Yucca Mountain shipments if the repository goes forward. That means testing one truck cask and four rail casks plus additional testing and analysis at a total estimated cost of $45 to $70 million.

To put these costs in perspective, the cost of Nevada's more effective full-scale testing program would be small compared to the overall cost of the Yucca Mountain transportation system. The Department of Energy estimates that transportation system costs would be about $8.4 billion over 38 years. The State of Nevada has estimated approximately $9.2 billion for the same period. So Nevada's testing program is less than one percent of the projected transportation expenditures.

Another way to put testing costs in perspective is to compare that to the cost of cleanup after a worse-case transportation accident involving the release of radioactive materials. DOE acknowledges that cleanup could cost up to $10 billion, and that is for one accident. State of Nevada analysts have run the same DOE computer models and concluded that the worse-case accident or successful terrorist attack could involve cleanup costs in excess of $10 billion. Again, whichever figure we use, Nevada's comprehensive cask testing

program would cost less than one percent of the projected cleanup cost of a worse-case accident of our terrorist scenario.

In conclusion, I'd like to thank this panel for the opportunity to share my views and experiences with you and also the willingness of each of you gentlemen to offer your expertise to this important Committee. It will take cooperation at every level of this effort to make safety the primary concern, and it is vital that we all remember that it is the decision-making and performance of individuals, sometimes acting alone, sometimes acting as members of a team or committee, that directly determines how safe an organization or an operation is. Thank you, sir. I'll be glad to take questions or wait until we have the other presentations.

MR. LEVENSON: Mike, do you have any questions?

DR. RYAN: No.

MR. LEVENSON: John?

DR. GARRICK: Jim, just one. You, of course, have a tremendous amount of experience dealing with transportation systems and accidents and investigations and what have you. And of course DOE doesn't have much experience in instituting a

transportation system of this type. Is there any example in the background of the field of transportation and transportation safety that there could be an activity that would be a source of lessons learned here that would be anywhere close to an analog of what's being -- what the problem is?

MR. HALL: Well, John, I think obviously that we can look, as you pointed earlier, to the experience we've had in transporting hazardous materials in this country, and we have had tragic accidents on our highways and in our rail systems, with our pipelines systems and our refineries in trying to handle dangerous products. And of course we have the background and experience at our nuclear facilities and the existing experience to draw on from the successful transport of nuclear material up to this -- nuclear waste material up to this point.

One of my primary concerns here, and one of the reasons that I'm here to emphasize the importance of casks, is my experience at the NTSB has taught me any time you have several organizations responsible for the same activity it is a cause for concern.

DR. GARRICK: Yes.

MR. HALL: And I think that's the case,

whether you see that in the private sector or whether you see it in the public sector. And I have been trying to work at the State of Tennessee when I had this experience for the oversight of Oak Ridge and working here trying to advise the State of Nevada, and I have a great deal of respect for people with lots of expertise in this area, which I do not have, but my common sense tells me that we don't really have clear lines of accountability in this area.

DR. GARRICK: Yes. I think --

MR. HALL: And I think that's why then the testing of the cask itself becomes so important.

DR. GARRICK: Yes. This Committee has expressed concern on several occasions to the NRC Chairman about who's in charge when a transportation accident happens involving nuclear materials. And you're absolutely right, there's multiple agencies and multiple organizations, and it has been a problem not only for the Yucca Mountain project but it was a major consideration in the WIPP project as well.

It's getting at with the experience base here of something that might be an analog to what we're addressing is whether or not there's experience there with respect to the testing of containers and systems for handling the material that would be

similar to what all of you are suggesting for Yucca Mountain.

MR. HALL: I think some of the other presenters are going to cover that subject, sir.

DR. GARRICK: Okay. Very good. Thank you.

MR. LEVENSON: Well, let me -- your last statement, I guess, follow up on John's question, from your background, are you aware of any cases where when decisions were made to starting shipping things like fluorene or hydrogen or other very dangerous and toxic materials were full-scale tests of rail cars ever performed or done routinely when new types of materials were to be shipped?

MR. HALL: Prior to my time at the NTSB, you had the accident, and I'm trying to remember where it was, down in Tennessee, absolutely devastated one whole town down there that ended up with your head shields being placed on your rail cars and there is of course testing and requirements of tank cars. I am not --

MR. LEVENSON: None of that is crash testing --

MR. HALL: There's been of course crash testing in the aviation area, and we've had several --

MR. LEVENSON: No. I'm not talking -- I'm talking about railroads.

MR. HALL: Right.

MR. LEVENSON: Okay. Thank you.

MR. HALL: Okay.

MR. HALSTEAD: Well, given the Chairman's wise counsel that we attempt to stay on time, I'm going to -- am I on with the mic? Okay. Is that coming through? I'm Bob Halstead, for the record, Transportation Advisor to the State of Nevada Agency for Nuclear Projects. The presentation that I'm going to give you now is an attempt to outline the State of Nevada's current position on full-scale testing, but I also want to tell you that this is a position that is in progress right now, because we're trying to, first of all, find ways to dovetail our approach to full-scale cask testing with the approach that's been suggested in NUREG-1768, the draft testing protocols for the PPS.

And, secondly, in the process of participating in the Package Performance Study meetings and in reviewing NUREG-1768 as is always the case I think when you carry out a good technical review, some things that we thought we totally understood we've realized we didn't understand as well

as we thought we did.

So it's been an educational experience. And the comment I made at the beginning of the meeting that my back and forth exchanges with Tim Kobetz had been helpful in making me understand where there were some issues particularly with the fire testing that either we had not thought through sufficiently or we weren't communicating clearly.

So with that said, I also want to acknowledge that Fred Dilger of Clark County has been my colleague on this task of developing a proposal for the state, and let's go to the next slide, please. Just an overview, outline, of what we'll be talking about. And then if we can go to the next slide.

I think it's useful to review the current situation which is that the NRC doesn't require physical testing full scale. There are currently 16 shipping casks certified in this country. None of the currently certified U.S. casks has been tested full scale to demonstrate compliance with 10 CFR 71 performance standards. Two truck cask designs have been subjected with half-scale replica models to the drop test. Three rail cask designs have been subjected to the drop test, and more than half of the tests of the casks have been subjected to scale model

impact limiter tests. That's the sum of the testing that has been done. No full-scale testing and pretty much limited scale model testing and a lot of reliance on analysis. Next slide, please.

For years, we've argued the advantages of full-scale testing and organized the arguments in various ways. When I went back over files I found an old report that Sandia National Labs did for the Department of Energy in 1993, and I don't usually like to do large quotations from other people's work, but in fact I've never seen a clearer statement of the advantages of full-scale testing than are provided in this 1993 Sandia report. And I offer them to you.

The first and most obvious one is direct demonstration of compliance with the regulations. And remember here now referencing the focus of Nevada's proposal on regulatory, confirmatory testing. And we'll talk about extra regulatory testing separately. Secondly, while there are some issues that can be addressed through half-scale model testing, there's certainly a clarity of characterization when you're using a full-scale model. And one of the issues that's been brought to our attention by the cask manufacturers in the PPS meetings is that in fact there may not be that much of a cost savings in using

a half-scale replica model. There are other advantages in terms of being able to look at the operation of the closure and the seal as a total package. Next slide, please.

It's also important to remember that with the new generation of casks designed for Yucca Mountain where to my knowledge one unit of the Holtec cask has been produced but there haven't been any orders yet, so in fact we don't have any fabrication experience with these new cask designs. And advantage of full-scale testing would be that it would require the manufacturers to actually get some early lessons learned in preparing a prototype, acknowledging that preparing a prototype is somewhat different than producing 50 units under a large contract. Eliminating the need for scaling and providing direct visual evidence are other important advantages.

Frankly, the only disadvantage that I have ever heard anyone say in this context is cost -- the cost of fabrication and testing, the cost of handling the test article and so forth. And as I'll say in my concluding remarks at the end of this session when we talk about lessons learned, indeed what we know about full-scale testing is, a, it's expensive, and, b, it's always more expensive than people thought it was going

to be at the beginning of the test program. But the argument we would make is that from a standpoint of regulatory testing while there are clear advantages and no technical disadvantages to full-scale testing, cost clearly can be seen as a disadvantage. Next slide, please.

Nevada's approach to regulatory testing has five components: a strong stakeholder involvement, actual full-scale sequential testing according to the NRC performance standards, preferably prior to NRC certification but since many of the casks we're talking about have been certified already doing this prior to DOE's procurement would serve the same purpose. Importantly, we see the need for additional testing to address the issues that the NRC staff is proposing be addressed in the Package Performance Study, but we're not so sure that full-scale testing is necessary for all of those tests. We do think full-scale testing is necessary for the fire test, but a combination of simulations, scale models and full-scale component testing may be just as effective, may be more effective in determining -- in particular in determining failure thresholds.

Finally, the last two points are things that might grow out of findings, and perhaps we

shouldn't speculate about what the findings would be. I find it gratifying that as the PPS meetings have gone on, the NRC has clarified in response to questions from the public that when they have these tests and they find problems in the NRC regulations, they of course are not going to ignore those findings. Next slide, please.

Nevada argues that this testing should be focused on the casks used for Yucca Mountain shipments of which five of the certified casks have been identified by NRC as likely to be used either in Yucca Mountain shipments or shipments to the private fuel storage facility. And certainly there have been many people -- I don't want to say many -- there have been a number of people who have come to the PPS meetings and have said that they see our approach as deficient because we're not arguing that all the casks should be tested full scale. I recognize that people can make that criticism with validity. Our argument is that the casks we focused on represent at least 95 percent of the spent fuel shipments that are likely to occur over the next four or five decades, including shipments to PFS.

In particular, we think it's important to focus on these new cask designs, because these are the

casks where a combination of new designs, new materials and larger payloads raise new questions that can't be directly answered by looking at the performance of the casks that have been used over the last 20 years. We believe that to a certain extent code benchmarking can be accomplished through these regulatory compliance tests, although we will acknowledge that the test objective should be reflected in the test design and in some ways will limit the applicability of the tests. And, again, I'm going to talk about this at the very end of this session when we review the lessons learned from past full-scale testing.

We think it's an appropriate use of the waste fund. This is going to be an expensive activity, and frankly I think there would be a problem if we were proposing to use money from the waste fund to test casks that weren't going to be used for the Yucca Mountain shipment. Not to say that that perhaps shouldn't be done, but I think we'd have to argue for some other source of funding.

And, finally, the testing that we would like to see done could be required through regulation by NRC and DOT. We believe it could be done through a DOE program decision unilaterally, although some at

DOE would argue that they would need congressional approval. And, certainly, a congressional mandate, either through statute or appropriations conditions, could be used to require such testing.

Now, turning to the area of extra-regulatory testing, we believe the focus should be on fire tests, and, again, I'll be happy to answer questions on this so I don't belabor the points of the -- I'm sorry, next slide, please. The analyses conducted to date by DOE and Nevada generally conclude that accidents that involve long-duration, high-temperature fires are likely to produce the worst consequences. Real-world fires, we believe, are particularly a concern with the new generation of casks, larger payloads and particularly carrying large inventories of Cesium-137.

If you'll review the findings of your November 19 meeting, I think you'll agree with me that the people who spoke there agreed in their statements that in fact there is very little physical data on actual cask performance in severe fires. Certainly, there have been other types of benchmarking exercises with large calorimeters, for example, but we simply haven't done any fire testing with full-scale casks since the 1970s. And a key objective of these tests

would be both to determine failure thresholds and benchmarks codes. Next slide, please.

I've identified five different approaches to the fire test, five options that we're considering, and this will be one of our major tasks over the next five weeks as we send written comments to the NRC on the Package Performance Study draft testing protocols. There is considerable debate among our own technical reviewers, not only over what's desirable to do in a fire test but frankly what is physically possible to do in a fire test. And in particular, our reviewers have raised questions about combining an impact test and a fire test, particularly because prior to the fire test we would like to have instrumentation installed at several points in the cask. And there's a question then if you subject that cask to an impact test, can you reasonably expect your instrumentation, such as thermocouples, to accurately report the temperature data that we see?

So without going into them in detail, there are five combinations of undamaged and damaged casks with different ways of defining -- or different ways of approaching the identification of failure thresholds either by modeling a predicted failure threshold and then creating a test fire that creates

that or the other case which some people on our team suggest is best, particularly for the truck cask, is simply to instrument the cask and take the undamaged cask and run the regulatory fire without a constraint until certain temperature thresholds, usually the agreed upon value is 750 degrees C, are reached in what would be the fuel containment region inside the cask. Next slide, please.

We've estimated costs carefully. We've tried to err by overstating the costs. As I said, this is expensive business. We think that the first effort of doing this testing program on a legal weight cask is going to require a lot of stakeholder involvement, a lot of expensive modeling and a lot of rigorous peer review. And there are also some cost unknowns that have to do with not just the instrumentation but how we will design the dummy or surrogate fuel that would be inside the cask. We've considered some scenarios in which a fresh fuel assembly has been used.

So these costs represent our best estimate to err on the high side. We think, however, that there will be a learning curve after the first truck cask and after the first rail cask is tested. So while we think that a $27 to $30 million cost for the

first two casks is pretty accurate, we certainly think that the larger cask program that we're recommending can be accomplished in the range of $45 to $70 million.

And let me say I think costs are important, and I'm very concerned by the position that the NRC staff has taken, and, again, I'll talk about this in my last presentation, but I believe that anybody who's bold enough to propose a full-scale cask testing program needs to put a sticker price on it, partly because money isn't free and partly because in a world where we're asked to do cost/benefit analysis on everything, it's fair for people to be asked to put a dollar figure on this. Next slide, please -- or this one, I'm sorry.

Issues to be resolved. Well, they're pretty much the same issues that we'll tell the PPS staff and contractors at the NRC they have to address: Develop your protocols for full-scale sequential tests, got to have a good defensible definition of cask and fuel failure, same attention needs to be paid to developing the protocols for the regulatory fires, and we really need to look at some options for extra-regulatory impact tests. As I said, while we think a full-scale test is necessary for the fire test, it's

quite possible that some of the other extra-regulatory issues can be answered with something less than full-scale testing.

There is this outlying issue of the need possibly for other extra-regulatory tests, particularly the puncture, deep immersion and crush tests. The last two, deep immersion and crush, are tests that aren't currently required in the regulations. And, of course, validating cost and schedule estimates, always an important burden that anyone proposing a course of action must carry. Last slide, please.

We have assembled a review team to prepare comments on the package performance draft protocols. Some of those people have been at the table with us today, some of the others I mentioned, in particular Lindsey Audin and Professor Miles Greiner. We've already been working on our comments for the end of May. We hope to have draft comments for our own and external review by the middle of May. Realistically, this is a very big piece of work, and we won't have it done to our satisfaction, putting forth our proposal by May 30. I believe we can meet a target schedule of December 2003, and I also believe that will dovetail with the NRC staff deliberations. I find it hard to

believe that they will be able to evaluate all the comments on the PPS and decide where their next decision goes sometime before the middle of fall 2003. I could be wrong. Thank you very much.

MR. LEVENSON: George?

CHAIRMAN HORNBERGER: It strikes me that you've done a pretty good job of giving us detail on what and how, but I'm still pretty much in the dark as to why; that is, what is it -- you mentioned again costs because we think in terms of cost/benefits, and you haven't given me a clue yet about what the benefits are.

MR. HALSTEAD: Well, sure, let me summarize those. First of all, we have some wonderfully elegant finite analysis codes these days. If you look real hard, you'll find out that there's not a lot of benchmarking. So at the very least I think we've got to do one full-scale rail and full truck cask simply for benchmarking purposes. Now, I understand that the Committee took a different position in their meeting last June and, you know, wrote a pretty-well argued letter. And, frankly, as a risk-informed letter, if I remember, Mr. Chairman, I believe that NUREG/CR-6672 was used where this Committee said, "Look, if the calculated risks of an

accident involving a release are so low, why in the world do we have to do this testing?" And I agree, if you accept NUREG/CR-6672, it's hard to make an argument for full-scale testing.

MR. LEVENSON: I don't think our letter was against full-scale testing. It was against extreme unrealistic conditions.

MR. HALSTEAD: Okay. I'm going to get to that part, though, but I thought your letter, first of all, said from a risk-informed basis you saw no clear need and weren't sure that the benefits were commensurate with the expenditure of doing the test properly. And I, secondly, also agree with you that any extra-regulatory testing that's done has to be well justified either by replication of a realistic worse-case accident or done the other way to define a failure threshold which we can then compare our full body of knowledge about real-world accidents, and say, "Look, there's not a real-world accident that comes halfway near this failure threshold." So there are two ways to approach it.

But let me start by saying that I believe there's an absolute need to do one full-scale rail and one full-scale truck cask for benchmarking purposes simply because we haven't done that with the casks in

this country since the '70s. Secondly, there probably is not a direct need to test more than one truck cask if as we think the GA-4 is going to be the workhorse cask and the GA-4 and the GA-9, the two versions, are so physically similar I don't think there's a case for testing both of them. I certainly would argue against it as being redundant and unnecessary.

With the rail casks it's not so clear. There is some significant variation between the NAC dual purpose cask, for example, and the Holtec Transport System. And this is one of the areas that I think we need some back and forth with the NRC staff on with the PPS and the selection of a cask. Now, maybe we're wrong. Maybe there is a representative new rail cask that for benchmarking purposes will suffice, but it looks to me that there's a good argument for at least two, basically looking at steel-lead-steel casks and then looking at the larger monolithic forged-steel body approach.

Beyond that I would turn the argument around on those people who oppose testing. Go back to that first principle from the 1993 Sandia report. What better evidence -- and again we're talking about confirmatory testing -- what better evidence can there be that you meet the requirements of 10 CFR 71 that

the physical article has been tested and it complies with the leak and radiation test? And of course you'll have to calculate the radiation test because we're not going to test it with live spent fuel in it.

And while I very much support extensive modeling, I think there is an argument here that at some point a symbolic representation of reality is not better than reality. And it's certainly not when we turn to the final -- and I'm uncomfortable making this argument, understand you, because I know how fickle public opinion is, and one of my great nightmares is that Nevada succeeds in getting all the extra-regulatory safety enhancements that we've asked for, that we get those agreed to and they're done and for whatever reason the public still doesn't respond to them.

So I don't think you can say public opinion is the goal, but my experience is this: When you take this issue to the public being able to say that the specific cask being used in a campaign have been tested to demonstrate compliance with the regulations that's very powerful. Now, again, I planned to save that argument for the closing discussion where we do lessons learned.

But, you know, your argument is right on

the point. No one who isn't willing to significant benefits should stand before you and argue that we should take on this as a matter of public policy. And I probably have answered inadequately but some of the answers I plan to give I've saved for the end of the session.

MR. LEVENSON: George? John?

DR. GARRICK: A specific question: What was the basis for the fire option tests that you showed earlier?

MR. HALSTEAD: Coming into our current debate with the NRC and NIST staff over what happened in the Baltimore fire we felt pretty confident that that was a pretty good analog for if not a worst case a very, very severe fire. And now, frankly, that on review of these findings we're beginning to see some evidence maybe the other people who reviewed this didn't see it. But, for example, as we look at the Southwest Regulatory Institute and the Battelle and the NIST findings, we see some evidence that maybe the temperatures in the Baltimore fire got a lot hotter. They might have gotten up to 1600 degrees C. So that said that we're still rethinking this.

Over the last ten years, Dr. Resnikoff and I have looked at a whole range or real-world

accidents. We had the benefit of an assessment that was done in 1986 for the State of Nevada by an expert study team put together by a research team. And we're possibly going to change these temperatures, but right now we feel comfortable laying them out there. And Dr. Birky would like to add a point on this as well.

DR. BIRKY: Well, I think you've raised a very fundamental issues in terms of what fire test or what intensity should one use on testing these casks. And if I may reference about 35 years in fire experiments and testing and accident investigation, you can go through a long litany of examples of accidents in which the resulting fires were more intense or the damage was more intense than one would expect based on existing knowledge.

And I'm afraid, for example, the present regulation that we're talking about for NRC, the cask compliance, is really too low for too short a time for any accidental fire, and the reasons I would suggest that we need to rethink this question of what prior temperature should it endure. Eight-fifty is not a very high temperature when you're talking about a fire, and we've seen them much higher in almost every accident which have involved hazardous materials and of which a fire has ensued as a result.

But let me talk more about more of a general response to the question that was asked earlier about why do we need to -- do we have examples of testing of vehicles, transportation vehicles, and other vehicles prior to their use in transportation. And I would like to reference a couple of accidents that I was involved in that result in rather dramatic changes in the way we do business. But it was the result of an accident that was very, very costly, much more costly than what it takes to test.

And one of those was the Exxon Valdez in which the result of that we ended up with double-hulled tankers. And another one that Jim Hall just mentioned, of course, was the tank cars in which they finally put shields on the front of them to prevent penetration of the tank during collisions. And we've had tanker truck fires and explosions also that have resulted in changes in the way we do business. And this was done after or as a result of an accident and was not done beforehand, and I think we can compile a list of these things that resulted in dramatic changes in the way we do business as a result of tragic accidents rather than doing the studies beforehand to prevent these accidents from happening. Thank you.

