more than 200 pits and trenches to remove alluvial material or weathered rock to be able to observe surface and near-surface features directly, as well as to understand what events and processes have occurred or might occur at the Mountain.
- They have drilled more than 450 surface boreholes and collected over 75,000 feet of geologic core samples and some 18,000 geologic and water samples. They used the information obtained to identify rock and other formations beneath the surface, monitor infiltration of moisture, measure the depth of the water table and properties of the hydrologic system, observe the rate at which water moves from the surface into subsurface rock, and determine air and water movement properties above the water table.
- They have conducted aquifer testing at sets of wells to determine the transport and other properties of the saturated zone below Yucca Mountain. These tests included injecting easily identified groundwater tracers in one well, which were then detected in another; this helped scientists understand how fast water moves.
- They have conducted tectonic field studies to evaluate extensions of the earth's crust and the probability of seismic events near Yucca Mountain.

Underground:

The Department's scientists have conducted a massive project to probe the area under the Mountain's surface where the repository will be built.

- They constructed a five mile-long main underground tunnel, the Exploratory Studies Facility, to provide access to the specific rock type that would be used for the repository. This main tunnel is adjacent to the proposed repository block, about 800 feet underground. After completing the main tunnel, they excavated a second tunnel, 1.6-miles long and 16.5 feet in diameter. This tunnel, referred to as the Cross-Drift tunnel, runs about 45 feet above and across the repository block.
- They then mapped the geologic features such as faults, fractures, stratigraphic units, mineral compositions, etc., exposed by the underground openings in the tunnels.
- They collected rock samples to determine geotechnical properties.
- They conducted a drift-scale thermal test to observe the effects of heat on the hydrologic, mechanical, and chemical properties of the rock, and chemical properties of the water and gas liberated as a result of heating. The four yearlong heating cycle of the drift-scale test was the largest known heater test in history, heating some seven million cubic feet of rock over its ambient temperature. This test also included samples of engineered materials to determine corrosion resistance in simulated repository conditions.

In various laboratory-based studies:

Yucca Mountain scientists have supplemented with laboratory work the surface and underground tests previously described.

- They have tested mechanical, chemical, and hydrologic properties of rock samples in support of repository design and development of natural process models.
- They have tested radionuclides to determine solubility and colloid formation that affect their transport if released.
- They have tested over 13,000 engineered material samples to determine their corrosion resistance in a variety of environments.
- They have determined the chemical properties of water samples and the effects of heat on the behavior and properties of water in the host rock.

The findings from these numerous studies were used to develop computer simulations that describe the natural features, events, and processes that exist at Yucca Mountain or that could be changed as the result of waste disposal. The descriptions in turn were used to develop the models discussed in the next section to project the likely radiation doses from the repository.

7. RESULTS OF SUITABILITY EVALUATIONS AND CONCLUSIONS

As explained above, the Guidelines contemplate that the Secretary will evaluate the suitability of the Yucca Mountain site for a repository on two separate bases.

The Guidelines first contemplate that I will determine whether the site is suitable for a repository during the entire pre-closure or operational period, assumed to be from 50 to 300 years after emplacement of nuclear materials begins. To answer this

question, the Guidelines ask me to determine whether, while it is operating, the repository is likely to result in annual radiation doses to people in the vicinity and those working there that will fall below the dosage levels set in the radiation protection standards.[35] The Guidelines contemplate that I will use a pre-closure safety evaluation to guide my response.[36]

Second, the Guidelines contemplate that I will determine whether the repository is suitable—in other words, may reasonably be expected to be safe—after it has been sealed. To answer that question, the Guidelines ask me to determine whether it is likely that the repository will continue to isolate radionuclides for 10,000 years after it is sealed, so that an individual living 18 kilometers (11 miles) from the repository is not exposed to annual radiation doses above those set in the radiation protection standards.[37] The Guidelines contemplate that I will use a Total System Performance Assessment to guide my response to this question.[38]

The Department has completed both the Pre-Closure Safety Evaluation and TSPA called for by the Guidelines. These project that a repository at Yucca Mountain will result in radioactive doses well below the applicable radiation protection standards. As I explain below, I have reviewed these projections and the bases for them, and I believe them to be well founded. I also believe both the Pre-Closure Safety Evaluation and the Total System Performance Assessment have properly considered the criteria set out in the Guidelines for each period. Using these evaluations as set out in the Guidelines,[39] believe it is likely that a repository at Yucca Mountain will result in radiation doses below the radiation protection standards for both periods. Accordingly, I believe Yucca Mountain is suitable for the development of a repository.

7.1. Results of Pre-Closure Evaluations

As explained in section 6.1.1, the Pre-Closure Safety Evaluation method I have employed is commonly used to assess the likely performance of planned or prospective nuclear facilities. Essentially what it involves is evaluating whether the contemplated facility is designed to prevent or mitigate the effects of possible accidents. The facility will be considered safe if its design is likely to result in radioactive releases below those set in the radiation protection standards.

The Department has conducted such a Pre-Closure Safety Evaluation, which is summarized in the *Yucca Mountain Science and Engineering Report, Revision 1.*[40] In conducting this evaluation, the Department considered descriptions of how the site will be laid out, the surface facilities, and the underground facilities and their operations. It also considered a series of potential hazards, including, for example, seismic activity, flooding, and severe winds, and their consequences. Finally, it considered preliminary descriptions of how components of the facilities' design would prevent or mitigate the effects of accidents.

The Pre-Closure Safety Evaluation concluded that the preliminary design would prevent or dramatically mitigate the effects of accidents, and that the repository would therefore not result in radioactive releases that would lead to exposure levels above those set by the radiation protection standards. It considered the pre-closure criteria of 10 CFR 963.14 in reaching this conclusion. In particular, it found that the preliminary design has the ability to contain and limit releases of radioactive materials; the ability to implement control and emergency systems to limit exposures to radiation; the ability to maintain a system and components that perform their intended safety functions; and the ability to preserve the option to retrieve wastes during the pre-closure period. The annual doses of radiation to which the Pre-Closure Safety Evaluation projected individuals in the vicinity of the repository and workers would be exposed are set out in the following table. These doses fall well below the levels that the radiation protection standards establish.

I have carefully reviewed the Pre-Closure Safety Evaluation and find its conclusions persuasive. I am therefore convinced that a repository can be built at Yucca Mountain that will operate safely without harming those in the repository's vicinity during the pre-closure period. Finally, I would note that although many aspects of this project are controversial, there is no controversy of which I am aware concerning this aspect of the Department's conclusions. This stands to reason. The kinds of activities that would take place at the repository during the pre-closure period—essentially, the management and handling of nuclear materials including packaging and emplacement in the repository—are similar to the kinds of activities that at

[35] 10 CFR part 963.
[36] Ibid.
[37] Ibid.
[38] Ibid.
[39] Ibid.
[40] *Yucca Mountain Science and Engineering Report, Revision 1.*

present go on every day, and have gone on for years, at temporary storage sites around the country. These activities are conducted safely at those sites, and no one has advanced a plausible reason why they could not be conducted equally if not more safely during pre-closure operations at a new, state-of-theart facility at Yucca Mountain.

That is not an insignificant point, since the pre-closure period will last at least 50 years after the start of emplacement, which will begin at the earliest eight years from today. Moreover, the Department's Pre-Closure Safety Evaluation also assumed a possible alternative pre-closure period of 300 years from the beginning of emplacement, and its conclusions remained unchanged. Thus, the Department's conclusion that the repository can operate safely for the next 300 years—or for about three generations longer than the United States has existed—has not been seriously questioned.

Table 1. Summary Pre-Closure Dose Performance Criteria and Evaluation Results[41]

Standard	Limits	Results
Public Exposures[a]		
Pre-closure standard: 10 CFR 63.204, referenced in 10 CFR 963.2; Pre-Closure Performance Objective for normal operations and Category 1 event sequences per 10 CFR 63.111(a)(2), referenced in 10 CFR 963.2	15 mrem/yr[b]	0.06 mrem/yr[b]
Constraint specified for air emissions of radioactive material to the environment (not a dose limitation): 10 CFR 20.1101 (d)[c]	10 mrem/yr[b,d]	0.06 mrem/yr[b]
Dose limits for individual member of the public for normal operations and Category 1 event sequences: 10 CFR 20.1301[c]	100 mrem/yr[b,d]	0.06 mrem/yr[b]
	2 mrem/hr in any unrestricted area from external sources	<<2 mrem/hr
Pre-Closure Performance Objective for any Category 2 event sequence: 10 CFR 63.111(b)(2), referenced in 10 CFR 963.2	5 rem[b]	0.02 rem[b]
	50 rem organ or tissue dose (other than the lens of the eye)	0.10 rem
	15 rem lens of the eye dose	0.06 rem
	50 rem skin dose	0.04 rem
Workers' Exposures		
Occupational Dose Limits for Adults from normal operational emissions and Category 1 event sequences: 10 CFR 20.1201[e]	5 rem/yr[b]	0.01 rem/yr[b]
	50 rem/yr organ or tissue dose (other than the lens of the eye)	0.10 rem/yr
	15 rem/yr lens of the eye dose	0.15 rem/yr
	50 rem/yr skin dose	0.13 rem/yr
Routine Occupational Dose Limits for Adults: 10 CFR 20.1201[e]	5 rem/yr[b]	0.06 to 0.79 rem/yr[b]

NOTES:
[a] Results for public exposures are calculated at the site boundary.
[b] Total effective dose equivalent.
[c] 10 CFR 63.111(a)(1), which is referenced in 10 CFR 963.2, would require repository operations area to meet the requirements of 10 CFR part 20.
[d] 10 CFR 20.1301(a)(1), which is cross-referenced through 10 CFR 963.2; dose limit to extent applicable.
[e] 10 CFR 63.111(b)(1), which referenced in 10 CFR 963.2, would require repository design objectives for Category 1 and normal operations to meet 10 CFR 63.111(a)(1) requirements (10 CFR part 20).

7.2. Results of Post-Closure Evaluations

The most challenging aspect of evaluating Yucca Mountain is assessing the likely post-closure performance of a repository 10,000 years into the future. As previously explained, the Department's Guidelines contemplate that this will be done using a Total System Performance Assessment. That assessment involves using data compiled from scientific investigation into the natural processes that affect the site, the behavior of the waste, and the behavior of the engineered barriers such as the waste packages; developing models from these data; then developing a single model of how, as a whole, a repository at Yucca Mountain is likely to behave during the post-closure period. The model is then used to project radiation doses to which people in the vicinity of the Mountain are likely to be exposed as a result of the repository. Finally, the assessment compares the projected doses with the radiation protection standards to determine whether the repository is likely to comply with them.

The challenge, obviously, is that this involves making a prediction a very long time into the future concerning the behavior of a very complex system. To place 10,000 years into perspective, consider that the Roman Empire flourished nearly 2,000 years ago. The pyramids were built as long as 5,000 years ago, and plants were domesticated some 10,000 years ago. Accordingly, as the NRC explained, "Proof that the geologic repository will conform with the objectives for post-closure performance is not to be had in the ordinary sense of the word because of the uncertainties inherent in the understanding of the evolution of the geologic setting, biosphere, and engineered barrier system"[42] over 10, 000 Years. The judgment that the NRC envisions making is therefore not a certainty that the repository will conform to the standard, certainty being unattainable in this or virtually any other important matter where choices must be made. Rather, as it goes on to explain, "For such long-term performance, what is required is reasonable expectation, making allowance for the time period, hazards, and uncertainties involved, that the outcome will conform with the objectives for post-closure performance for the geologic repository.[43] The Nuclear Waste Technical Review Board recently summarized much the same thought (emphasis added): "Eliminating all uncertainty associated with estimates of repository performance would never be possible at repository site."[44]

These views, in turn, inform my understanding of the judgment I am expected to make at this stage of the proceeding in evaluating the likely post-closure performance of a repository at Yucca Mountain. To conclude that it is suitable for post-closure, I do not need to know that we have answered all questions about the way each aspect of the repository will behave 10,000 years from now; that would be an impossible task. Rather, what I need to decide is whether, using the TSPA results, and fully bearing in mind the inevitable uncertainties connected with such an enterprise, I can responsibly conclude that we know enough to warrant a predictive judgment on my part that, during the post-closure period, a repository at Yucca Mountain is likely to meet the radiation protection standards.

I believe I can. Essentially, the reason for this is the system of multiple and redundant safeguards that will be created by the combination of the site's natural barriers and the engineered ones we will add. Even given many uncertainties, this calculated redundancy makes it likely that very little, if any, radiation will find its way to the accessible environment.

Before I describe in broad terms how the TSPA results and the criteria used in the regulations lead to this conclusion, I would like to give an illustration of how this works. The illustration draws on the TSPA analyses, but also explains what these analyses mean in the real world.

An Example

The most studied issue relating to Yucca Mountain, and the single most pressing concern many have felt about the post-closure phase of a repository there, is whether there might be a way for radionuclides from the emplaced nuclear materials to contaminate the water supply. This is not a problem unique to Yucca Mountain. Rather, besides disruptive events discussed later, water is the primary mechanism to transport radionuclides to people and is also the most likely mechanism for radionuclides to escape from the storage facilities we have now.

In the case of Yucca Mountain, the concern has been that rainwater seeping into the Mountain might contact disposal casks and carry radionuclides down to the

[41] Yucca Mountain Site Suitability Evaluation.

[42] Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada, Final Rule, 66 Fed. Reg. 55731, 55804, November 2, 2001.

[43] Ibid.

[44] Nuclear Waste Technical Review Board Letter Report from all Board members to Speaker Hastert, Senator Byrd, and Secretary Abraham, January 24, 2002.

water table in sufficient amounts to endanger sources of groundwater. In my judgment, when one considers everything we have learned about the multiple natural and engineered barriers that lie at the core of the Department's planning for this Project, this concern turns out to have virtually no realistic foundation.

Yucca Mountain is in the middle of a desert. Like any desert, it has an arid climate, receiving less than eight inches of rain in an average year. Most of that runs off the Mountain or evaporates. Only about five percent, less than four-tenths of an inch per year, ever reaches repository depth.

In order to reach the tunnels where the waste casks would be housed, this water must travel through about 800 feet of densely welded and bedded tuffs,[45] a trip that will typically require more than 1,000 years. The amount of water that eventually reaches the repository level at any point in time is very small, so small that capillary forces tend to retain it in small pores and fractures in the rock. It is noteworthy that all our observations so far indicate that no water actually drips into the tunnels at this level and all of the water is retained within the rock.

In spite of this finding, our TSPA ran calculations based on the assumption that water does drip into the tunnels. At that point, even just to reach radionuclides in the waste, the water would still have to breach the engineered barriers. These include waste packages composed of an outer barrier of highly corrosion-resistant alloy and a thick inner barrier of high quality stainless steel.

The waste package is designed to prevent contact between the waste pellets and water that might seep into the tunnels unexpectedly, and thus to prevent release of radionuclides.[46] In addition, anchored above each waste package is a titanium drip shield that provides yet more protection against seepage. But even assuming the water defeats both the titanium shield and the metal waste package, the waste form itself is a barrier to the release of radionuclides. Specifically, the spent fuel is in the form of ceramic pellets, resistant to degradation and covered with a corrosion-resistant metal cladding.

Nevertheless, DOE scientists ran a set of calculations assuming that water penetrated the titanium shield and made small holes in three waste packages, due to manufacturing defects (even though the manufacturing process will be tightly controlled). The scientists further assumed that the water dissolves some of the ceramic waste. Even so, the analyses showed that only small quantities of radionuclides would diffuse and escape from the solid waste form. In order to reach the water table from the repository, the water, now assumed to be carrying radionuclides, must travel another 800 feet through layers of rock, some of which are nearly impenetrable. During this trip, many of the radionuclides are adsorbed by the rock because of its chemical properties.

The result of all this is instructive. Even under these adverse conditions, all assumed in the teeth of a high probability that not one of them will come to pass, the amount of radionuclides reaching the water table is so low that annual doses to people who could drink the water are well below the applicable radiation standards, and less than a millionth of the annual dose people receive from natural background radiation. Extrapolating from these calculations shows that even if all of the waste packages were breached in the fashion I have described above, the resulting contribution to annual dose would still be below the radiation safety standards, and less than one percent of the natural background.[47]

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[45] Yucca Mountain consists of alternating layers of welded and nonwelded volcanic material known as welded and non-welded tuff: welded tuff at the surface, welded tuff at the level of the repository, and an intervening layer of nonwelded tuffs. These nonwelded units contain few fractures; thus, they delay the downward flow of moisture into the welded tuff layer below, where the repository would be located. At the repository level, water in small fractures has a tendency to remain in the fractures rather than flow into larger openings, such as tunnels. Thus, the small amount of water traveling through small fractures near any emplacement tunnel would tend to flow around the tunnel, rather than seeping, forming a drip, and falling onto the drip shields below. Non-welded tuffs below the repository also provide a significant barrier to radionuclide transport. Deposits of minerals in the fractures demonstrate that for the last several million years the repository host rock has been under unsaturated conditions, even when higher precipitation, owing to the continent's overall glacial conditions, prevailed at the Mountain's surface.

[46] These engineered barriers will protect the waste under a wide range of conditions. For example, the barriers are protected by their underground location from the daily variations in temperature and moisture that occur above ground. As a result, the Mountain provides favorable conditions for the performance of these barriers. Indeed, the battery of tests we have conducted suggests that the waste packages are extremely resistant to corrosion.

[47] *Yucca Mountain Science and Engineering Report, Revision 1.*

Total System Performance More Generally

It is important to understand that there is nothing unique about the kind of planning illustrated in the water seepage scenario described above. Rather, the scenario is characteristic of the studies DOE has undertaken and the solutions it has devised: deliberately pessimistic assumptions incorporated sometimes to the point of extravagance, met with multiple redundancies to assure safety. For example, one of our scenarios for Nevada postulates the return of ice ages, and examines Yucca Mountain assuming that it would receive about twice as much rain as it does today with four times as much infiltration into the Mountain.

As in the example above, the Department evaluated physical and historical information used to develop models of repository components, and then employed those models to forecast how the repository would perform in the post-closure period. These results are described at length in the TPSA analyses and summarized in Chapter 4 of the *Yucca Mountain Science and Engineering Report.*[48]

The Department used the suitability criteria set forth in 10 CFR 963.17 in the TSPA analyses. It carefully evaluated and modeled the behavior of characteristics of the site, such as its geologic, hydrologic, geophysical, and geochemical properties. Likewise it evaluated what are called unsaturated zone flow characteristics, such as precipitation entering the Mountain and water movement through the pores of the rock—in other words, natural processes which affect the amount of water entering the unsaturated zone above the repository and potentially coming in contact with wastes inside. DOE also evaluated and modeled near-field environment characteristics, such as effects of heat from the waste on waterflow through the site, the temperature and humidity at the engineered barriers, and chemical reactions and products that could result from water contacting the engineered barriers.

The Department carefully studied and modeled the characteristics of the engineered barriers as they aged. DOE emphasized specifically those processes important to determining waste package lifetimes and the potential for corroding the package. It examined waste form degradation characteristics, including potential corrosion or break-down of the cladding on the spent fuel pellets and the ability of individual radionuclides to resist dissolving in water that might penetrate breached waste packages. It examined ways in which radionuclides could begin to move outward once the engineered barrier system has been degraded—for example, whether colloidal particles might form and whether radionuclides could adhere to these particles as they were assumed to wash through the remaining barriers. Finally, the Department evaluated and modeled saturated and unsaturated zone flow characteristics, such as how water with dissolved radionuclides or colloidal particles might move through the unsaturated zone below the repository, how heat from the waste would affect waterflow through the site, and how water with dissolved radionuclides would move in the saturated zone 800 feet beneath the repository (assuming it could reach that depth).

Consistent with 10 CFR 963.17, the Department also evaluated the lifestyle and habits of individuals who potentially could be exposed to radioactive material at a future time, based, as would be required by NRC licensing regulations,[49] on representative current conditions. Currently, there are about 3,500 people who live in Amargosa Valley, the closest town to Yucca Mountain. They consume ground or surface water from. the immediate area through direct extraction or by eating plants that have grown in the soil. The Department therefore assumed that the "reasonably maximally exposed individual"—that is, the hypothetical person envisioned to test whether the repository is likely to meet required radiation protection standards—likewise would drink water and eat agricultural products grown with water from the area, and built that assumption into its models.

Using the models described above, as well as a host of others it generated taking account of other relevant features, events and processes that could affect the repository's performance, the Department developed a representative simulation of the behavior of the proposed Yucca Mountain site. It then considered thousands of possibilities about what might happen there. For example, it considered the possibility that waste packages might be manufactured defectively. It considered the possibility that the climate would change. It considered earthquakes. Our studies show that earthquakes probably will occur at Yucca Mountain sometime in the future. Because the occurrence of earthquakes is difficult to predict, our models conservatively treat earthquakes by assuming that they will occur over the next 10,000 years.