DR. GARRICK: Yes. And of course it's

never straightforward because taking your example of the double-hulled tankers. There's still a debate going on as to whether that has resulted in less risk of tanker spills.

I wanted to ask one other question. An issue that we discussed a great deal when it comes to tests is the protocol concept or the basis for the protocol test being test-to-failure versus test-to-reasonable severe conditions. And the concern of test-to-failure is of sending a message out that is very difficult for the public to relate to in terms of the actual system that we're dealing with. And this seems to me to be an issue of risk communication that's kind of important, and I'd like to know what your views are on that whole issue of test-to-failure versus test-to-severe accidents.

MR. HALSTEAD: First, I want to put that in the larger perspective. That is in fact one of the key issues that this team is going to be working on, hopefully having a resolution by May 30 so we can inform the PPS proceeding. It's very difficult to deal with this issue, cask performance, without dealing with the issue of spent fuel performance. And, again, that's one of the things I'm going to talk about at the end, but one of the working definitions,

for example, that we have used for defining cask failure is cask failure would be a condition in which there is a one percent release of the inventory of Cesium-137, and I think it has to be some way precisely defined.

I was disturbed, frankly, to hear at the NRC public meeting in Pahrump, Nevada that people had come to the meeting arguing that cask failure meant that a fuel assembly could pop out of a cask and lay on the road. That is exactly what we don't need to result from this discussion. So for me jumping in first rather than on a specific issue, we're trying to find something that's the equivalence of a performance measure based on a consequence analysis that we think we understand to define what test-to-failure means. I don't have a sufficient answer. I thought I had an answer five weeks ago, but after we discussed this in the context of the PPS meetings, I realized that we need to rethink and be more precise in our definition.

DR. GARRICK: For the sake of science, of course, there's great interest in the consequences of test-to-failure, but we're not talking about science here so much as we're talking about a project and what needs to be done to assure the safety of that project.

One thing I wanted to say for the record,

the same national laboratory that you referenced in terms of pushing for a full-scale test also indicated in that same report that they thought the regulations that were in place now were acceptable and provided the necessary safety. I think it's very important to keep that in perspective.

MR. HALSTEAD: Well, I'll go further and add to that. I'm sure some of my colleagues like John Vincent from NEI and earlier from GPU who has been involved in these discussions with us for years I'm sure they find it quite ironic that Nevada representatives are sitting at the table arguing, you know what? Those hypothetical regulatory accident conditions represent a very severe accident.

DR. GARRICK: Yes.

MR. HALSTEAD: We've always said that. We've always said they don't necessarily represent a worst-case accident, whatever that is, but I think that is an important point, that we're now at the table saying that while we need information on extra-regulatory accidents and the implications of those for the standards, we're not saying that we have a basis to argue that the current standards are inadequate. I do think the fire standard has been one that was flagged as early as 1986, that perhaps the duration

should be increased from 30 minutes to one to two hours and the fire standard increased from 1475 to 2000 to 2000 Fahrenheit. And we've always said we were concerned about the fire standard. But, in general, we've said that's a pretty good regulatory standard. The problem is you're not testing casks to that, and you haven't even done one truck and one rail to benchmark the codes that you're using to enforce that standard.

DR. GARRICK: Yes. My point is we're not saying one is right or one is wrong. I'm just saying that the people that have been advocating casks are also on record as saying that the regulations are adequate in their opinion.

MR. HALSTEAD: Absolutely.

DR. GARRICK: Thank you.

MR. LEVENSON: Mike? I've got a couple of questions for clarification. You listed what you're going to at least tentatively suggest be done in the way of fire tests, and there are a number of them --

MR. HALSTEAD: Could we put the slides back up, please, on this?

MR. LEVENSON: Well, I don't know that we need them.

MR. HALSTEAD: Okay.

MR. LEVENSON: A number of them where you say the fire should continue long enough till the fuel gets to 750 degrees. Are you proposing to have real fuel in the casks while those tests are done?

MR. HALSTEAD: No, absolutely not, sir; good point.

MR. LEVENSON: It's simulated.

MR. HALSTEAD: We're talking about simulated with heaters to represent the internal heat level.

MR. LEVENSON: Okay. My question is if you're not using real fuel or if you're just using simulated fuel, presume the reason for heating the fuel to 750 is to see what happens to the cladding in the fuel?

MR. HALSTEAD: Absolutely. Although that number is subject to refinement.

MR. LEVENSON: Yes, yes. But my point is if what you want to do is find out what happens to the fuel, why do you advocate spending tens of millions when you can do the same thing in a furnace for tens of thousands?

MR. HALSTEAD: Well, in fact we're also advocating that that be done for fuel testing purposes. I think that there are some technical

difficulties of putting instrumentation inside a cask in a full-scale fire test and whether you use some type of transponder technology or whether you have to run wires through the cask which create pathways equivalent to what happens if you look at different parts of the cask in a fire, the drain plug opening, for example. So there are difficult ways to do that, but we would argue that all the information on fire testing with the testing of the CAFE code is based on the premise that you can't scale model fires, and you haven't got the basis yet for benchmarking the codes.

MR. LEVENSON: Yes. Well, I'm not questioning what you're recommending for fire testing of the cask. What I'm saying is that if what you want to study is fuel failure, then the scaling issue doesn't come up and you can do it in a furnace for tens of thousands other than tens of millions.

MR. HALSTEAD: You've correctly raised the issue of why we have some hard thinking about what we're -- because we can only recommend one. You can't recommend some unlimited number of tests, and it's quite possible that pellet testing in a furnace will do the job.

MR. LEVENSON: Well, I'm not talking about just pellet testing. Whatever you wanted to do. If

you wanted to do a full sub-assembly, doing it in a furnace is orders of magnitude cheaper than doing it in a cask.

MR. HALSTEAD: No, I agree. I absolutely agree.

MR. LEVENSON: Good. Okay. Go on.

DR. RESNIKOFF: I think I'm on. I'm back to the Baltimore Tunnel fire, and I'm going to talk specifically -- I'm going to get into the nitty-gritty of actual casks and talk about why it's difficult to generalize from one cask to another.

I'm going to discuss -- each cask has major and subtle differences that make it difficult to generalize and apply the results from one to another. I'm going to focus on the Holtec HI-STAR 100 cask but also discuss the IF-300 cask, the GE cask.

As this slide -- this slide is schematic of the Holtec cask. This is an overpack within which fits this sealed canister, welded shut canister, containing the fuel itself. The overpack is constructed of these concentric steel shells, approximately nine inches thick for gamma attenuation and structural integrity. Some casks use for lead for gamma attenuation, some casks use depleted uranium for gamma attenuation.

Outside the steel shells in this area right here is what's called -- what Holtec calls Holtite, a neutron-absorbing material on the outside. Some casks, such as the IF-300, contain water rather than a resin or plastic. On the end of the cask is an impact limiter which is designed to crush on impact. For the Holtec cask, this impact limiter is made of aluminum in honey comb formation. So it crushes on impact.

Inside the MPC, inside the canister, you have a latticework which holds fuel, either 24 PWR assemblies or 68 BWR assemblies. And this MPC, or internal canister, fits within the transportation overpack or fits within a concrete storage overpack. When fuel is prepared the water is evacuated from the overpack and replaced with helium which is a better heat conductor. And this has been the practice since 1980. Helium also prevents oxidation of uranium in fuel with damaged cladding.

I want to focus on several features of the HI-STAR 100. Points 5 and 8 are plugs that cover valves. And those valves are used to evacuate the overpack, evacuate it of water, replace the water with helium. Helium, as you know, is a better heat conductor than air. The bolt structure at Point 6,

the bolt structure is also important. And I want to talk about that too.

The next slide shows a cross section of the HI-STAR 100 overpack. I want to focus for right now on the neutron-absorbing area on the outside of the cask. In older casks, this section is a water jacket, and in a potential accident the water jacket can be pierced, water is replaced with air, and the outer section serves somewhat as an insulator in a fire, but that's not true for the HI-STAR cask.

Since resin is an insulator, the HI-STAR cask is constructed with radial connectors. Those connectors that you see, the radial connectors are a half-inch thick and are designed to conduct heat out of the cask. They serve as heat conductors. The next slide shows a closeup of the radial channel. Let me show the next slide. And this shows the construction of the radial channel. The Holtite material is located within, and then you have these half-inch thick pieces of iron which conduct the heat out of the cask. Unlike the IF-300, the HI-STAR 100 is not going to serve as an insulator in a fire but actually will conduct the heat into the cask.

The next slide is from the TSAR for the HI-STAR cask and shows how the Holtite performs in a

regulatory fire, a half-hour regulatory fire. You can see the temperature rise for the first half hour and then steeply decline, but if you were to project that up to an 1800 degree fire that lasted for three hours, you can see that the Holtite would quickly evaporate, which is also what Holtec assumes for their cask, that the Holtite material, the neutron-absorbing material would actually evaporate in an accident. And as I mentioned earlier, without that neutron-absorbing material, the dose at the cask surface rises to 500 millirems an hour.

DR. RYAN: Could you expand on that a little bit? That sounds high to me. What's the basis for 500 millirem per hour?

DR. RESNIKOFF: We've actually done -- well, we've actually done the calculation removing the hydrogen which is -- the hydrogen and boron which absorbs the neutrons. We've actually removed that to see what the neutron dose would be on the surface of the cask. We've done calculations to look at neutron attenuation.

DR. RYAN: Tell me about it. My point is how did you get 500? You had to have so much -- I mean where did the neutrons come from? What's in the fuel? I mean what burn-up is it? How do you get 500

millirem neutrons? What's the starting point of your calculation?

DR. RESNIKOFF: The burn-up of the fuel that's assumed in the HI-STAR cask is 40,000 megawatt days per metric ton. The material that gives you the neutrons is --

DR. RYAN: And what age is it?

DR. RESNIKOFF: Oh.

DR. RYAN: I mean, you know, there's a lot of factors that go into that calculation. I'm just trying to understand that, because it sounds very high to me --

DR. RESNIKOFF: Absolutely.

DR. RYAN: -- by a factor of about 20.

DR. RESNIKOFF: It's generally ten-year pooled fuel, and the neutrons come from spontaneous fission --

DR. RYAN: I know where they come from.

DR. RESNIKOFF: -- of curium.

DR. RYAN: Of curium?

DR. RESNIKOFF: Curium.

DR. RYAN: I just wanted to know --

DR. RESNIKOFF: Two-forty-two and 244.

DR. RYAN: -- details of your calculations because, again, I think that's a very high number. If

you look at what's measured for a storage cask today, those rates in the 25 millirem per hour for unshielded parts of large assembly array seem to be about reasonable. That sounds like it's about 20 times too high.

DR. RESNIKOFF: The storage containers have concrete which contains hydrogen.

DR. RYAN: I'm talking about without an absorber.

DR. RESNIKOFF: Which absorber, I'm sorry?

DR. RYAN: I'm talking without an absorber.

DR. RESNIKOFF: I'll be happy to send you the calculations.

DR. RYAN: Please do.

DR. RESNIKOFF: Okay. Finally, the last slide discusses some of the components of the cask, and I've projected some of these lines upward. This is, again, for a half-hour fire at 1475 degrees Fahrenheit. According to the calculations done by Holtec, the closure plate bolts will reach 512 degrees Fahrenheit in a regulatory fire. Their calculations show that. Their calculations show that the accident limit is 600 degrees Fahrenheit. So I've projected plate bolts curve, and it shows that in less than an

hour of a closure plate bolts will exceed the design limit for a fire at 1475 degrees Fahrenheit and less time for a fire at 1800 degrees Fahrenheit. Okay?

Now, I admit this is not -- I haven't done a calculation, I've just projected up a curve, and it would be useful to see that calculation, but this is my conjecture.

DR. RYAN: What's the basis for your projection?

DR. RESNIKOFF: Well, I've just taken the tangent of that curve.

DR. RYAN: I understand what you've done on your graph.

DR. RESNIKOFF: You saw what I did.

DR. RYAN: But what's the physical basis for doing it?

MR. HALSTEAD: Well, it's the assumption that there are real-world fires that can produce those conditions, and it goes to the question of both what happens in the regulatory fire and what happens in an extra-regulatory fire. And it goes, frankly, to an area that we're still working on which is to look at the TSARs for a lot of the currently certified casks.

And I don't mean to jump in here on this but frankly we would have had a much more interesting

discussion if we had looked at the IF-300, which is currently licensed and currently used for shipments in the Carolinas. And in fact you would -- the point we're trying to make is these are the kinds of issues that we believe have not been sufficiently dealt with in the background analysis that supports the PPS approach to testing. We actually want to go and look at the performance of specific currently certified casks under regulatory, slightly higher than regulatory and considerably higher than regulatory conditions and make sure that we have that information in hand before we make decisions on the testing protocols.

And frankly it's a cruel thing to say because I like a lot of the people at Sandia, but I'd have to say right now we can't support the recommendations that are made for testing in NUREG-1768 even though we'd like to be able to support this testing because we've been supporters of it for so many years. Because when we actually look at what we think are the specific technical issues that need to be resolved in the testing, it doesn't seem to us that they've even considered these issues. In the impact area they've looked very closely at some of these issues, but they, for example, have not sufficiently

looked at the issue of bolts, seals and fuel performance in certain temperature ranges.

DR. RYAN: I appreciate the fact that you're expressing your view on a testing protocol, and I accept that you're constructing that view, but I just want to point out that doesn't come from a dotted line on a projection on a graph. It's an independent thing of trying to tie it to what would happen --

DR. RESNIKOFF: I agree with you on that, but I just want to emphasize the point again: A half-hour fire at 1475 has the closure plate bolts reach 512 degrees Fahrenheit. You've raised the issue of do you think they will not reach 600 degrees Fahrenheit if you have a three-hour fire at 1800 degrees Fahrenheit? Another 90 degrees more?

DR. RYAN: I didn't raise that issue. I'm just talking about how you projected this graph. I do appreciate your comment on your developing a protocol kind of from principle.

MR. HALSTEAD: I personally don't like -- I don't put dotted lines on graphs, so there's a little bit of a difference of opinion between Marvin and I as to how to make the point. I think, unfortunately, the way the point is displayed on the graph undercuts the credibility of why we're asking

the question. So occasionally these things occur at the table.

DR. RESNIKOFF: You can shoot me.

DR. RYAN: That answered my question. Thank you.

DR. GARRICK: He may do that.

(Laughter.)

DR. RESNIKOFF: Well, not in public.

MR. LEVENSON: Let me just --

DR. RESNIKOFF: And also, if things get too hot, then Meritt Birky is a thermal chemist and he'll take care of it.

MR. LEVENSON: Let me just point out you have 40 minutes more for your group.

DR. RESNIKOFF: Okay. I'm almost done. I want to point out that once the closure bolts -- the closure bolts are under considerable stress. Once the closure bolts exceed the design limit, helium will be released from the overpack, which also will serve to insulate the MPC somewhat. That's true.

We have asked for the calculations from Battelle. Battelle has done a study of what happens in this kind of fire, the Baltimore Tunnel fire. And yesterday I received some overheads but not a report. Maybe there doesn't exist a report by Battelle. It's

only a two-dimensional study done of a cross-section of a cask. They haven't actually looked at the closure bolts at the end of the cask without the impact limiter there.

This is a difficult study to do because for the case of the Holtec cask the impact limiter can melt; it's aluminum. And therefore the dimensions change over time. The Holtite, the resin within the -- the resin on the outside of the cask can melt. So in other words, the dimensions of your system begin to change, and the materials begin to change. And it's not an easy matter to just model that type of change.

Let me point out some other things. The drain port plug seal I've projected that line as well boldly. And you'll notice that all of those -- the peak in the regulatory fire, the peak is all moved over a little further for some of these other components. In other words, for the drain port plug, the peak is reached right at the end of the regulatory fire, but for the others, the peak is reached a little after, because the cask has so much metal that there is some thermal inertia involved. But that peak also is for a half-hour fire at 1475 degrees Fahrenheit, not for a three-hour fire at 1800.

The Battelle overheads that I've seen also discuss whether the MPC itself -- none of this makes a difference if the MPC -- if the internal canister stays shut. If it stays shut, the only environmental implication is if you lose the neutron absorber. Of course, if the fuel is damaged, that's a problem at DOE's end if you have fuel that has degraded cladding. But if the MPC container itself stays closed, then material will not get out into the environment.

The calculations by Holtec show that for a half-hour fire the temperature rises to -- for the MPC rises to 419 degrees Fahrenheit, and the failure limit is 775 degrees Fahrenheit. So there is some room there, and we encourage the NRC to actually do this kind of analysis to see whether the MPC itself is going to fail at that temperature, is actually going to exceed 775 degrees Fahrenheit.

So I just want to make one final point, which is not all casks have the same construction as the Holtec cask. Not all casks are going to have these radial conductors for heat. Some will have just an empty area or an area filled with water, and all of those casks then have to be modeled. And I don't think it's a simple job, and that's one of the reasons why I'm suggesting that several of these type of casks

be actually tested.

DR. GARRICK: Is your concern here principally loss of shielding with these kind of scenarios?

DR. RESNIKOFF: Well, I'm concerned about loss of neutron shielding, and I'm also concerned for the Holtec cask about the destruction of cladding. That will be a DOE problem at the repository end. And I'm concerned about --

DR. GARRICK: But I mean as far as --

DR. RESNIKOFF: I'm concerned about leak from the MPC container itself if the -- in a long duration fire.

DR. GARRICK: Okay. So what's the pathway for the leak? I can see the direct radiation issue with respect to the loss of the neutron shield, but what's the pathway that you're --

DR. RESNIKOFF: The pathway would be if the welds are loosened.

DR. GARRICK: Okay.

DR. RESNIKOFF: And if there's a leak from the MPC itself. Because the MPC itself is a half-inch thick --

DR. GARRICK: Right.

DR. RESNIKOFF: -- container.

DR. GARRICK: Okay. Thank you.

MR. LEVENSON: George? Mike? Okay. Next speaker.

MR. HALSTEAD: Before I go onto the next presentation, I just want to say while there's no way we would reach closure on this discussion today, it's important to say for the record that NRC staff has scheduled a meeting for May 8 which now probably has to be increased from two hours to four hours where we're going to discuss the findings regarding the Baltimore fire and the application of the fire history based on those findings and how it would affect currently certified casks including the new designs and the designs that are currently in use. And it's frankly one of the reasons why this meeting is helpful to us and helpful to me specifically as a person who's trying to manage what we have to get done in that meeting, that in fact questions that you've raised over the last 20 minutes are very helpful to us and tell us some of the things that we need to resolve in that meeting before we submit our written comments.

Now, turning to the last presentation, and I do promise to keep us on schedule, next slide, please, there are many testing programs that we probably need to review before we put our draft

document at the end of this year, that I promised for December of this year. The ones that we have reviewed in some detail, of course, are the Sandia tests from the '70s, the Central Electricity Generating Board tests on the Magnox cask in the UK. These are often known as the "Operation Smash Hit" test based on the best-selling movie of the same name.

We're somewhat intrigued by innovative approaches to testing, and the approach that was used in certifying the Nupac 125B cask, which many of you are familiar, is the cask that was used for shipping the Three Mile Island debris to Idaho as a test program that we've studied. And, of course, we've studied extensively the TRUPACT-II Program, frankly, for some reasons that have nothing to do with Yucca Mountain, that have to do with the fact that Nevada is both a shipper and a corridor state for shipments to the WIPP facility in New Mexico.

And it's a very difficult thing to look at all of these different types of tests, and there are some British, European and Japanese tests that I need to review that I didn't have time to review before this meeting, to try and draw some lessons learned. But let me tell you what I think those lessons learned are that have some applicability to our proposal and

the NRC staff and contractor proposal, the NUREG-1768.

First of all, full-scale cask testing is expensive and it almost always turns out to be more expensive than the people doing it thought. The best numbers we have are that the UK tests on the Magnox Program were $8 million, 1984 dollars; TRUPACT testing appears to have cost about $5 million in 1989, and I haven't ever seen a full package of costs I was comfortable with on the Sandia testing program, but Bob Jefferson on one occasion told me that he thought the cumulative costs of all those tests, including the terrorism sabotage tests that were done on the IF-200 a few years later, were probably less than the cost of one current generation rail cask at the time, which would save $3 to $4 million.

And remember a big factor in those tests was a constrained budget, and both Yoshima and Jefferson said repeatedly for the record they would have liked to have used current generation casks but at the time the costs they were being quoted were half a million dollars back in 1977 when half a million dollars was half a million dollars for a truck cask and about $3.5 million for a rail cask.

One of the things I find intriguing about the Nupac 125B testing is that there was an innovative

decision by the designers who were under pressure, literally the enticement of financial rewards to get a quick licensing decision out of the Commission, and they not only decided to do full-scale testing of the casks but they decided to build full-scale canisters and test them, arguing that if the full-scale internal canister met the test requirements for the entire package, it was certainly assumable even though it was difficult to model that the entire package would comply with the standard.

And there I think is the issue that Mr. Levenson raised before. An important lesson learned here is before we decide what has to be done full-scale, what has to be done in scale model and what can be done with a component test, we need to do a lot more thinking about that, both to save money and guarantee that we get the results. And in fact I'd take this one step further, not just as a cost issue. I think perhaps there's an argument here that we ought to think about whether in the future the large-scale rail casks whether the welded container shouldn't be seen as a requirement, possibly as a testing requirement.

Point number two, benchmarking of codes. Most of these tests we've talked about here weren't

really designed for benchmarking. The Sandia tests were. They were generally considered successful. The TRUPACT-II testing was, in part, required because in that soft body/large package, the ability to model the heat paths was not well known. So I really don't have much in the way of lessons to report on benchmarking except perhaps it's obvious that you need to decide what your objective is in designing the test. And if your objective is benchmarking, then you're going to design that test differently I think than if regulatory confirmation is the issue. And in particular I'd argue if you're trying to benchmark a fire code, I'm very concerned about the performance of the instrumentation and I maybe have to make a sacrifice. You can't use the same test to benchmark with equal confidence a fire code and an impact code. They may have to be done differently.

Point number three, regulatory compliance. Again, that wasn't part of the Sandia test, but it was a very significant part of the other tests, and the tests were deemed extremely successful. And indeed in the case of the Nupac 125B, probably guaranteed that that cask was licensed in time for the purpose for which it was needed and it probably couldn't have been otherwise licensed.

There's some argument on the TRUPACT testing that as you got into the testing you found more problems, and that required more testing, and so there's some possible argument that the speed of licensing was certainly negative there, but the overall confirmation and public confidence in the cask I think can be seen as counter weight balances to that.

Public acceptance is a very, very difficult issue. First of all, it's always hard to measure. Secondly, to my knowledge, no one has done any opinion survey research or focus group research to see how the public will react to cask testing. This occurred to me in the shower this morning as I was getting ready to come here. My goodness, of all the things we've thought about here, we've got people proposing to spend $20 million on testing at the NRC and people from Nevada proposing to spend $70 million, and nobody has spent $30, $40,000 to do a good basic public opinion survey. I certainly plan to discuss that with our folks.

Let me tell you why we haven't done it in the past. What we have found on the public acceptance issue is that members of the general public that we have sampled unscientifically tend to assume that the

packages that are used have been tested full scale. They either assume this because they assume that that is a principle of regulation in an advanced industrial society -- they certainly have no reason for this but this seems to be why they do this -- or in Nevada, the people who have seen the test films from the Sandia tests assume that the casks that would be used for Yucca Mountain have been --

DR. GARRICK: Bob, do you think it's really a case of assuming that they've been subjected to tests or assuming that there is sufficient evidence in place to have confidence? I mean we don't test the Golden Gate Bridge. There's thousands of engineering projects throughout the world that we don't test, but there's confidence, there's public confidence that they know what they're doing.

MR. HALSTEAD: Well, I agree. I'd say most of those aren't coming through their neighborhoods in Nevada, and there's a voluntary issue of whether you feel safe going up in the Sears Tower or the Stratosphere in downtown Las Vegas, for that matter, which on a windy day is kind of spooky at the top.

The point I'm trying to make here with cask testing is that it simply had not occurred to me

until this morning that there's all this talk about public confidence, and there's actually been some opinion polling on other safety enhancements like specifically for New Mexico is your level of comfort with the WIPP shipments more or less because you know about driver safety programs, because you know about escort requirements. But to my knowledge, nobody has done any polling on the testing issue, and I just throw it out.

What I was trying to explain before, though, is when I asked our polling people how we would go about asking this question the issue that came up was that the first question you would have to ask is something that would disturb people's knowledge, that is to say if someone thinks the casks have been tested full scale and at the beginning of the survey you make it clear to them that they haven't been tested full scale, you've probably biased the rest of the survey. So what I'm trying to say is this is a particularly difficult issue to give you any statistically verifiable opinion data.

What I will tell you from my personal experience is this: The TRUPACT testing was a great success because of the impact it had on the way state officials, emergency responders and law enforcement

people have been trained, because the test program produced honest footage of honest, indeed somewhat boring and repetitive, drop after drop and fire testing. The State of Idaho State Police produced a video called, "Safe Way Out," which we've used in our training programs, and it's been very, very effective. It's effective partly because there's good visual evidence, partly because the package that's actually being used was tested and partly because the people who are normally the great critics of this testing are there at the table saying this package was tested properly.

I think the British claim that they've had similar experience with the Operation Smash Hit testing and not just because they did the locomotive attack but because part of the testing program that is referred to in their publicity work is a series of regulatory tests that were done at Cheddar Gorge. And I think that the Sandia tests are an example of how not to do tests and attempt to use them to influence the public, because all a critic has to do is say those aren't the casks that are going to be used for shipments for Yucca Mountain, and almost immediately, 100 percent of the time, in my experience, those films are then dismissed as either irrelevant or worse a

public relations exercise.

In terms of safety enhancement, that's a difficult argument to make as well because it involves judgment calls. The judgment calls certainly on the part of the people who've done technical reviews for the State of New Mexico, the Environmental Evaluation Group, clearly believe that major safety enhancements to the TRUPACT-II, both in the closure mechanism and the O-ring resulted from the findings of the full-scale test program.

There is some argument that the findings in the Sandia test about the importance of the tiedowns and the importance of designing tiedowns that would break away from either the truck or rail conveyance at the right point were an important finding that the designers hadn't anticipated. And in the CEGB tests, the fact that there was a minor opening below what is allowed under the regulation but that it did result in a redesign of the lid can be argued to be a safety enhancement, although one could argue that it wasn't necessary under the regulations.

The long and the short of it, I guess, is there are limits, severe limits to the lessons learned from past testing that are applicable to what we're planning to do in the current time, but it is worth,

I think, reviewing them, and we intend to review them in writing. Let's turn to the next slide, please.

I've tried to summarize our concerns about spent fuel testing. I've been assisted in this very largely by Hank Collins. Issue Number 1 is simply that the NRC staff and contractors have not told us exactly what they plan to do and perhaps this has been developed in the last few weeks since we discussed this in Chicago, but we don't have a good sense of what the schedule for the spent fuel testing is compared to the cask testing, and it's important to resolve that, particularly because Issue Number 2 -- one of the really big debatable issues out here is what value to use for the gap inventory of Cesium-137, and in shorthand this is what percentage of the total inventory in a spent fuel assembly of Cesium-137, and also 134 but that's a much smaller contributor, is in the tiny gap between the pellet and the cladding and therefore can be assumed to be not only released in a fire environment but even possibly in a serious impact accident that doesn't involve a fire. And the range of values is as low as 0.3 percent and there are some data that indicates for some fuels and some burn-ups that it's over 20 percent. And a range that we've used in our risk calculations that Resnikoff and

company have done is a geometric mean, which is around then.

This is a really important -- I would argue that this is the single most important spent fuel issue to resolve because when you actually look at all of our models, they're all driven by your assumption about what value to use for the gap inventory for Cesium.

There is also the issue of determining temperature and impact limits for burst rupture and certainly the discussion that Dr. Levenson and I had goes right to that. We think the way to do that is through laboratory testing of spent fuel, and that's promised to be part of the Package Performance Study. Similarly, this issue of the size distribution of released particles -- now, this has been more of a -- this particular issue has been more contentious in the debates over the consequences of a sabotaged terrorism incident where you're looking at the blast from a shape charge, possibly releasing a considerable quantity of physical material from the cask and then the size distribution of the particles becomes very important for the consequence assessment, perhaps less important for accident consequent analysis.

We think we know a lot about the behavior

of Cesium-137 in fire environments, but we probably don't know enough in impact environments. And generally we need to know a lot more about what happens to the Strontium. To what extent is it affected by heat and under what circumstances? Again, that issue may be more important for total consequence assessment with the terrorism sabotage work than for an accident. And, certainly, CRUD behavior is an issue that's been noted by virtually all the people who've looked at the areas where we need more data.

And, finally, the implications of higher burn-up, the overall change in industry fuel management practices, which has, generally speaking, over the last 20 years, on average, resulted in about a 50 percent increase in burn-up. DOE to its credit has done a good job of looking at the implications both of burn-up and cooling time on the performance of specific representative spent fuels and accident conditions. But in general the issue of higher burn-up on the physical performance of fuel in accidents is an area that we would highlight. Next slide, please.

Well, we're getting late and I have the advantage of saying that this is work in progress that we're going to provide, and I can see there may be some reason for us to come back in a few months after

the May 8 meeting on the Baltimore fire and after the May 30 filing on NUREG-1768. Let me review some general points.

The NRC has done a splendid job, let me say that again, a splendid job of stakeholder involvement in the first phase of the Package Performance Study as it relates to planning these tests, and I'm very heartened by that. Splendid not only in the way they have presented information but the way that they have allowed pretty much unfettered interaction between a variety of stakeholders -- state government, industry people but also members of the public and their staff at the public meetings that they've held. Our concerns now are whether there's a commitment to an appropriate level of stakeholder participation throughout the conclusion of the program.

Point Number 2, selection of cask to be tested. Of the casks that are currently certified, if you had to test one full scale, I'd say the GA-4 is the logical choice. On the other hand, the selection of the Holtec as the rail cask is open to question on a number of grounds. And, again, without belaboring the point here, this is an area that we will be addressing in our comments. How do you decide what

the best or most representative rail cask is if you're only going to test one?

Selection of test scenarios is an area that we'll also be commenting on. In general, I would give the NRC staff kudos for the way -- I don't know if that comes in the record -- kudos means they get an A grade for the way they have approached the impact scenarios. They unfortunately get an incomplete for the way they've approached the fire testing scenarios. Now, that doesn't mean that I agree with the scenarios or that I'll suggest that our team limit themselves to the two impact scenarios that they've identified, but particularly the willingness to model the backbreaker impact for the truck cask shows a willingness to go where no modelers have been willing to go before. And, frankly, that's the sideways truck impact with the bridge abutment. I can't take credit nor can any of our people take credit. Bill Rhein down at Oak Ridge started arguing that that was an impact scenario that should be evaluated, I believe as early as 1979.

Selection of cask testing facilities, we have some real concerns here with the presumption that Sandia is both going to design the test program and get the contract to carry out the tests. I've been told that there will be some type of competitive

procurement, but I think it's very important for the integrity of this testing program that the people at NRC who make the decision not only look at this issue of whether there's a real or perceived conflict of interest but they make sure that the testing facility that's chosen is the one that's appropriate for the particular set of tests that need to be carried out and also that the test facility is accessible and that their staff are conducive to stakeholder and other witness participation.

Program costs and availability of funding. They've been very shy talking about this. Someone finally got them to admit at the second meeting that more than $20 million was their cost estimate. I think it could be considerably higher than that, perhaps between $25 and $30 million, but I'm just making assumptions based on our own cost analysis. I think they have an obligation to put a cost more precise than more than $20 on what they're proposing.

And, finally, very important is the commitment to carry out the testing program, particularly if this discussion is dragged on for some time. Maybe we've just grown cynical in Nevada but we're quite concerned about a situation where we've raised this issue of testing and now every DOE and

industry and NRC person who cares to says, "Wait a minute. We're going to deal with that testing issue. We've got the Package Performance Study tests." And that's fine if the tests are actually going to go forward, but if there isn't a commitment to carry out these tests, then it just complicates the discussion of testing. And on our part, we can just proceed to take these issues to the Congress and ask for creation of a testing program through congressional means. Next slide, please.

I'm not going to go into any detail here, but I just want to give you four out of my preliminary list of about 100 topic areas for specific comments on NUREG-1768. I think it's a mistake not to define failure thresholds and model them on the part of the people who seem to be willing to model almost failure. And I say again the modeling has been pretty close to failure on the impact analysis, but they've not done the same degree of modeling on fire performance. There also is some previously published work funded by the Department of Energy, carried out by Professor Miles Greiner at UNR. We've provided you with a summary report on some of the performance envelope analysis there. We think that kind of analysis should have been in the report.

It's clear that there's a prioritization of impact versus fire testing and a lack of specificity in the staff and contractor opinion for fire tests. We have concerns about the assumption that the impact tests should be done doing impact limiters. Haven't decided yet which side we're going to come down on. The regulatory nine-meter drop test was done without an impact limiter to assess compliance. Some pretty high accelerations have been considered for the drop test options identified in 1768 using impact limiters. But there is a question. We know a lot about impact limiter performance from our scale model testing, and do we need to do full-scale testing, in effect, to test impact limiters?

Test instrumentation is another big issue, both the reliability of the instrumentation in different combinations of tests and the availability and cost of different alternative ways of reporting and recording the data.

And, finally, the probablistic metric on Page A2/A3 is a classic example of where we don't dispute the effort to approach -- or to apply probablistic analysis, in this case it's an effort by the NRC to argue that the particular impact and fire scenarios they've proposed are realistic based on a

probablistic analysis. My argument is that they have only used one set of numbers and there are a number of different assumptions they should have used for numbers of shipments, accident rates and the values that are assigned to different events in their event trees.

So there is an example of five of the specific types of comments we'll be making. Again, I very much appreciate the opportunity that you've given us today, and I hope it's not the last time that we'll have an opportunity to discuss these issues. Thank you.

MR. LEVENSON: Thank you. Let me just -- so you realize you're not alone, we haven't seen any of the plans for the fuel testing either. But if you stop in -- I don't know whether the program will be anything like the one you're suggesting or not, but if it is, assume they accepted your program absolutely, then it wouldn't involve the same group of people, the same testing facilities or anything else, because it's essentially all with real fuel or with Cesium or with high burn-up so you have CRUD on the surface so that it really wouldn't make any sense to have it part of the same program. It would have to be done by different people, different places, et cetera. But we

haven't seen that yet. Questions?

DR. RYAN: We received a packet of material as background to get us started today, and I just would like to call your attention to one of the papers in that packet and ask a couple of questions about it. It's "Radiologic Impacts of Incident-Free TNR Transportation to Yucca Mountain of Collective and Maximally Exposed Individuals." And in reading this paper I was confused. It looks like you're calculating exposures to a maximum individual and then applying cancer risk factors to that dose. And that doesn't seem to me to be, one, a fair assessment or, two, frankly correct, because the application of a risk estimator, and you quote, for example, the teratogenic risk of birth defects, I think, on Page 6, that doesn't apply to an individual.

No risk estimator from NCRP should be applied to an individual dose. It's just flat-out epidemiologically wrong. So you end up with doses and cancer deaths as you list them. Now, whether the FEIS did that too, I understand they may have just from reading what you've written here, I caution you to think about perhaps a different way to look at that. Maximal individual doses may in fact not be realistic. You should maybe take a look at probablistic kinds of

approaches to what public dose or worker dose or whoever it is might be and then be real careful about the application of cancer risk estimated because in an epidemiologic sense they do not apply to individuals clearly, and they may in fact not apply accurately to small groups.

So I just think that kind of analysis is not helpful in that it may mislead if people don't realize the limitations. And had you listed some of these limitations and artifacts that occur, that would have been one thing, and maybe I missed it, but I didn't see where you had brought all that together. So just a thought as you may reconsider additional analysis of these types.

MR. COLLINS: Bob, do you want me to -- the Committee hasn't heard my dulcet tones yet, but -- or do you want to field this.

MR. HALSTEAD: Let me respond first, generally, then turn you loose, Hank, although I want to warn you we are near the end of the time period. Your comments are very well taken and in particular we were trying to respond, frankly, in a preparation for litigation over NEPA issues with the way the Department had addressed these risks. I agree with some of what you -- certainly, I agree with what you

said about the ability to predict cancer risk in a specific individual, and I think that's a problem in all of the Department's EISs.

And it also relates to the issue of using latent cancer fatality as the measure of radiological health risks. And the process of critiquing them we probably didn't make it clear, certainly as Hank can say, that we have a lot of reservations about those approaches also. I do think it's important to note that with worker doses the key issue here is that there are potential issues depending on certain policy decisions for frankly fairly large routine doses to be delivered to workers.

DR. RYAN: I would also add there's a large body of worker dose evidence you could have drawn on to look at actual work doses for transport units in transport. I mean there is a large body of worker exposure data out there.

MR. HALSTEAD: Agreed.

DR. RYAN: So it's not a theoretical. That's a real one.

MR. HALSTEAD: Right. But data that was absent in the Department's analysis and again what -- again, what I'm saying is what you saw was a very narrowly defined article basically responding to the

way the Department had dealt with these issues in their EIS and is not necessarily the way we would have or should have dealt with those issues in a holistic and general way.

DR. RYAN: I appreciate that, but the fact that you were narrow on purpose is not commented on in the report, and that's frankly a flaw of that approach. If you want to be narrow and you define it that way, I understand how you'd want to do that, but if you want to do as the title says, an accident-free assessment, that's a much broader question.

MR. HALSTEAD: Again, we're running -- I would really like afterwards as a follow-up to the meeting if you would be willing to give us your comments, I would very much be interested in receiving them and working them into our work plan.

DR. RYAN: Thank you. That's all.

MR. COLLINS: I just wanted to echo what Bob said. When we did that, when Bob and I wrote that paper it was basically to compare our results to the FEIS methodology in Appendix J, in Chapter 6, where they did use those peak cancer risks. And thank you for drawing our attention to that, the dubious methodology there.

DR. GARRICK: The only comment that I

think I'd like to make is that I think one of the most important issues here is a sensible protocol for the tests, one that can be anchored to something that indicates that it's realistic and has some rational, technical basis. A lot has been said about the various risk assessments that have been performed in transportation, and while certain elements of the work has been very, very good, the truth is that the transportation risk assessment business is many years behind the quality of risk assessments that were done in the nuclear power plants ten, 15 years ago, particularly behind with respect to identifying specific contributors to risk,behind in terms of coming up with rational and convincing risk metrics, as you say, or risk measures, behind in terms of comprehensiveness of the uncertainty analysis and behind in terms of the scope.

The analyses have been very helpful and useful, but I think that particularly with respect to the cask and the kind of insults that it can receive, but there's still the need for a more comprehensive treatment of that, and I think it would be nice to see that actually in advance of serious decision-making about what the test protocols should be. In the ideal world, what you'd like to see is that if you had a

very comprehensive risk assessment of the transportation system and it would have to be carefully scoped, then you would like to think that there would be a rational mapping that you could do from the results of that analysis to the test protocols. And I think that's very much missing.

It's kind of -- when the PPS came out, members of this Committee were pretty critical of many aspects of it. One of the things we were critical of was the scope of the test, the protocols for the test. Another thing we were critical of was generally the absence of what we would call a comprehensive risk assessment, particularly with regard to uncertainty analysis, because that's where the risk really is. So I'd sure like to see more evidence that whatever we end up as test protocols that they can be anchored to some sort of technical case or analysis that convinces us all that there's real logic and rational thought associated with it.

MR. LEVENSON: George?

CHAIRMAN HORNBERGER: Thanks, Milt. Again, I just probably want to second John's comment just before I make any comment. I think that what I gather the activity that's been going on and the discussions about the PPS appear to have really gotten

the dialogue going, and I think that is good to have all of the discussion to line this out.

I think that from my view, as like John's, some kind of systems approach is really where we need to go and we need to think about this not so much in the narrow sense of exactly what test needs to be done on what cask. For example, Jim made a comment about the institutional, potential institutional problem of someone who's in control here. And when it's not clear, then we have a problem. I don't think that that goes away just because we work on designing a test. I think that that somehow has to be built into our thinking about a test.

By the same token, we don't want to learn from terrible accidents like we have in the past, but by the same token if I think of the Exxon Valdez, I'm not sure exactly even in retrospect what kind of scale model test I would have done to prevent such an accident. I think that what is needed is to just have people think very carefully about the whole system and try to anticipate as best one can as what's going on, what may happen.

So, again, as John said, I think that perhaps in a broader view of the system, particularly taking into account the risks in the context of a risk

analysis may lead us to define a protocol and testing program that may have a better impact overall for the whole program.

MR. BAHADUR: I just had a specific question for Dr. Resnikoff. You conducted a base study on the Baltimore fire and presented your results. Has this study been peer-reviewed?

DR. RESNIKOFF: You mean has it been sent to a journal? We've sent it to other of our peers in the State of Nevada to look over.

MR. BAHADUR: Okay. All right. And their conclusion was also matching with the conclusions that you had made?

DR. RESNIKOFF: Did they concur, is that what you asked?

MR. BAHADUR: Yes.

DR. RESNIKOFF: Yes. They gave us helpful comments that improved the paper, yes.