Essentially, if the Department believed that there was close to a 1 in 10,000 per year probability of some potentially adverse occurrence in the course of the 10,000

[48] Ibid.
[49] 10 CFR part 63.

year post-closure period (which comes to a probability close to one during the entire period) the Department considered that possibility, unless it concluded the occurrence would not affect the repository's performance. It then used the simulation model to calculate what the resulting dose would be based on each such possibility. Finally, it used the mean peak values of the results of these calculations to project the resulting dose.

The Department then proceeded to consider the impact of disruptive events, such as volcanism, with a lower probability of occurrence, on the order of one in 10,000 over the entire 10,000 year period (meaning roughly a one in a 100 million per year of occurring during that time). This led it to analyze, for example, the effects that a volcano might have on the repository's waste containment capabilities. Scientists started with a careful analysis of the entire geologic setting of Yucca Mountain. Then, with substantial data on regional volcanoes, they used computer modeling to understand each volcanic center's controlling structures. Experts then estimated the likelihood of magma intruding into one of the repository's emplacement tunnels. The DOE estimates the likelihood of such an event's occurring during the first 10,000 years after repository closure to be one chance in about 70 million per year, or one chance in 7,000 over the entire period.

Including volcanoes in its analyses, the TSPA results still indicate that the site meets the EPA standards.[50] What the calculations showed is that the projected, probability-weighted maximum mean annual dose to an individual from the repository for the next 10,000 years is one-tenth of a millirem. That is less than one-fifth of the dose an individual gets from a one-hour airplane flight. And it is less than one one-hundredth of the dose that DOE's Guidelines, using the EPA standards, specify as acceptable for assessing suitability.

Finally, in a separate assessment, analysts studied a hypothetical scenario under which people inadvertently intruded into the repository while drilling for water. The Guidelines' radiation protection standards, based on EPA and NRC rules, specify that as part of its Total System Performance Assessment, DOE should determine when a human-caused penetration of a waste package could first occur via drilling, assuming the drillers were using current technology and practices and did not recognize that they had hit anything unusual. If such an intrusion could occur within 10,000 years, the 15 millirem dose limit would apply.

DOE's analyses, however, indicate that unrecognized contact through drilling would not happen within 10,000 years. Under conditions that DOE believes can realistically be expected to exist at the repository, the waste packages are extremely corrosion-resistant for tens of thousands of years. Even under pessimistic assumptions, the earliest time DOE could even devise a scenario under which a waste package would be unnoticeable to a driller is approximately 30,000 years. Before then, the waste package structure would be readily apparent to a driller who hit it.

Table 2 presents the summary results of the Total System Performance Assessment analyses and how they compare to the radiation protection standards.[51]

In Summary

Using the methods and criteria set out in DOE's Yucca Mountain Site Suitability Guidelines, I am convinced that the Yucca Mountain site is scientifically suitable—in a word, safe—for development of a repository. Specifically, on the basis of the safety evaluation DOE has conducted pursuant to 10 CFR 963.13, it is my judgment that a repository at the site is likely to meet applicable radiation protection standards for the pre-closure period. And on the basis of the Total System Performance Assessment DOE has conducted pursuant to 10 CFR 963.16, it is my judgment that a repository at the site is likely to meet applicable radiation protection standards for the post-closure period as well. Additionally, I have evaluated the pre-closure suitability criteria of 10 CFR 963.14 and the post-closure suitability criteria of 10 CFR 963.17, and am convinced that the safety evaluations were done under the stringent standards required. Accordingly, I find the Yucca Mountain site suitable for development of a repository.

8. THE NATIONAL INTEREST

Having determined that the site is scientifically suitable, I now turn to the remaining factors I outlined above as bearing on my Recommendation. Are there compelling national interests favoring going forward with a repository at Yucca Mountain? If so, are there countervailing considerations of sufficient weight to overcome

[50] The results produced under volcanic scenarios are weighted by probability under the NRC method specified for how to treat low probability events. 10 CFR Part 63.

[51] *Yucca Mountain Site Suitability Evaluation.*

those interests? In this section I set out my conclusions on the first question. In section 9 I set out my views on the second.

8.1. Nuclear Science and the National Interest

Our country depends in many ways on the benefits of nuclear science: in the generation of twenty percent of the Nation's electricity; in the operation of many of the Navy's most strategic vessels; in the maintenance of the Nation's nuclear weapons arsenal; and in numerous research and development projects, both medical and scientific. All these activities produce radioactive wastes that have been accumulating since the mid-1940s. They are currently scattered among 131 sites in 39 states, residing in temporary surface storage facilities and awaiting final disposal. In exchange for the many benefits of nuclear power, we assume the cost of managing its byproducts in a responsible, safe, and secure fashion. And there is a near-universal consensus that a deep geologic facility is the only scientifically credible, long-term solution to a problem that will only grow more difficult the longer it is ignored.

Table 2. Summary Post-Closure Dose and Activity Concentration Limits and Evaluation Results

Standard	Limits	Results[e]
Individual protection standard: 10 CFR 63.311, referenced in 10 CFR 963.2	15 mrem/yr TEDE	0.1 mrem/yr[a] (HTOM) 0.1 mrem/yr[a] (LTOM)
Human intrusion standard: 10 CFR 63.321, referenced in 10 CFR 963.2	15 mrem/yr TEDE	NA[b]
Groundwater protection standard: 10 CFR 63.331, referenced in 10 CFR 963.2	5 pCi/L combined radium-226 and radium-228, including natural background	1.04 pCi/L[c] (HTOM) 1.04 pCi/L[c] (LTOM)
	15 pCi/L gross alpha activity (including radium-226 but excluding radon and uranium), including natural background	1.1 pCi/L[c,d] (HTOM) 1.1 pCi/L[c,d] (LTOM)
	4 mrem/yr to the whole body or any organ from combined beta-and photon-emitting radionuclides	.000023 mrem/yr (HTOM) .000013mrem/yr (LTOM)

NOTES: [a] Probability-weighted peak mean dose equivalent for the nominal and disruptive scenarios, which include igneous activity; results are based on an average annual water demand of approximately 2,000 acre-ft; the mean dose for groundwater-pathway-dominated scenarios would be reduced by approximately one-third by using 3,000 acre-ft.

[b] Human-intrusion-related releases are not expected during the period of regulatory compliance; the DOE has determined that the earliest time after disposal that the waste package would degrade sufficiently that a human intrusion could occur without recognition by the driller is at least 30,000 years, so the dose limits do not apply for purposes of the site suitability evaluation.

[c] These values represent measured natural background radiation concentrations; calculated activity concentrations from repository releases are well below minimum detection levels, background radiation concentrations, and regulatory limits.

[d] Gross alpha background concentrations are 0.4 pCi/L $\pm$ 0.7 (for maximum of 1.1 pCi/L).

[e] Peak value of the mean probability-weighted results within the regulatory timeframe.

TEDE= total effective dose equivalent; HTOM= higher temperature operating mode; LTOM= lower-temperature operating mode; NA= not applicable. Source: Williams 2001a, Section 6, Tables 6-1, 6-2, 6-3, and 6-4.

8.2. Energy Security

Roughly 20 percent of our country's electricity is generated from nuclear power. This means that, on average, each home, farm, factory, and business in America runs on nuclear fuel for a little less than five hours a day.

A balanced energy policy—one that makes use of multiple sources of energy, rather than becoming dependent entirely on generating electricity from a single source, such as natural gas—is important to economic growth. Our vulnerability to shortages and price spikes rises in direct proportion to our failure to maintain diverse sources of power. To assure that we will continue to have reliable and affordable sources of energy, we need to preserve our access to nuclear power.

Yet the Federal government's failure to meet its obligation to dispose of spent nuclear fuel under the NWPA—as it has been supposed to do starting in 1998—is placing our access to this source of energy in jeopardy. Nuclear power plants have been storing their spent fuel on site, but many are running out of space to do so. Unless a better solution is found, a growing number of these plants will not be able to find additional storage space and will be forced to shut down prematurely. Nor are we likely to see any new plants built.

Already we are facing a growing imbalance between our projected energy needs and our projected supplies. The loss of existing electric generating capacity that we will experience if nuclear plants start going off-line would significantly exacerbate this problem, leading to price spikes and increased electricity rates as relatively cheap power is taken off the market. A permanent repository for spent nuclear fuel is essential to our continuing to count on nuclear energy to help us meet our energy demands.

8.3. National Security

8.3.1. Powering the Navy Nuclear Fleet

A strong Navy is a vital part of national security. Many of the most strategically important vessels in our fleet, including submarines and aircraft carriers, are nuclear powered. They have played a major role in every significant military action in which the United States has been involved for some 40 years, including our current operations in Afghanistan. They are also essential to our nuclear deterrent. In short, our nuclear-powered Navy is indispensable to our status as a world power.

For the nuclear Navy to function, nuclear ships must be refueled periodically and the spent fuel removed. The spent fuel must go someplace. Currently, as part of a consent decree entered into between the State of Idaho and the Federal Government, this material goes to temporary surface storage facilities at the Idaho National Environmental and Engineering Laboratory. But this cannot continue indefinitely, and indeed the agreement specifies that the spent fuel must be removed. Failure to establish a permanent disposition pathway is not only irresponsible, but could also create serious future uncertainties potentially affecting the continued capability of our Naval operations.

8.3.2. Allowing the Nation to Decommission Its Surplus Nuclear Weapons and Support Nuclear Non-Proliferation Efforts

A decision now on the Yucca Mountain repository is also important in several ways to our efforts to prevent the proliferation of nuclear weapons. First, the end of the Cold War has brought the welcome challenge to our country of disposing of surplus weapons-grade plutonium as part of the process of decommissioning weapons we no longer need. Current plans call for turning the plutonium into "mixed-oxide" or "MOX" fuel. But creating MOX fuel as well as burning the fuel in a nuclear reactor will generate spent nuclear fuel, and other byproducts which themselves will require somewhere to go. A geological repository is critical to completing disposal of these materials. Such complete disposal is important if we are to expect other nations to decommission their own weapons, which they are unlikely to do unless persuaded that we are truly decommissioning our own.

A repository is important to non-proliferation for other reasons as well. Unauthorized removal of nuclear materials from a repository will be difficult even in the absence of strong institutional controls. Therefore, in countries that lack such controls, and even in our own, a safe repository is essential in preventing these materials from falling into the hands of rogue nations. By permanently disposing of nuclear weapons materials in a facility of this kind, the United States would encourage other nations to do the same.

8.4. Protecting the Environment

An underground repository at Yucca Mountain is important to our efforts to protect our environment and achieve sustainable growth in two ways. First, it will allow us to dispose of the radioactive waste that has been building up in our country

for over fifty years in a safe and environmentally sound manner. Second, it will facilitate continued use and potential expansion of nuclear power, one of the few sources of electricity currently available to us that emits no carbon dioxide or other greenhouse gases.

As to the first point: While the Federal government has long promised that it would assume responsibility for nuclear waste, it has yet to start implementing an environmentally sound approach for disposing of this material. It is past time for us to do so. The production of nuclear weapons at the end of the Second World War and for many years thereafter has resulted in a legacy of high-level radioactive waste and spent fuel, currently located in Tennessee, Colorado, South Carolina, New Mexico, New York, Washington, and Idaho. Among these wastes, approximately 100,000,000 gallons of high-level liquid waste are stored in, and in some instances have leaked from, temporary holding tanks. In addition to this high-level radioactive waste, about 2,100 metric tons of solid, unreprocessed fuel from a plutonium-production reactor are stored at the Hanford Nuclear Reservation, with another 400 metric tons stored at other DOE sites.

In addition, under the NWPA, the Federal government is also responsible for disposing of spent commercial fuel, a program that was to have begun in 1998, four years ago. More than 161 million Americans, well more than half the population, reside within 75 miles of a major nuclear facility—and, thus, within 75 miles of that facility's aging and temporary capacity for storing this material. Moreover, because nuclear reactors require abundant water for cooling, on-site storage tends to be located near rivers, lakes, and seacoasts. Ten closed facilities, such as Big Rock Point, on the banks of Lake Michigan, also house spent fuel and incur significant annual costs without providing any ongoing benefit. Over the long-term, without active management and monitoring, degrading surface storage facilities may pose a risk to any of 20 major U.S. lakes and waterways, including the Mississippi River. Millions of Americans are served by municipal water systems with intakes along these waterways. In recent letters, Governors Bob Taft of Ohio[52] and John Engler of Michigan[53] raised concerns about the advisability of long-term storage of spent fuel in temporary systems so close to major bodies of water. The scientific consensus is that disposal of this material in a deep underground repository is not merely the safe answer and the right answer for protecting our environment but the only answer that has any degree of realism.

In addition, nuclear power is one of only a few sources of power available to us now in a potentially plentiful and economical manner that could drastically reduce air pollution and greenhouse gas emissions caused by the generation of electricity. It produces no controlled air pollutants, such as sulfur and particulates, or greenhouse gases. Therefore, it can help keep our air clean, avoid generation of ground-level ozone, and prevent acid rain. A repository at Yucca Mountain is indispensable to the maintenance and potential expansion of the use of this environmentally efficient source of energy.

8.5. Facilitating Continuation of Research, Medical, and Humanitarian Programs

The Department has provided fuel for use in research reactors in domestic and foreign universities and laboratories. Research reactors provide a wide range of benefits including the production of radioisotopes for medical use—e.g., in body-scan imaging and the treatment of cancer. To limit the risk to the public, and to support nuclear non-proliferation objectives, these laboratories are required to return the DOE-origin spent fuel from domestic research reactors and from foreign research reactors. These spent fuels are temporarily stored at Savannah River, South Carolina, and at the Idaho National Engineering and Environmental Laboratory while awaiting disposal in a permanent repository.

Again, we can either implement a permanent solution—Yucca Mountain—or risk eroding our capacity to conduct this kind of research. The chances of a person becoming sick from the nuclear materials to be stored at the Yucca Mountain site are, as shown above, all but nonexistent. Responsible critics must balance that against the chance of a person becoming sick as a result of the research that may not be undertaken, remaining sick for want of the drug that may not be found, or dying for lack of the cure that may not be developed—all because the nuclear fuel-dependent science that could produce these things was never done, our country having run out of places to dispose of the waste.

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[52] Letter, Governor Bob Taft to Secretary Spencer Abraham, July 30, 2001.
[53] Letter, Governor John Engler to Secretary Spencer Abraham, September 5, 2001.

8.6. Assisting Anti-Terrorism at Home

As I have noted previously, spent fuel and other high level radioactive waste is presently stored at temporary storage facilities at 131 locations in 39 states. Ten of these are at shutdown reactor sites for which security would not otherwise be required. Moreover, many reactors are approaching their storage capacity and are likely to seek some form of off-site storage, thereby creating potential new targets.

Storage by reactor-owners was intended to be a temporary arrangement. The design of the storage facilities reflects that fact. They tend to be less secured than the reactors themselves, and the structures surrounding the fuel stored in above-ground containers are also less robust.

These storage, facilities should be able to withstand current threats. But as the determination and sophistication of terrorists increases, that may well change. That means we will have to choose one of two courses. We can continue to endeavor to secure each of these sites, many of which, as noted above, are close to major metropolitan areas and waterways. Or we can consolidate this fuel in one remote, secure, arid underground location and continue to develop state-of-the-art security arrangements to protect it there.

To me the choice is clear. The proposed geologic repository in the desert at Yucca Mountain offers unique features that make it far easier to secure against terrorist threats. These include: 1) disposal 800 feet below ground; 2) remote location; 3) restricted access afforded by Federal land ownership of the Nevada Test Site; 4) proximity to Nellis Air Force Range; 5) restricted airspace above the site; 6) far from any major waterways. The design and operation of a geologic repository, including surface operations, can also incorporate from the beginning appropriate features to protect against a terrorist threat and can be changed, if necessary, to respond to future changes in the terrorist threat.

An operational repository will also be an important signal to other nuclear countries, none of which have opened a repository. Inadequately protected nuclear waste in any country is a potential danger to us, and we can't expect them to site a facility if we, with more resources, won't. A fresh look at nuclear material security should involve new concepts such as those inherent in a geologic repository, and should set the standard for the manner in which the international community manages its own nuclear materials.

To understand Yucca Mountain's relative advantage in frustrating potential terrorist attacks compared to the status quo, one need only ask the following: If nuclear materials were already emplaced there, would anyone even suggest that we should spread them to 131 sites in 39 states, at locations typically closer to major cities and waterways than Yucca Mountain is, as a means of discouraging a terrorist attack?

8.7. Summary

In short, there are important reasons to move forward with a repository at Yucca Mountain. Doing so will advance our energy security by helping us to maintain diverse sources of energy supply. It will advance our national security by helping to provide operational certainty to our nuclear Navy and by facilitating the decomissioning of nuclear weapons and the secure disposition of nuclear materials. It will help us clean up our environment by allowing us to close the nuclear fuel cycle and giving us greater access to a form of energy that does not emit greenhouse gases. And it will help us in our efforts to secure ourselves against terrorist threats by allowing us to remove nuclear materials from scattered above-ground locations to a single, secure underground facility. Given the site's scientific and technical suitability, I find that compelling national interests counsel in favor of taking the next step toward siting a repository at Yucca Mountain.

9. NONE OF THE ARGUMENTS AGAINST YUCCA MOUNTAIN WITHSTANDS ANALYSIS

After explained above, after months of study based on research unique in its scope and depth, I have concluded that the Yucca Mountain site is fully suitable under the most cautious standards that reasonably might be applied. I have also concluded that it serves the national interest in numerous important ways. The final question I shall examine is whether the arguments against its designation not rise to a level that outweighs the case for going forward. I believe they do not, as I shall explain. I do so by briefly describing these principle arguments made by opponents of the Project, and then responding to them.

9.1. Assertion 1: The Citizens of Nevada Were Denied an Adequate Opportunity to Be Heard

Critics have claimed that the decision-making process under the NWPA was unfair because it allowed insufficient opportunity for public input, particularly from

the citizens of Nevada. That is not so. There was ample opportunity for public discussion and debate; the Department in fact went well beyond the Act's requirements in providing notice and the opportunity to be heard.

My predecessors and I invited and encouraged public, governmental, and tribal participation at all levels. The Department also made numerous Yucca Mountain documents available to the public. These included several specifically prepared to inform any who might be interested of the technical information and analyses that I would have before me as I considered the suitability of the site. There was no statutory requirement for producing these documents; I considered it important to make them available, and thus to provide a timely sharing of information that would form the basis of my consideration and, ultimately, decision.

To assist in discharging part of the Secretarial responsibilities created by the Act, the Department conducted official public meetings before starting the Environmental Impact Statement. Subsequently, the Department held a total of 24 public hearings on the draft and the supplemental draft Environmental Impact Statements. With the release of the *Yucca Mountain Science and Engineering Report* in May 2001, the DOE opened a public comment period lasting approximately six months; the period continued through the release of the *Preliminary Site Suitability Evaluation* in July 2001 and closed on October 19, 2001. After publishing DOE's final rule, "Yucca Mountain Site Suitability Guidelines," on November 14, 2001, 1 announced an additional 30-day supplemental comment period with a closing date of December 14, 2001. During these combined public comment periods, the DOE held 66 additional public hearings across Nevada and in Inyo County, California, to receive comments on my consideration of a possible recommendation of the Yucca Mountain site. More than 17,000 comments were received.[54]

The lengths to which the Department went to solicit public comment can be seen in the details: from 1995 through 2001, there were 126 official hearings with a court reporter present. The Nevada cities where these hearings were held included: Amargosa Valley, Battle Mountain, Caliente, Carson City, Crescent Valley, Elko, Ely, Fallon, Gardnerville, Goldfield, Hawthorne, Las Vegas, Lovelock, Pahrump, Reno, Tonopah, Virginia City, Winnemucca, and Yerington. Elsewhere, meetings were held in Independence, Lone Pine, Sacramento, and San Bernardino in California; Washington, DC; Boise, ID; Chicago, IL; Denver, CO; Dallas/Ft. Worth, TX; Salt Lake City, UT; Baltimore, MD; Albany, NY; Atlanta, GA; Kansas City, MO.; Cleveland, OH; and St. Louis, MO.

There were 600 hours of public meetings for the 2001 hearings alone. All in all, there were a total of 528 comment days, or about a year and a half. Additionally, the science centers were open for 340 hours (both with and without court reporter) to receive comments. Since 1991, there have been 2,062 tours of Yucca Mountain, and 49,073 visitors have been to the site.

In light of the extensive opportunities DOE has provided for public input, it is my judgment that the opportunities for hearing and consideration of comments were abundant and met any procedural measure of fairness.

9.2. Assertion 2: The Project Has Received Inadequate Study

Critics have said that there has been inadequate study to determine Yucca Mountain's suitability. To the contrary, and as I believe section 6 of this Recommendation makes clear at length, the characterization process at Yucca Mountain is unprecedented for any even remotely comparable undertaking. Indeed, Yucca Mountain studies have now been under way for nearly five times as long as it took to build the Hoover Dam and more than six times the entire duration of the Manhattan Project. Yucca Mountain is, by any measure, the most exhaustively studied project of its kind the world has ever known.

Beginning in 1978 and continuing to the present day, the Department has spent billions of dollars on characterization studies. There has been ongoing dialogue between the Department and the NRC over the goals, content and results of the test programs. As noted, there have been ample opportunities for public involvement. At this still early stage, and with many more years before the Yucca Mountain site could become operational, the request for yet more preliminary study, even before seeking a license from the NRC, is unsupportable. Additional study will be undertaken at stages to come as an appropriate part of the licensing process.

For these reasons, I have concluded that the current body of accumulated scientific and technical knowledge provides a more than adequate technical basis to designate the Yucca Mountain site, thereby beginning the licensing phase of the

[54] *Comment Summary Document and Supplemental Comment Summary Document,* February 2002.

project. For convenience, a listing of the types of tests that have been performed is provided in Table 3.

9.3 Assertion 3: The Rules Were Changed in the Middle of the Game

The State of Nevada claims that at some point the Department concluded that Yucca Mountain was not suitable under earlier regulations, and then changed the rules to fit the site. That is not true. Even the most elementary knowledge of the history of the program shows this claim is baseless.

The Guidelines did change, but not in a way that disadvantaged critics from making their case, and certainly not to suit any pre-existing agenda at the Department. Rather, they were changed to conform to changes in the statutory and regulatory framework governing the siting process and in the scientific consensus regarding the best approach for assessing the likely performance of a repository over long periods of time.

Table 3: Types of Tests Performed to Collect Data for Site Characterization of Yucca Mountain [55]

Process Models	Types of Tests and Studies
Unsaturated Zone (the rocks above the water table containing little water that limit the amount of water that can contact waste packages)	Future climate studies
	Infiltration model studies
	Unsaturated zone flow model studies
	Seepage model studies
	Unsaturated zone transport studies
Near-Field Environment (moisture, temperature, and chemistry conditions surrounding and affecting the waste packages)	Drift scale test
	Single heater test
	Large block test
	Field tests on coupled processes
	Laboratory coupled processes tests
Engineered Barrier System (EBS) (man-made features comprising the repository that influence how radionuclides might move)	Cementicious materials tests
	EBS design tests
	In-drift gas composition tests
	In-drift water chemistry, precipitates and salts tests
	Microbial communities tests
	Radionuclide transport tests
	Drift degradation analysis tests
	Rock mass mechanical properties tests
Waste Package (metal container that the wastes would be placed in)	Waste package environment tests
	Materials selection studies
	General corrosion tests
	Localized corrosion tests
	Stress corrosion cracking tests
	Hydrogen-induced cracking tests
	Metallurgical stability/phases tests
	Manufacturing defects tests
	Filler material tests
	Welding tests
Waste Form (high-level wastes and spent fuel that are the source of radionuclides)	Radioisotope inventory study
	In-package chemistry tests
	Commercial spent nuclear fuel cladding degradation tests
	Defense spent nuclear fuel degradation tests
	High level waste glass degradation tests
	Dissolved radioisotope concentration tests
	Colloid radioisotope concentration tests
Saturated Zone (movement of water in rocks below the water table)	Saturated zone characterization studies
	Saturated zone flow studies
	Saturated zone transport studies

[55] Summary information about progress in testing is provided to the NRC twice each year. There are 23 Semiannual Progress Reports available, covering all testing for the Yucca Mountain site. These documents include references to numerous technical reports of the Program, which number in the thousands.

Table 3: Types of Tests Performed to Collect Data for Site Characterization of Yucca Mountain, continued

Integrated Site Model (computer models of the geology)	Geologic framework model studies
	Rock properties model studies
	Mineralogical model studies
Site Description (description of the repository)	Geologic mapping studies
	Fracture data collection studies
	Natural resources assessment studies
	Erosion studies
	Natural and man-made analog studies
Disruptive Events (unlikely disruptions to the repository)	Probability of igneous activity studies
	Characteristics of igneous activity studies
	Seismic hazards studies

The DOE's original siting Guidelines were promulgated in 1984. At the time, the Nuclear Waste Policy Act called on the Department to evaluate and characterize multiple sites and to recommend one or more among them. Also at the time, consistent with the scientific and regulatory consensus of the late 1970's, the Nuclear Regulatory Commission had in place regulations for licensing repositories that sought to protect against radioactive releases by focusing on the performance of individual subparts, or subsystems, that were part of the repository. Finally, the EPA had proposed rules for repositories that also focused on limiting the amount and type of radionuclides released from a repository. Consistent with this framework, DOE's Guidelines focused on making comparative judgments among sites and emphasized mechanisms for evaluating the performance of potential repository subsystems against the NRC subsystem performance requirements and the EPA release limits.

Starting in 1987, however, both the regulatory framework and scientific consensus began to change. To begin with, Congress changed the law governing evaluation and selection of a repository site. In 1987, it amended the Nuclear Waste Policy Act to eliminate any authority or responsibility on the part of the Department for comparing sites, directed the Department to cease all evaluation of any potential repository sites other than Yucca Mountain, and directed it to focus its efforts exclusively on determining whether or not to recommend the Yucca Mountain site. This change was important, as it eliminated a central purpose of the Guidelines—to compare and contrast multiple fully characterized sites for ultimate selection of one among several for recommendation.

Next, Congress reinforced its directive to focus on Yucca Mountain in section 801 of the Energy Policy Act of 1992. This provision also gave three new directives to EPA. First, it directed EPA, within 90 days of enactment, to contract with the National Academy of Sciences for a study regarding, among other topics, whether a specific kind of radiation protection standard for repositories would be protective of public health and safety. The question posed was whether standards prescribing a maximum annual effective dose individuals could receive from the repository—as opposed to the then-current standards EPA had in place focusing on releases—would be reasonable standards for protecting health and safety at the Yucca Mountain site. Second, Congress directed EPA, consistent with the findings and recommendations of the Academy, to promulgate such standards no later than one year after completion of the Academy's study. Finally, it directed that such standards, when promulgated, would be the exclusive public health and safety standards applicable to the Yucca Mountain site. Section 801 also contained a directive to the NRC that, within a year after EPA's promulgation of the new standards, NRC modify its licensing criteria for repositories under the NWPA as necessary to be consistent with the EPA standards.

Pursuant to the section 801 directive, in 1995 the National Academy of Sciences published a report entitled "Technical Bases for Yucca Mountain Standards."[56] This report concluded that dose standards would be protective of public health and safety.[57] It also concluded that if EPA adopted this kind of standard, it would be appropriate for the NRC to revise its licensing rules, which currently focused on subsystem performance, to focus instead on the performance of the total repository sys-

[56] *Technical Bases for Yucca Mountain Standards,* National Academy of Sciences, National Research Council, 1995.
[57] *Ibid.*

tem, including both its engineered and natural barriers. It noted that this would be a preferable approach because it was the performance of the entire repository, not the different subsystems, that was crucial, and that imposition of separate subsystem performance requirements might result in suboptimal performance of the repository as a whole.[58] Finally, National Academy of Sciences noted that its recommendations, if adopted, "impl[ied] the development of regulatory and analytical approaches for Yucca Mountain that are different from those employed in the past" whose promulgation would likely require more than the one-year timeframe specified in the Energy Policy Act of 1992.

Along with these changes in regulatory thinking, the scientific and technical understanding of repository performance at Yucca Mountain was advancing. The DOE's use of Total System Performance Assessment to evaluate repository performance became more sophisticated, and helped focus DOE's research work on those areas important to maximizing the safety of the repository and minimizing public exposure to radionuclide releases from the repository.

In 1999, the culmination of years of scientific and technical advancements and careful regulatory review resulted in EPA and NRC proposals for new regulations specific to a repository at Yucca Mountain based on state-of-the-art science and regulatory standards.[59] Since section 113(c) of the NWPA directed DOE to focus its site characterization activities on those necessary to evaluate the suitability of the site for a license application to the NRC, the proposed changes to the EPA and NRC rules in turn required DOE to propose modifications to its criteria and methodology for determining the suitability of the Yucca Mountain site. Accordingly, DOE proposed new state-of-the-art Yucca-Mountain-specific site suitability Guidelines consistent with NRC licensing regulations.[60] After EPA and NRC finalized their revisions,[61] DOE promptly finalized its own.[62] For the reasons explained in the National Academy of Sciences study, the revised Guidelines' focus on the performance of the total repository system also makes them a better tool for protection of public safety than the old Guidelines, since the old subsystem approach might have resulted in a repository whose subsystems performed better in one or another respect but whose total performance in protecting human health was inferior.

In short, far from seeking to manipulate its siting Guidelines to fit the site, DOE had no choice but to amend its Guidelines to conform with the new regulatory framework established at Congress's direction by the National Academy of Sciences, the EPA, and the NRC. Moreover, this framework represents the culmination of a carefully considered set of regulatory decisions initiated at the direction of the Congress of the United States and completed nine years later, in which top scientists in the country have participated, and in which expert regulatory authorities, the NRC and the EPA, have played the leading role. These authorities likewise agree that the new regulatory framework, of which the Department's revised Guidelines are a necessary part, forms a coherent whole well designed to protect the health and safety of the public.

9.4. Assertion 4: The Process Tramples States' Rights

Some have argued that a Federal selection of siting disrespects states' rights. That is incorrect. Indeed, Nevada's interests have been accorded a place in Federal law to an extent seldom, if ever, seen before.

As provided by the NWPA, the State of Nevada has the right to veto any Presidential site recommendation. It may do so by submitting a notice of disapproval to Congress within 60 days of the President's action.

If Nevada submits a notice of disapproval, Congress has 90 calendar days of continuous session to override the notice by passing a resolution of siting designation. If it does not do so, the State's disapproval becomes effective.

The respect due Nevada has not stopped with grudging obedience to the statutory commands. Instead, as noted previously, the Department has held hearings over a

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[58] *Ibid.*

[59] Disposal of High-Level Radioactive Wastes in a Proposed Geological Repository at Yucca Mountain, Nevada, Proposed Rule, 64 Fed. Reg. 8640, February 22, 1999; Environmental Radiation Protection Standards for Yucca Mountain, Nevada, Proposed Rule, 64 Fed. Reg. 46975, August 27, 1999.

[60] General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories, Yucca Mountain Site Suitability Guidelines, 64 Fed. Reg. 67054, November 30, 1999.

[61] Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada, Final Rule, 66 FR 32073, June 13, 2001; Disposal of High-Level Radioactive Wastes in a Proposed Geologic Repository at Yucca Mountain, Nevada; Final Rule, 66 FR 55732, November 2, 2001.

[62] General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories, Yucca Mountain Site Suitability Guidelines, Final Rule, 66 Fed. Reg. 57303, November 14, 2001.

range of dates and places well in excess of what reasonably could have been viewed as a statutory mandate. And I have taken full account of Governor Guinn's comment and those of Nevada's other elected officials who oppose this Project. Although they reflect a view I do not share, I will continue to accord them the highest degree of respect.

Finally, the Federal Government has appropriated more funds to Nevada to conduct its own Yucca Mountain studies than any other State has ever been given for any remotely similar purpose. Since the start of the Program in 1983, the State of Nevada has received over $78 million in oversight funding. Since 1989, when the affected units of local government requested oversight funding, they have received over $67 million. In total, the State of Nevada and the affected units of local government have received over $145 million over that timeframe; with Nye County, home to Yucca Mountain, receiving over $22 million and Clark County, home to Las Vegas, receiving about $25 million. In addition, over the last 10 years, the State of Nevada and the affected units of local government have been given over $73 million to compensate for taxes they would have collected on the site characterization and the development and operation of a repository if they were legally authorized to tax activities of the Federal Government. Nye County has also conducted its own oversight drilling program since 1996, for which over that time Nye has received almost $21 million. Thus, the grand total that has been awarded to the state and its local governments simply on account of Yucca Mountain research has been nearly $240 million.

Given the extensive evidence that the state has been, and will be, accorded a degree of involvement and authority seldom if ever accorded under similar circumstances, it is my judgment that the assertion of an infringement on state's rights is incorrect.

9.5. Assertion 5: Transportation of Nuclear Materials is Disruptive and Dangerous

Critics have argued that transporting wastes to Yucca Mountain is simply too dangerous, given the amount involved and the distances that will need to be traversed, sometimes near population centers.

These concerns are not substantiated for three principal reasons. First, they take no account of the dangers of not transporting the wastes and leaving them to degrade and/or accumulate in their present, temporary facilities. Second, they pay no heed to the fact that, if the Yucca Mountain repository is not built, some wastes that would have been bound for that location will have to be transported elsewhere, meaning that our real choice is not between transporting or not transporting, but between transporting with as much planning and safety as possible, or transporting with such organization as the moment might invite. And third, they ignore the remarkable record of safe transportation of nuclear materials that our country has achieved over more than three decades.

The first point is not difficult to understand. The potential hazards of transporting wastes are made to appear menacing only by ignoring the potential hazards of leaving the material where it is—at 131 aging surface facilities in 39 states. Every ton of waste not transported for five or ten minutes near a town on the route to Yucca Mountain is a ton of waste left sitting in or near someone else's town—and not for five or ten minutes but indefinitely. Most of the wastes left where they are in or near dozens of towns (and cities) continue to accumulate day-by-day in temporary facilities not intended for long-term storage or disposal.

The second point is also fairly simple. Many of these older sites have reached or will soon reach pool storage limits. Over 40 are projected to need some form of dry storage by 2010. Additional facilities will therefore be required. There are real limits, however, to how many of these can realistically be expected to be built on site. Many utilities do not have the space available to build them, and are likely to face major regulatory hurdles in attempting to acquire it.

Therefore one way or another, unless all these reactors shut down, off-site storage facilities will need to be built, substantial amounts of waste will have to be transported there, and this will happen not in the distant future but quite soon. For example, today nuclear utilities and a Native American tribe in Utah are working toward construction of an "interim" storage facility on tribal land. Whether or not this effort ultimately succeeds, it is likely that some similar effort will. Thus, if we are merely to keep our present supply of nuclear energy, at some fast-approaching point there will be transportation of nuclear wastes. The only question is whether we will have (a) numerous supplemental storage sites springing up, with transportation to them arranged *ad hoc,* or (b) one permanent repository, with transportation to it arranged systematically and with years of advance planning. The second alternative is plainly preferable, making the Yucca Mountain plan superior on this ground alone.

Finally, transportation of nuclear waste is not remotely the risky venture Yucca's critics seek to make it out to be. Over the last 30 years, there have been over 2,700 shipments of spent nuclear fuel. Occasional traffic accidents have occurred, but there has not been one identifiable injury related to radiation exposure because of them. In addition, since 1975, or since the last stages of the war in Vietnam, national security shipments have traveled over 100 million miles—more than the distance from here to the sun—with no accidents causing a fatality or harmful release of radioactive material.[63]

Our safety record is comparable to that in Europe, where nuclear fuel has been transported extensively since 1966.[64] Over the last 25 years, more than 70,000 MTU (an amount roughly equal to what is expected to be shipped over the entire active life of the Yucca Mountain Project) has been shipped in approximately 20,000 casks. France and Britain average 650 shipments per year, even though the population density in each of those countries grossly exceeds that of the United States.

Even so, we need not, and should not, be content to rest upon the record of the past no matter how good. For transportation to Yucca Mountain, the Department of Transportation has established a process that DOE and the states must use for evaluating potential routes. Consistent with Federal regulations, the NRC would approve all routes and security plans and would certify transportation casks prior to shipment.

In short, for all these reasons, I have concluded that the stated concerns about transportation are ill-founded and should not stand in the way of taking the next step toward designation of the Yucca Mountain site.

9.6. Assertion 6: Transportation of Wastes to the Site Will Have a Dramatically Negative Economic Impact on Las Vegas

There have been repeated assertions that shipments of radioactive waste through the Las Vegas valley could have effects on the local, entertainment-based, economy. Such effects could include, for example, discouraging tourism and lowering property values. These assertions are largely unsupportable by any evidence and are addressed in the Final Environmental Impact Statement.

Much of what has been said in the preceding section applies here as well. The record speaks for itself. In addition to the history of safe shipment on interstate highways through relatively open spaces, five metric tons of spent nuclear fuel from 27 countries have, over the last 16 years, been transported without incident through Concord, California, and Charleston, South Carolina (the latter, like Las Vegas, a tourist destination). There is no reason to believe that a similar safe record will not be achieved in Nevada.

The truth of it is that many tourists coming to Las Vegas will be farther from nuclear sites when they get there than when they left home. All major nuclear power generation facilities in the United States are located near large metropolitan centers in order to minimize the amount of power lost during transmission. It is thus not surprising that more than 161 million Americans are closer to a commercial nuclear facility than anyone in Las Vegas is to Yucca Mountain, as shown in Table 4. Indeed there are few large metropolitan centers that do not have a major nuclear facility located within 75 miles.[65]

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[63] *About the Transportation Safeguards System,* Office of Transportation Safeguards Fact Sheet.

[64] Presentation by Ronald Pope, Head of Transport Safety Unit for the Internal Atomic Energy Agency, at 13th International Symposium for Packing of Radioactive Materials 2001, Chicago, IL, September 2001.

[65] It is noteworthy that Atlantic City has three reactor sites closer than 75 miles at the same time its tourism-based economy has been expanding. Yucca Mountain, by contrast, would be one of the few nuclear facilities in the country in a remote area with no metropolitan center within 75 miles

Table 4. U.S. Population in Contiguous United States Living Within Various Distances of Commercial Nuclear Facilities

State	Zone (miles from facilities)				
	0 - 25	*25 - 50*	*50 - 75*	*0 - 50*	*0 - 75*
AL	327,488	617,283	452,817	944,771	1,397,588
AR	91,993	159,544	859,399	251,537	1,110,936
AZ	25,803	1,550,878	1,608,816	1,576,682	3,185,497
CA	2,488,467	8,666,094	11,962,159	11,154,561	23,116,719
CO	*	*	*	*	*
CT	962,725	2,394,573	55,292	3,357,298	3,412,590
DC		153,634	418,425	153,634	572,059
DE	457,523	184,324	123,438	641,847	765,285
FL	1,135,427	2,865,538	3,550,098	4,000,965	7,551,063
GA	186,028	886,879	1,145,585	1,072,907	2,218,491
IA	512,517	566,867	474,723	1,079,384	1,554,107
ID	*	*	*	*	*
IL	2,068,321	7,970,381	835,971	10,038,701	10,874,673
IN	34,431	945,514	468,802	979,945	1,448,747
KS	19,797	161,268	686,554	181,065	867,619
KY					
LA	786,052	1,592,771	772,888	2,378,823	3,151,710
MA	740,668	4,346,548	1,275,039	5,087,217	6,362,255
MD	438,958	2,528,095	2,007,566	2,967,053	4,974,619

[65] It is noteworthy that Atlantic City has three reactor sites closer than 75 miles at the same time its tourism-based economy has been expanding. Yucca Mountain, by contrast, would be one of the few nuclear facilities in the country in a remote area with no metropolitan center within 75 miles.

Table 4. U.S. Population in Contiguous United States Living Within Various Distances of Commercial Nuclear Facilities, continued

ME	151,828	521,691	280,266	673,520	953,785
MI	898,433	3,815,786	2,491,128	4,714,219	7,205,346
MN	450,935	2,999,162	330,754	3,450,097	3,780,850
MO	72,929	393,186	952,824	466,115	1,418,939
MS	36,411	169,211	561,585	205,622	767,207
MT					
NC	1,864,567	2,265,107	2,577,799	4,129,674	6,747,239
ND					
NE	564,594	181,950	379,944	746,544	1,126,488
NH	278,528	649,119	188,301	927,646	1,115,947
NJ	795,512	5,628,139	2,023,890	6,423,650	8,447,540
NM	*	*	*	*	*
NV					
NY	1,866,267	9,017,732	5,435,801	10,883,999	16,319,800
OH	656,156	2,790,959	2,074,628	3,447,115	5,521,743
OK			5,479		5,479
OR	45,053	1,381,995	432,829	1,427,047	1,859,876
PA	3,206,819	6,437,719	1,564,624	9,644,538	11,209,162
RI	19,252	284,282	744,786	303,534	1,048,320
SC	705,470	1,760,435	747,457	2,465,906	3,213,363
SD			569		569
TN	532,368	456,157	927,261	988,525	1,915,786
TX	136,390	1,337,035	3,766,243	1,473,425	5,239,668
UT	*	*	*	*	*
VA	597,715	2,377,308	2,221,770	2,975,024	5,196,794
VT	54,257	43,739	77,319	97,996	175,315
WA	331,397	500,577	585,734	831,974	1,417,708
WI	542,083	2,065,518	1,646,584	2,607,601	4,254,185
WV	43,813	65,183	37,095	108,996	146,090
WY					
Grand Total	24,126,975	80,732,181	56,752,239	104,859,156	161,651,160
Proposed Repository at Yucca Mountain					
Population around Yucca Mountain	1,678	13,084	19,069	14,762	33,831

*State with no commercial facilities but with other nuclear facilities depending on a repository for waste disposition.

As shown in Table 5, 22 of the 30 most populous metropolitan areas in the United States have 36 operating nuclear reactors closer to them than a waste repository at Yucca Mountain would be to Las Vegas, some 90 miles distant.