MR. HALSTEAD: Let me add to that. We've been unfortunately involved in a serious dispute with the NRC over the availability of data and in particular in three areas. First of all, we believe that our contractors were unwisely and perhaps illegally excluded from some meetings between the NRC and NIST back in July and August. Secondly, we

requested reports that were withheld from us. We then filed a Freedom of Information Act action to obtain them, and the bottom line is it took us six or seven months to receive documents that had been completed in August. They weren't made available till February. And, finally, there's a whole range of reports which are claimed to be reports and turned out to be a handful of overheads that were given at a meeting that buttress critical technical points in the NRC's analysis.

Now, we fully intend at some future date to submit the analysis that RWMA has done along with the analysis that some of our other people have done possibly for the PATRAM Conference, possibly for waste management, and there are a number of journals where it would go through the peer review. And we don't always feel the need, frankly, to publish the peer review articles because we're writing things that are going into a review process, say, at the NRC. In this case, I think it is important that we submit that publication -- that we submit this material in a peer-reviewed forum. We haven't done it because we haven't been able to get the rest of the information that we need.

Now, hopefully that meeting on May 8 will

be the first step in resolving this issue, but this has become a terribly difficult political issue that has ended up besmirching the integrity of both sides, both the State of Nevada and the NRC, and we really need to find a better way to resolve technical disputes. That would then allow us to submit the work in a peer-reviewed forum having had access to all the information. It's a very fair comment that in fact we've not submitted the report to what would normally be considered an objective peer review.

MR. LEVENSON: I have one more question. I have one question. Like my colleague Mike here, I sometimes have trouble sleeping so I read all this stuff too. And there's a statement in here I found very interesting and that is that there were not detectable releases of any airborne hazardous materials in the smoke billowing from the tunnel fires, even though hydrochloric acid was in the tank car right next to the fire and leaked.

I don't find that very surprising because I experienced, which in the nuclear business is 60 years this year, covers quite a few accidents, 12 core meltdowns, et cetera. And reaction in played out mechanisms are almost never properly modeled by the modelers. Always have to explain why are they

overpredicting huge consequences.

I wondered if you had given any thought to whether there was anything to be learned from this that might help in doing analysis on tunnel fire? It seems to me that this is a good experiment, ought to get some use out of it.

DR. RESNIKOFF: I think we note that as an issue that we need to address, particularly after our meeting with the NRC consultants on the 8th.

(Off mic to Birky.)

DR. RESNIKOFF: I agree. In our study we assume 50 percent of the volatile materials got out of the tunnel to do an analysis, but that was just a conjecture on our part.

MR. LEVENSON: Yes. That doesn't correspond to any experience or experiment.

MR. KOBETZ: I just wanted to follow up on one thing that Mr. Birky did say earlier in the presentations, and that was that there was a concern that the regulations may not be conservative enough for fire with regard to the fire test. And I guess that's the one thing I haven't heard through all this as far as the safety issue. Does the state feel that there's a current safety issue that the regulations aren't adequate as far as your response to the PPS

test protocols?

MR. HALSTEAD: Yes. I want to answer that first because Tim has made that point very clearly to me on several occasions. There's a point where if we had the technical information in hand to argue that the current standard was inadequate, we're not shy about filing a petition for rulemaking. And I guess that would be the appropriate route to go, and that's -- we've never frankly spent the amount of resources that are necessary to look at that question even though I say as early as 1986 one of our review groups said, "One thing you should think about is the adequacy of the current fire standard, both duration and maximum temperature." So the answer -- at the current time, I don't think we have sufficient information that I would feel would justify challenging the existing regulations.

MR. KOBETZ: Not just the fire but also any of the impact, anything else that they're doing. Because one of your things was talking about actually full-scale testing each of the casks.

MR. HALSTEAD: Well, understand, if you've read PRM 73-10, we're not shy about going into excruciating detail about the deficiencies regarding the vulnerability of casks to attack where shape

charges, so that's kind of the model we would follow. We would have to have done that much of our own analysis to feel that we could stand the heat of scrutiny, and frankly we don't have that information now. That's one of the reasons why we're going to pursue this I think in considerable detail and in depth.

MR. LEVENSON: Any questions or comments from anyone in the audience?

MS. GUE: I know it's the end of the day -- sorry, Lisa Gue with Public Citizen. I know it's the end of the day, but I just wanted to take a moment to thank --

MR. LEVENSON: Do you want to identify yourself, Lisa?

MS. GUE: I did.

MR. LEVENSON: Oh, okay.

MS. GUE: I wanted to take a moment to thank the Committee for holding this meeting and doing so in a public forum and Mr. Chairman for building time into the agenda for public comment. And I also want to appreciate the State of Nevada's persistent technical review of these issues and for bringing them to the attention of the Committee.

Public Citizen, as a public interest

organization, has a long-standing commitment to issues of transportation safety as well as nuclear waste management, so the question of nuclear waste transportation is an interesting nexus for us of issues that we care deeply about and work in coalition with concerned citizen groups across the country. And I think that the Committee and the various agencies involved should have no doubt that this is a matter of significant public concern that cannot be addressed simply through a PR campaign but in fact relates to the question of credibility in terms of the various regulatory agencies involved, their credibility as regulators that protect public health and safety. And, unfortunately, the history with respect to both the NRC and DOE is not particularly inspiring in that regard.

And I think that this Committee actually should be playing a vital role to address that problem. And we were very concerned in the first round of these meetings when the Committee heard exclusively from an industry panel, and in fact we sent you a letter expressing our concerns, which incidentally we received no response to, but we were very happy to see this meeting subsequently scheduled, and we would hope that in the future the Committee

build in this kind of balance to its presentations and perhaps takes more of the lead in addressing some of the questions that do remain about these issues. I think it's vitally important that ACNW as an independent advisory committee demonstrates its commitment to fully exploring dissenting views as well as the well-known positions of the nuclear industry.

On the issue of the Package Performance Study, well, there's a lot to debate in terms of detail, and we've heard some of it today. I think it's clear that this could be a very important study, and we'll of course be submitting comments, and maybe we'll send you a copy. But just to say, first of all, perhaps the -- I think perhaps the Commission could benefit maybe from some thoughts of the Committee in terms of whether this is actually a Yucca Mountain study or whether it's a generic study. I think there's some inconsistencies in how it's been presented, and it's important again in terms of credibility that it be accurately portrayed one way or the other. Thank you again.

MR. LEVENSON: Thank you, Lisa. Let me point out that I won't tell some of the people at the workshop what you said, because the people from DOT and the Railroad Association I think would resent

being included with industry.

MS. GUE: Government and industry.

MR. LEVENSON: Government and industry covers a pretty big percentage of the U.S. population, I'm afraid. Okay. Including the State of Nevada. Okay. I declare the workshop section of this as done, and it's back to you, George.

CHAIRMAN HORNBERGER: Thanks. We will now take a break, and we will reconvene in the room upstairs in 15 minutes.

(Whereupon, at 5:07 p.m., the Transportation Working Group meeting was concluded.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Nuclear Waste 141st Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Rebecca Davis
Official Reporter
Neal R. Gross & Co., Inc.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555-0001

April 9, 2003 (REVISED)

AGENDA
141st ACNW MEETING
APRIL 22-23, 2003

TUESDAY, APRIL 22, 2003, CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

1) 10:30 - 10:40 A.M. — Opening Statement (Open) (GMH/JTL)
The Chairman will open the meeting with brief opening remarks, outline the topics to be discussed, and indicate several items of interest.

2) 10.40 - 11:30 A.M. — ONE STEP AT A TIME: The Staged Development of Geologic Repositories for High-Level Radioactive Waste (Open) (GMH/MPL)
The Committee will hear presentations by and hold discussions with representatives of the National Academy of Sciences on their recent report on staged development of a proposed HLW repository at Yucca Mountain, NV.

11:30 A.M. - 12:30 P.M. — ***LUNCH***

NRC AUDITORIUM, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

3) 12:30 - 5:15 P.M. — TRANSPORTATION WORKING GROUP FOLLOW-ON SESSION

National Academy of Sciences Transportation Study (Open) (ML/TJK), 12:30-1:00 P.M.
The Committee will hear presentations by and hold discussions with representatives of the National Academy of Sciences regarding a study the Academy will perform to analyze a broad range of matters including transportation cask testing, selection of routes to the proposed burial site, possible health impacts and public perceptions of risk.

State of Nevada Technical Concerns with the Transportation of Spent Fuel and High-Level Waste (Open) (ML/TJK), 1:00 - 2:40 P.M.

I. State of Nevada Introduction and Overview, R. Loux
II. State of Nevada Review of Yucca Mountain System Issues Related to Transportation Safety, R. Halstead
III. State of Nevada Analysis of July 2001 Baltimore Rail Tunnel Fire and Implications for Spent Fuel Transportation, M. Resnikoff

2:40 - 3:00 P.M. *****BREAK*****

Full Scale Testing Issues including an Assessment of NUREG-1768 (Open) (ML/TJK), 3:00 - 5:15 P.M.

I. Public Safety, Public Confidence, and Full Scale Testing, J. Hall
II. Nevada proposal for Full Scale Regulatory Testing and Testing to Failure, R. Halstead
III. Testing Cask Performance in Very Severe Accidents (Impact, Fire, Puncture, Immersion), M. Resnikoff and M. Birky
IV. Spent Fuel Testing, H. Collins
V. Past Experience and Lessons Learned, R. Halstead

4) 5:15 - 5:30 P.M. Committee Discussion (Open) - The Committee will further discuss today's topics.

5:30 - 5:45 P.M. *****BREAK*****

CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

5) 5:45 - 7:00 P.M. Preparation of ACNW Reports (Open)
The Committee will discuss proposed reports on the following topics:

5.1) Report of March 2003 Working Group Meeting on NRC and DOE Performance Assessments: Assumptions and Differences (BJG/NMC)
5.2) State of Nevada Technical Concerns with the Transportation of Spent Fuel and HLW (ML/TJK)

WEDNESDAY, APRIL 23, 2003, CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

6) 8:30 - 8:35 A.M. Opening Statement (Open) (GMH/JTL)
The Chairman will make opening remarks regarding the conduct of today's sessions.

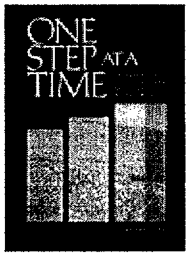
7) 8:35 - 9:30 A.M. Update on NRC Division of Waste Management Activities (Open) (GMH/HJL)
The Committee will hear presentations by and hold discussions with the Director, Division of Waste Management on recent DWM activities of interest.

8)	9:30 - 10:30 A.M.	Discussion of Self-Assessment Survey Results (Open) (GMH/RPS) The Committee will discuss the results of the self-assessment survey.
	10:30 - 10:45 A.M.	*****BREAK*****
9)	10:45 - 12:00 Noon	ACNW Action Plan (Open) (GMH/JTL/MPL) The Committee members will discuss an update to the ACNW 2002-2003 Action Plan.
	12:00 - 1:00 P.M.	*****LUNCH*****
10)	1:00 - 5:00 P.M.	Preparation of ACNW Reports (Open) The Committee will discuss proposed reports on the following topics: 10.1) Report of Working Group on NRC and DOE Performance Assessment: Assumptions and Differences (BJG/NMC) 10.2) State of Nevada Technical Concerns with the Transportation of Spent Fuel and HLW (ML/TJK) 10.3) Self-Assessment Survey Results (GMH/RPS) 10.4) ACNW 2002-2003 Action Plan Revisions (Tentative) (GMH/JTL/MPL)
11)	5:00 - 5:15 P.M.	Miscellaneous (Open) The Committee will discuss matters related to the conduct of Committee activities and matters and specific issues that were not completed during previous meetings, as time and availability of information permit.
	5:15 P.M.	Adjourn 141st Meeting

NOTE:

- Presentation time should not exceed 50 percent of the total time allocated for a specific item. The remaining 50 percent of the time is reserved for discussion.
- Thirty-Five (35) copies of the presentation materials should be provided to the ACNW.
- ACNW meeting schedules are subject to change. Presentations may be canceled or rescheduled to another day. If such a change would result in significant inconvenience or hardship, be sure to verify the schedule with Mr. Howard Larson at 301-415-6805 between 8:00 a.m. and 4:00 p.m. prior to the meeting.

Advisory Committee on Nuclear Waste Meeting April 22, 2003



One Step at a Time: The Staged Development of Geologic Repositories

Tom Isaacs and Robert Bernero
National Research Council Committee on Principles and Operational Strategies for Staged Repository Systems

www.nap.edu

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

1

Study Origin

- ***There exists substantial worldwide interest in step-wise or staged approaches for the development of geologic repositories for high-level waste.***
  - **NEA**
  - **IAEA**
  - **EDRAM**
  - **KASAM (Sweden)**
  - **EKRA (Switzerland)**
  - **AkEnd (Germany)**
  - **NAS (USA)**
  - **DOE (USA)**
- ***Study sponsored by U.S. Department of Energy (DOE). Findings and recommendations are addressed principally to repository implementers.***

2

Statement of Task

- *DOE asked the National Research Council for specific advice with regard to staging:*
  - Operational meaning of "staging."
  - The technical, policy, and societal objectives and risks.
  - Potential impacts.
  - Strategies for developing a staged system, including monitoring.
  - Knowledge gaps.
  - Potential incompatibilities with licensing.

3

Adaptive Staging

- *Management approach that emphasizes:*
  - Commitment to systematic learning and iterative safety review.
  - Flexibility and reversibility.
  - Cautious startup/pilot stage.
  - Broad participation.
- *Stages separated by decision points*

4

Selected Generic Findings on Adaptive Staging

1. *Adaptive staging is a promising approach to successful repository development.*
2. *Iteration of safety case is central.*
3. *Requires continuous active learning in technical AND societal areas.*
4. *Provides opportunities for stakeholder and public interactions.*
5. *Can be compatible with regulatory systems.*

5

Generic Recommendations on Adaptive Staging

- *Should be the approach used for geologic repository development.*
  - Places emphasis on iterative review of safety.
  - Makes full use of learning opportunities.
  - Integrates independent technical advice and stakeholder and public input.

6

Additional Findings Relevant to U.S. Program

- *DOE has recognized potential advantages of staging.*
- *U.S. regulatory system allows for adaptively staged development.*

7

Specific Recommendations for U.S. Program

1. *DOE should adopt adaptive staging.*
2. *Pilot, test, and possibly demonstration activities.*
3. *Independent scientific oversight group and stakeholder advisory board (in addition to the NWTRB).*
4. *Safety analysis and a safety case based on the full inventory.*

8

Specific Recommendations for U.S. program (cont.)

5. *Ensure (with USNRC) that the regulatory process enables the application of adaptive staging.*
6. *Consider the impact of adaptive staging on the overall waste management system.*

9

Open issues

- *Assertion that adaptive staging will cause delays.*
- *Specifics of pilot stage.*
- *Repercussions on buffer storage.*
- *Proposals for oversight groups.*
- *Details of long-term science program.*
- *Interactions with USNRC licensing.*
- *Relation of safety case to USNRC.*

10

USNRC Licensing issues

- ***Does adaptive staging imply adding an extra licensing step?***
  - *It depends, if new information warrants.*
- ***Is the committee proposing a new regulatory requirement for "safety cases"?***
  - *No.*

11

Attributes of Adaptive Staging

- ***"Flexibility.*** Flexibility is the capability and the willingness to reevaluate earlier decisions and redesign or change course if warranted by new information." [emphasis added]
- ***"Reversibility.*** Reversibility is the distinct option to abandon an earlier path and reverse the course of action to a previous stage if new information warrant[s]." [emphasis added] (Report p. 29)

12

Example in Report (p. 113)

1. Complete application for CA (with EIS)-supported by full repository safety analysis-emphasis on learning cycles with first part of repository.
2. Review and adjudication of entire application (all contentions)-license to construct issued.
3. Construction of initial surface and underground facilities per design approved-includes checkout and cold testing.

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Example (cont'd)

4. Application for license amendment to receive and emplace waste, supported by update of CA application to reflect new information:

- Experience of construction, checkout and test
- *In situ* monitoring and testing
- Data and analysis from external activities

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Example (cont'd)

5. USNRC grants prior hearing for contentions accepted as based on new information.
6. Review and adjudication of application for amendment–license to receive and emplace waste issued.
7. Receive waste in buffer storage, package and emplace waste in first part with focus on operational test experience.

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Example (cont'd)

8. Re-evaluate licensed repository design based on learning from:
   - Hot operational test experience
   - *In situ* monitoring and testing
   - Data and analysis from external activities including S&T improvement program
9. Apply for amendment <u>if new information warrants</u>.

16

Safety Cases

- ***The collection of arguments that demonstrate the safety of the proposed repository***
- ***USNRC does not use the term but requires the content:***
  - **for pre-closure safety**
  - **for post-closure safety**

17

Committee on Principles and Operational Strategies for Staged Repository Systems

- Charles McCombie, *Chair*, Independent Consultant
- David E. Daniel, *Vice-Chair*, University of Illinois
- Robert M. Bernero, USNRC (retired)
- Radford Byerly, Jr., University of Colorado
- Barbara L. Dutrow, Louisiana State University
- Jerry M. Harris, Stanford University
- Thomas Isaacs, LLNL
- Leonard F. Konikow, USGS
- Todd R. LaPorte, University of California-Berkeley
- Jane C. S. Long, Mackay School of Mines
- Werner Lutze, The Catholic University of America
- Eugene A. Rosa, Washington State University
- Atsuyuki Suzuki, University of Tokyo
- Wendell Weart, Sandia National Laboratories

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REMARKS OF JIM HALL
ON BEHALF OF THE STATE OF NEVADA
TO THE
U.S. NUCLEAR REGULATORY COMMISSION'S WASTE ADVISORY
COMMITTEE OF NUCLEAR WASTE

Good afternoon. My name is Jim Hall and for almost seven years, I served as Chairman of the National Transportation Safety Board (NTSB). The NTSB is the federal agency that is charged with the investigation of major transportation accidents, or as I liked to say, is the "eyes and ears" of the American people at transportation accidents across the country and around the world. In that role, I became all too familiar with the human and economic toll caused by these accidents. As a result, the Board and I did everything possible to find ways to prevent such tragedies from recurring.

Since leaving the NTSB in 2001, I have attempted to lend my voice to important transportation safety and security issues that I firmly believe in.

Prior to heading the NTSB, I served for six years as the Director of the State of Tennessee's State Planning Office which was charged with overseeing the Department of Energy's clean-up of the Oak Ridge nuclear weapons complex.

As Chairman of the NTSB, I repeatedly saw the results of the failure to adequately address safety at the front end of a transportation project. From my work in Tennessee, I have an understanding of the complexity associated with the storage and transportation of spent nuclear fuel. I am here today speaking on behalf of the State of Nevada to focus our collective attention on one specific issue associated with potential transportation to Yucca Mountain – the need for full scale physical testing of the shipping casks. I believe that full-scale testing is essential for both the protection of public health and safety and the promotion of public confidence.

Last summer, when Congress was debating the siting of Yucca Mountain as the nation's nuclear repository, I was asked to comment on the safety aspects of DOE's Yucca transportation plan. During that time, I was surprised when Secretary Abraham testified before the Congress and informed them, [DOE] "...is just beginning to formulate its preliminary thoughts about a transportation plan." It has now been more than 14 months since the Secretary of Energy sent the Yucca site recommendation to President Bush and the DOE has yet to present a transportation plan.

Although a plan has not been presented, DOE has suggested several possible approaches to the transportation issue in its Final Environmental Impact Statement (FEIS) for the Yucca Mountain project. And, you've already heard Nevada consultants discussing those possible scenarios earlier today. However, I feel it is important to mention again that, as this process continues to move forward, DOE has not yet even formally declared its stated modal preference.

DOE said in their FEIS that they would issue a record of their decision declaring their commitment to rail. At the current time, DOE does not even have a schedule of when they will make that most basic decision. So, when I hear DOE spokespeople saying that there won't be 109,000 truck and 4,000 barge shipments – I wonder what I am missing? Really, we need to remember, that it was DOE who put these scenarios and numbers forward and it was DOE that stated, in their opinion, the risks and impacts of many thousands of truck and barge shipments would be legally and socially acceptable.

Finally, when Secretary Abraham and his representatives say that there will only 175 shipments per year, it is important to mention that by all accounts such a number is unrealistic. At the very least, there would be twice as many shipments per year. Conceivably, there could be as many as 2,900 per year.

One assumption we can make about DOE's transportation intentions is that DOE will likely assume title to commercial spent nuclear fuel at the power plants and thus DOE will legally own the fuel and be the shipper of record. The NRC has clearly concluded that this will be the case. Of course, DOE already owns the thousands of tons of high-level radioactive waste from defense activities and a large amount of spent fuel from civilian defense and naval reactor operations. Now why is this significant? DOE ownership at the time of shipment is significant because it limits the degree of NRC regulation, and that is no small matter.