Table 5. Top 30 Metropolitan Areas in Contiguous U.S. by Population - Distance to Nearest Commercial Power Reactor (does not include other nuclear facilities that are dependent on a high-level repository for waste disposition)

Rank	Name	Population (2000 Census) (Note 1)	Major Population Centers	State	Nearest Commercial Nuclear Reactor	Distance (Miles) (Note 4)
1	New York—Northern New Jersey—Long Island, NY—NJ—CT—PA CMSA (Note 2)	21,199,865	New York	NY	INDIAN POINT	45.0
			Jersey City	NJ	INDIAN POINT	44.4
2	Los Angeles—Riverside—Orange County, CA CMSA	16,373,645	Los Angeles	CA	SAN ONOFRE	61.5
			Riverside	CA	SAN ONOFRE	41.2
3	Chicago—Gary—Kenosha, IL—IN—WI CMSA	9,157,540	Chicago	IL	ZION	44.9
			Rockford	IL	BYRON	17.7
4	Washington—Baltimore, DC—MD—VA—WV CMSA	7,608,070	Baltimore	MD	PEACH BOTTOM	43.0
			Washington D.C.	DC	CALVERT CLIFFS	51.2
5	San Francisco—Oakland—San Jose, CA CMSA	7,039,362	San Francisco	CA	RANCHO SECO	81.3
			Oakland	CA	RANCHO SECO	73.3
			San Jose	CA	RANCHO SECO	81.8
6	Philadelphia—Wilmington—Atlantic City, PA—NJ—DE—MD CMSA	6,188,463	Philadelphia	PA	LIMERICK	34.1
7	Boston—Worcester—Lawrence, MA—NH—ME—CT CMSA	5,819,100	Boston	MA	PILGRIM	45.2
			Worcester	MA	VERMONT YANKEE	60.3
8	Detroit—Ann Arbor—Flint, MI CMSA	5,456,428	Detroit	MI	FERMI	30.4
9	Dallas—Fort Worth, TX CMSA	5,221,801	Dallas	TX	COMANCHE PEAK	69.3
			Fort Worth	TX	COMANCHE PEAK	41.7
10	Houston—Galveston—Brazoria, TX CMSA	4,669,571	Houston	TX	SOUTH TEXAS PROJECT	82.7
11	Atlanta, GA MSA (Note 3)	4,112,198	Atlanta	GA	SEQUOYAH	121.7
12	Miami—Fort Lauderdale, FL CMSA	3,876,380	Fort Lauderdale	FL	TURKEY POINT	57.9
			Miami	FL	TURKEY POINT	29.6
13	Seattle—Tacoma—Bremerton, WA CMSA	3,554,760	Seattle	WA	TROJAN	111.4
			Tacoma	WA	TROJAN	86.4
14	Phoenix—Mesa, AZ MSA	3,251,876	Glendale	AZ	PALO VERDE	40.4
			Scottsdale	AZ	PALO VERDE	56.3
			Phoenix	AZ	PALO VERDE	45.8
			Tempe	AZ	PALO VERDE	55.2
			Mesa	AZ	PALO VERDE	60.2
			Chandler	AZ	PALO VERDE	59.4
15	Minneapolis—St. Paul, MN—WI MSA	2,968,806	Minneapolis	MN	MONTICELLO	39.1
			Saint Paul	MN	PRAIRIE ISLAND STATION	34.2
16	Cleveland—Akron, OH CMSA	2,945,831	Cleveland	OH	PERRY	39.3
			Akron	OH	PERRY	59.3
17	San Diego, CA MSA	2,813,833	San Diego	CA	SAN ONOFRE	50.7
18	St. Louis, MO—IL MSA	2,603,607	Saint Louis	MO	CALLAWAY	91.7
19	Denver—Boulder—Greeley, CO CMSA	2,581,506	Denver	CO	FORT CALHOUN	495.6
20	Tampa—St. Petersburg—Clearwater, FL MSA	2,395,997	Tampa	FL	CRYSTAL RIVER	81.9
21	Pittsburgh, PA MSA	2,358,695	Pittsburgh	PA	BEAVER VALLEY	29.6

Table 5. Top 30 Metropolitan Areas in Contiguous U.S. by Population - Distance to Nearest Commercial Power Reactor, continued

22	Portland—Salem, OR—WA CMSA	2,265,223	Portland	OR	TROJAN	37.2
23	Cincinnati—Hamilton, OH—KY—IN CMSA	1,979,202	Cincinnati	OH	DAVIS BESSE	206.8
24	Sacramento—Yolo, CA CMSA	1,796,857	Sacramento	CA	RANCHO SECO	26.1
25	Kansas City, MO—KS MSA	1,776,062	Kansas City	MO	WOLF CREEK	88.2
			Kansas City	KS	WOLF CREEK	87.0
26	Milwaukee—Racine, WI CMSA	1,689,572	Milwaukee	WI	ZION	44.2
27	Orlando, FL MSA	1,644,561	Orlando	FL	CRYSTAL RIVER	98.7
28	Indianapolis, IN MSA	1,607,486	Indianapolis	IN	CLINTON	156.5
29	San Antonio, TX MSA	1,592,383	San Antonio	TX	SOUTH TEXAS PROJECT	161.3
30	Norfolk—Virginia Beach—Newport News, VA—NC MSA	1,569,541	Newport News	VA	SURRY	23.2
			Virginia Beach	VA	SURRY	53.4
			Norfolk	VA	SURRY	37.3

Notes

1 Populations from 2000 Census data for Continental USA
2 CMSA means "Consolidated Metropolitan Statistical Area"
3 MSA means "Metropolitan Statistical Area"
4 Distances shown are relative to a central feature such as a city hall, county seat, or capitol building.

Many cities with strong tourism industries are located closer to existing storage facilities than Las Vegas would be to a repository at Yucca Mountain. Therefore, those who assert that a repository 90 miles from Las Vegas would have dramatically negative effects on local tourism have the burden of producing strong evidence to back up their claims. They have not done so. Thus, I know of no reason to believe that there is any compelling argument that the Las Vegas economy would be harmed by a repository at Yucca Mountain.

9.7. Assertion 7: It is Premature for DOE to Make a Site Recommendation for Various Reasons

9.7.1. The General Accounting Office has concluded that it is premature for DOE to make a site recommendation now

The GAO did make this statement in its draft report, *Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project,* which was prematurely released.[66] After receiving the Department's response, however, in the final version of this report, released in December 2001, GAO expressly acknowledged that "the Secretary has the discretion to make such a recommendation at this time."[67]

9.7.2. DOE is not ready to make a site recommendation now because DOE and NRC have agreed on 293 technical items that need to be completed before DOE files a license application

The Nuclear Regulatory Commission provided a sufficiency letter to DOE on November 13, 2001, that concluded that existing and planned work, upon completion, would be sufficient to apply for a construction authorization. The agreed upon course of action by DOE and the NRC is intended to assist in the license application phase of the project, not site recommendation. In consultation with the Nuclear Regulatory Commission staff concerning *licensing,* DOE agreed it would obtain certain additional information relating to nine "key technical issues" to support license application. The DOE agreed to undertake 293 activities that would assist in resolution of these issues.

The NRC has never stated that this was work that DOE needed to complete before *site recommendation.* In fact, it went out of its way not to do so. The Commission is well aware that section 114(a)(1)(E) of the NWPA requires a Secretarial recommendation of Yucca Mountain to be accompanied by a letter from the Commission providing its preliminary comments on the sufficiency of the information the Department has assembled for a construction license application. Had it been of the view that site recommendation should not proceed, its preliminary views would have

[66] *Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project,* Unpublished Draft.
[67] *Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project,* GAO-02-191, December 21, 2001.

stated that this information is not sufficient and that the Commission has no confidence that it ever will be.

Instead, in its section 114(a)(1)(E) letter, the Commission said the opposite: "[T]he NRC believes that sufficient at-depth characterization analysis and waste form proposal information, although not available now, *will be available at the time of a potential license application such that development of an acceptable license application is achievable*" (emphasis added). It also listed the outstanding issues as "closed pending," meaning that the NRC staff has confidence that DOE's proposed approach, together with the agreement to provide additional information, acceptably addresses the issue so that no information beyond that provided or agreed to would likely be required for a license application.

The DOE has completed over one-third of the actions necessary to fulfill the 293 agreements and has submitted the results to the NRC for review. The NRC has documented 23 of these as "complete." The remaining work consists largely of documentation (improve technical positions and provide additional plans and procedures) and confirmation (enhance understanding with additional testing or analysis or additional corroboration of data or models).

As I explained earlier, the NWPA makes clear that site recommendation is an intermediate step. The filing of a construction license application is the step that comes after site recommendation is complete. It is entirely unsurprising that the Department would have to do additional work before taking that next step. But the fact that the next step will require additional work is no reason not to take this one.

9.7.3. It is premature for DOE to make a recommendation now because DOE cannot complete this additional work until 2006. The NWPA requires DOE to file a license application within 90 days of the approval of site designation

When Congress enacted the NWPA in 1982, it included in the Act a series of deadlines that represented its best judgment regarding how long various steps should take. These deadlines included the 90-day provision referenced above. They also included a requirement that DOE begin disposing of waste in 1998, in the expectation that a repository would by then have been built and licensed.

Obviously, the timeframes set in the Act have proven to be optimistic. That is no reason, however, for the Department not to honor what was plainly their central function: to move along as promptly and as responsibly as possible in the development of a repository. Accordingly, to read the 90-day provision at issue as a basis for proceeding more slowly stands the provision on its head.

Our current plans call for filing a license application at the end of 2004, not 2006. Assuming Congressional action on this question this year, that would mean that DOE could be two years late in filing the application. But any delay in site recommendation will only result in *further* delay in the filing of this application. For the reasons explained in section 7,1 believe I have the information necessary to allow me to determine that the site is scientifically and technically suitable, and I have so determined. That being so, I am confident that I best honor the various deadlines set out in the Act, including the central 1998 deadline (already passed) specifying when the Department was to begin waste disposal, by proceeding with site recommendation as promptly as I can after reaching this conclusion.

10. CONCLUSION

As I explained at the outset of this document, the Nuclear Waste Policy Act vests responsibilities for deciding how this country will proceed with regard to nuclear waste in a number of different Federal and state actors. As Secretary of Energy, I am charged with making a specific determination: whether to recommend to the President that Yucca Mountain be developed as the site for a repository for spent fuel and high-level radioactive wastes. I have endeavored to discharge that responsibility conscientiously and to the best of my ability.

The first question I believe the law asks me to answer is whether the Yucca Mountain site is scientifically and technically suitable for development as a repository. The amount and quality of research the Department of Energy has invested into answering this question—done by topflight people, much of it on the watch of my predecessors from both parties—is nothing short of staggering. After careful evaluation, I am convinced that the product of over 20 years, millions of hours, and four billion dollars of this research provides a sound scientific basis for concluding that the site can perform safely during both the pre- and post-closure periods, and that it is indeed scientifically and technically suitable for development as a repository.

Having resolved this fundamental question, I then turned to a second set of considerations: are there compelling national interests that warrant proceeding with this project? I am convinced that there are, and that a repository for nuclear waste at Yucca Mountain will advance, in important ways, our energy security, our national security, our environmental goals, and our security against terrorist attacks.

Finally, I examined the arguments that opponents of the project have advanced for why we should not proceed. I do not believe any of them is of sufficient weight to warrant following a different course.

Accordingly, I have determined to recommend to the President that he find Yucca Mountain qualified for application for a construction authorization before the Nuclear Regulatory Commission, and that he recommend it for development of a repository.

THE WHITE HOUSE,
Washington, DC, February 15, 2002

DEAR MR. PRESIDENT: In accordance with section 114 of the Nuclear Waste Policy Act of 1982, 42 U.S.C. 10134 (the "Act"), the Secretary of Energy has recommended approval of the Yucca Mountain site for the development at that site of a repository for the geologic disposal of spent nuclear fuel-and high level nuclear waste from the Nation's defense activities. As is required by the Act, the Secretary has also submitted to me a comprehensive statement of the basis of his recommendation.

Having received the Secretary's recommendation and the comprehensive statement of the basis of it, I consider the Yucca Mountain site qualified for application for a construction authorization for a repository. Therefore, I now recommend the Yucca Mountain site for this purpose. In accordance with section 114 of the Act, I am transmitting with this recommendation to the Congress a copy of the comprehensive statement of the basis of the Secretary's recommendation prepared pursuant to the Act. The transmission of this document triggers an expedited process described in the Act. I urge the Congress to undertake any necessary legislative action on this recommendation in an expedited and bipartisan fashion.

Proceeding with the repository program is necessary to protect public safety, health, and the Nation's security because successful completion of this project would isolate in a geologic repository at a remote location highly radioactive materials now scattered throughout the Nation. In addition, the geologic repository would support our national security through disposal of nuclear waste from our defense facilities.

A deep geologic repository, such as Yucca Mountain, is important for our national security and our energy future. Nuclear energy is the second largest source of U.S. electricity generation 4nd must remain a major component of our national energy policy in the years to come. The cost of nuclear power compares favorably with the costs of electricity generation by other sources, and nuclear power has none of the emissions associated with coal and gas power plants.

This recommendation, if it becomes effective, will permit commencement of the next rigorous stage of scientific and technical review of the repository program through formal licensing proceedings before the Nuclear Regulatory Commission. Successful completion of this program also will redeem the clear Federal legal obligation safely to dispose of commercial spent nuclear fuel that the Congress passed in 1982.

This recommendation is the culmination of two decades of intense scientific scrutiny involving application of an array of scientific and technical disciplines necessary and appropriate for this challenging undertaking. It is an undertaking that was mandated twice by the Congress when it legislated the obligations that would be redeemed by successful pursuit of the repository program. Allowing this recommendation to come into effect will enable the beginning of the next phase of intense scrutiny of the project necessary to assure the public health, safety, and security in the area of Yucca Mountain, and also to enhance the safety and security of the Nation as a whole.

Sincerely,

GEORGE W. BUSH.

The Honorable Richard B. Cheney
President of the Senate
Washington, D.C. 20510

OFFICE OF THE GOVERNOR,
Carson City, NV, April 8, 2002.

The Hon. ROBERT C. BYRD,
President Pro Tempore, U.S. Senate, U.S. Capitol, Washington, DC.

Re: Official-Notice of Disapproval of the Yucca Mountain Site

DEAR MR. PRESIDENT PRO TEMPORE: Pursuant to Section 116(b)(2) of the Nuclear Waste Policy Act of 1982, as amended, 42 U.S.C. § 10136(b)(2), I am transmitting to you for submission to the Congress a Notice of Disapproval of the site designation of Yucca Mountain in Nevada as the nation's high level nuclear waste repository.

A Statement of Reasons explaining why I have submitted the Notice of Disapproval accompanies this notice.

Sincerely,

KENNY C. GUINN,
Governor.

[Attachment.]

STATEMENT OF REASONS SUPPORTING THE GOVERNOR OF NEVADA'S NOTICE OF DISAPPROVAL OF THE PROPOSED YUCCA MOUNTAIN PROJECT

Honorable members of Congress, it is my privilege and duty, under Section 116(b)(2) of the Nuclear Waste Policy Act, to articulate my reasons for issuing a Notice of Disapproval of the designation of Yucca Mountain in Nevada as the site for the nation's high-level nuclear waste repository. I trust you will carefully consider Nevada's views. As a matter of science and the law, and in the interests of state comity and sound national policy, Yucca Mountain should not be developed as a high-level nuclear waste repository.

INTRODUCTION

Nevada strongly opposes the designation of Yucca Mountain for nuclear waste disposal because the project is scientifically flawed, fails to conform to numerous laws, and the policy behind it is ever changing and nonsensical. The Department of Energy has so compromised this project through years of mismanagement that Congress should have no confidence in any representation made by DOE about either its purpose or its safety. Nevada is not anti-nuclear and does not oppose nuclear power. Our state is pro-science and pro-common sense.

Because of the state's longstanding opposition to the Yucca Mountain project, some have accused Nevada of being a not-in-my-backyard, or NIMBY, state. Nothing could be further from the truth. Nevada has already borne more than its fair share of this nation's radioactive waste burdens.

During the Cold War, Nevada served as host to hundreds of nuclear weapons tests, most with bombs several times more powerful than the Hiroshima blast. The government misrepresented the risks and impacts of those tests to our citizenry, and many Nevadans were injured as a result. Nearly 300 million curies of toxic radioactive contaminants remain in the ground in our state to this day. We have not forgotten this legacy.

Nevada is also being forced by the Energy Department to play host to the world's largest low-level and mixed radioactive waste disposal facility, at the Nevada Test Site. DOE plans to use this site for the disposal of hundreds of millions of cubic feet of radioactive and hazardous garbage and contaminated soil from the nation's nuclear weapons complex. Tens of thousands of shipments of this waste through our state are anticipated.

Once upon a time not long ago, the concept of "environmental equity" would have made it unthinkable, given the sacrifices already imposed on Nevada, that the state would be forced to play host to yet an additional nuclear waste dump—indeed, the dump to end all dumps. DOE plans to use Yucca Mountain for the disposal of 77,000 tons of high-level radioactive waste and spent fuel from throughout the United States and 42 other countries. And we know if we permit it to happen, it won't end there.

But Nevada will not permit it to happen. Not simply because it is the wrong thing to do, at the wrong time, from the standpoint of environmental equity. Even when carrying the load of others, Nevadans will never tire of serving their country for a worthy cause.

We will not permit Yucca Mountain to happen—and it will not happen—because the project is manifestly not a worthy cause. Yucca Mountain is but the latest in a long series of DOE boondoggles—one based on bad science, bad law, and bad public policy. In addition, better, cheaper, and safer alternatives exist. Finally, national security will not be helped, but hindered, by this ill-advised project.

Some say Nevada should acquiesce to the project because the Yucca Mountain repository is now inevitable. Obviously, they fail to understand Nevadans, or the power of the American legal system. I assure you, the only thing inevitable about Yucca Mountain is that it will plot the course of so many other doomed DOE megaprojects.

THE SCIENCE

Although DOE bureaucrats claim the Yucca Mountain site is suitable for nuclear waste disposal based on "sound science," it is hard to find a scientist who agrees. Even the project's apologists know that hundreds of technical issues remain unresolved. Initially, the scientific community was optimistic about the prospects of Yucca Mountain. When Congress selected the site in 1987 for intensive study, preliminary data showed it would likely have good geology. In the past four years, however, DOE's own studies proved the mountain was in fact so porous to water, and otherwise so geologically unfit, that the very concept of geologic isolation of the waste had to be abandoned. But geologic isolation was the very purpose of the federal repository program.

DOE no longer refers to the Yucca Mountain project as a deep "geologic" repository. Rejecting the global scientific consensus that nuclear waste should be disposed of by means of geologic isolation, DOE now calls Yucca Mountain merely a deep "underground" repository. This is no surprise. There is nothing "geologic" about it. As the former director of the Yucca Mountain project, Dr. John Bartlett, recently testified, the project has become nothing more than a series of fancy engineered waste packages that just happens to be located 1000 feet underground. The Nuclear Energy Institute recently bragged that the repository can be licensed "without the mountain."

Which begs several questions: If the mountain itself is irrelevant, and waste packages can now be made to last for 10,000 years, why make tens of thousands of shipments of lethal radioactive waste through the nation's cities to the seismically adverse, volcanic zone of Yucca Mountain? It can go practically anywhere else—or stay where it is. If the only reason the waste must be buried is to protect it from terrorists, why spend $60 billion putting it 1000 feet underground, when a mere 20 feet would do the job? And this could surely be done at the reactor sites. NRC has recently re-affirmed the safety of on-site storage.

In the absence of geologic isolation. we don't believe for a minute that DOE can demonstrate the long-term safety of the Yucca Mountain repository. We don't believe an agency that, as the General Accounting Office has noted, has rarely succeeded at building anything can now build a first-of-a-kind waste package that will soak in Yucca Mountain groundwater for 10,000 years without a leak.

DOE's computer models of Yucca Mountain repository performance and radiation emissions currently have an uncertainty factor of up to 10,000. This incredible number bears some pondering. Imagine if a salesman with nothing but fancy computer models told you the brakes on his new model car would be safe for 10,000 miles, plus or minus an uncertainty factor of 10,000. Think about it. What this means is, your brakes could be safe for as many as 100 million miles, or as few as one mile. We simply can't know.

Maybe we Nevadans are a people of uncommon sense. Because that's a car we simply wouldn't buy. That's a car we wouldn't let on our roads.

DOE has yet to finish the very design of the Yucca Mountain repository. We don't even know whether it will be a high temperature repository (above the boiling point of water) or a low temperature repository (below the boiling point of water), a feature that could change the amount of real estate required for the project by up to a factor of 10. Imagine if you submitted a plan for your new house to local authorities for a building permit. You tell them: It may be a 4,000 square-foot gas-heated house, or a 40,000 square-foot all-electric house; the design is still unfinished. I don't have to tell you what our local authorities would do with that plan.

The scientific uncertainties of the Yucca Mountain project are so numerous as to defy enumeration. Attempting to count them all, the Nuclear Regulatory Commission recently identified 293 unresolved technical issues in 9 critical areas. Though DOE dismisses these as trivial, perfunctory, or problems that will be solved "as we go" over the next 300 years, their mere specification belies this claim.