Last May, Senator Durbin of Illinois, wrote to the NRC asking, "What role would your Agency play in the transportation of spent fuel if Congress approves Yucca Mountain?" Then NRC Chairman Meserve responded, "If DOE takes custody of the spent fuel at the licensee's site, DOE regulations would control the actual spent fuel shipment. Under such circumstances, the NRC's primary role in transportation of spent fuel to a repository would be the certification of the packages used for transport." Senator Durbin asked a second question, "How would your agency be involved in selecting modes and routes for the relocation of nuclear waste if Congress approves Yucca Mountain?" Meserve again stated, "...the only involvement NRC will have in the transport will be the certification of the transport cask."

The outgoing Chairman of the Commission has clearly taken the position that cask certification is the only aspect of DOE's transportation to Yucca Mountain that would be regulated by the NRC. Over the course of the past five weeks, Commission staff have repeated this position at public meetings on the package performance study here in Rockville, in Las Vegas & Pahrump, Nevada and in Chicago. This underscores the importance of the Commission's decisions regarding full-scale cask testing, since cask certification is really the only area in which the Commission will be directly involved with Yucca Mountain safety planning.

Other representatives of the State of Nevada are here today to offer the specifics of the State's proposal for full-scale testing. They will also discuss reasons why the full-scale cask testing plan proposed by NRC staff and contractors is not only technically questionable and very costly, but is also unlikely to result in increased public confidence.

It is not the NRC's responsibility to promote public confidence in DOE's transportation activities. The NRC should not approach the full-scale testing issue with public confidence as its objective. It can and must approach this testing with protection of public health and safety and the environment as its objective. If the testing is done properly, public confidence will logically follow.

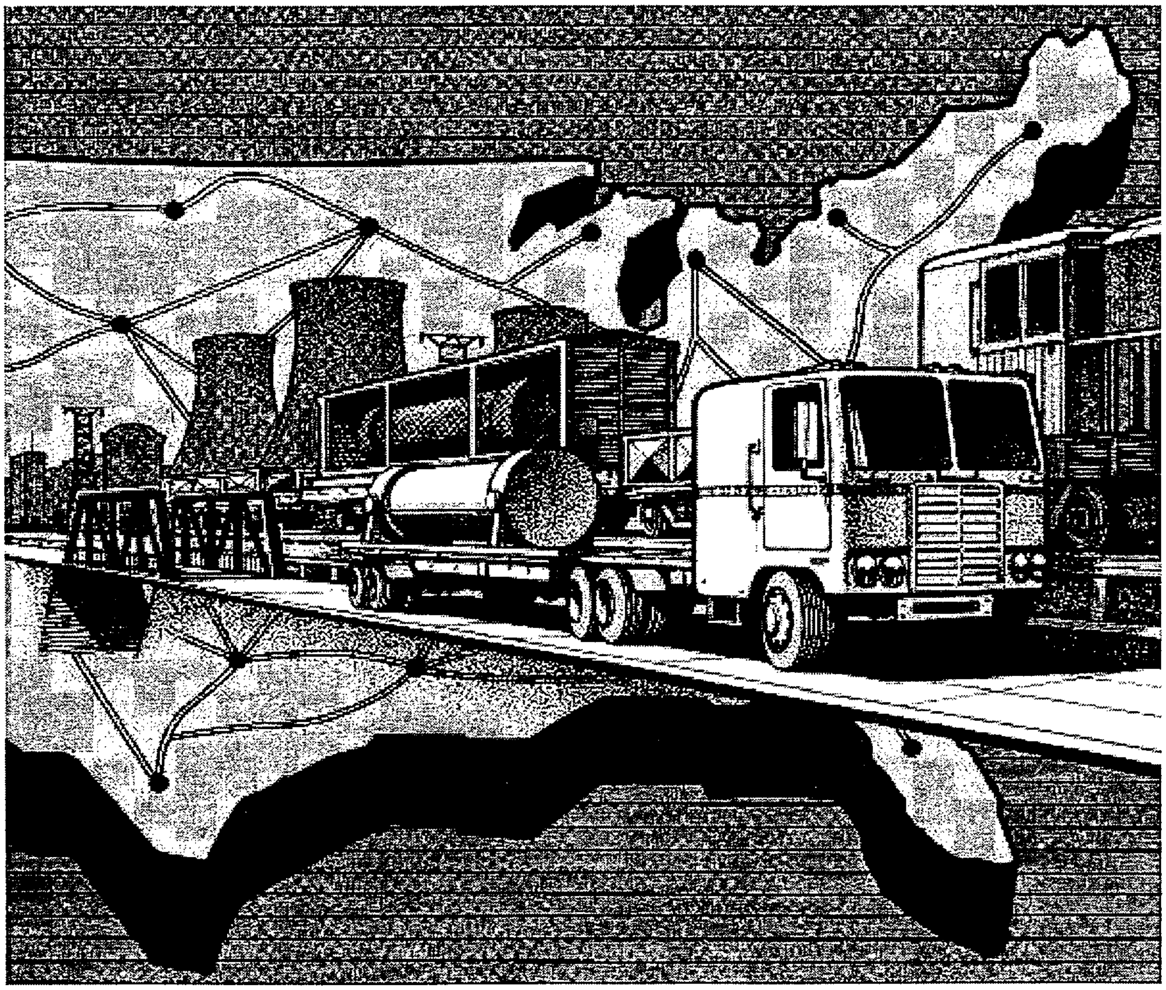
For the past twenty-five years, opponents of full-scale testing have focused upon costs. Indeed full-scale testing will be expensive. NRC staff has stated that their program to test one truck cask and one rail cask will cost more than $20 million. Nevada analysts believe the NRC proposal could cost as much as $30 million. Nevada has proposed a plan to test all of the cask types that would be used for Yucca Mountain shipments, if the repository goes forward. That means testing one truck cask and four rail casks, plus additional testing and analysis, at a total estimated cost of $45-70 million.

How can we put these costs in perspective? The cost of Nevada's more effective full-scale testing program would be small compared to the overall cost of the Yucca Mountain transportation system. DOE estimates the transportation system cost would be about $8.4 billion over 38 years. The State of Nevada has estimated approximately 9.2 billion for the same system over the same period. So Nevada's testing program is less than 1 percent of total projected transportation expenditures.

Another way to put testing costs in perspective is to compare them to the cost of cleaning up after a worst-case transportation accident involving the release of radioactive materials. DOE acknowledges that clean up could cost up to $10 billion, and that is for one accident. State of Nevada analysts have run the same DOE computer programs and conclude that a worst case accident or successful terrorist attack could involve clean-up costs in excess of $10 billion. Again, which ever figure we used, Nevada's comprehensive cask-testing program would cost less than 1 percent of the projected clean-up cost of a worst case accident or terrorist scenario.

In conclusion, let me thank you for this opportunity to share my views and experiences with you. It will take the cooperation of every level of this effort to make safety the primary concern. It is vital that we all remember that it is the decision making and performance of individuals, sometimes acting alone, sometimes acting as members of a team or committee that directly determine how safe an organization is.

Spent Fuel Transportation Package Analysis, Testing, and Experience



Transportation Working Group Follow-on Meeting

April 22, 2003

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ADVISORY COMMITTEE ON NUCLEAR WASTE
142nd MEETING
TRANSPORTATION WORKING GROUP
MEETING WITH THE STATE OF NEVADA
REGARDING SPENT FUEL TRANSPORTATION
APRIL 22, 2003

Contact: Tim Kobetz (301-874-8716, tjk1@nrc.gov)

-PROPOSED SCHEDULE-

	Topics	Presenters	Time
I.	Opening Remarks	M. Levenson, ACNW	12:30-12:35 p.m.
II.	Overview of the National Academy of Sciences Transportation Study	K. Crowley, NAS J. Morris, NAS	12:35-1:00 p.m.
III.	State of Nevada Introduction and Overview	R. Loux, State of Nevada	1:05-1:20 p.m.
IV.	State of Nevada Review of Yucca Mountain System Issues Related to Transportation Safety	R . Halstead, State of Nevada	1:20-2:00 p.m.
V.	State of Nevada Analysis of July 2001 Baltimore Rail Tunnel Fire and Implications for Spent Fuel Transportation	M. Resnikoff	2:00-2:40 p.m.
	BREAK		**2:40-3:00 p.m.**
VI.	Full Scale Testing Issues including an Assessment of NUREG-1768		3:00-5:15 p.m.
	1. Public Safety, Public Confidence, and Full Scale Testing	J. Hall	
	2. Nevada Proposal for Full Scale Regulatory Testing and Testing to Failure	R. Halstead	
	3. Testing Cask Performance in Very Severe Accidents (Impact, Fire, Puncture, Immersion)	M. Resnikoff M. Birky	
	4. Spent Fuel Testing	H. Collins	
	5. Past Experience and Lessons Learned	R. Halstead	
VII.	Adjourn		5:15 p.m.

Transportation Of Radioactive Waste: Background Briefing

Kevin D. Crowley
Director, Board on Radioactive Waste Management
Joseph R. Morris
Senior Staff Officer, Transportation Research Board

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Motivations for Study ...

- Joint study by the Board on Radioactive Waste Management & Transportation Research Board
- Study was motivated by DOE's plans to open a Yucca Mountain repository:
  - Many decisions remain to be made in the U.S. transportation program (e.g., modes, routes, schedules)
  - Potentially affected parties (corridor states, Nevada) are concerned about the potential impacts of a large and sustained transportation campaign on safety, security, and other quality-of-life issues
  - The first shipments to Yucca Mountain (assuming it is licensed) are at least seven years into the future
  - There is time to develop a transportation program that minimizes these potential impacts and addresses public concerns

Study Development

- Board on Radioactive Waste Management & Transportation Research Board organized mini-workshop on radioactive waste transportation in September 2000
- Federal agencies (DOE, USNRC, DOD), states, and NGOs made presentations on issues and perceived problems
- It was clear from this workshop that an opinion gap exists between some "experts" and "public groups" with respect to views on transportation risks:
  - SNF/HLW has been and can continue to be transported safety.
  - Past experience is not necessarily indicative of future success. Previous studies are incomplete and do not take into account important public values with respect to issues such as routing and economics/quality of life concerns

More Study Development

- Final version of prospectus was approved by National Research Council in fall 2001
- A survey of potentially interested organizations was undertaken to better understand issues and potential data sources
- Fundraising for project began in 2002
- Project was officially started in November 2002 with solicitation of nominations for committee
- About 250 nominations were considered
- Committee slate has been approved by NAS President and NRC Chair Bruce Alberts

Study Sponsors

- Project budget is $842,000
- Sponsors to date
  - USNRC
  - DOE
  - DOT
  - EPRI
  - NCHRP
  - Nye County, Nevada (committed)
- Other state/local sponsors still in play

Questions to be Addressed

- What are the risks (i.e., from accidents, terrorism, routine exposures) for spent nuclear fuel/high-level waste (SNF/HLW) transportation? How well do we know them? How do they compare with other societal risks?
- What are the principal technical and societal concerns for transporting SNF/HLW over the next two decades?
- What can/should be done to address them?
- Study has a U.S. focus.

Transportation Issues

- Risk (accidents, terrorism, routine exposures)
- Waste package (shipping cask) performance
- Modes (highway vs. rail) and routing, especially through highly populated regions
- Public participation and communication in transportation programs
- Emergency response capabilities
- Economic/quality-of-life impacts
- Trust (or lack thereof) in government agencies responsible for transportation

What Can Study Accomplish?

- Help make risk analyses transparent; assess their technical soundness
- Suggest changes to transportation "systems" to improve technical soundness and safety
- Suggest ways to improve public participation and trust-building activities

Committee Expertise

- Decision Analysis
- Emergency response
- Health physics
- International practices
- Nuclear security
- Public participation
- Public policy
- Risk assessment (quantitative)
- Risk perception and communication
- Transportation operations
- Transportation safety

Committee Composition and Balance

- Chair: Strong leader with national policy experience who is not associated with either nuclear waste or transportation issues
- Vice-chair: Strong leader and nationally recognized transportation expert who is not associated with nuclear waste issues
- Committee balance factors:
  - Technical, social science, and policy experience
  - Federal and state experience
  - International experience
  - Nuclear and non-nuclear experience

Preliminary Study Plan

- 7-8 meetings planned
  - First (organizational) meeting in Washington, DC on May 16-17
  - Second meeting likely in Las Vegas. Date TBD
  - Dates, times, and topics of remaining meetings TBD
- Final report to be issued in early 2005

Transportation Routing

- Congressionally requested study
- Will examine procedures used to select routes for transporting research reactor SNF to/between DOE facilities
- Study will examine the extent to which procedures utilize assessments of risk
- 6-month study
- Awaiting funds from DOT to begin work
- Study to be coordinated with broader transportation study

Contacts

- To be added to project notification list, contact Ms. Laura Llanos at lllanos@nas.edu
- Check the current projects database at www.nationalacademies.org. Search on project name (Transportation of Radioactive Waste)

REMARKS OF ROBERT R. LOUX, EXECUTIVE DIRECTOR
NEVADA AGENCY FOR NUCLEAR PROJECTS
TO THE
U.S. NUCLEAR REGULATORY COMMISSION'S
ADVISORY COMMITTEE ON NUCLEAR WASTE

April 22, 2003

Introduction

Let me preface my remarks this afternoon by saying the State of Nevada contends that DOE should have fully and adequately addressed transportation of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) to Yucca Mountain in the Final Yucca Mountain Environmental Impact Statement (FEIS). Instead, the transportation analysis contained in the FEIS is legally and substantively deficient and entirely inadequate.

We contend that the only acceptable vehicle for engaging in planning for SNF and HLW shipments in Nevada or nationally is the process set forth by the National Environmental Policy Act (NEPA) and its implementing regulations.

That means DOE must commit to the preparation of an Environmental Impact Statement (EIS) for the transportation program. Such EIS must encompass an integrated transportation program that covers both the national transportation system and the transportation system within Nevada.

The EIS must show how the national and Nevada components function in a consistent and integrated manner, and how decisions with respect to the national system affect the Nevada system, and vice versa. What DOE appears to be doing instead is a piecemeal approach to transportation planning, crafting the message to fit whatever audience the Department is trying to appease at the time.

That being said, for the better part of two decades, the State of Nevada has consistently and repeatedly recommended specific measures that the Federal government should take to manage the risks associated with transportation of spent nuclear fuel and high-level radioactive waste.

Despite our opposition to construction of a repository at Yucca Mountain, and to construction of an interim storage facility at the Nevada Test Site, the State of Nevada has taken virtually every possible opportunity to make constructive proposals to the appropriate Federal agencies: DOE, the U.S. Nuclear Regulatory Commission (NRC), and the U.S. Department of Transportation (DOT).

In addition, the Western Interstate Energy Board and the Western Governor's Association have done extensive work on nuclear waste transportation and provided DOE with detailed and substantive guidance over the past 15 or more years.

WIEB has even developed an extensive High-Level Waste Transportation Primer that provided DOE with a comprehensive framework for an adequate transportation system.

WGA has passed numerous resolutions urging DOE to adopt an integrated and comprehensive approach to transportation planning, including adequate preparations to deal with terrorism and to prevent catastrophic accidents through meaningful cask testing.

Nevada's Recommendations

Since 1997, Nevada's recommendations regarding high-level nuclear waste transportation risk management have been focused on four areas:

1) A comprehensive approach to risk assessment, risk management, and risk communication;

2) Development of a preferred transportation system;

3) Full-scale, physical testing of shipping casks; and

4) Accident prevention and emergency response.

The presentations you will hear from other Nevada transportation experts today will address specific Nevada issues and recommendations in more detail. But let me point out that the basis for any meaningful spent fuel and high-level waste transportation planning must be veracity and accuracy in disclosing the nature, scope, and extent of the effort. Unfortunately, DOE's pronouncements on the transportation aspects of the Yucca Mountain program, meager as they have been, appear more designed to obscure and minimize the challenges for political reasons than to illuminate them.

The Numbers Game

For example, Nevada believes that DOE's recently-devised estimate of 175 shipments per year to a Yucca Mountain repository is not only inaccurate, but grossly underestimates the nature, magnitude, and scope of the shipping campaign required to support the repository program.

To realize such a low number of shipments, DOE will, among other things, have to ship over 90% of all SNF by rail; assure that each shipment is made up of at least 3 rail cars per train; make thousands of barge and/or heavy-haul truck shipments to move SNF from reactor sites without rail access to rail heads; create staging areas in rail yards and ports around the country in order to assemble the trains; and construct a 300 – 400 mile rail access line in Nevada at the cost of over $1 billion.

Nevada has carefully reviewed the estimates of future spent fuel shipments contained in the DOE Final Environmental Impact Statement for Yucca Mountain and believes these

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estimates to be far more realistic than the shipment numbers DOE is currently using. The FEIS includes projections of spent nuclear fuel and high-level radioactive waste shipments for two inventory disposal scenarios (24 years and 38 years) and two national transportation modal scenarios ("mostly legal-weight truck" and "mostly rail").

According to the DOE FEIS, about 70,000 MTHM of spent fuel and high-level nuclear waste could be shipped to Yucca Mountain over 24 years, and about 119,000 MTHM could be shipped over 38 years (2010-2048).

The DOE "mostly legal-weight truck" scenario would result in the largest number of shipments, about 108,900 shipments over 38 years, or about 2,865 per year.

The DOE "mostly rail" scenario, over 38 years, could result in more than 45,000 shipments (about 1,185 per year) or as few as 13,500 (about 355 per year). Commercial spent fuel would compromise about 88% of the wastes shipped to the repository, and about 73 % of repository cask-shipments.

We conclude that estimates of projected shipments to Yucca Mountain must continue to consider a range of modal scenarios and shipment numbers.

Rail Access Issues

DOE's blithe assumption that the shipping campaign will involve mostly rail transportation is equally suspect. At present, there is no railroad access to Yucca Mountain. Construction of a new rail spur, 99 to 344 miles in length, could take 10 years and cost more than $1 billion. The alternative to rail spur construction, delivery of thousands of large rail casks by 220-foot-long, heavy-haul trucks, over distances of 112 to 330 miles on public highways, is probably not feasible.

Maximum utilization of rail for cross-country transportation, as described in the FEIS, appears unlikely. 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 the Ports of 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 connections using large heavy-haul trucks, which will require special state permits and route approvals.

In the end, even if rail access to Yucca Mountain and all of the other impediments to rail transport can be resolved, "mostly rail" would mean moving no more than 60-75 percent

of the commercial spent fuel by rail, and moving the remaining 25-40 percent by legal-weight truck.

The DOE "mostly legal-weight truck scenario" is the only national transportation scenario that is currently feasible and is the one Nevada believes to be most likely in the event the Yucca Mountain program goes forward. All 72 power plant sites and all 5 DOE sites can ship by legal-weight truck.

Cask Safety and Shipment Safeguards

Nevada, together with other western states and regional groups, has long advocated full scale testing of shipping casks as part of the cask certification process. In light of the new terrorist threats facing the nation and the unprecedented nature and scope of the planned Yucca Mountain shipping campaign, it is imperative that NRC immediately address this issue, and we are gratified that the Commission staff if moving ahead with the Package Performance Study. Nevada experts have been, and will continue to be, closely involved with this effort.

We remain concerned, however, that the Commission has yet to act on the State of Nevada's rulemaking petition asking NRC to reassess and strengthen protections against and terrorism with respect to spent fuel shipments. That petition was filed in 1999 and, to date, no action has been taken despite the increased urgency occasioned by the events of September 11th and subsequent developments.

I trust that you will find the information provided today by Nevada transportation consultants useful and enlightening. I appreciate the Committee's willingness to provide this opportunity to present information and perspectives not afforded to you at your transportation workshop in December.

Yucca Mountain Transportation Safety Issues

Bob Halstead
State of Nevada Agency for Nuclear Projects
Fred Dilger
Clark County Nevada Nuclear Waste Division

Presentation to

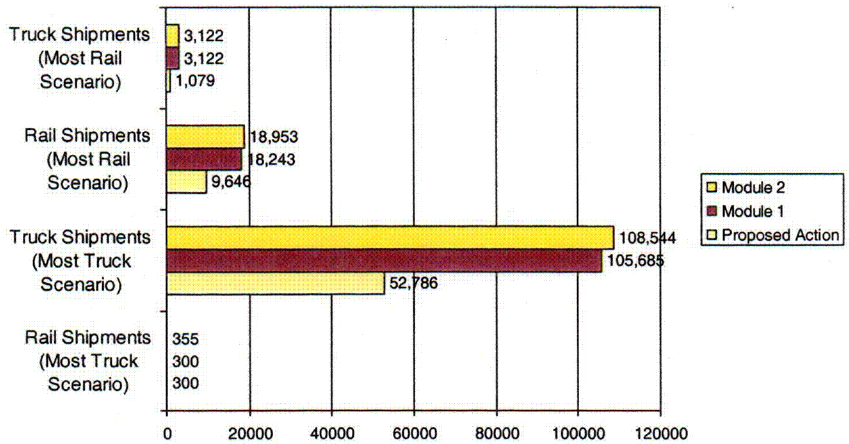
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Rockville, MD
April 22, 2003

Yucca Mountain Transportation Safety Issues

- Rail Access to Yucca Mountain
- Shipment Modes, Numbers, & Routes
- Radiological Risk Issues
- Risk Management Recommendations

Additional documentation available at
www.state.nv.us/nucwaste/trans.htm

Rail Access is Desirable



Consideration of Rail Access in Repository Site Evaluations

- 1980 GEIS assumed rail access
- 1984 Siting guidelines identified proximity to mainline railroads and ease of rail access favorable conditions
- 1986 DOE Env. Assessments evaluated rail access for 5 repository candidate sites
- Yucca Mt had the most difficult rail access

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Yucca Mountain Transport Access Compared

Condition	Davis Canyon, Utah	Deaf Smith, Texas	Hanford, Washington	Richton, Mississippi	Yucca Mountain, Nevada
Nearest Mainline railroad (miles)	74	25	51	17	100
Nearest Alternative Rail line	Not identified	40	101	26	265
Rail Access new Construction (miles)	39	26	3	26	100
Rail Access cost (Million 1985 dollars)	142	21	6	16	151
Nearest Interstate Highway (miles)	89	14	28	26	100
Nearest Alternative Interstate (miles)	198	200	72	84	208

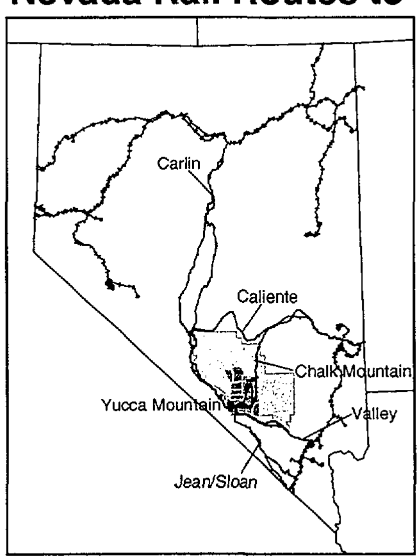
Current DOE Approach to Yucca Mountain Rail Access

- Final EIS: "DOE would prefer to use a branch rail line to ship spent nuclear fuel and high-level radioactive waste to Yucca Mountain."
- Final EIS identified five potential rail corridors:
  Caliente, Carlin, Chalk Mt, Jean, Valley
- DOE has not yet issued a Record of Decision (ROD) formally announcing a preference for rail or a preference between the rail corridors
- DOE is considering delay or deferral of rail spur construction plans (March 27, 2003)

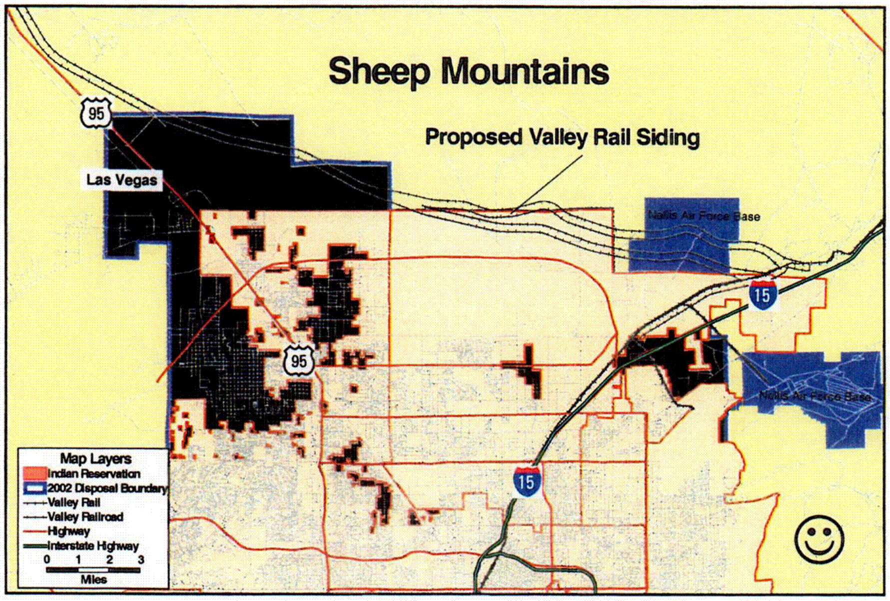
DOE FEIS Rail Corridors Compared

	Caliente	Carlin	Chalk Mountain	Jean	Valley
Cost (Millions of 2001 $)	$880	$821	$622	$462	$283
Length (miles)	319	323	214	114	98
One-way travel time (hrs)	10	9	8	4	3
Disturbed land area (sq mi)	18.3	19.3	12.6	9.2	5
Construction time	46	46	43	43	40
1990 Population	350	3200	589	492	219
Tribal Lands	None	None	None	None	None

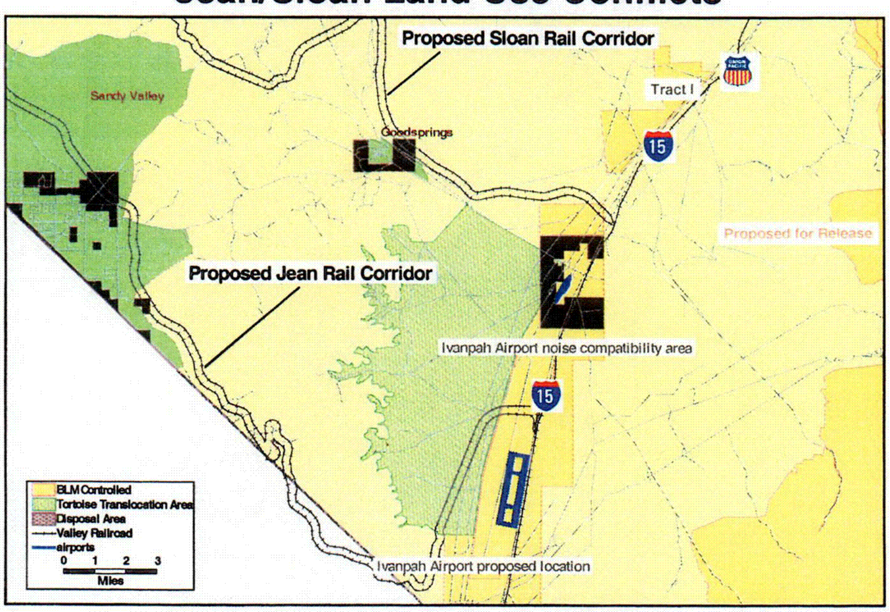
Potential Nevada Rail Routes to Yucca Mt



Valley Corridor Land Use Conflicts



Jean/Sloan Land Use Conflicts



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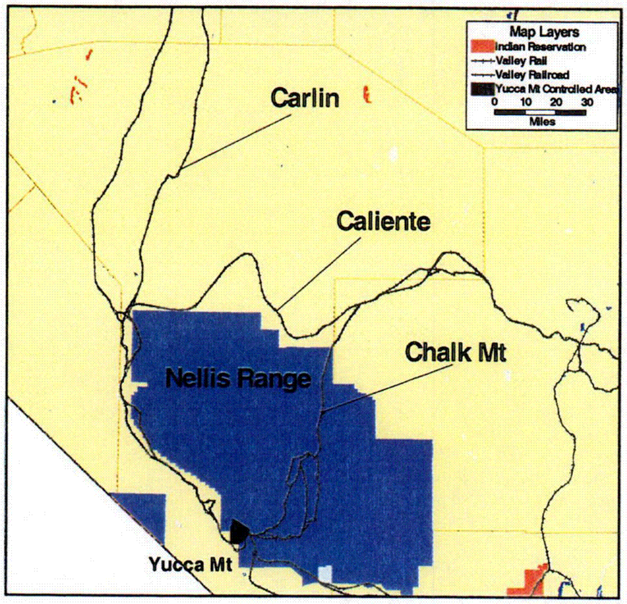
Caliente Chalk-Mountain Land Use Conflicts



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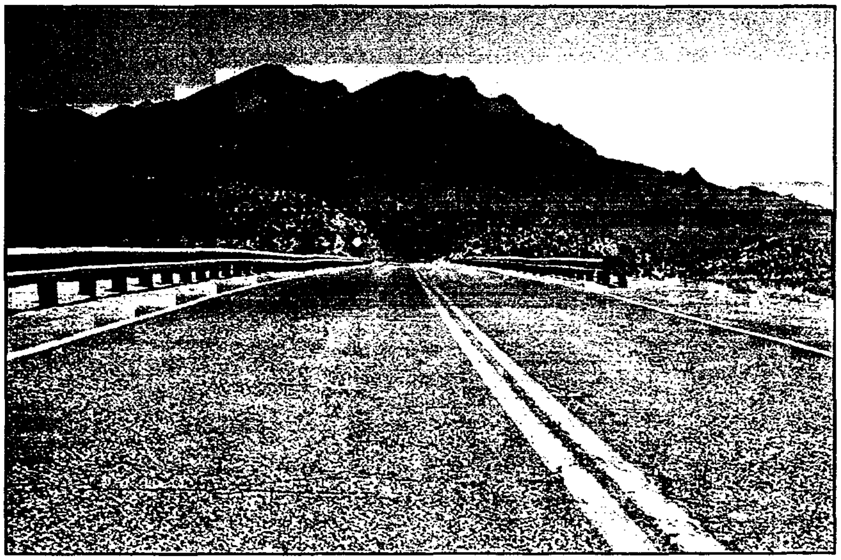
Hancock Summit

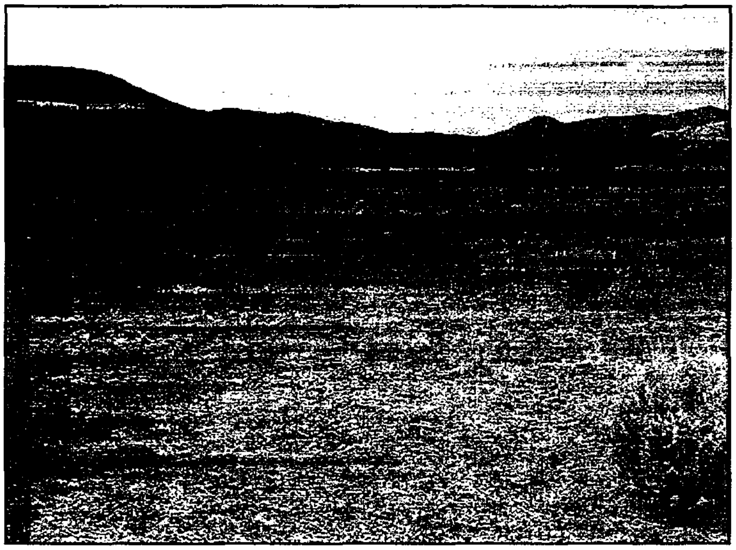
(Original Caliente Rail Route, Current HHT Route)



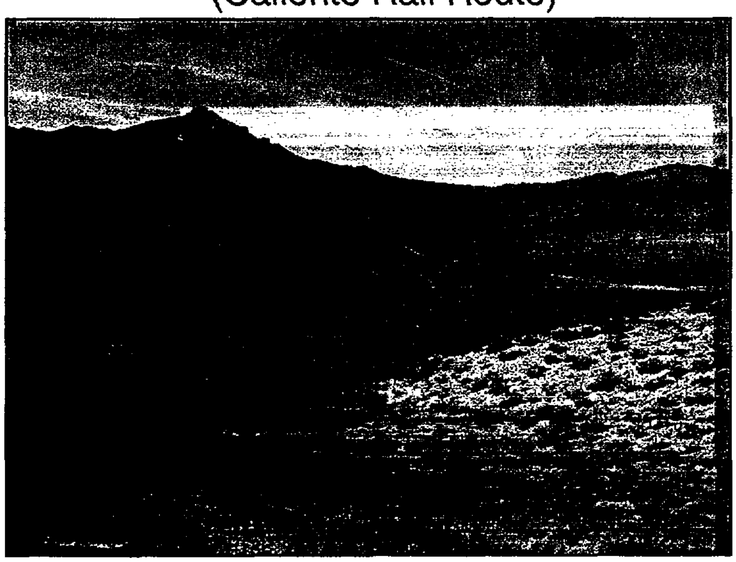
Crystal Springs

(Original Caliente Rail Route, Current HHT Route)

Bennett Pass
(Caliente Rail Route)

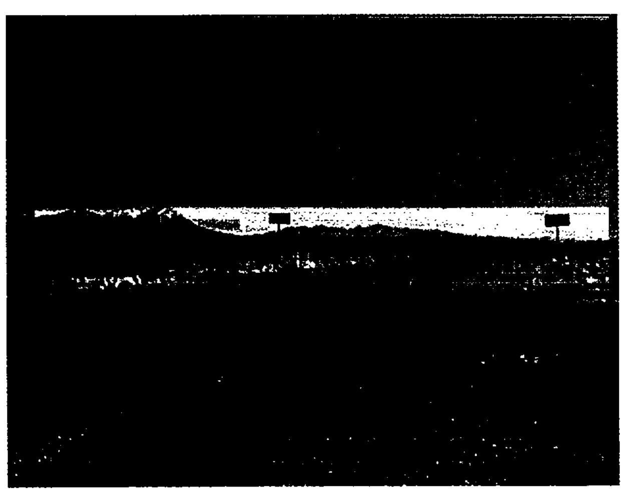


Timber Mountain Pass
(Caliente Rail Route)



Beowawe - Crescent Valley
(Carlin Rail Route)

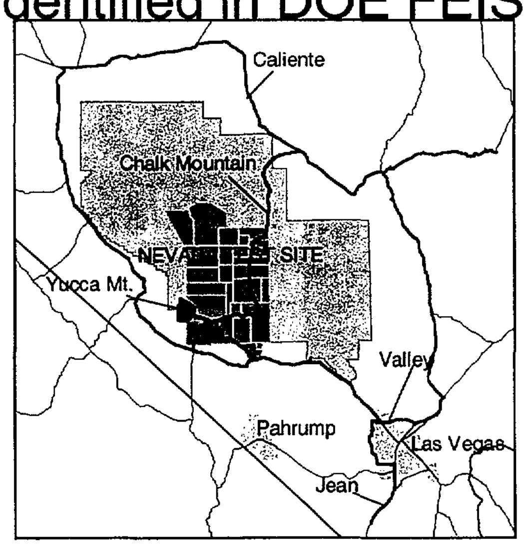
Southern Crescent Valley
(Carlin Rail Route)



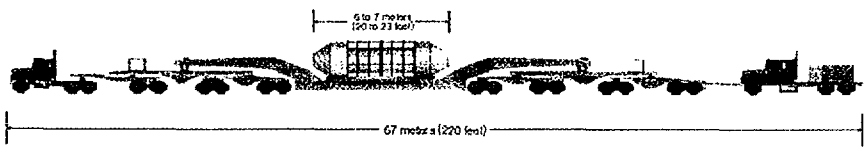
Rail Access Feasibility Issues

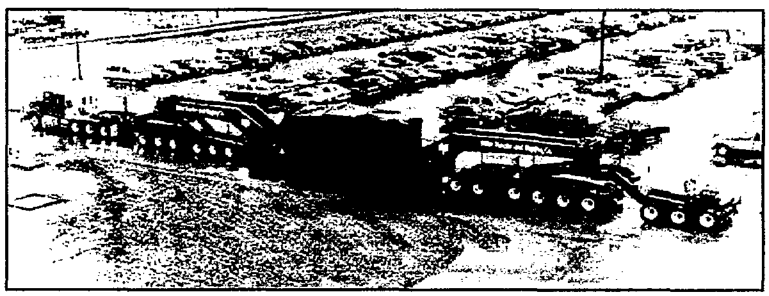
- Known land use conflicts: all 5 FEIS rail corridors
- U.S. Air Force opposition to Chalk Mountain
- Caliente or Carlin options would be longest new rail construction in US since 1930s
- Significant terrain and environmental challenges on Caliente and Carlin routes
- Potential Native American cultural resource issues
- Construction cost could exceed $1 Billion

Nevada Heavy Haul Truck Routes Identified in DOE FEIS



Heavy Haul Truck Rig for Use With Yucca Mountain Shipments





Nevada Heavy Haul Truck Feasibility Issues

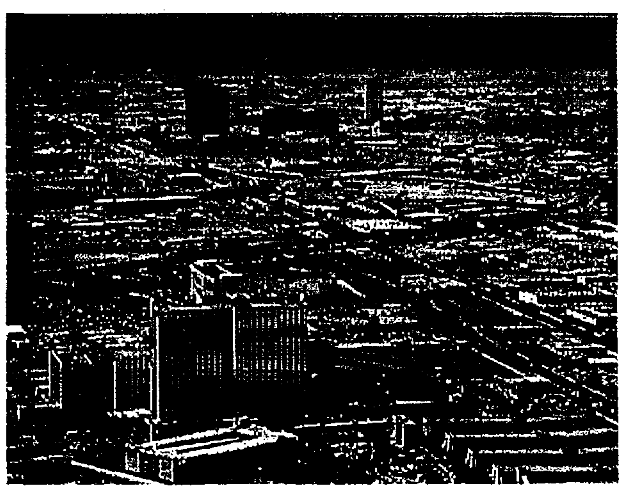
- Permit requirements
- Travel restrictions
- Unprecedented HHT shipment frequency & distances
- Route options: Las Vegas versus mountain passes
- Safety issues (traffic flow impacts, safe passing distances)
- Routine radiation exposures (Goldfield, Beatty)
- Cost versus Rail & Legal-Weight Truck

Potential Rail Shipments Through Las Vegas

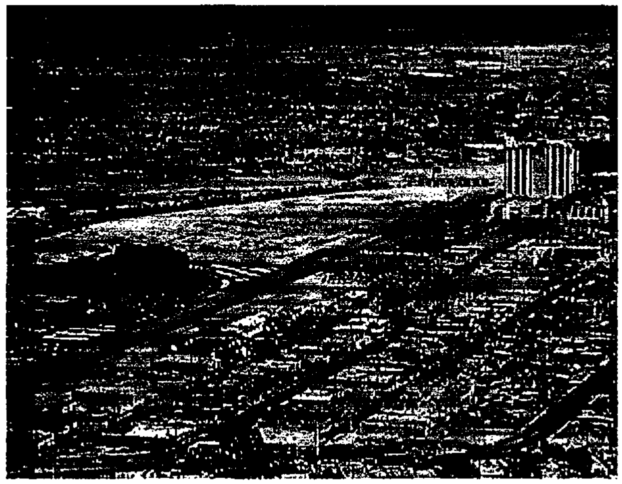
- 4 of 5 Rail access options identified by DOE would route Yucca Mountain shipments through downtown Las Vegas
- All 3 intermodal transfer options identified by DOE would route Yucca Mountain shipments through downtown Las Vegas
- Up to 85 percent of all rail shipments to Yucca Mountain would use the UP mainline through downtown Las Vegas

Union Pacific RR – Las Vegas

(Looking West from Stratosphere)



Union Pacific RR – Las Vegas
(Looking East from Stratosphere)



Las Vegas Population within ½ Mile of Union Pacific Railroad

Route Segment Data	Union Pacific Mainline through Las Vegas
Corridor Length (miles)	35.74
2000 Resident Population	39,291
Total Employment	83,976
Est. Avg. Daily Hotel/Casino Guests	18,032
Est. Avg. Daily Hotel/Casino Guests	18,032
School Population	597
Est. Avg. Daily Exposed Population	85,912

Rail Access Summary

- Direct rail access to national rail network is highly desirable for repository site
- Yucca Mountain site lacks rail access
- DOE has not demonstrated feasibility of any of the 5 rail access options identified in the FEIS
- Alternative to rail spur, HHT delivery from intermodal transfer station, probably not feasible
- Rail shipments through downtown Las Vegas will be a major issue in any future DOE transportation planning activities

U.S. Commercial SNF Shipment Experience (1964 –2001)

- Amount Shipped: 2,457 MTU (65 MTU per year)
- Truck Shipments: 2,396 (63 per year)
- Rail Shipments: 326 (9 per year)
- Rail Cask-Shipments: 479 (13 per year)
- Truck Share of Shipments: 88%
- Rail Share of MTU: 64%
- Average Truck Distance: 748 miles
- Average Rail Distance: 454 miles

Source: Halstead & Dilger, "How Many Did You Say? Historical and Projected Spent Nuclear Fuel Shipments in the United States, 1964-2048," Waste Management'03 Conference, February 25, 2003, Tucson, AZ

Potential Shipments- DOE Mostly Truck Scenario

109,000 Cask-Shipments over 38 Years (2010-2048)

- 108,544 Legal-Weight Truck (LWT) Shipments
- 355 Rail Shipments (Naval SNF)
- 2,866 Shipments per Year (7.9/day)
- 105,000 MTU Civilian SNF
- 15,000 MTU Equivalent Defense HLW, DOE SNF, Naval SNF, Civilian HLW