The unresolved issues include critical matters such as volcanism: DOE's gamblers say the odds of a volcano at Yucca Mountain are only 1 in 70 million per year. Yet, there have actually been three active volcanic eruptions within 50 kilometers of the Yucca Mountain site in the past 80,000 years. Indeed. Nevada's geologic studies indicate Yucca Mountain appears to be at the center of one of the most potentially active volcanic areas in the west.

Unresolved are issues such as the seismic integrity of the site: Yucca Mountain sits dead-center in one of the largest earthquake fault zones east of California. In 1992, a magnitude 5.6 earthquake caused tens of thousands of dollars of damage to DOE's own facilities right at Yucca Mountain. More than 600 earthquakes greater than magnitude 2.5 have been recorded at Yucca Mountain just in the past two decades.

Among other things, there remains a real question whether the above-ground storage facility required to facilitate storage and burial of spent fuel at the site can ever meet Nuclear Regulatory Commission temporary storage standards, given the site's adverse seismicity. In other words, it may not be possible to license an above-ground concrete storage pad at this earthquake-prone location. What does this say about the safety of the complex underground facility? And why is it not necessary for DOE to complete seismic studies before plunging ahead with a site determination?

The plethora of unresolved issues includes critical problems such as rapid groundwater flow through the repository: Flows measured by DOE have been more than 100 times greater than was expected when Congress designated Yucca Mountain in 1987 as the only site to be characterized. Surface water that was supposed to have taken thousands of years to pass through the planned repository area to the underlying water table was found to have actually done so in less than 50 years. One former NRC Commissioner visiting the underground test area at Yucca Mountain described its humid environment as a "tropical rain forest."

Secretary Abraham recently wrote, in a *Washington Post* Op-Ed piece March 26, that "Yucca Mountain has an average precipitation of under 8 inches a year, less than half an inch of which actually makes it below the surface." If that is true, Mr. Secretary, why has DOE posted a sign deep within the mountain informing visitors not to worry about liquid dripping from the ceiling of underground caverns, that this liquid is only water, and that it is normal for the subterranean environment of Yucca Mountain? Why is DOE proposing to build a $5 billion titanium "drip shield" around buried spent fuel to channel away effusive dripping water?

The tangled web of man-made contrivances necessary to compensate for the stunning geological surprises at Yucca Mountain has turned the repository system into a kind of Rube Goldberg contraption. To prevent the unexpected water from corroding spent fuel containers, a titanium drip shield is required for each package to channel water away from the containers. But channeled water is apparently subject to boiling from the decay heat of buried spent fuel. Therefore, say independent experts, the repository must be redesigned to space the fuel packages further apart, vastly increasing the real estate, and of course the amount of titanium, required. But there may not be enough real estate within the Yucca Mountain site boundary to do that. And the titanium itself is subject to corrosion. Therefore, all waste packages must be fabricated from a "miracle metal," Alloy-22, to prevent them from corroding if the drip shield fails.

And what about Alloy 22? You guessed it. As recently as last month, the Chairman of the Nuclear Waste Technical Review Board wrote DOE that so little is known "it is not currently possible" to assess the likelihood of corrosion of Alloy 22 for the thousands of years that will be required to assure the safety of the facility. Indeed, Nevada's independent laboratory tests of Alloy 22 showed corrosion in less than half a year. And the titanium apparently fares no better. Just two weeks ago. DOE's own Waste Package Materials Performance Peer Review Panel issued its report with the astonishing revelation that, unless the proposed titanium drip shields somehow perform better in the ground than they have in laboratory tests, they cannot be used at Yucca Mountain. What's next? Maybe the drip shield will need a drip shield.

Secretary Abraham calls this "sound science." We beg to differ.

THE LAW

Nevada currently has four legal actions pending against the Yucca Mountain project. These include a challenge to the siting guidelines re-released at the eleventh hour by DOE, and a challenge to the Environmental Protection Agency's gerrymandered health and safety standards for Yucca Mountain licensing. They include a challenge to DOE's misuse of Nevada's precious water resources, and a challenge to the legal soundness of both the Secretary's and the President's Yucca Mountain site recommendations.

At least two additional actions, one challenging DOE's Environmental Impact Statement, and one challenging NRC's Yucca Mountain licensing rule, will be filed imminently by Nevada.

These are each serious lawsuits, raising fundamental, dispositive legal issues—issues that ought to concern every member of Congress. Issues such as whether DOE cavalierly ignored the dictates of your institution and blatantly violated the Nuclear Waste Policy Act or the National Environmental Policy Act. Issues such as whether the repository is fundamentally unsafe even if it is theoretically "licensable." Issues such as whether radioactive emissions from the site can be declared safe by EPA merely by first diluting them in Nevada's drinking water.

We are not suing simply for the sake of suing. We are suing to enforce the law, because, unfortunately, government bureaucrats pushing Yucca Mountain have chosen to ignore it. It is not necessary for us to win them all, though we believe all are legally sound. One and only one will suffice.

It is astounding to Nevada that DOE refused to postpone its site recommendation pending the outcome of any of these lawsuits. After all, DOE itself says it will not be ready to submit a license application to NRC until at least December 2004. What, then, is the rush? It is likely that all of Nevada's cases will have been decided long before that time.

Let me describe to you just one of our lawsuits—the one against DOE. It's really quite remarkable: After 17 years of using one set of site suitability rules, DOE made the surprising determination that Yucca Mountain, unlike the WIPP nuclear waste repository in New Mexico, couldn't pass the "good geology" test. Instead of reporting this bad news to Congress, as the law requires. DOE changed the rules late last fall. A mere 17 days or so later. DOE proclaimed the site "suitable" using these new rules, ignoring the bedrock geologic isolation requirements of Congress. "Good geology"—the cornerstone of every high-level nuclear waste repository program in the world—was simply ignored by DOE.

To Nevadans, we are like passengers sitting on the runway in a brand new experimental aircraft for 17 hours while mechanics crawl all over the plane inspecting it. After this enormously long wait, the mechanics finally determine the plane is unfit to fly. At the same time, bureaucrats come on the loudspeakers: "Not to worry, folks. We've just changed the flight fitness rules, and the plane will be taking off in 17 seconds." Needless to say, that's a plane none of us would dare dream of flying. But that is exactly what DOE has done with Yucca Mountain.

The *New York Times* recently published an editorial suggesting Congress should simply approve the Yucca Mountain site recommendation and refer all remaining issues of site suitability to the NRC, which was purported to have the expertise to make appropriate decisions in this regard. Remarkably, notwithstanding his own agency's clear statutory duties, Secretary Abraham likewise adopted this view in his recent editorial.

This approach, however, poses both a scientific and a legal paradox. DOE and NRC have each taken the position, in their respective Yucca Mountain rules, that site suitability is a matter to be assessed by DOE and its geologists, not by NRC and its nuclear engineers. Under NRC's current licensing rule for Yucca Mountain (which Nevada will soon fight in court), site suitability is presumed determined the moment the Yucca Mountain application comes in the door. NRC merely determines repository licensability, not Yucca Mountain site suitability. NRC will not evaluate the suitability of Yucca Mountain's geology. That was supposed to have been DOE's job.

Adopting the approach suggested by the *New York Times* would mean DOE's bogus site suitability determination could never be reviewed on the technical merits. On an issue of this magnitude, Nevada and the country as a whole deserve their day in court. And we think Congress should wait until that day has come and gone.

NATIONAL SECURITY AND PUBLIC POLICY

In the wake of the terrorist attacks of 9/11, DOE has tried to paint the Yucca Mountain project—as a badly needed national security measure. A well-financed promotional campaign by the nuclear industry appears to have helped shape the public policy debate in this regard. The Secretary himself, in his *Washington Post* piece last month, strongly urged that "one safe site" for the nation's nuclear waste is best for national security, rather than having the waste scattered at numerous reactor sites across America. This national security myth is one that can and must be debunked. The Yucca Mountain site will contribute nothing to national security.

Even if you believe DOE's optimistic schedule, Yucca Mountain will not be ready even to begin receiving spent fuel from reactor sites for a decade. DOE plans to ship 77,000 tons of high-level waste and spent fuel—the project's design capacity—in up to 98,000 shipments extending through 2046. Once there, the spent fuel will remain stored above ground at Yucca Mountain for up to 100 years while it cools. In the

meantime, reactors (many operating on renewed licenses) will continue to generate at least 2000 additional tons of waste each year.

By 2046, even if (in the unlikely event) Yucca Mountain proceeds on schedule, there will be at least 77,000 tons of additional waste still stored at reactor sites, awaiting shipment to a supposed second repository. As the waste is removed, it will merely make room for an equivalent amount of newly generated waste that will take its place at the various sites. I'm no nuclear engineer, but this sounds like the status quo to me. I fail to understand how this aids national security.

DOE's Acting Director of the Yucca Mountain project affirmed last month before a House appropriations committee that as long as there are nuclear reactors operating, there will continue to be spent fuel stored above ground at sites all across America. In fact, he confirmed, given the slow pace at which spent fuel will be transported to Yucca Mountain, together with the fact that newly generated waste will continue to pile up almost as fast as the old waste is removed, the current backlog of 46,000 tons at plant sites now will never be less than 42,000 tons by the time Yucca Mountain is filled to its design capacity. In short, Yucca Mountain will change nothing.

And that may not be the end, but apparently only the beginning. In its annual strategic plan, "Vision 2020," the Nuclear Energy Institute claims utilities will build as many as 50 new nuclear plants by 2020 if their growing nuclear waste stockpiles are bounded by the availability of Yucca Mountain. More waste is coming to your jurisdictions, not less.

The bottom line is this: Even if Yucca Mountain proceeds, spent fuel will continue to be stored above ground at reactor sites across America for many decades, perhaps centuries, to come. Secretary Abraham's "one safe site" is a figment of DOE's imagination. The Yucca Mountain site is neither "safe" nor will it ever be "one."

The solution to the security issue is to shore up existing storage facilities and increase security at the reactor sites—not to magnify the existing storage facility targets with shipments of tens of thousands of mobile, new targets traversing the country on their way to a geologically flawed Yucca Mountain repository. Not to expose tens of millions of additional citizens to the risks posed by spent fuel packages.

Utilities across the nation are now building interim dry storage facilities, where spent fuel will be stored in casks capable of safely containing the fuel for up to hundreds of years. Several such interim storage facilities are already operating at various utility sites. Since, in any event, these casks will be stored on site for many decades, some experts say they should be covered in a concrete containment to shield them from terrorist attack. NRC is studying the use of anti-aircraft guns at nuclear sites. Reactor sites already have armed guards and comprehensive security plans. Given these measures, the casks will continue to be far more secure at reactor sites than they will ever be on the streets of St. Louis, Chicago, or Peoria—or on barges cruising the Hudson River.

What really does implicate national security is the widespread shipment of spent fuel in casks that, we now know, are not impervious to ubiquitous armor-piercing weapons. It was surprising for us to learn recently from NRC that, since 9/11, the only analysis done by industry or the government of the impacts of terrorism on spent fuel shipments involved merely a computer simulation of a Boeing 767 engine (unaccompanied by aircraft and fuel) striking a railcar shipping cask at 350 miles per hour. Not to worry, said the modelers: the virtual train car moved only a virtual tenth of an inch from the virtual impact, and the virtual lethal waste was contained.

To anyone who watched in horror as the twin towers of the World Trade Center collapsed, this timid virtual test result seems more than a bit incredible. On the other hand, the possibility of a terrorist shooting at a cask from the back of a pickup truck with a small optically-guided armor-piercing missile has been considered by NRC and the industry as "too remote." We once heard the same about suicide bombers.

Thanks to a secret videotape of an industry-sponsored test done by the Army at the Aberdeen Proving Grounds in 1998, obtained last month by Nevada representatives, we now know such a weapon can blow a hole through even the heartiest of spent fuel casks. According to credible sources, there are over 500,000 TOW missiles alone in circulation in at least 36 countries, including over 1700 in Iran. These missiles can penetrate up to 30 inches of armor. Smaller, hand-held weapons in widespread use, like the Stinger, can pierce up to 15 inches of steel.

If Yucca Mountain proceeds, just one of these could potentially give a terrorist access to tens of thousands of radioactive "dirty bombs," with free delivery to hundreds of U.S. targets. Clearly, this is an issue warranting careful investigation by Congress, not a cover-up of the facts by DOE. Many in Congress already share my view; hearings on the security of waste transport to Yucca Mountain are scheduled for later this spring.

In responding to our legitimate concerns, some have accused Nevada of fearmongering, claiming the Aberdeen test was flawed, that a small missile would "only" blow a six-inch hole in some casks, that few if any people would die in such an event, and that further tests are unnecessary. Since no one has studied the issue in light of current events, however, we don't really know. If DOE will not undertake these studies, surely Congress must. If Nevada's mere mention of the potential event is causing fear, imagine the panic if, God forbid, it actually happens.

THE "PECO ALTERNATIVE"

Though the nuclear industry seems to prefer you didn't know it, there is a viable alternative to Yucca Mountain—one that has already been quietly embraced by DOE and at least one utility, DECO Energy, a division of the nation's largest nuclear utility, Exelon Corporation.

In June 2000, PECO signed a deal with DOE that would ultimately have DOE take title to PECO's spent fuel on-site at the Peach Bottom nuclear plant in Pennsylvania. PECO will construct a dry storage facility, ownership of which will also eventually be assumed by DOE. At a date certain, DOE will own, operate, and manage the facility, with the waste stored there in robust, dry casks for the indefinite future. Funds for the deal are provided from the $8 billion Nuclear Waste Fund.

At the time. DOE touted the deal as an arrangement all nuclear utilities should follow. And for good reason. If adopted by the industry, the PECO alternative would solve a host of pressing problems.

First, it would end all utility spent fuel lawsuits against DOE—now estimated to pose up to a $58 billion contingent liability. Second, it would allow utilities to remove spent fuel liabilities from their books and decommission their retired nuclear plants on schedule. Third, it would remove the fuel from utility rate bases and the jurisdiction of state utility commissions, ending their numerous lawsuits against DOE as well. Fourth, it would buy the government time to find a viable new repository or develop new technologies to vastly reduce the dangers of nuclear waste. (Many of these technologies, under development at our national laboratories, already look promising.) Fifth, as Senator Domenici has long indicated, it would preserve the substantial energy content of spent fuel for later use if necessary to supplement the nation's energy needs. Finally, implementing the PECO alternative would cost ratepayers and taxpayers merely pennies on the dollar to the estimated $60 billion (and growing) price tag of Yucca Mountain.

Far from embracing the deal, however, a group of competing utilities sued last year to block it, claiming, ironically, that it gives PECO an unfair economic advantage over utilities who choose to sue the government and place their bets on Yucca Mountain. A ruling is expected from the Eleventh Circuit Court of Appeals soon. Rather than await this key decision. DOE pressed forward with its Yucca Mountain site recommendation as if its own PECO deal were nonexistent. The PECO alternative is not even mentioned in the 67 pounds of Yucca Mountain documents DOE recently sent to the President. It is not even mentioned in the so-called "no action" alternative to Yucca Mountain in DOE's voluminous Final Environmental Impact Statement. Yet, when the deal was signed less than two years ago, DOE endorsed it as "a precedent for additional settlement negotiations with other utilities.

I urge Congress to explore DOE's arrangement with PECO in detail. I applaud the deal made by the nation's leading nuclear utility in the state of our new Homeland Security Director, Tom Ridge, while he was a fellow Governor in Pennsylvania. The PECO arrangement is a convincing and practical alternative to a diseased and utopian Yucca Mountain project. It is a real contributor to national security, not a mythical one.

CONCLUSION

The State of Nevada will redouble its efforts to bring science and the law back to the nation's high-level waste program, and to restore sanity to America's nuclear energy security policy. But we are not alone.

A growing chorus of scientists and independent technical reviewers has voiced grave reservations about the project. These include the NRC's Advisory Committee on Nuclear Waste, the General Accounting Office, the Congressionally-created Nuclear Waste Technical Review Board, the National Academy of Sciences, *Physics Today,* the International Atomic Energy Agency, and the OECD's Nuclear Energy Agency, among others. A recent national poll concludes that those Americans opposed to Yucca Mountain now equal in number those in favor.

I urge each and every one of you to look carefully at the facts. Yes, Yucca Mountain is the most studied piece of real estate in the world. What the studies starkly concluded, however, has been overshadowed by the mere fact they occurred. A hun-

dred more years of study will not change the fatally poor geology of Yucca Mountain, or remove the site from an earthquake fault zone. Nor will decades of moving waste across the countryside to Yucca Mountain even dent the amount of spent nuclear fuel stored above ground at nuclear sites throughout America.

We are well beyond the days when Yucca Mountain was simply Nevada's problem. If the project proceeds, high-level nuclear waste shipments will impact as many as 44 states, 703 counties, and 109 cities with populations of 100,000 or greater, including several major metropolitan areas. Nearly 50 million American citizens reside within three miles of a proposed shipping route. There will be more spent fuel shipments in the first year of Yucca Mountain operations than occurred in the entire history of such shipments in this country. We are in this together.

In short order, Congress will have the prerogative to consider my Notice of Disapproval and, under procedures in the Nuclear Waste Policy Act, override it by simple majority vote in both houses, with a signature by the President. I respectfully urge Congress not to take such action. With the proliferation of safe, economical dry storage facilities at reactor sites, we face no spent fuel emergency. Nuclear power plants face no risk of shutdown. We have the time to do this right. And Yucca Mountain is not right.

Nevada deserves better, and so does this nation.

* * * *

For additional information, see Nevada's Yucca Mountain website at www.state.nv.us/nucwaste. This Statement of Reasons has been posted there.

NUCLEAR WASTE STRATEGY COALITION,
Pinehurst, NC, May 16, 2002.

Hon. JEFF BINGAMAN,
Chairman, Senate Energy and Natural Resources Committee, Washington, DC.
Re: Senate Joint Resolution 34

DEAR MR. CHAIRMAN: As testimony for the record, the members of the Nuclear Waste Strategy Coalition (NWSC) strongly support the President's recent designation of Yucca Mountain as the nation's geological permanent repository for the disposal of spent nuclear fuel and high-level radioactive waste. Accordingly, we strongly support approval of Senate Joint Resolution 34 (S.J. Res. 34), and we urge the Senate Energy and Natural Resources Committee to send it to the full Senate for a vote as soon as possible.

The NWSC is comprised of state regulators, state attorneys general, nuclear electric utilities and associate members working together to hold the Federal government accountable for its contractual and statutory obligations to remove spent nuclear fuel from power plants across the nation to interim storage and eventually to a permanent repository. Our membership includes participants front 44 organizations in 25 states.

There have been many recent efforts to obfuscate the facts about transportation of high-level nuclear waste to Yucca Mountain by those opposed to this Resolution. The Department of Energy (DOE) is approximately 5 years away from selecting the mode, routes and timetable as to how 70,000 MTU, as mandated by the NWPA, will be transported to Nevada.[1] The DOE will be collaborating with the State of Nevada, Tribal and local governments, and Federal agencies on the transportation infrastructure systems in accordance with the Department of Transportation regulations.

Over the last 30 years, there have been more than 2,700 shipments of spent nuclear fuel travelling over 1.6 million miles and there has never been a release of radioactive material harmful to the public or the environment—not one.[2] If a repository is licensed at Yucca Mountain, the DOE projects approximately 4,300 shipments over a 24-year period, averaging 175 shipments of spent nuclear fuel per year, a relatively small amount compared with the approximately 300 million annual, shipments of hazardous materials, (explosives, chemicals, flammable liquids, corrosive materials, and other type of radioactive materials), that are currently transported around the country every day.[3]

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[1] The Department of Energy/OCRWM, Transportation of Radioactive Materials and Yucca Mountain, April 2002.

[2] The Department of Energy/OCRWM, Transportation of Radioactive Materials and Yucca Mountain, April 2002.

[3] The Department of Transportation Office of Hazardous Materials Safety Research and Special Programs Administration, October 1998.

Further, the DOE has spent more than 20 years investigating whether Yucca Mountain would be a suitable site as a repository. Studies undertaken clearly demonstrate that the science and technical evaluations support the President's decision to recommend that the Yucca Mountain site be developed as a permanent repository Additionally, the 1982 Nuclear Waste Policy Act (NWPA), as amended, clearly mandates the DOE to continue with scientific studies as it proceeds with the multi-year formal licensing process. As further specified in the NWPA, the licensing process will be conducted before an independent federal agency, the Nuclear Regulator Commission, which will hold several years of hearings designed to scrutinize the DOE's findings. Failure by the Senate Energy and Natural Resources Committee to pass S.J. Res. 34 designating Yucca Mountain site will kill the only Federal spent nuclear fuel and high-level radioactive waste management program and keep spent nuclear fuel rods and high-level nuclear waste stranded indefinitely at multiple locations nationwide.

Under the NWPA, Congress created the Federal Nuclear Waste Fund for the purpose of funding the removal of spent nuclear fuel and high-level radioactive waste from the nation's plant sites and to provide a permanent disposal repository. Since 1983, the nation's ratepayers have contributed more than $20 billion, including interest, into the Fund—it should now be used for its intended purpose.

We urge the members of the Committee to keep S.J. Res. 34 focused as specified under Section 115(a), in the NWPA, and vote "no" to any amendments or procedural issues that would effectively kill the Resolution. We urge the Committee to allow the Resolution to proceed to the Senate floor unencumbered and unimpeded.

In conclusion, the NWSC urges the Committee to recognize that failure to override Nevada's objection to development of the Yucca Mountain site could be detrimental to the nation's energy supply, security, economy the ratepayers, and our environment.

Sincerely,

LEROY KOPPENDRAYER,
Chairman.

NATIONAL ASSOCIATION OF REGULATORY UTILITY COMMISSIONERS,
Washington, DC, May 22, 2002.

Hon. JEFF BINGAMAN,
Chairman, Committee on Energy and Natural Resources, U.S. Senate, Washington, DC.

Re: Yucca Mountain Hearings

DEAR MR. CHAIRMAN: The National Association of Regulatory Utility Commissioners respectfully requests that the attached statement be included in the record of the hearings your Committee is currently conducting on the President's recommendation of the Yucca Mountain site for development of a national nuclear waste repository.

Thank you for the opportunity to present our views on this most important issue.

Sincerely,

CHRISTOPHER MELE,
Legislative Director, Energy.

[Attachment.]

STATEMENT OF THE NATIONAL ASSOCIATION OF REGULATORY UTILITY COMMISSIONERS

SUMMARY

- NARUC supports the president's decision to approve the site at Yucca Mountain for the geologic repository.
- Analyses show that a repository at Yucca Mountain can be designed, built, operated, monitored and eventually sealed while meeting all statutory and regulatory requirements to protect public health and the environment. While the scientific research about Yucca Mountain continues, enough is known at this point to support the site designation today.
- Transportation of nuclear material is not new and the public is largely unaware of that there has been an excellent safety record of transportation of nuclear materials over the past-30 years.
- Unless the government finds a way to dispose of spent nuclear fuel, some nuclear plants may need to shut down if they are unable to meet their license requirements to store used fuel in pool or dry storage. That will have heavy finan-

cial, environmental or energy supply consequences—probably all three. And it likely rules out any utility being willing to invest in a new nuclear plant.

- Most importantly, NARUC represents ratepayers in 41 States who have, in good faith, paid over $16 billion into the Nuclear Waste Fund (including interest), according to DOE, and have little to show for it. Worse, they have also had to pay utilities that had to bear additional on-site waste storage expenses when DOE missed the 1998 date to begin removing the fuel. In fact, among the States, we often ask, "Why, after DOE failed to meet its contracted 1998 deadline, are we still paying that fee?"
- The so-called "PECO Alternative" is NOT an alternative.
- Reform the Nuclear Waste Fund so it is fully available for its intended purpose.

NARUC is a quasi-governmental, nonprofit organization founded in 1889. Its membership includes the State public utility commissions for all States and territories. NARUC's mission is to serve the public interest by improving the quality and effectiveness of public utility regulation. NARUC's members regulate the retail rates and services of electric, gas, water and telephone utilities. Each State Commission has the obligation under State law to ensure the establishment and maintenance of such energy utility services as may be required by the public convenience and necessity, and to ensure that such services are provided at rates and conditions that are just, reasonable and nondiscriminatory for all consumers.

NARUC has had a direct stakeholder interest in the civilian radioactive waste management program ever since the Nuclear Waste Policy Act of 1982 (NWPA) established that the federal government is responsible for safe, permanent disposal of high-level radioactive waste and spent nuclear fuel from commercial nuclear reactors, as well as making certain that the utilities pay their share of these disposal costs. The primary reason for NARUC's interest is that the fees paid by nuclear utilities to the Nuclear Waste Fund (NWF) are passed along to ratepayers through their electric bills. We would submit that passing the costs of the NWT on to the ratepayers has been the only aspect of the NWPA that has taken place on schedule.

We strongly support the President's decision to approve the site at Yucca Mountain for the geologic repository. It is an historic milestone for this troubled program and it is legally and scientifically sound.

We say "troubled" because, as the Committee members know well, there have been a series of technical, political, legal and financial hurdles that have had the cumulative effect of delay to the point where, even under the most optimistic schedule, nuclear waste will not begin to be emplaced in the repository until 2010—twelve years after the mandate set in the NWPA.

The Department of Energy (DOE) has spent over four billion dollars studying the site at Yucca Mountain for suitability for repository use, in what I have heard described as the most studied piece of real estate on earth. NARUC praises the dedication and professionalism of the inter-disciplinary public and private sector team of scientists who have worked on this unprecedented venture and upon whose analytic investigations the President can rely upon with confidence.

The science is right. Analyses by the DOE team show that a repository at Yucca Mountain can be designed, built, operated, monitored and eventually sealed while meeting all statutory and regulatory requirements to protect public health and the environment. Principle among those requirements is the radiation standards established by the Environmental Protection Agency. While the scientific research about Yucca Mountain continues, more than enough is known at this point to support the site designation today.

The time is right. Yucca Mountain is the right place. While we can never have perfect information, it is hard to imagine a better site. We know there are questions that remain to be addressed to the fullest extent required to support a license approval by the Nuclear Regulatory Commission, but extensive findings support the President's decision to advance toward that next step. Secretary of Energy Abraham put it in the right context in his site recommendation when he observed that Yucca Mountain has been studied for a longer amount of time than it took to plan and complete the moon landing. Let us move on.

First and foremost, let us continue to focus on sound scientific facts surrounding the site designation, not the fear campaign being conducted, in particular, on the subject of nuclear waste transportation. These arguments ignore the excellent safety record of transportation of nuclear materials over the past 30 years. Each of those shipments, and all future shipments to Yucca Mountain, are and will be carefully planned and conducted under NRC, as well as other federal and State agency regulatory oversight. The public is largely unaware of that record, however, and is often predisposed to believe the worst about anything nuclear. The public may not realize, that despite claims of "100,000 shipments through 43 States and many large cities

over 40 years," DOE has yet to choose either the mode (truck or rail) of shipments or any of the routes. In the Final Environmental Impact Statement for Yucca Mountain, DOE states a "preference for the mostly rail scenario," which would involve approximately 11,000 shipments over 24 years. If the "mostly truck" alternative is more feasible, it would involve 53,300 shipments over the same period. We join others in urging that DOE consult with federal, State, tribal and local governments—as DOE has said it will—to coordinate these important decisions so that all will be prepared to ensure that the past safety record is sustained or exceeded. DOE is working today with the transuranic shipments to the Waste Isolation Pilot Plant (WIPP) in New Mexico and we believe that States and local governments, with the assistance to public safety officials provided for in Section 180 of the NWPA, can be prepared so that waste can be safely moved to Yucca Mountain.

The Secretary of Energy's Site Recommendation to the President is compelling. While NARUC did not join the flurry of press releases that were unleashed the day the report was out, because we chose to read the recommendation first, we did issue a release praising the recommendation and the President's acceptance of it the following Monday. The Secretary carefully examined the statutory and regulatory requirements and summarized the analyses derived from a plethora of supporting technical documents. As a result of this exhaustive examination of the data, the Secretary presented the conclusion that the scientific basis exists to meet the requirements. Additionally, he developed and added the five "compelling national interests" that are found in the recommendation. It is often lost in the discussions of this subject, for example, that a geologic repository would still be needed for defense-related materials even if there never were nuclear power plants. Secretary Abraham is to be commended for the diligence with which he applied his own evaluation of the site qualifications and need, including addressing the arguments against recommending the site.

NARUC supports the President's decision to accept the recommendation. He is aware of the likely criticism and expected reactions from those who either oppose anything to do with nuclear energy or the actions taken by Congress in 1987 to designate a single site to examine for suitability. In our opinion, President Bush has the sound science basis to support the decision he has made.

NARUC and its members have a direct interest in the disposal of spent fuel from commercial power plants for two reasons:

1. Unless the government finds a way to dispose of spent nuclear fuel, some nuclear plants may need to shut down if they are unable to meet their license requirements to store used fuel in pool or dry storage. That will have heavy financial, environmental or energy supply consequences—probably all three. And it likely rules out any utility being willing to invest in a new nuclear plant.
2. Most importantly, we represent ratepayers in 41 States who have, in good faith, paid over $16 billion into the Nuclear Waste fund (including interest), according to DOE, and have little to show for it. The utility ratepayers that are represented by NARUC's members have paid the fees required to pay for this program. Worse, they have also had to pay utilities that had to bear additional on-site waste storage expenses when DOE missed the 1998 date to begin removing the fuel. In our opinion, this begs the question, "Why, after DOE failed to meet its contracted 1998 deadline, are we still paying that fee?"

Therefore, it is a matter of equity to those who are paying for this program that we move forward to the next step. Let the technical and legal experts of the Nuclear Regulatory Commission make the decision that really counts, whether to issue a construction license for the repository. That is the role the NWPA assigns to the independent Commission which bears the mission to protect the public health, safety, and the environment for all nuclear activities in this country, in a rigorous and adjudicative public process.

The equity issue is pretty simple. When you make an obligation, you honor it or you face the consequences. Since the Nuclear Waste Policy Act set the policy that the disposal of the Nation's high-level radioactive waste must be the Federal Government's responsibility, the utilities can hardly switch to another removal agent. Similarly, the electric utility ratepayers or consumers have upheld their part of the deal. The money has been paid to the utilities to pay the Federal Government to pay for the program. Given the sound scientific basis for the Secretary and President's decisions to recommend the site, it is now time for the U.S. Congress to do the right thing, honor its commitment and move this program to the next step of the license application process.

A final issue that needs to be addressed is the so-called "DECO Alternative." Some opponents of the Yucca Mountain site have asserted that there is a viable alternative to Yucca Mountain, referring to the example of a settlement agreement

reached between DECO Energy and DOE over expenses already incurred by PECO at its Peach Bottom Nuclear Plant. Those expenses were due solely to DOE's failure to meet the NWPA mandate to begin accepting commercial spent nuclear fuel in 1998, as contractually bound with DECO. Governor Guinn has misinterpreted the stopgap measure to recover costs of waste acceptance delay as a substitute for geologic disposal. In short the "PECO Alternative" is not an alternative at all.

The Nuclear Waste Policy Act sets national policy for geologic disposal as the permanent solution for all high-level radioactive waste disposal. It does not allow for temporary on-site storage costs to be paid from the Nuclear Waste Fund, which is why several utilities are suing DOE over the Peach Bottom settlement. The settlement agreement basically allows the utility to forgo required payments to the Nuclear Waste Fund up until the amount agreed in the settlement. This has the effect of diverting NWF payments that are intended for permanent disposal to cover on-site storage costs that are due solely to the government's ongoing failure to begin waste acceptance. If all utilities were to enter into similar settlements, there would be no revenue flowing to the NWF and the repository could never be built. Moreover, for those plants already shut down there are no payments to credit against the storage costs.

Leaving spent fuel at current commercial and government storage sites indefinitely is not the solution to the waste disposal problem that the NWPA contemplated twenty years ago. The DECO settlement does not provide for geologic disposal nor has the Peach Bottom site or any of the other 71 reactor locations been studied for suitability for indefinite storage. The Yucca Mountain Environmental Impact Statement compared disposing of nuclear waste at the Yucca Mountain geologic repository with leaving the waste at the 77 commercial and government sites, where it is currently, for the same 10,000 year period of isolation from the human environment. The "No Action" approach was found to have one of two consequences; it would either cost $5 trillion dollars or have intolerable human and environmental repercussions, depending on what assumptions were made about regulatory compliance for the sites once the reactors reach the end of their productive operating lives. There is no need for Congress to "explore" the PECO approach: the Environmental Impact Statement has already done that and the financial or environmental consequences are simply unacceptable.

In conclusion, NARUC has been frustrated in the past with all the delays, but we are encouraged that the President has recommended that the program move forward and we urge the Senate to concur with the House by passing a resolution approving the President's site recommendation.

Thank you for the opportunity to present our views. We hope that once Congress has addressed the issue of site recommendation, that it will then undertake the equally important issue of reforming the Nuclear Waste Fund, so it is fully available for its intended purpose. Without such reform the repository may never be built, even if approved.

Glen Echo, MD, May 28, 2002.

Hon. JEFF BINGAMAN,
U.S. Senate, Committee on Energy and Natural Resources, Washington, DC.

DEAR MR. CHAIRMAN: In last Thursday's hearing on Yucca Mountain you asked NRC Chairman Meserve to respond to my testimony that "the NRC's licensing rule does not have any separate requirement for effectiveness of geologic barriers." You received the following answer (with my emphasis):

> NRC CHAIRMAN MESERVE: Let me say that the testimony, Mr. Gilinsky's testimony may reflect some misunderstanding of both of the statute and of our regulatory requirements in that the statute requires the consideration of both natural and engineered barriers. As to our regulatory requirements, it is part of our general philosophy that we supply defense in depth and that we look for a variety of different means to ensure that the regulatory requirements can be satisfied and that would include both natural and engineered barriers. And we anticipate that any DOE application for the site would reflect the effectiveness of various of these barriers. *We do not have separate requirements for each of the barriers.* And that of course is consistent with the advice that the Department of Energy and we received from the National Academy of Sciences that the systems should be viewed as an integrated whole and that all the barriers should work synergistically with each other. And that we see an integrated picture rather than looking at each barriers in isolation.

In short, Chairman Meserve agreed that NRC's licensing rule does not have any separate requirements for effectiveness of geologic barriers. But he also prefaced

this specific response with a discussion that could easily have left the listener with the opposite impression. In view of the question's significance for distinguishing between DOE's and NRC's responsibilities, I thought it was important to provide this additional clarification and emphasis. I would be grateful if you would include this letter in the record of the hearing.

It was a pleasure to appear before you and the members of the Committee on this issue which is so important to the Nation.

Sincerely,

VICTOR GILINSKY.

STATEMENT OF ELLEN G. ENGLEMAN, ADMINISTRATOR RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION U.S. DEPARTMENT OF TRANSPORTATION

Mr. Chairman, Senator Murkowski, and members of the committee, I appreciate the opportunity to provide this statement discussing DOT's role in ensuring the safe transportation of hazardous materials; including spent nuclear fuel.

Spent nuclear fuel has been transported safely in the United States for many years. It is noteworthy that there have been many hundreds of domestic shipments of spent nuclear fuel with no deaths, no injuries, and no releases of the hazardous material. Right now, approximately 15 shipments of spent nuclear fuel are being made annually by utilities, academic institutions, and other facilities that are regulated by the Nuclear Regulatory Commission (NRC). There also are shipments by the military and other shippers not regulated by NRC. All future shipments of spent fuel, just as the ones being made today, will be subject to mandatory transportation requirements and operational procedures to minimize the risks involved in that transportation.

AGENCY ROLES

Under the Nuclear Waste Policy Act (NWPA), the Department of Energy (DOE) has primary responsibility to plan for and arrange the transportation of spent nuclear fuel to a geological repository. NRC licenses storage facilities and also approves the packages and requires transportation in accordance with a physical protection plan. Within DOT, the Research and Special Programs Administration (RSPA) issues hazardous materials regulations, the Federal Railroad Administration (FRA) issues rail safety regulations, the Federal Motor Carrier Safety Administration (FMCSA) issues motor carrier safety regulations, and the United States Coast Guard issues marine transportation safety regulations—all of which apply to the transportation of spent nuclear fuel and other radioactive materials. RSPA, DOE, and the Federal Emergency Management Agency (FEMA) have provided grants, courses, and course materials for emergency responder training related to this transportation.

REGULATORY REQUIREMENTS

I want to provide a brief overview of the regulatory requirements that would apply to spent fuel shipments to Yucca Mountain. Because of NRC's jurisdiction over these and other facets of nuclear waste and other radioactive materials transportation, and DOT's jurisdiction over hazardous materials transportation, the two agencies have entered into a Memorandum of Understanding (MOU) for the regulation of the transport of all radioactive materials. Under the MOU, NRC has the lead responsibility for the review and certification of the packages that are and will be used for spent nuclear fuel transportation. The MOU has been an effective vehicle for a sound regulatory program drawing upon the expertise of both agencies.

Nuclear fuel must be packaged for transportation in cask containers approved by NRC. These specialized casks both reduce the effects of radiation during routine transportation and in a transport accident. NRC's certification process requires demonstration through tests and analyses that casks can survive hypothetical accident scenarios. The on-going radiation exposure protection provided by the casks is equally important for transportation workers who load and unload a shipment of spent nuclear fuel from its conveyance or remain near it during its movement in transportation. Because the time that it takes to move a shipment from origin to destination directly affects radiation exposure, DOT requires that shipments of spent nuclear fuel be planned to avoid intermediate stops to the extent practicable.

Within DOT, several agencies are involved in regulating the transportation of spent nuclear fuel. RSPA's regulations, issued under the Federal hazardous material transportation law, impose packaging, hazard communication, training, operational, and other requirements; they specifically prohibit unnecessary delay in the

transportation of hazardous materials. FRA's regulations, issued under the Federal Railroad Safety Act, impose requirements to ensure the safe rail transportation of hazardous materials. FMCSA's regulations, issued under the Motor Carrier Safety Improvement Act, impose requirements to ensure the safe highway transportation of hazardous materials; they require the use of routes that minimize time in transit when spent nuclear fuel is transported by motor vehicle. FMCSA's routing regulations permit States, following Federal regulatory guidelines, to designate certain routes for transporting hazardous material. Preferred routes are Interstate highways and alternate routes designated by a State routing agency. An Interstate bypass or beltway around a city, when available, must be used rather than an Interstate route through a city. Many States have designated highway routes for radioactive and other hazardous materials (or restricted the use of other routes), in accordance with FMCSA's regulations. Under these DOT regulations, a State or locality may not designate (or restrict the use of) routes that "export" transportation risks to a neighboring jurisdiction or unnecessarily delay the transportation of hazardous materials. To protect barges engaged in spent fuel transportation, the Coast Guard can impose moving security zones around barges under the Magnuson Act and 33 C.F.R. Part 6, and can impose moving safety zones around barges under the Ports and Waterways Safety Act (PWSA); under the PWSA, Coast Guard captains of the port can take other protective actions.

Rail shipments of spent nuclear fuel adhere to recommendations of the Association of American Railroads for the use of special or dedicated trains over key routes. These special trains carry no other cargo and have priority use of the mainline. Key routes are higher volume lines that have safety detection devices (such as wheel bearing detectors) and receive the most frequent inspections and best maintenance.

The NRC's requirements for physical protection of a shipment of spent nuclear fuel, including armed escorts who must be in close contact with a communications center about the status of the shipment, protect against intentional or unintentional disruption of the transportation and reduce the risks of an accident or incident. The same is true of other operational requirements, including State and local provisions that address traffic control and local safety hazards, as well as regulations of RSPA and its sister agencies within DOT—FRA for rail carriers, FMCSA for motor carriers, and the Coast Guard for water carriers. All transportation workers must have training in the requirements that apply to the functions they perform and how to avoid accidents and protect themselves from the hazards of materials being transported. Escorts for shipments of spent nuclear fuel must be trained in security measures, communications, responding to contingencies and threats, the hazards of radiation, and the Federal, State and local requirements that apply to the transportation of radioactive materials.

Many Federal and State agencies enforce these regulatory requirements through inspections. For example, FMCSA has worked with DOE and the Commercial Vehicle Safety Alliance (CVSA) to develop the CVSA Level VI Enhanced Radioactive Inspection Protocols. Under these protocols, every vehicle transporting spent nuclear fuel is required (by DOE contract) to be inspected at its point of origin. This inspection includes radiation scans, as well as driver and vehicle compliance checks. Any defect discovered during the inspection, regardless of how minor, must be corrected before transportation begins.

EMERGENCY RESPONSE

In addition to imposing regulatory requirements intended to prevent incidents and releases, DOT and its partners are concerned about emergency response in the event an incident should occur. Effective response to a transportation accident or incident involving spent nuclear fuel is enhanced through Federal requirements and resources, including financial assistance to States and localities for emergency response planning and training. DOE maintains regional emergency management field offices that can dispatch qualified response teams to an incident involving nuclear material, although the first responders on the scene of an accident usually are local fire departments and law enforcement agencies. RSPA's hazard communication requirements (placarding, shipping papers, and package marking and labeling) inform these responders of the hazards involved. For shipments of spent nuclear fuel, coordination with local responders is also enhanced by the NRC's physical protection requirements that provide for advance notification to the State governor of each shipment to or through the State and advance arrangements with local law enforcement agencies for response to an emergency or a call by escorts for assistance. Local emergency response capabilities are strengthened by RSPA's planning and training grants to States, who in turn pass at least 75% of the grants through to local communities. Significantly, both DOE and FEMA have actively conducted and promoted

emergency responder training that enhances the ability of State and local fire, police and other emergency personnel to respond to and mitigate hazardous materials spills and other incidents.

SUMMARY

DOT provides a regulatory structure for the safe transportation of spent nuclear fuel, other radioactive materials, and all other hazardous materials. Our enforcement of those regulatory requirements would be greatly assisted by passage of legislation to reauthorize the hazardous materials transportation safety program; the Administration's proposal was introduced last year as H.R. 3276 and S. 1669. In partnership with other Federal agencies, States, local and tribal governments, and carriers and shippers of hazardous materials, we will continue to ensure the safe transportation of all hazardous materials into, through, and within the United States.