Source: DOE/EIS-0250, February, 2002, Table J-1

Factors Favoring LWT Transportation to Yucca Mountain

- All existing reactors and DOE sites can ship by legal-weight truck (LWT); 25-32 sites will have difficulty shipping by rail
- DOE repository thermal loading strategy may requirement LWT shipment of 5 year-cooled SNF
- Utilities may exercise contract options to ship 5 year-cooled SNF by LWT rather than older SNF by rail
- Current DOE privatization plan does not require transportation service providers to maximize use of rail
- LWT is cost-competitive with rail

Potential Shipments- DOE Mostly Rail Scenario

22,000 Cask-Shipments over 38 Years (2010-2048)

- 18,935 Rail Cask-Shipments
- 3,122 Legal-Weight Truck (LWT) Shipments
- 498 Rail Cask-Shipments per Year (1.4/day)
- 82 LWT shipments per Year (1.6/week)
- Requires an additional 3,004 Barge and 1,061 HHT Shipments from 24 reactors lacking rail access
- Could require an additional 18,935 HHT shipments in Nevada if no rail spur constructed

Source: DOE/EIS-0250, February, 2002, Table J-1

Potential Shipments- NV Current Capabilities Scenario

42,000 Cask-Shipments over 38 Years (2010-2048)

- 27,435 Legal-Weight Truck (LWT) Shipments from 25 reactor sites (35% of Civilian SNF total)
- 14,886 Rail Cask-Shipments from 52 reactor and DOE sites (65% of Civilian SNF total)
- 721 LWT shipments per Year (2.0/day)
- 392 Rail Cask-Shipments per Year (1.1/day)

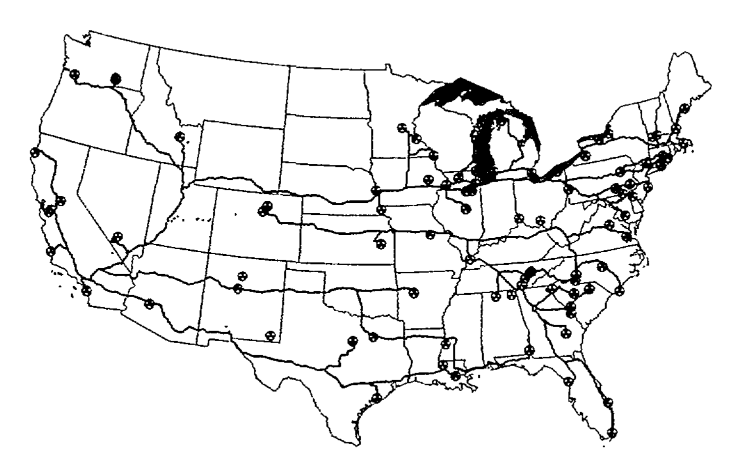
Source: Halstead, May 22, 2002, based on DOE/EIS-0250, February, 2002, Tables J-1, J-2, J-4, & J-5

Yucca Mountain Shipments Compared to Past Shipments

- 43 Times More SNF Shipped Per Year
- 8 to 38 Times More Casks Shipped Per Year
- 5 to 40 Times More Shipments Per Year
- 443% Increase In Average Rail Shipment Distance
- 280% Increase In Average Truck Shipment Distance
- Western Route Characteristics and Operating Conditions
- Potential Unprecedented Reliance on Heavy Haul Truck and Barge Shipments

Source: Halstead & Dilger, "How Many Did You Say? Historical and Projected Spent Nuclear Fuel Shipments in the United States, 1964-2048," Waste Management'03 Conference, February 25, 2003, Tucson, AZ

Most Likely Highway Routes to Yucca Mountain



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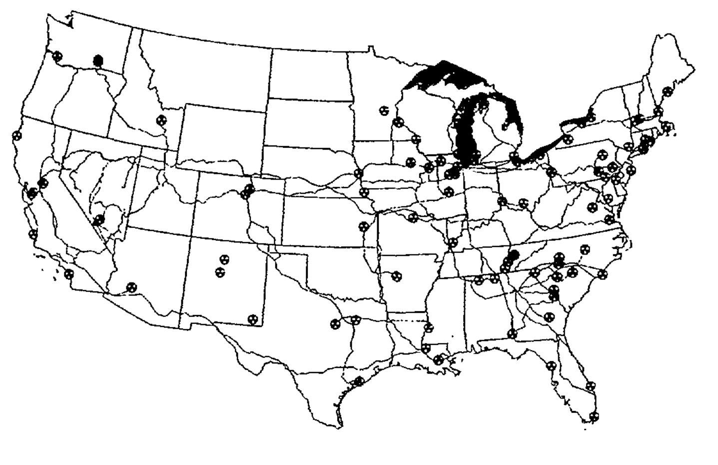
Most Likely Rail Routes to Yucca Mountain



Affected Jurisdictions & Populations Along Yucca Mountain Routes

- Truck and rail routes could traverse 45 states, 700 counties, and 50 Indian Reservations
- More than 120 million people live in counties traversed by truck routes
- More than 100 million people live in counties traversed by rail routes
- More than 11 million people live within one-half mile (800 meters) of a potential highway route

Source: Dilger & Halstead, Many Roads to Travel, WM'03, February 2003

Radiological Characteristics of Spent Nuclear Fuel

(DOE/NE-007, 1980)

SNF Age (Years)	Activity (Curies)	Surface Dose Rate (Rem/Hr)	Lethal Exposure (Time)
1	2,500,0000	234,000	10 sec.
5	600,000	46,800	1 min.
10	400,000	23,400	2 min.
50	100,000	8,640	4 min.

Shipping Cask Inventories

- The representative truck cask (GA-4) loaded with 23-year cooled PWR SNF contains a radionuclide inventory of 355,000 curies total activity, including 136,000 curies of Cesium-137 (for 10-year cooled SNF, total inventory is 846,000 curies, including 177,000 curies of Cesium-137)
- The representative large (26 PWR) rail transport-only cask loaded with 23-year cooled PWR SNF contains a radionuclide inventory of 2,100,000 curies, including 816,000 curies of Cesium-137
- Casks loaded with HLW, DOE SNF, and Naval SNF also contain large radionuclide inventories dominated by Cesium-137 (27,000-450,000 curies)

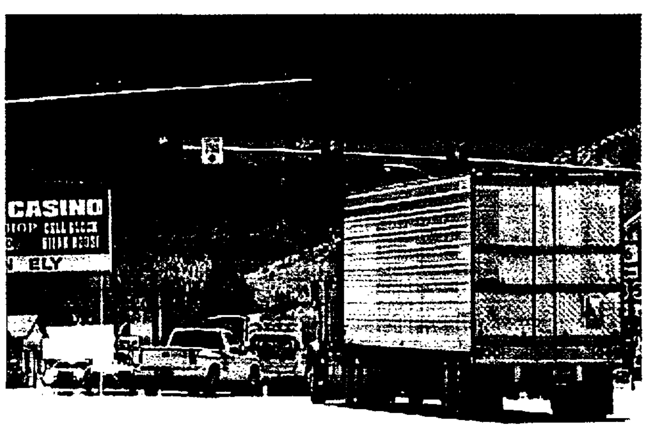
Source: DOE FEIS, Table J-12

Routine Radiation Exposures

- Exposure rate 10 mrem/hour at 2 meters from cask
- Exposure to truck safety inspectors: 2,000-8,000 mrem/year (Potential for 200 rem over 24 years)
- Exposure to occupants of vehicle next to SNF truck cask in traffic gridlock (1 - 4 hours): 10 - 40 mrem per person per incident
- Exposure to service station attendant (maximally exposed member of public): 100-1,000 mrem/year
- Exposures at commercial and residential locations along potential routes in Nevada: 30 - 200 mrem/year

Source: Collins, Gathers, and Halstead, HPS 47th Mtg, July, 2002

Ely, NV – Potential Route



Goldfield, NV – Potential Route

Expected Transportation Accidents and Incidents

- DOE Mostly Truck National Scenario, 38 Years
- 159 Truck Accidents
- 2,391 Truck Regulatory Incidents
- DOE Mostly Rail National Scenario, 38 Years
- 384 Rail/ 6 Truck Accidents
- 767 Rail/ 91 Truck Regulatory Incidents
- Nevada Current Capabilities National Scenario, 38 Years
- 291 Rail/ 46 Truck Accidents
- 581 Rail/ 691 Truck Regulatory Incidents

Source: Halstead Testimony, 5/22/02

Consequences of Rail Accident – DOE Estimates

Maximum reasonably foreseeable rail accident in urban area

Draft EIS (July 1999), Table 6-12

- Probability 1.4 in 10 million)
- Population dose (person-rem): 61,000
- Latent cancer fatalities: 31

Final EIS (February 2002), Table 6-15

- Probability 2.8 in 10 million
- Population dose (person-rem): 9,900
- Latent cancer fatalities: 5

Consequences of Rail Accident- Nevada Estimate

Nevada-sponsored study of rail accident similar to July 2001 Baltimore Tunnel Fire (equal to engulfing fire, 800°C, 7-12 hours)

- Radioactive Release: 73,000 curies Cs-134 & Cs-137 (respirable aerosol)
- Contaminated Area: 32 square miles
- Latent cancer fatalities: 4,000-28,000 over 50 years (200-1,400 during first year)
- Cleanup cost (2001$): $13.7 Billion

Source: RWMA, 9/15/01

Consequences of Successful Terrorist Attack

Successful attack on truck cask in urban area using high-energy explosive device (90% penetration)

- DOE estimated impacts [FEIS, Pp. 6-50 to 6-52]
- Latent cancer fatalities: 48
- Nevada estimated impacts [RWMA, 4/15/02]
- Latent cancer fatalities: 300 – 1,800
- Economic cost (2000$): More than $10 Billion

Nevada Recommendations Comprehensive Risk Management

- Comprehensive risk assessment (CRA) should cover all transportation system phases, events, and consequences (Golding and White, 1990)
- CRA calculates probabilities only where existing data, theories, and models are sufficient to support use of rigorous quantitative methods, and uses sensitivity analysis to illustrate impact of differing assumptions and variations in quality of data
- CRA should be used as working risk management tool throughout life of project, with ongoing public participation
- CRA should be basis of risk communication throughout life of the project

Nevada Recommendations
Preferred Transportation System

- Dual purpose casks for at-reactor storage and transport
- Ship oldest fuel first (at least 20 years at-reactor cooling)
- Maximum use of rail (mode of choice)
- Mandatory use of dedicated trains, special safety protocols, and special car designs as recommended by AAR
- Early DOE and carrier identification of preferred cross-country mainline routes in consultation with stakeholders
- Early involvement of corridor states and Indian Tribes, including financial assistance under Section 180(c)

Nevada Recommendations
Full-Scale Physical Testing of Casks

- Meaningful stakeholder role in development of testing protocols & selection of test facilities and personnel
- Full-scale physical testing (sequential drop, puncture, fire, and immersion) prior to NRC certification
- Additional testing (casks, components, models) and computer simulations to determine performance in extra-regulatory accidents and to determine failure thresholds
- Reevaluate Modal Study findings , and if appropriate, revise NRC cask performance standards
- Evaluate costs and benefits of destructive testing of a randomly-selected production model cask

Nevada Recommendations
Accident Prevention & Emergency Response

- Maximize use of regional organizations such as Western Governors Association (WGA) and Western Interstate Energy Board (WIEB) for planning, implementation, and program evaluation
- Coordinate with Indian Tribes and local governments
- Develop comprehensive safety program modeled after WGA-State-DOE WIPP Transportation Program
- Adopt WIEB Sept.,1994 proposal for evaluation and final designation of preferred shipping routes
- Implement Section 180(c) Financial Assistance to State, local, & tribal governments through rulemaking
- Revise DOE Plan for Privatization of Transportation Services to emphasize safety and public acceptance

Baltimore Tunnel Fire

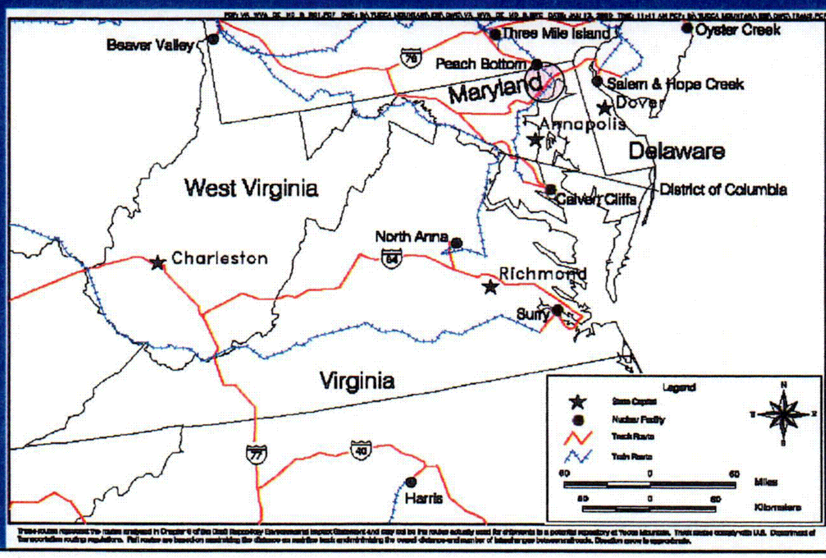
Advisory Committee on Nuclear Waste
April 22, 2003

Presentation by
Marvin Resnikoff, Ph.D.
Radioactive Waste Management Associates
On behalf of the
State of Nevada

Why investigate the Baltimore Tunnel Rail Fire ?

- Fire appeared to exceed cask design specs
- Calvert Cliffs reactor would use CSX tracks
- What are the implications for cask design, accident probability estimates, emergency preparedness and environmental impact?

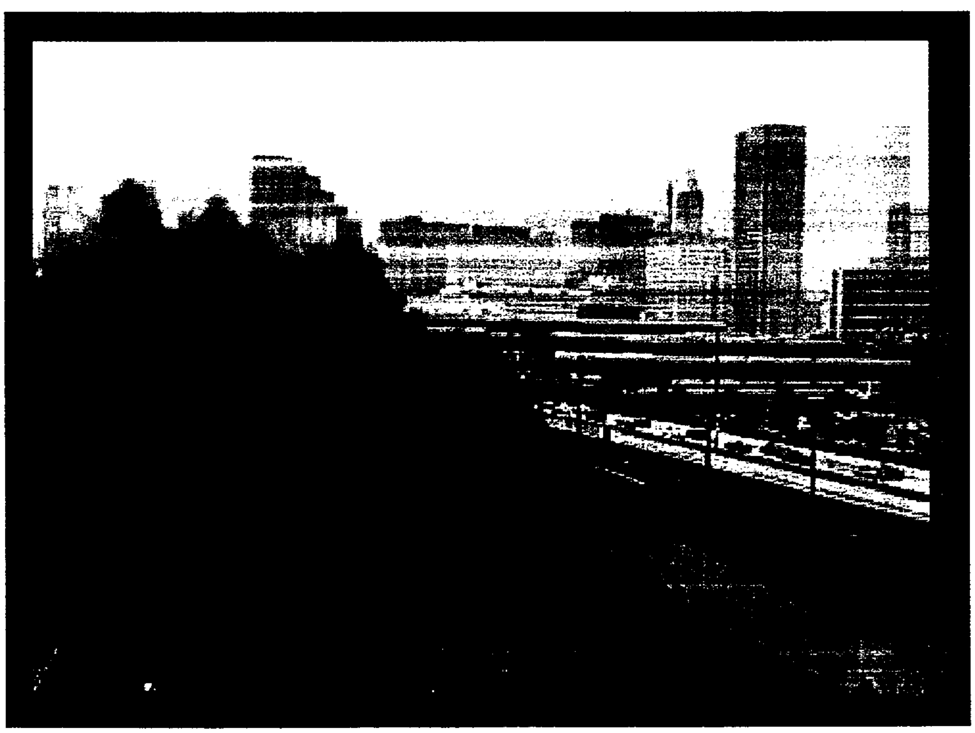
DOE's Proposed Routes to Yucca Mountain



Chronology

- 7/18, 3:04 PM, train 100 yards south of tunnel entrance, traveling 23 mph
- 3:07 PM, emergency brakes activated, train in tunnel, 0.5 miles from northern end, black fumes fill tunnel
- 3:15 PM, train crew uncouples engines, drives out of north end, phones dispatcher
- 3:25 PM, black smoke pouring out of tunnel, crew reaches dispatcher
- 4:15 PM, fire department receives notification, cannot enter tunnel

C04
40



- 5-6 PM, Coast Guard closes Inner Harbor, fans evacuated from Camden Yards ballpark, roads closed 1.3 miles within inner city, major highways closed, severe gridlock
- 6:15 PM, water main breaks, power failure
- 10 PM firefighters enter tunnel through south end
- 7/19, workers begin removing cars from tunnel, car containing tripropylene and burning cars remain
- 7/21, 4 PM, empty tripropylene tanker removed

Steel Temperatures

- 1000 °F, dark red color
- 1500 °F, newspaper report
- → 1650 °F, orange
- 1825 °F, yellow
- 2200 °F, white

C05
42

NIST Findings

- Peak calculated temperature 1800 °F within the flaming region for 1st 3 hours
- Wall surface temperature reached about 1500 °F
- Steel temperatures of rail cars expected to be similar to gas temperatures

Regulatory Tests

30 foot drop onto essentially unyielding surface

40 inch drop onto 6 inch steel spike

30-minute fire @ 1475°F

8-hour submersion of undamaged cask under 50 feet of water

Source: Sandia National Laboratories

C06
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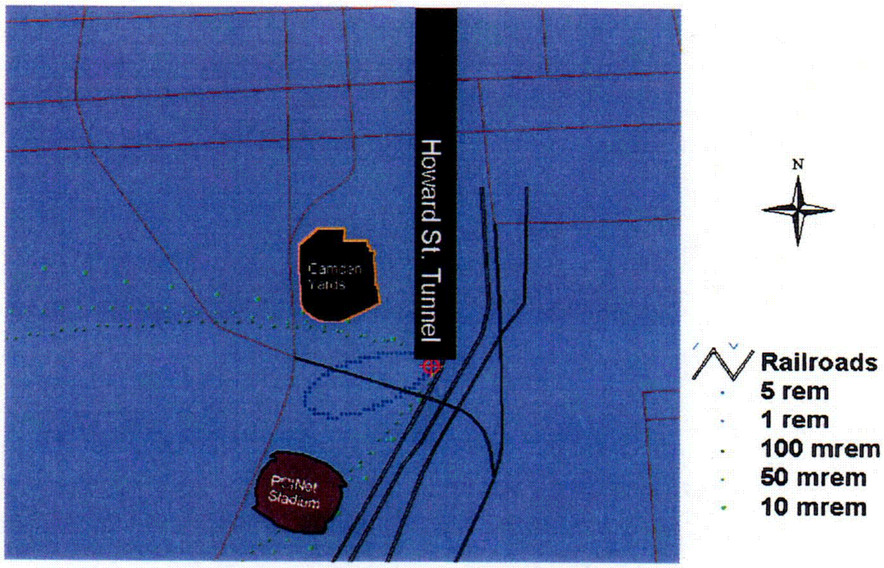
Figure 7:
Close-Up View: Camden Yards and PCINet Stadium



Implications

- cask design (time, temperature of regulatory fire)
- accident probability estimates (is this a one in a million year accident?)
- emergency preparedness (how do local governments prepare for a severe accident?)
- environmental impact (dose to the public and emergency personnel)

COT
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Safety Implications of the Baltimore Tunnel Fire

Advisory Committee on Nuclear Waste
April 22, 2003

Presentation by
Marvin Resnikoff, Ph.D.
Radioactive Waste Management Associates
On behalf of the
State of Nevada