STATEMENT OF DR. GAIL H. MARCUS, PRESIDENT, AMERICAN NUCLEAR SOCIETY

Mr. Chairman, as President of the American Nuclear Society, I appreciate the opportunity to provide a written statement on behalf of ANS regarding transportation issues related to the nuclear waste repository at Yucca Mountain for the committee's hearing.

ANS' confidence in the safety of high-level waste (HLW) transportation arises from the robustness of the cask design, the demonstrated safety record of HLW transportation and safeguards in the transportation process. I would like to elaborate on each of these factors.

ROBUSTNESS OF THE CASK DESIGN

Casks used for shipping spent nuclear fuel are designed to protect against radiation exposure to the public under both normal and accident conditions. The casks are designed and tested in accordance with requirements established by the Nuclear Regulatory Commission and the Department of Transportation and documented in volumes 10 and 49 of the U.S. Code of Federal Regulations.

The casks are about 15 times thicker than a gasoline tank truck shell and they include three inches of stainless steel with thick lead radiation shields. Typically, for every ton of spent nuclear fuel, there are more than three tons of protective packaging and shielding.

Casks are designed and tested to withstand crashes, fire, water immersion and puncture. To be certified, a cask design must withstand a sequence of four tests that measure its performance in specified crash and fire accident conditions. This means the casks are designed to contain its contents in the event an accident occurs.

Safety Record of Transportation

Over the past 40 years, about 3,000 shipments of spent nuclear fuel have navigated more than 1.7 million miles of U.S. roads and railways. Since the early days off HLW transportation, 90 spent fuel casks have been involved in accidents. None of these accidents resulted in any release of radioactive material.

It should be noted that the impact tests required by Federal Regulation exert forces on the casks that are greater than the impact forces (g forces) in the worst recorded accidents. Temperatures produced in the casks by the regulatory fire tests are higher than those in any recorded fire accident.

In addition, Sandia National Laboratories has conducted three extra-regulatory types oh tests:

- A 20-ton truck cask struck by a 120-ton diesel locomotive traveling at 81 mph
- A 22-ton cask on a flatbed crashed into a 690-ton concrete block at 84 mph
- A propane tank car exploding next to a cask in a pool fire, throwing the cask 33 feet.

The casks emerged from these tests with only minor damage, and in none of the tests did the casks fail to hold their contents.

While there would be more shipments of nuclear waste in the coming years as a result of the opening of Yucca Mountain, the probability of radiation exposure to the public from an accident would remain low because casks of the same design would be used and the same safety procedures would be followed.

Recently, concerns have been raised about the potential impacts of terrorist attacks during the transport of HLW. While there are many dimensions to the issue of terrorism that we, as a nation, are only beginning to understand, we can say that the same features that render casks highly resistant to highway and rail accidents

tend to make them difficult targets for such attacks. By comparison, many hazardous chemical and other substances are shipped by truck and rail in less robust containers, and are more apt, if successfully attacked, to result in immediate casualties.

SAFEGUARDS IN THE TRANSPORTATION PROCESS

Public routes used for the transport of nuclear materials must meet strict safety requirements before nuclear fuel is transported. Department of Transportation regulations require carriers of certain controlled radioactive materials, such as spent fuel, to use the safest routes available. Risk assessments of the transportation of radioactive materials evaluate factors such as accident rate, transit time, population density, other vehicles sharing the route and time of day.

The DOT identifies "preferred routes," which consist primarily of interstate highways and bypass routes around cities, where such bypass routes exist, or an alternative route selected by a state routing authority. If the routing authority selects an alternate route, it must demonstrate by a routing analysis that using the alternate route does not increase overall risk. Alternate route selections must be preceded by consultations between DOT and affected state and local authorities before such designations can go into effect.

Most materials being transported are monitored by global satellites and are monitored at all times during the transportation process. Specialized trucking companies handle spent nuclear fuel shipments in the United States. These experienced, specially licensed companies haul all kinds of hazardous materials more than 50 million miles annually. Vehicles are state of the art, equipped with computers that provide an instantaneous update on the truck's location and convey messages between driver and dispatcher through a satellite communications network. Drivers receive extensive training and must be certified by the federal government.

IN SUMMARY

The regulatory requirements on casks and transportation security, and the industry's high level of performance, have produced a safety record that would be difficult to match. This performance record gives us strong confidence that the transport of spent nuclear fuel to Yucca Mountain can and will be conducted without harm to the public.

Mr. Chairman, we sincerely appreciate the opportunities to share our views and facts concerning the safety of transporting nuclear fuel.

The American Nuclear Society is a professional society devoted to advancing nuclear science and technology.

STATEMENT OF ALLAN RUTTER, ADMINISTRATOR FEDERAL RAILROAD ADMINISTRATION, U.S. DEPARTMENT OF TRANSPORTATION

Mr. Chairman, Senator Murkowski, and members of the Committee, I am very pleased to have the opportunity to present this statement on the important subject of the transportation of nuclear wastes. The Federal Railroad Administration (FRA), on behalf of the Secretary of Transportation, administers the Federal railroad safety laws, including those concerning the transportation of hazardous materials by rail. Ranking at the top of FRA's priorities is the safety of rail shipments involving Spent Nuclear Fuel (SNF)[1] and High-Level Radioactive Waste (HLRW).[2] These materials have been transported safely by rail in the United States for more than 45 years. Since 1957, approximately 1,100 shipments of SNF and HLRW have traversed our Nation's railroad system.

To ensure the safe transportation of nuclear materials by rail, FRA works as part of a multi-agency team that includes, among others: the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), the Federal Emergency Management Agency, the Research and Special Programs Administration (RSPA), and the Federal Motor Carrier Safety Administration (FMCSA). We also work closely with

[1] The Nuclear Waste Policy Act of 1982 (NWPA) defines "spent nuclear fuel" as "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing."

[2] NWPA defines "high-level radioactive waste" as "(A) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and (B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation." The term "Commission" as used in the definition means the Nuclear Regulatory Commission.

various State governmental organizations, including the Council of State Governments, the Western Governors Association, and the Southern States Energy Board.

DOE, of course, has broad responsibilities in the area of nuclear power that include planning and arranging for the transportation of SNF and HLRW. NRC, in addition to licensing nuclear facilities, has developed the overall design criteria for the casks in which these materials are transported and reviews and approves physical security plans for spent fuel shipments. RSPA, another agency of the Department of Transportation, sets the standards for the transportation of all hazardous materials, including SNF and HLRW. RSPA's relevant standards cover hazard communication, shipment documentation, packaging safety, and training. FMCSA oversees the safety and routing of shipments by highway.

In general, FRA establishes safety standards concerning the design, maintenance, and inspection of many elements of our Nation's railroad system, including track, motive power and equipment, signal and train control, operating practices, and hazardous materials transportation. Railroads are required to conduct their own inspections to ensure that these safety standards are being met. FRA leads a cadre of approximately 400 Federal and State safety inspectors whose role is not to conduct safety inspections for the railroad industry, but to monitor the railroad industry's own inspection forces to ascertain whether the railroads are in compliance with applicable Federal safety standards. FRA inspectors accomplish this task by conducting routine, random and programmed inspections of railroad properties and comparing their findings to a railroad's own inspection records. Thus, while primary responsibility for inspecting the railroads rests with the railroads themselves, FRA's inspection strategy is to ensure the integrity and effectiveness of the railroads' own inspection programs.

With regard to rail transportation of SNF and HLRW in particular, FRA conducts inspections to verify that the shipment is properly prepared and in compliance with all applicable hazardous materials regulations. We also help to ensure that the track, signal systems, grade crossings, bridges, and rail vehicles used for these shipments are in safe condition and that responsible railroad employees are properly trained and briefed. In these activities, of course, we work very closely with the railroads, their employees, and the affected communities. We believe the regulatory structure, planning, monitoring, coordination, and experience have produced a very safe system for the transportation of nuclear wastes by rail, but we understand the need to continue to improve that system to meet the new challenges posed by the expected increase in those shipments and the post-September 11th security environment.

RAIL TRANSPORTATION OF RADIOACTIVE MATERIALS

Railroad transportation is well suited to moving high-level radioactive materials safely and efficiently. Complementary Federal regulations issued by RSPA and NRC require SNF and HLRW, even when shipped in small amounts, to be transported in specially shielded containers or casks that conform to NRC's regulations for Type B containers. Typically, in accordance with NRC's standards, these casks are constructed of multiple layers of stainless steel with shielding sandwiched in between the layers of steel to protect against radioactive emissions. Railroads are ideally suited to moving these large, heavy casks.

Most rail shipments of SNF or HLRW move in casks that weigh up to 125 tons when loaded and are capable of carrying large quantities of high-level radioactive material. Many truckloads would be required to move an equivalent amount of nuclear material by highway. To get a sense of the great efficiencies that can be achieved by moving high-level nuclear materials by rail, consider the data projections presented in the environmental impact statement (EIS) for the Yucca Mountain site. Over the 24-year period covered by the EIS, there will be approximately 10,700 shipments of SNF, which means there will be about 150 train movements carrying up to 450 shipments (three shipments per train) annually. To carry this same quantity of SNF by truck would require approximately 53,000 shipments over 24 years, which would mean 2,200 highway movements (one shipment per truck) annually. The inherent efficiency of rail transportation in moving SNF and HLRW has a direct bearing on safety, as fewer shipments of nuclear materials mean less public exposure and less opportunity for a transportation incident.

Rail movements of SNF and HLRW have a long and very positive history, and the volume of these shipments is growing. The Navy has been shipping SNF to disposal sites since 1957. In 1989, Carolina Power and Light began sending SNF from its commercial nuclear reactors to temporary storage facilities. Several years ago, FRA realized that the relatively modest number of rail shipments of SNF and HLRW, which had numbered between 15 and 25 annually during the early 1990s,

was likely to increase dramatically. In 1995, DOE began shipment of SNF and HLRW as part of its Foreign Research Reactor Fuel Program, which is intended to safeguard SNF shipped from research reactors around the world and is an important element in the Nation's nuclear nonproliferation efforts. As a result of these programs, rail shipments of SNF and HLRW increased from 38 shipments in 1997 to an average of more than 64 shipments per year in the succeeding years. Furthermore, two separate consortiums of commercial nuclear power producers each anticipate initiating as many as 100 rail shipments per year of SNF and HLRW to temporary storage facilities, possibly as early as next year. Therefore, even without the Yucca Mountain shipments, rail shipments of SNF and HLRW are destined to increase sharply.

FBA'S SAFETY COMPLIANCE OVERSIGHT PLAN (SCOP)

Ultimately, the safe movement of SNF and HLRW depends on the application of sound safety regulations, policies and procedures. This requires extensive planning and coordination among Federal agencies, State and local governments, and commercial transportation companies.

In the mid-1980s, partly as a result of the rail shipments from the Three Mile Island Nuclear Power Plant, FRA implemented its High-Level Nuclear Waste Rail Transportation Inspection Policy for all known rail shipments of SNF and HLRW. Under FBA's Inspection Policy, there has never been a rail accident or incident involving the transportation of SNF or HLRW that has resulted in a release of the material from the packaging. Furthermore, there has never been a single death or injury resulting from a rail shipment of radioactive material.

Taking a proactive approach to railroad safety, FRA recognized the need to enhance its high-level radioactive materials rail transportation inspection policy to ensure that the railroad industry's outstanding safety record for nuclear material shipments could continue unabated despite the sharp increase in nuclear materials shipments. Therefore, in 1998, FRA developed the Safety Compliance Oversight Plan For Transportation of High-Level Radioactive Waste and Spent Nuclear Fuel (SCOP), which set forth an enhanced FRA policy to address the safety of rail shipments of SNF and HLRW. While the SCOP was originally developed in support of DOT's Foreign Research Reactor Fuel program, FRA believes this enhanced policy is necessary to ensure the safety of future rail shipments of SNF and HLRW, which are destined to increase significantly with or without the opening of Yucca Mountain.

Development of the SCOP involved a coordinated effort between FRA, DOE, the Association of American Railroads (AAR), railroad labor organizations, and representatives of affected States. Also, through participation in DOT's Transportation External Coordination Working Group, FRA has consulted with Native American groups on the relevant issues. FRA wishes to acknowledge the invaluable contribution of its safety partners, whose insight and wisdom were instrumental in formulating the policies and procedures that are incorporated into the SCOP.

Key elements of the SCOP include: planning the most appropriate routes, training of railroad employees and emergency responders, and enhancing FRA safety inspection practices and overall safety oversight policies.

Under the SCOP, FRA works with DOE, the offeror or its agent, and the rail carriers in planning and selecting the routes, emphasizing the selection of the highest classes of track. (FRA regulations define various classes of track; each class of track has a maximum allowable operating speed and specific design, maintenance, and inspection requirements. The higher the class of track, the higher the permissible operating speed and the more stringent the safety standards.) FRA also prepares an accident prediction model for the highway-rail grade crossings along the intended route and uses this model to assist DOE in coordinating with appropriate State, local, and tribal agencies in route planning activities. We also coordinate with Operation Lifesaver, a private safety organization, to increase grade crossing safety awareness and education in communities along designated routes. We also work with DOT's Office of Intelligence and Security in coordinating security precautions, such as the identification of "safe havens," with the offeror, law enforcement officers, and intelligence communities. As the new Transportation Security Administration begins its work in the Department, we will be coordinating closely with them to ensure the security of these shipments. Finally, FRA reviews the emergency response plans of the offeror, rail carrier, and DOE to ensure that they adequately address the actions to be taken in the unlikely event of an accident or incident involving the train.

Training is another important element of the SCOP. It is FRA's policy to assist DOE, and the offeror or its agent, in the development of emergency response train-

ing and safety briefings and to monitor the industry to verify that requisite training and briefings have been performed. FRA also conducts reviews to ensure that train crews who operate the trains in which nuclear materials are transported are properly certified, trained, and experienced in running over the designated routes. FRA also checks to see that these crews have received specific training concerning the nature of the shipments.

As explained above, FRA's safety inspection program is primarily designed to monitor the safety performance of railroads, which are responsible for performing their own inspections and ensuring the safety of their operations. However, under the SCOP, FRA plays a more direct role by conducting more focused and intensive safety inspections to ensure the highest level of safety for rail shipments of SNR and HLRW. For example, instead of inspecting a limited sample of locomotives and freight cars as we do for routine rail operations, FRA equipment inspectors conduct a thorough inspection of each and every locomotive and freight car for every train that transports SNF and HLRW. These inspections ensure that locomotives, freight cars, and the train's braking systems meet all applicable Federal safety standards. Furthermore, along a designated route, it is FRA's policy to observe the operation of all automated warning devices at highway-rail grade crossings, to ascertain that they are operational before the shipment. FRA signal inspectors also conduct inspections of selected grade crossing warning devices to gauge the reliability and integrity of the grade crossing warning system. Furthermore, FRA places operating practices experts in the rail carriers' dispatching centers during SNF and HLRW shipments on designated routes to observe firsthand the progress of the shipments and any operational problems that might arise. It is also FRA's policy to inspect all the tracks along the entire route of a nuclear shipment; this includes both visual inspections and automated inspections by FRA's track geometry vehicle (the T-2000), which is capable of measuring the alignment, gage and cross-level of every foot of railroad track. In addition, FRA reviews the rail carrier's rail flaw detection vehicle data to ensure that rail flaw inspections have been performed on the designated route, and necessary rail repairs have been made prior to the shipments.

It must be emphasized that the SCOP is a living document that has evolved from 45 years of accumulated experience regarding the safe movement of nuclear materials by rail. FRA will continue to work in partnership with the rail community to periodically review, evaluate, and update the SCOP to keep pace with the latest developments and technologies involving the safe transportation of nuclear materials.

From this brief description of FRA safety inspection policies under the SCOP, one can understand why FRA inspection resources are stretched to their limits, even with the relatively modest number of nuclear rail shipments that are currently taking place. We are working within the budget process to anticipate the resources needed to maintain the highest level of safety for SNF and HLRW rail shipments. For example, one of the budgetary challenges FRA will need to overcome involves our automated track geometry vehicle, which is capable of inspecting 30,000 miles of track per year. When the interim nuclear storage facilities or Yucca Mountain begins accepting shipments of SNF and HLRW, the number of track miles over which SNF and HLRW travel will most assuredly exceed 30,000, and we must be prepared to respond to the challenge.

SAFETY AND SECURITY PROTOCOLS

Federal regulations for shipment of nuclear material by rail are augmented by a series of safety and security protocols and special operating restrictions that have been agreed upon by DOE and the railroads. These protocols and operating restrictions have evolved over the years and are often tailored to the particular needs of the individual shipments. Under these protocols, a train carrying SNF or HLRW would typically include the cask cars, two buffer cars (one on each end of the shipment to cushion against impacts in the event of a collision), and an occupied escort car staffed by security personnel. Special operating restrictions have included limitations on the maximum speed of trains carrying nuclear materials, requirements to stop opposing trains on adjacent tracks when they meet a train carrying nuclear materials, and requirements that nuclear material cars be switched only with an attached locomotive rather than allowing them to roll to a stop on their own during switching.

Another convention involving the shipment of SNF and HLRW by rails concerns the use of dedicated trains. Until the mid-1970s, most rail shipments of these radioactive materials were handled in regular service trains that carried a wide variety of freight in addition to the radioactive materials cars. In 1974, the railroad industry began insisting that radioactive materials shipments move in dedicated trains that solely transport the radioactive material cars. There has been much debate

about this topic over the years; while many nuclear materials shipments do move in dedicated trains today, this is not the case for all such shipments. (In 1977, the Interstate Commerce Commission issued a decision that prevented railroads from mandating the use of dedicated trains.) FRA has engaged the services of the John A. Volpe National Transportation Systems Center to conduct a thorough study of the safety and security implications surrounding the transportation of high-level radioactive materials in dedicated trains versus regular service trains. We hope to have the study completed by the end of this year or early next year.

The security of rail shipments of radioactive materials has long been a priority even before the tragic events of September 11th. Some of the protocols described above contain stringent security measures to protect against terrorist threats, including the accompaniment of these shipments by armed security forces and requirements to protect the cars when sitting in rail yards or sidings.

More recently, Global Positioning Satellite (GPS) technology is being used to track the location of trains carrying radioactive materials. FRA is leading a departmental effort to build a Nationwide Differential Global Positioning System (NDGPS) that can greatly improve the accuracy of conventional GPS to several centimeters. This level of precision permits the system's user to determine exactly which track (where there are adjacent tracks) a train is occupying. Our goal is to have dual NDGPS coverage for the entire United States. Presently, 80 percent of the continental U.S. has NDGPS coverage while 40 percent has dual coverage.

Although security concerns have long played a prominent role in the safety of rail shipments of radioactive materials, the events of September 11th have reinforced the fact that we must constantly reassess our assumptions and beliefs. A few weeks after the attacks on the World Trade Center and the Pentagon, the Association of American Railroads secured the services of an experienced security firm to conduct a comprehensive review and assessment of the security of our Nation's freight railroad system. The security of hazardous materials, including radioactive materials, and defense-related shipments are two areas that have received special emphasis in the security review. FRA has obtained the services of its own security experts to review the AAR security assessment. We will provide input into the security review, which may include proposed enhancements for the security of rail shipments of nuclear materials.

Nothing that we do in transportation after last September 11th can ignore the threats to security posed by terrorist organizations. The Federal agencies responsible for direction or oversight of these movements have worked successfully over the years through the Governors' offices of the respective States to ensure that emergency planning and emergency response agencies have the information and training they need to do their jobs. This sharing of information and cooperation must continue. However, it will be particularly important that specific information regarding routes and timing of individual shipments is kept secure by those with a need to know. The Transportation Security Administration and other participating agencies, including FRA, will need to evaluate how best to address this security concern.

CONCLUSION

FRA believes that it is critical that rail shipments of high-level radioactive materials continue to be conducted with a maximum degree of safety and security. This can only be accomplished through a sound and meaningful safety partnership involving all relevant elements of the nuclear industry, the railroad community and appropriate Federal, State, and local governmental bodies. Our current safety requirements and practices have evolved over a period of 45 years. We must build upon the knowledge and experience we have gained over that period to meet the challenges that are likely to arise with the projected increase in rail shipments of SNF and high-level radioactive materials in today's railroad environment. As noted above, new challenges will arise regardless of whether or when the Yucca Mountain storage facility becomes operational, and when they do, FRA and its many partners are determined to be prepared to successfully meet these challenges.

STATEMENT OF JOAN CLAYBROOK, PRESIDENT OF PUBLIC CITIZEN

Mr. Chairman and Members of the Committee: Thank you for the opportunity to submit for the record written testimony on the president's February 14th recommendation that a nuclear waste repository be developed at Yucca Mountain, Nevada, and Senate Joint Resolution 34. I am President of Public Citizen, a national non-profit public interest organization with 150,000 members nationwide. Public

Citizen works to protect citizens and the environment from the dangers posed by nuclear power and advocates for safe, affordable, and sustainable energy policies.

Soon the Senate will face an unprecedented decision about whether to support or override the Governor of Nevada's Notice of Disapproval to prevent establishing a Yucca Mountain repository for 70,000 metric tons of high-level radioactive waste from commercial nuclear power plants and Department of Energy (DOE) weapons activities.

Public Citizen urges the Committee to decisively reject Energy Secretary Spencer Abraham's unscientific site recommendation, support the Notice of Disapproval and stop the Yucca Mountain Project, in order to protect public health and safety. The DOE has a long record of investing in wasteful ventures and white elephants at a cost of tens of billions of dollars to the U.S. taxpayer. No private business could survive operating with such a string of misjudgments and failures. It is time for the Congress to insert a dose of reality and pull the plug on the hazardous Yucca Mountain venture. Just look at the DOE's mishandling of military nuclear waste projects, some of which were highlighted by *60 Minutes* on Sunday, March 17, 2002 (transcript available on request). Yucca Mountain is poised to become another contaminated DOE site if the repository proposal moves forward.

THE SITE IS UNSUITABLE

After fifteen years of site characterization studies at a cost exceeding $5 billion, DOE scientists have been unable to demonstrate that a repository at Yucca Mountain could effectively isolate high-level nuclear waste throughout the quarter million years it remains dangerously radioactive. Having originally instructed the DOE to assess the suitability of the site for a geologic repository, Congress should now consider this question answered in the negative, and terminate repository activities at Yucca Mountain.

The geology of the site is ill-suited to the task of containment. Yucca Mountain is a ridge of porous volcanic tuff, highly fractured as a result of seismic activity. Thirty-three earthquake faults are known to exist within and adjacent to the Yucca Mountain site, with additional fault lines expected to develop over time. The proposed repository would lie about 1,000 feet above a freshwater aquifer, which currently provides the only source of drinking water for area residents in Amargosa Valley, Nevada, and parts of Inyo County, California. If radioactivity from the proposed repository reaches the aquifer below, it not only will contaminate this important source of drinking water, which is in short supply, but also will provide a pathway for potentially dangerous levels of radioactivity to reach the accessible environment.

Although the climate at Yucca Mountain is generally dry, evidence points to relatively rapid movement of water through the rock. Elevated levels of the tracer isotope Chlorine-36 found in the DOE's test tunnel at Yucca Mountain indicate that water traveled from surface- to repository-level (about 1,000 feet) in 50 years or faster. The original siting guidelines (10 CFR 960) would have disqualified the Yucca Mountain site on the basis of water flow time alone.

To prevent the site from being disqualified, the government changed the rules. The DOE inappropriately rewrote the repository siting guidelines in November 2001 to accommodate the deficiencies in the Yucca Mountain site. The revised guidelines (10 CFR 963) are a dangerous departure from the concept of geologic containment and offer an inadequate basis for site recommendation. The new performance-based siting guidelines permit a reliance on "engineered barriers" in an attempt to mask the many problems that should disqualify the Yucca Mountain site. DOE's repository design proposals rely more than 99% on engineered barriers for containment. The geology of Yucca Mountain contributes less than 1%.[1]

Given the difficulties in accurately predicting, on the basis of very limited experience, the performance of engineered barriers over tens of thousands of years, coupled with the inadequacies of the "natural barriers" at Yucca Mountain, it is only a question of when—not if—the proposed repository's isolation systems would fail.

High-level nuclear waste is intensely radioactive and very long-lived. It is one of the most hazardous substances ever created. The waste's dangerous radioactivity will outlast any engineered barriers employed at Yucca Mountain. The Environmental Protection Agency's (EPA) site-specific radiation protection standards for Yucca Mountain (40 CFR 197) arbitrarily established a 10,000-year limit on containment requirements at the repository, which has been subsequently adopted by the

[1] Nevada Nuclear Waste Project Office analysis of DOE presentation to Nuclear Waste Technical Review Board, 1/25/99.

DOE in its siting guidelines and the Nuclear Regulatory Commission (NRC) in its Yucca Mountain licensing rule.

Yet, high-level nuclear waste will remain dangerously radioactive for much longer. For example, Plutonium-239, which accounts for approximately 1-4% of high-level nuclear waste by weight, has a half-life of 24,400 years and remains dangerously radioactive for close to a quarter-million years. If DOE's optimistic predictions are correct and the underground nuclear waste storage containers at Yucca Mountain do not begin failing from corrosion for 40,000 years, peak radiation dose rates from the proposed repository are expected 100,000-200,000 years into the future—outside EPA's inadequate regulatory timeframe.

The EPA's radiation standards (40 CFR 197) also establish a lower level of environmental protection for Yucca Mountain than the generic rule applicable elsewhere, by expanding the unregulated zone to 18 kilometers from the repository boundary in the direction of groundwater flow. This site-specific rule allows the DOE to rely on dilution and dispersion in groundwater, rather than containment of radioactivity, and as such sets an inadequate benchmark for performance assessment evaluations. A map illustrating the unacceptable leniency of the EPA rule is attached. [1a] Public Citizen, together with the Natural Resources Defense Council and other environmental and public interest organizations, filed a lawsuit last June challenging these aspects of the EPA rule. Our case has been consolidated with a lawsuit from the State of Nevada, and the joint brief, filed with the District of Columbia Circuit Court of Appeals on May 3rd, 2002, is available online at http://www.nrdc.org/media/docs/020506.pdf.

But even projections of the proposed repository's compliance with this inadequate standard are inconclusive. The Nuclear Waste Technical Review Board [2] advised Congress on January 24, 2002, that "the technical basis for the DOE's repository performance estimates is weak to moderate." Also, a December 2001 report by the General Accounting Office highlighted 293 unresolved technical issues, identified by the Nuclear Regulatory Commission, that require further study and analysis.[3] As the GAO report suggests, Secretary Abraham's site recommendation is premature at best.

THE RISKS OF NUCLEAR WASTE TRANSPORTATION CANNOT BE JUSTIFIED

Intrinsic to any assessment of Yucca Mountain's suitability as a national nuclear waste repository is the feasibility of transporting waste to the site. Yet, the DOE has consistently downplayed the transportation impacts of the Yucca Mountain proposal. Secretary Abraham's site recommendation does not detail a specific plan for transporting waste from the 77 nuclear power plants and DOE weapons sites across the country where it's currently stored to Nevada. Basic decisions about the mode of transportation (truck, train, or barge) and routes have not yet been made.

The maps of potential Yucca Mountain transport routes, included in the project's final Environmental Impact Statement, indicate that tens of thousands of high-level radioactive waste shipments would likely pass through 44 states and the District of Columbia en route to Yucca Mountain.Recognizing the explosive nature of route designations, the DOE refuses to announce a specific proposal for transporting nuclear waste until after Yucca Mountain is licensed. At least until DOE reveals precisely which routes would be used for nuclear waste transportation and details a specific proposal for ensuring the safety of Yucca Mountain shipments, a vote in support of the repository proposal would be not only premature but grossly irresponsible.

Transporting nuclear waste is inherently dangerous because it increases the likelihood of radioactive release and introduces this risk to densely populated areas where the emergency response/public health infrastructure may lack the capacity to respond effectively to a nuclear emergency. The Department of Transportation (DOT) recorded 438,000 crashes involving large trucks in 2000, the most recent year for which statistics are available.[4] Over the same period, the Federal Railroad Administration reported 2,983 train crashes.[5] According to RailWatch analysis of acci-

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[1a] The map has been retained in committee files.

[2] The presidential-appointed Nuclear Waste Technical Review Board is an independent agency of the U.S. Government. The Board provides independent scientific and technical oversight of the civilian high-level radioactive waste management program.

[3] *Nuclear Waste: Technical, Cost and Schedule Uncertainties of the Yucca Mountain Project* (December 2001).

[4] *Large Truck Crash Facts, 2000*, Analysis Division, Federal Motor Carrier Safety Administration, U.S. Department of Transportation (March 2002).

[5] Federal Railroad Administration Office of Safety, http://safetydata.fra.dot.gov/officeofsafety/, viewed 5/28/02.

dent reports, a train carrying hazardous materials in the U.S. runs off the tracks, spills some of its load, and forces an evacuation about once every two weeks.[6]

Since the dawn of the Nuclear Age, approximately 3,000 shipments of high-level nuclear waste have traveled on U.S. roads and rails. This number would be exceeded within the first two years of shipments to the proposed Yucca Mountain repository. While the nuclear industry frequently refers to an accident-free shipping history, a 1996 analysis of DOE accident reports[7] documents 72 "incidents" since 1949 involving nuclear waste shipments, including four involving "accidental radioactive material contamination beyond the vehicle," four with radiation contamination confined to the vehicle, 49 of accidental container surface contamination, 13 traffic accidents with no release or contamination, and 2 incidents with no description. Extrapolating on the basis of this past history and considering, statistically, general traffic crash rates along probable nuclear waste transportation routes, crashes involving Yucca Mountain shipments are certain to occur if the repository program moves forward.

Given the statistical certainty of crashes involving Yucca Mountain nuclear waste shipments, the DOE and nuclear industry safety assurances rest upon the robustness of shipping containers, or "casks," and their ability to contain radioactivity even in the event of a crash. However, we are concerned that in the event of a severe crash casks may not perform as expected. DOE accident analyses fail to consider the statistical likelihood of manufacturing and human error and its impact on cask performance. Also, NRC license requirements for high-level radioactive waste transport casks rely on computer modeling. Amazingly, currently licensed casks have never had full-scale, dynamic tests. Limited dynamic tests in the 1970s were performed on now-obsolete casks and have not been repeated. In those tests, cask valves and shielding failed during extended fire tests. Furthermore, the NRC's performance requirements for nuclear waste casks (10 CFR 71.73), established in the 1970s, are outdated and dangerously underestimate the conditions of today's worst-case accident scenario:

- The drop test requires casks to withstand a fall from 30 feet onto an unyielding surface, which simulates a crash at 30 miles per hour. Yet, no regulations are in place to limit to 30 mph the speed at which nuclear waste shipments can travel. This test condition could easily be exceeded, if, for instance, a cask traveling at regular highway speeds (now 65-75 miles per hour) crashed into oncoming traffic or a virtually unyielding structure such as a bridge abutment.
- The burn test requires casks to withstand an engulfing fire at 1,475 degrees Fahrenheit for 30 minutes. Other materials routinely transported on our roads and rails could spark a hotter fire (diesel burns at 1,850 degrees) and could potentially burn for longer than half an hour. Last summer's fire in Baltimore's Howard Street train tunnel—which the DOE has identified as a potential Yucca Mountain shipment route—burned for more than 3 days and likely reached temperatures of at least 1,500 degrees. If a nuclear waste cask had been on the train involved in that accident, its containment would have been breached, exposing 345,493 people in the area to radiation and costing at least $13.7 billion dollars to clean up.[8]
- The puncture test requires casks to withstand a free-fall from 40 inches onto an 8-inch-long spike. A train derailment or a truck crash on a bridge could result in a fall from much higher than 40 inches and potentially result in puncture damage to the cask's shielding.
- The same cask is required to withstand submersion in 3 feet of water, and a separate test requires an undamaged cask to withstand submersion in 200 meters of water (656 feet) for 1 hour. If a crash involving a nuclear waste shipment occurred on a bridge or barge, a damaged cask could be submerged in depths greater than 3 feet. Furthermore, given the weight of nuclear waste transport casks, it is not reasonable to assume that a submerged cask could be rescued within one hour. Licensed truck casks weigh 24-27 tons, loaded, and train casks can weigh up to 125 tons, loaded. In the case of a barge transport accident, if a crane capable of lifting such a massive load out of the ocean were not immediately available, water pressure over longer periods could result in cask failure and radiation release.

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[6] *Why Is There a Train Accident Every 90 Minutes?* RailWatch (revised March 1999).

[7] *Reported Incidents Involving Spent Nuclear Fuel Shipments*, 1949 to Present, Nevada Nuclear Waste Project Office (1996).

[8] *Radiological Consequences Of Severe Rail Accident Involving Spent Nuclear Fuel Shipments To Yucca Mountain: Hypothetical Baltimore Rail Tunnel Fire Involving SNF*, Radioactive Waste Management Associates (September 2001).

The prospect of transporting high-level nuclear waste across the country through major population centers also poses a security risk, particularly in the current context of heightened national security concerns. Immediately following the September 11 terrorist attacks, at least 10 people were arrested on charges of possessing fraudulent permits for transporting radioactive and hazardous materials.

Regulatory requirements are also inadequate to protect against the risk of terrorist attacks. Although the Nuclear Regulatory Commission does not require transportation casks to be tested against this vulnerability, tests and studies have demonstrated that an anti-tank weapon could easily penetrate a nuclear waste transportation cask and result in a potentially catastrophic release of radiation. In a 1998 demonstration at Aberdeen Proving Ground, a TOW anti-tank missile shot at a Castor V-21 storage cask a blew a hole through the wall of the cask. Analysis by the state of Nevada indicates that a successful terrorist attack on a GA-4 truck cask using a common military demolition device could cause 300 to 1,800 latent cancer fatalities, assuming 90% penetration by a single blast. Full perforation of the cask, likely to occur in an attack involving a state-of-the-art anti-tank weapon, such as the TOW missile, could cause 3,000 to 18,000 latent cancer fatalities. Cleanup and recovery costs would exceed $17 billion.[9]

Yet, just a few months ago, on March 11, 2002, CIA national intelligence officer Robert Walpole told the Senate Government Affairs Committee that while the chance that a missile with a nuclear, chemical, or biological warhead will be used against U.S. forces or interests is greater today than during most of the Cold War, the agency's analysts believe there is an even greater threat that such a weapon will be delivered by truck, ship or airplane "because non-missile delivery means are less costly, easier to acquire, more reliable and accurate".[10]

On September 11, 2001, and again in October when U.S. forces entered Afghanistan, Secretary Abraham suspended all nuclear shipments because of the security risks they pose. Yet, his Yucca Mountain site recommendation, issued only 5 months later, failed to acknowledge or address this security concern in relation to the tens of thousands of nuclear shipments that would be launched by the Yucca Mountain Project.

The unintentional and non-accident risk of nuclear waste transportation is also a concern. NRC regulations allow nuclear waste shipping casks to emit 10 millirem of radiation—the equivalent of a chest X-ray—per hour from a distance of 6.5 feet. The cumulative impact of routine radiation exposure from Yucca Mountain nuclear waste shipments on other motorists (maximized in gridlock traffic scenarios) and people who live or work along transport routes has not been adequately examined.

The multiple risks associated with transporting large volumes of nuclear waste over long distances to an unsuitably sited repository in Nevada simply cannot be justified. Since a repository at Yucca Mountain necessarily involves an unprecedented program of nuclear transportation, we urge the Committee to fully consider the impact of the many transportation dangers in its evaluation of the Yucca Mountain Site Recommendation.

THE INTEGRITY OF THE PROCESS HAS BEEN UNDERMINED

The dramatically flawed process railroading the Yucca Mountain Project toward approval undermines the credibility of Secretary Abraham's site recommendation. The downgrading of environmental regulations (EPA's more lenient site-specific radiation protection standards and DOE's revised siting guidelines that prevent Yucca Mountain from being disqualified) has set a dangerous precedent of sacrificing public health and environmental safety to nuclear industry interests. And yet even these underhanded decisions cannot mask the fact that this site is not suitable, as the GAO, IG, and Nuclear Waste Technical Review Board have made clear.

A Public Citizen report released April 1, 2002, indicates that nuclear industry interests may have directly biased Secretary Abraham's site recommendation. The report is available online at http://www.citizen.org/documents/yuccamtbands.PDF. According to our research, the nuclear industry contributed $82,728 to Secretary Abraham's failed bid for re-election during the 2000 election cycle, and in 2000 alone, top nuclear contributors to his campaign spent more than $25 million—nearly half a million dollars each week—on lobbying efforts that included support for the repository proposal. Public Citizen, in January 2002, requested that Secretary Abraham recuse himself from Yucca Mountain site recommendation activities, based on the

[9] "Potential Consequences of a Successful Sabotage Attack on a Spent Fuel Shipping Container: An Analysis of the Yucca Mountain EIS Treatment of Sabotage," Radioactive Waste Management Associates, April 2002.

[10] The Boston Globe March 12, 2002 and The Milwaukee Journal Sentinel March 12, 2002 quoting the Associated Press.

precedent of Attorney General John Ashcroft recusing himself from the Justice Department's Enron investigations because the failed energy trading company had contributed $75,000 to his election campaign. We have received a legalistic response to our letter that doesn't deal with the issue of the appearance of impropriety.

As another indication of pro-industry bias in the Yucca Mountain Project, a November 2001 report by the DOE Inspector General disclosed that the law firm Winston & Strawn was simultaneously employed as counsel to the DOE, working on the Yucca Mountain Project, and registered as a member of and lobbyist for the Nuclear Energy Institute between 1992 and 2001. The executive summary of this report is attached. The DOE, as a federal agency, is supposed to be objective and unbiased in its evaluations of the repository proposal and to uphold the same standards of integrity for its contractors. Yet, it hired a member of the Nuclear Energy Institute, the lobbying arm of the nuclear industry that specifically advocates in favor of the proposed nuclear waste repository at Yucca Mountain, which would serve the narrow financial interests of its nuclear industry members. The involvement of Winston & Strawn lawyers in both shaping the DOE's Yucca Mountain activities and advising and lobbying on behalf of the Nuclear Energy Institute on nuclear waste legislation undermines the integrity of the recent site recommendation. After this conflict was publicly disclosed, Winston & Strawn resigned from the Yucca Mountain Project. But even in the wake of this scandal, but the firm's work was not withdrawn.

The same Inspector General report notes that TRW, Inc., hired by the DOE as the managing and operations contractor for the Yucca Mountain Project until February 2001, was simultaneously engaged in lobbying activities on nuclear waste storage issues. TRW was additionally implicated in December 2000 as the author of a memo attached to a leaked overview of the DOE Yucca Mountain Site Recommendation Considerations Report (later released as the Preliminary Site Suitability Evaluation and the Science and Engineering Report). The memo indicated that the overview was intended to help supporters of the Yucca Mountain Project express their support for a favorable site recommendation and that "the technical suitability of the site is less of a concern to Congress than the broader issue of whether the nuclear waste problem can be solved at an affordable price in both financial and political terms."

Clearly, the DOE has failed to exercise necessary and proper oversight of its contractors, resulting in an obvious pro-industry bias in the agency's site characterization and site recommendation activities. In January, Public Citizen joined 232 public interest and environmental groups calling on Congress to suspend consideration of the Yucca Mountain Project pending a thorough review of the causes and consequences of contractor conflict of interest in the DOE's site characterization and site recommendation activities. This letter and the list of co-signing organizations can be viewed online at http://www.citizen.org/cmep/enemy enviro nuclear/nuclear waste/hi-level/ conflict /articles.cfm?ID=7086. The public cannot—and lawmakers ought not—have confidence in Secretary Abraham's site recommendation, which has arisen out of such a conflicted and compromised process.

CONCLUSION

The 1957 National Research Council report, commissioned by the Atomic Energy Commission, marked the beginning of this government's continuing process to identify "disposal" options for high-level nuclear waste. Its summary states: "Unlike the disposal of any other type of waste, the hazard related to radioactive waste is so great that no element of doubt should be allowed to exist regarding safety."[11] Numerous unresolved technical, environmental, and policy issues plague the Yucca Mountain Project. To approve the repository proposal would directly threaten the health and safety of current and future residents of Nevada and more than 50 million people who live along likely nuclear waste transportation routes. Furthermore, the failed Yucca Mountain Project serves as a distraction from the serious policy examination and scientific study that is needed to more appropriately address the increasingly urgent issue of high-level nuclear waste management.

The Department of Energy and others have incorrectly suggested that the many outstanding concerns with the repository proposal would be more appropriately addressed by the Nuclear Regulatory Commission (NRC) in the licensing phase that would be initiated by Senate approval of S.J. Res. 34. This effort to downplay the role of Congress is dangerously misguided. In fact, the NRC's Yucca Mountain licensing rule (10 CFR 63) reflects the inadequacies of EPA standards, discussed above, and as such does not consider the fundamental issue of site suitability or

[11] *The Disposal of Radioactive Waste on Land*, National Research Council (1957).

issues related to nuclear waste transportation. Nor does the NRC's mandate extend to an examination of conflicts of interest with the DOE's Yucca Mountain program or the regulatory rollbacks that have inappropriately weakened EPA and DOE standards at Yucca Mountain. Thoughtful Congressional oversight of this unprecedented project is clearly in order, and the DOE's current incomplete and serious flawed proposal does not merit the Senate's approval.

We recommend that:

- the Committee uphold Nevada's anticipated Notice of Disapproval of the Yucca Mountain Project and reject any siting approval resolution;
- the Committee hold additional hearings in all major cities along nuclear waste transportation routes identified in the final Environmental Impact Statement for the Yucca Mountain Project to give the public a voice in this decision;
- Congress and its Committees maintain vigorous legislative oversight of the nuclear waste transportation program that accompanies any repository proposal; and
- Congress initiate a complete review of the civilian nuclear waste management program.

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