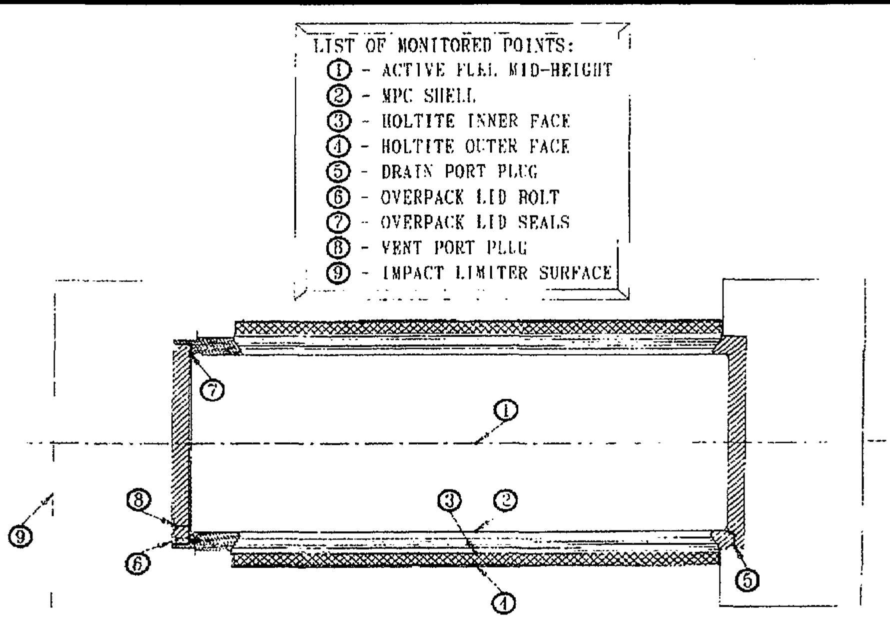
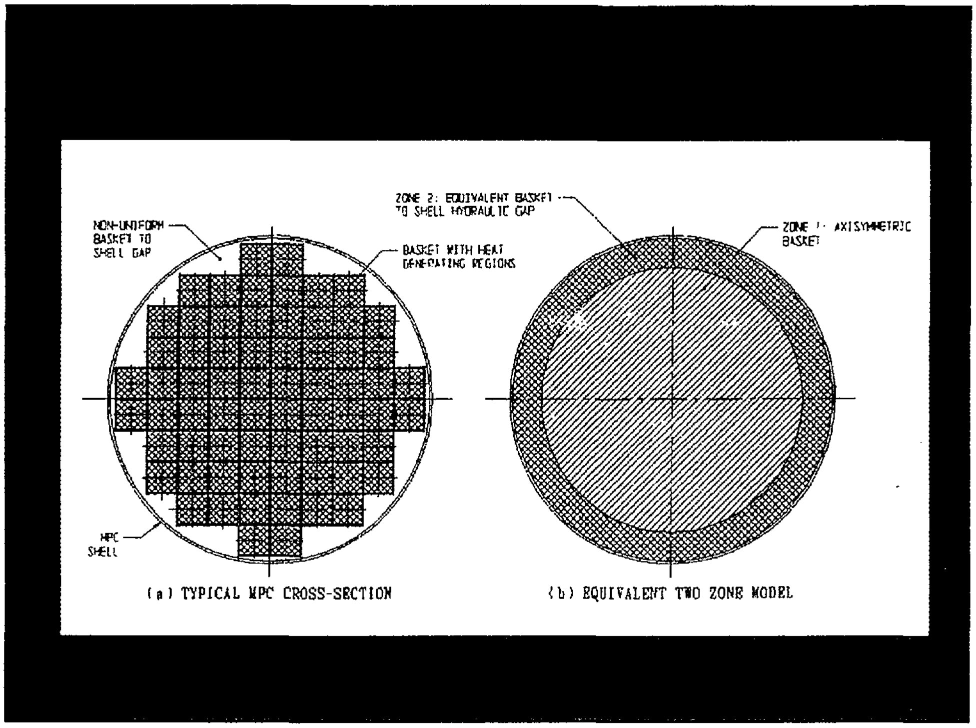


FIGURE 3.5.1; LOCATION OF HI-STAR 100 PACKAGE CONTROL POINTS MONITORED DURING HYPOTHETICAL FIRE ACCIDENT CONDITION



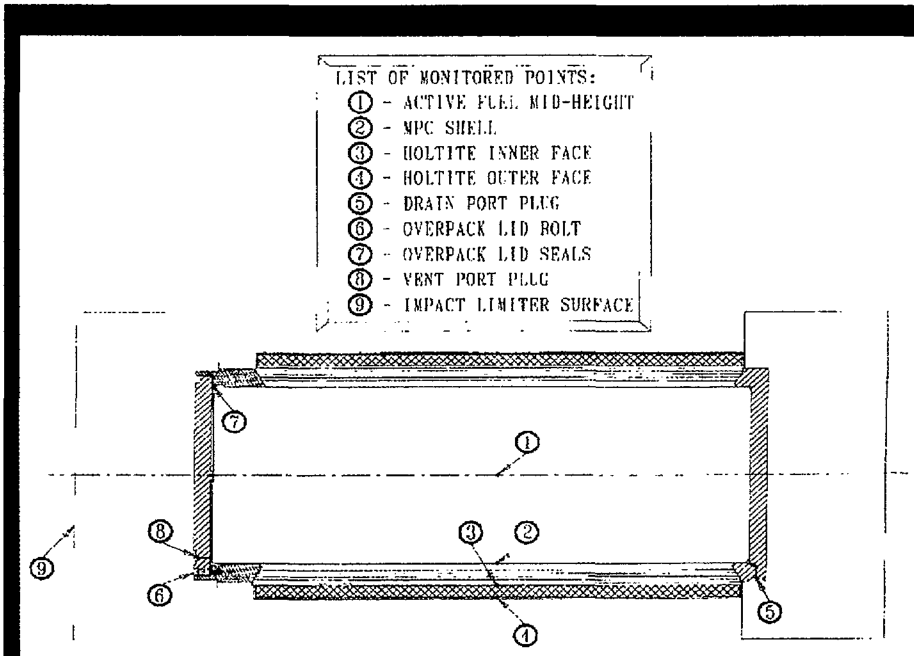
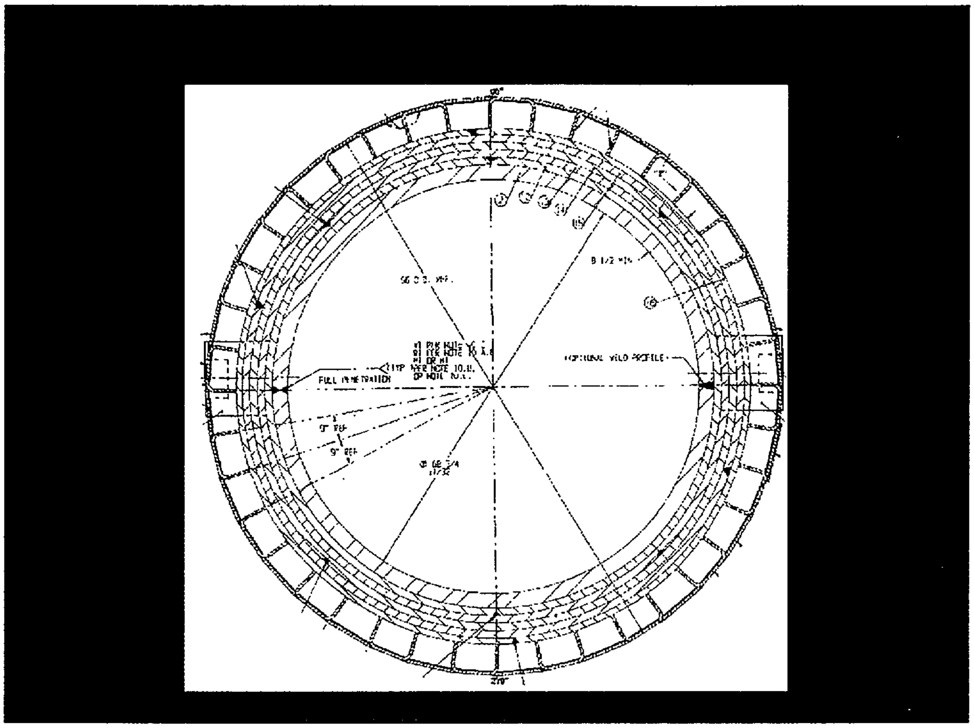
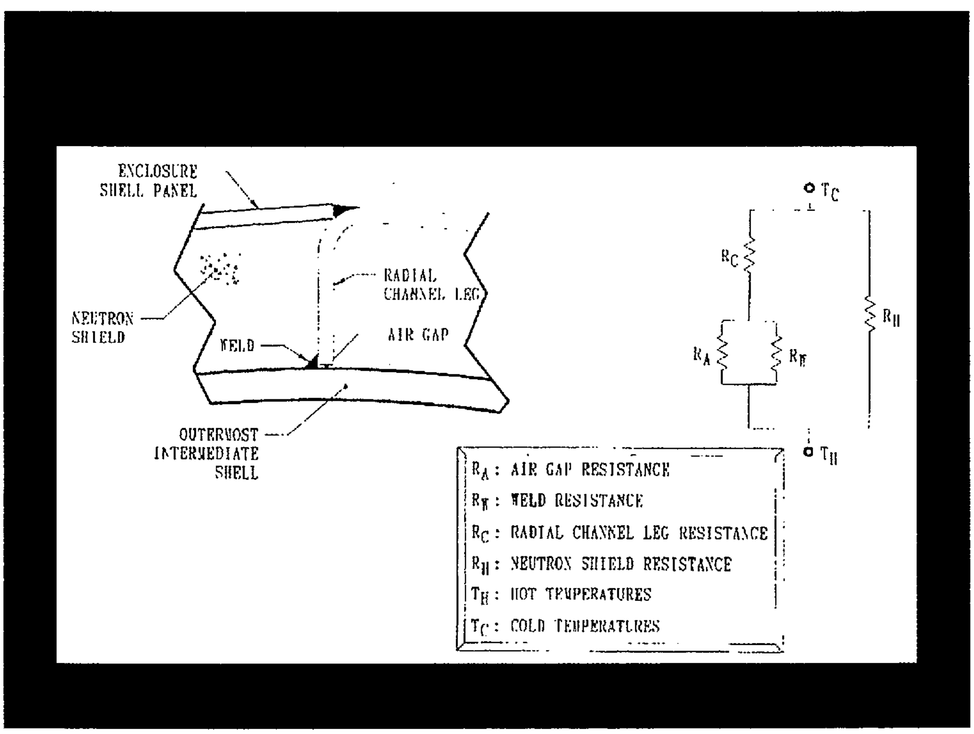
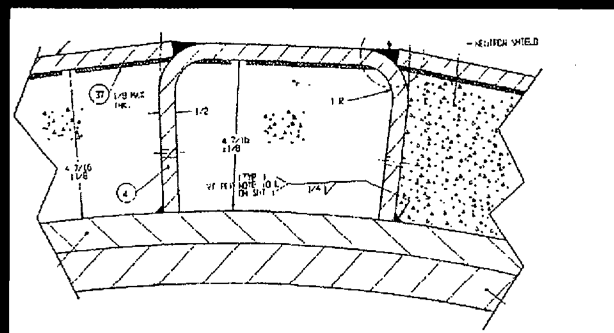


FIGURE 3.5.1; LOCATION OF HI-STAR 100 PACKAGE CONTROL POINTS MONITORED DURING HYPOTHETICAL FIRE ACCIDENT CONDITION




ENCLOSURE
SHELL PANEL
NEUTRON
SHIELD
WELD
RADIAL
CHANNEL LEG
AIR GAP
OUTERMOST
INTERMEDIATE
SHELL
T_C
T_H
R_C
R_A
R_W
R_H
R_A : AIR GAP RESISTANCE
R_W : WELD RESISTANCE
R_C : RADIAL CHANNEL LEG RESISTANCE
R_H : NEUTRON SHIELD RESISTANCE
T_H : HOT TEMPERATURES
T_C : COLD TEMPERATURES



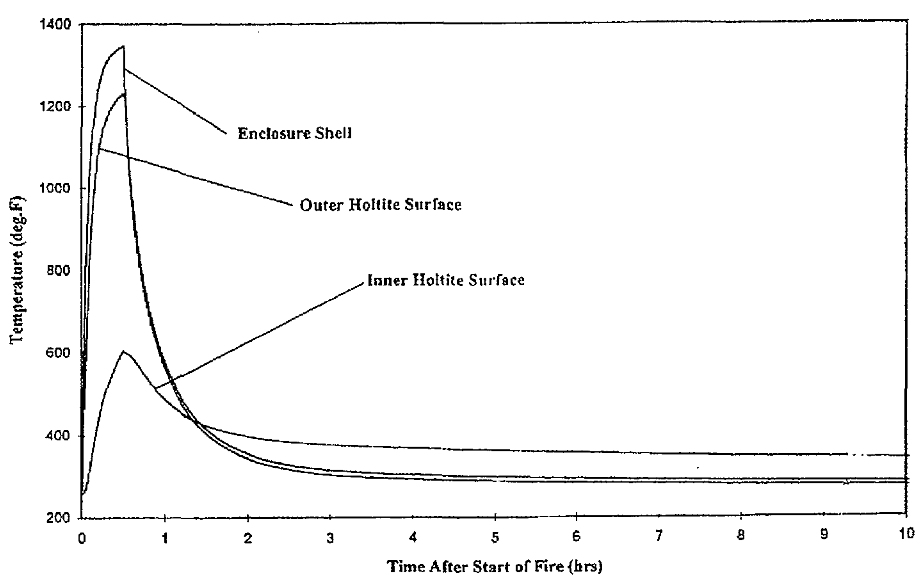


FIGURE 3.5.3; HI-STAR 100 PACKAGE NEUTRON SHIELDING REGION FIRE ACCIDENT TRANSIENT TEMPERATURE RESPONSE

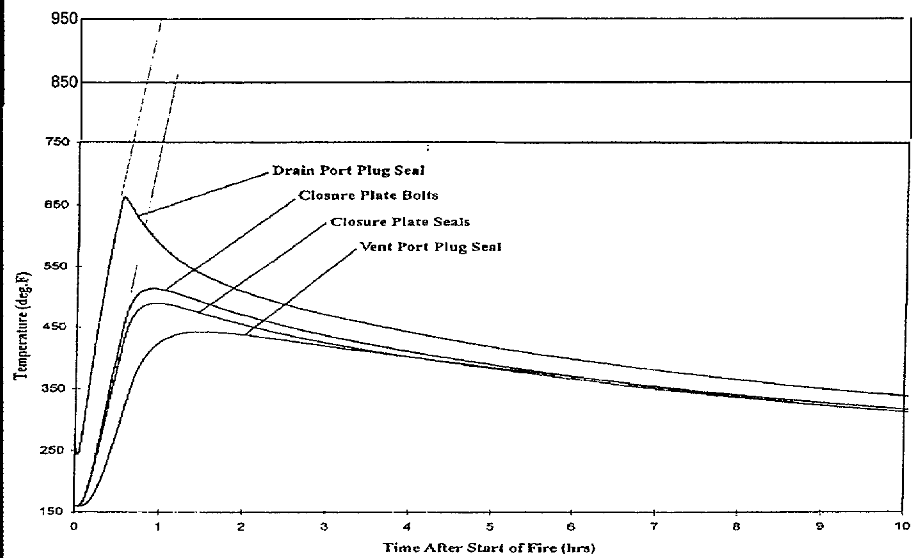


FIGURE 3.5.2; HI-STAR 100 PACKAGE CONTAINMENT BOUNDARY COMPONENTS FIRE ACCIDENT TRANSIENT TEMPERATURE RESPONSE

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Nevada Proposal for Full-Scale Regulatory Testing of Shipping Casks, & Testing to Failure

Robert J. Halstead
State of Nevada Agency for Nuclear Projects
Fred Dilger
Clark County Nuclear Waste Division
Presentation to
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Rockville, MD
April 22, 2003

Cask Testing Issues

- Absence of Cask Testing Requirements
- Advantages of Full-Scale Testing
- Nevada Proposal for Regulatory Testing
- Proposal for Extra-regulatory Testing
- Further Development of Proposal

Absence of Cask Testing Requirements

- NRC does not require physical testing
- 16 shipping cask designs currently certified
- No currently certified US cask has been tested full-scale to demonstrate compliance with 10CFR71(drop, puncture, fire, immersion)
- 2 truck cask designs drop-tested using half-scale models (TN-8 & GA-4)
- 3 rail cask designs drop-tested using 1/3- or 1/4-scale models (125-B, NAC-STC, TN-68)
- Scale-model impact limiter tests (9 casks)

Advantages of Full-Scale Testing – 1

(S.E.Gianoulakis, SNL, 1993)

- Single cask can be sequentially subjected to all normal and accident conditions defined by regulations; directly demonstrate compliance
- Clear characterization of package behavior and opportunities for design refinement (also achievable through half-scale model testing)
- Package closure and seal response can be directly measured; results represent actual package containment system response

Advantages of Full-Scale Testing – 2

(S.E.Gianoulakis, SNL, 1993)

- Allows early evaluation and monitoring of fabrication process
- Allows early operational testing
- Direct measurements (acceleration and surface deformation) eliminate need for scaling relationships
- Visual evidence (photos and videos) for system analyses and public demonstration
- Major disadvantage: Cost of fabrication and testing

Nevada Proposal for Regulatory Testing

- Meaningful stakeholder role in development of testing protocols & selection of test facilities and personnel
- Full-scale physical testing (sequential drop, puncture, fire, and immersion) prior to NRC certification or DOE procurement
- Additional testing (casks, components, models) and computer simulations to determine performance in extra-regulatory accidents and to determine failure thresholds
- Reevaluate Modal Study findings, and if appropriate, revise NRC cask performance standards
- Evaluate costs and benefits of destructive testing of a randomly-selected production model cask

Focus on Casks To Be Used for Yucca Mountain Shipments

- 5 currently-certified casks likely to be used
- These casks likely represent vast majority (perhaps 95% or more) of future SNF and HLW shipments, including PFS
- Directly address concerns regarding new (proposed) casks: new design configurations, new materials, larger payloads
- Demonstrate regulatory compliance & benchmark codes
- Appropriate use of Waste Fund
- Testing requirement could be implemented through NRC or DOT regulation, DOE program decision, or Congressional mandate

Extra-regulatory Tests Should Focus on Full-Scale Fire Tests

- Long-duration, high-temperature fires represent most severe accident environments evaluated by DOE and Nevada
- Real world fires could potentially result in significant release of radioactive materials (average SNF rail cask contains 816,000 curies Cs-137)
- There is little physical data on actual cask performance in severe fire environments
- Full-scale fire testing reduces uncertainties
- Determine failure thresholds and benchmark codes

Fire Test Options Under Consideration

- Undamaged cask in regulatory fire (800°C) for extended time period to replicate specific accident (e.g., 3-12 hours, per Howard Street Tunnel fire)
- Undamaged cask in regulatory fire (800°C) until fuel cladding temperature reaches containment limit (740°C)
- Undamaged cask in extra-regulatory fire (e.g., 1,000°C) for extended time period (e.g., 3 hours), or until fuel cladding temperature reaches containment limit (740°C)
- Damaged cask (9m drop) in regulatory fire (800°C) for extended time period based on predicted failure
- Damaged cask (per PPS) in regulatory fire (800°C) for extended time period based on predicted failure

Preliminary Cost Estimate for Nevada Cask Testing Proposal (2003 Dollars)

- Regulatory Testing of First Legal-Weight Truck Cask: $7.8-8.4 Million
- Regulatory Testing of First Rail Cask: $19.1-22.0 Million
- Assume one-time cost of $10 Million to upgrade test facility to drop 130 ton cask
- Regulatory testing of 5 casks, plus two extra-regulatory fire tests: $45-75 Million

Key Issues To Be Resolved

- Development of protocols for full-scale regulatory (sequential) tests
- Definition of cask (and SNF) failure
- Development of protocols for full-scale extra-regulatory fire tests
- Evaluation of options for extra-regulatory impact tests (full-scale, scale model, component)
- Evaluation of need for other extra-regulatory tests (puncture, deep immersion, crush)
- Validate cost and schedule estimates

Schedule for Nevada Proposal

- Nevada has assembled review team to prepare comments on PPS Draft Protocols
- Nevada comments on PPS Draft Protocols (Due 5/30/03) will provide additional details of Nevada testing proposal
- Nevada preparing work plan and budget for development of detailed proposal
- Draft proposal target date: December 2003

Full-Scale Cask Testing:
Past Experience, Lessons Learned, & Preliminary Assessment of NUREG-1768

Robert J. Halstead
State of Nevada Agency for Nuclear Projects
Presentation to
Advisory Committee on Nuclear Waste
U.S. Nuclear Regulatory Commission
Rockville, MD
April 22, 2003

Past Experience with Full-Scale Cask Testing

- SNF Shipping Cask Crash and Fire Test Program, Sandia National Laboratories, 1977-1978
- Magnox Cask Regulatory and Demonstration Test Program, CEGB, United Kingdom, 1983-1984
- Nupac 125B Quarter-scale Cask and Full-scale Canister Test Program, 1984-1985
- TRUPACT-II Test Program, Sandia National Laboratories, 1988-1989

Lessons Learned

- Costs
- Benchmarking of Codes
- Regulatory Compliance
- Licensing Time
- Public Acceptance
- Safety Enhancements

Spent Fuel Testing Issues

- PPS failure to integrate cask and fuel testing plans (plans not included in NUREG-1768)
- Gap inventory of Cs-137
- Rod & pellet temperature and impact limits (burst rupture)
- Size distribution of released particles
- Behavior of Cs-137, Sr-90, & CRUD in severe impacts and fires
- Implications of higher burn up

General Concerns Regarding PPS & NUREG-1768

- Extent of future stakeholder participation
- Selection of casks to be tested
- Selection of test scenarios
- Selection of cask testing facilities
- Program cost & availability of funding
- Commitment to carry out testing program

Selected Preliminary Concerns with NUREG-1768

- Absence of modeling to predict failure thresholds (performance envelope analysis)
- Prioritization of impact testing versus fire, and absence of specific fire test durations
- Use of impact limiters
- Test instrumentation
- Probabilistic Metric (Pp. A-2 to A-3)