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BRIEFING ON REQUIREMENTS FOR STORAGE AND

TRANSPORTATION .CASKS

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PUBLIC MEETING

Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

Thursday, September 30, 1993

The Commission met in open session, pursuant to notice, at 2:00 p.m., Forrest J. Remick, Commissioner, presiding.

COMMISSIONERS PRESENT:

KENNETH C. ROGERS, Commissioner
FORREST J. REMICK, Commissioner
E. GAIL de PLANQUE, Commissioner

STAFF SEATED AT THE COMMISSION TABLE:

SAMUEL J. CHILK, Secretary

C. WILLIAM REAMER, Office of the General Counsel

HUGH THOMPSON, Deputy Executive Director, NMSS and Op. Support

ROBERT BERNERO, Director, NMSS

CARL PAPERIELLO, Director, Division of Industrial & Medical Nuclear Safety

CHARLES HAUGHNEY, Chief, Source Containment and Devices Branch, NMSS

MARGARET LUSARDI, Transportation Branch, NMSS

P-R-O-C-E-E-D-I-N-G-S

2:00 p.m.

COMMISSIONER REMICK: Good afternoon, ladies and gentlemen.

The Commission is meeting today to receive a briefing by the staff on the NRC's regulatory requirements for certifying a spent fuel cask for storage and for transportation, including some of the technical issues that arise when reviewing a cask designed for both functions. It's also my understanding that the staff will address the so-called multipurpose canister, one that is intended to serve three functions, storage, transportation and disposal of spent fuel.

This is a subject that will become increasingly important during the next several years and one that the Commission is keenly interested in. It's a subject that crosses the boundaries of many activities that the NRC regulates, from reactors and independent spent fuel storage installations to monitored retrieval storage facilities in high level waste geologic repositories.

Well engineered and designed casks for storage, transportation and disposal of spent fuel is an important consideration for assuring the public's health and safety during the operation and decommissioning of these facilities.

It's my understanding that copies of SECY-93-265 and the staff's viewgraphs to be used in today's briefing are available at the entrances to the conference room.

Do any of the other Commissioners wish to make a comment?

If not, Mr. Thompson.

MR. THOMPSON: Thank you, Commissioner Remick.

Today's briefing will be kind of done in two parts, one a kind of an overall systematic review and then some specifics with respect to the casks themselves. Bob Bernero will do the overview of the systematic approach.

One of the agencies that we obviously have a significant interface with in the area of transportation is the Department of Transportation. In fact, today we have representatives of the Department of Transportation in the audience, and in particular Allen Roberts, who is the Associate Administrator for Hazardous Material Safety is here and we've worked very well with the Department of Transportation over the years and we continue to interface with them very frequently.

COMMISSIONER REMICK: We welcome them.

MR. THOMPSON: Okay. Bob?

MR. BERNERO: (Slide) May I have the purpose slide, please?

The purpose of this briefing is, as you said, Mr. Chairman, to focus on the storage and transport casks and to get into this newly arrived multipurpose canister. When Charlie does the detailed briefing, he will indeed focus on storage and transport because that's where we have reviewed, that's where we have approved, that's where we have been working on dual purpose machinery, that is storage and transport but not disposal. And, of course, it's at the center of some of the activities now that go with the storage, the transport and disposal, the multipurpose cask.

So, if we're going to talk about this stuff, I think it's useful to get a bit of a system overview and our focus is on spent fuel. Whenever we talk about high level waste transport, most of us are talking about spent fuel, even though that is not all the spent fuel. I've got on the projection, for those who haven't seen one, a spent fuel assembly. That, of course, looks like a new fuel assembly, but when they're old they're black or sort of reddish brown.

(Slide) But the key here is this is a bundle of dimensions suited to some particular reactor, a bundle of metal tubes full of uranium oxide. Now, if you maintain your focus on LWR fuel assemblies -- may I have that next slide, please -- it's quite a range. This appears in the handout.

If you look, the range covers PWRs and BWRs and there's an old rule of thumb that I like to use. If a container can contain a certain number of PWR assemblies, a fair estimate of how many BWR assemblies might fit in it is obtained by multiplying by 2.4. That's not an exact number, but it's a good approximation. If you look at this range, the things we're working on and the majority of the population are like a big light water reactor. They're going to be about 12 feet long and of corresponding boiling water or pressurized water reactor dimension. But there are notable outliers. If you look at the length in the PWR fuel, you see some of them go up to 16.6 feet. If you look at the length in BWR fuel, it goes down to 6.8. Now, containers that are certified for the bulk of the population may be suitable for the smaller fuel by putting spacers or some other apparatus. But those containers are not going to be able to handle the extra long fuel.

So, the Commission should recognize that the focus of work today and the focus of container approval reviews and so forth is on packages that will take care of the predominant or major population of fuel, but not all of it. Behind the spent fuel from commercial reactors, there's another whole population of high level waste, vitrified glass logs from the high level waste tanks on defense sites, the naval reactor fuel, things like that that sooner or later will have to be dealt with and then they will have to have suitable transport packages for the purpose.

(Slide) May I have the next slide, please?

The system then, again focusing on the commercial reactor industry, is we have the utility maintaining a system that is the reactor itself, the spent fuel pool of the reactor and possibly -- some reactors have them, most don't -- temporary storage facilities on site or adjacent to the site. Now, the spent fuel can go to and from or just simply to temporary storage. It can go directly to repository or to MRS. All of these things are possible.

DOE is managing right now under statute the repository, the MRS program if a site is obtained and so forth, and DOE has the statutory responsibility to develop the transport fleet. So, DOE is actively working on a body of transport casks that is suitable for some of these arrows. But when you look at it from a national point of view, a systems management perspective, this is where there is difficulty because no one agent has full control of the system. No one is right now optimizing the whole system to have an optimal set of packages, an optimal set of, for that matter, fuel dimensions and practices about local storage or remote storage. It's a real difficulty for the nation in that it does not have an overall system control.

But working within this framework, we are having a fair amount of success and now I'd like to turn it over to Charlie and ask him to take up the specific treatment of storage and transport.

COMMISSIONER REMICK: Bob, just one question. I assume it goes without saying that if we include non-power reactor fuel the range of sizes even becomes larger.

MR. BERNERO: Oh, the non-power reactor fuel is the kind of fuel I think would possibly fit if necessary in existing packages in mass transport.

COMMISSIONER REMICK: In the smaller --

MR. BERNERO: Because it's smaller. Because it's smaller. The real difficulty are those things that for one reason or another just don't have that kind of capability to fit what one might call a standard package.

COMMISSIONER REMICK: I see.

MR. BERNERO: Charlie?

MR. HAUGHNEY: Good afternoon.

What I'd like to try to do this afternoon is basically accomplish four things, talk about the regulatory framework that applies to storage and transport certification, then give you a brief summary of the approved casks that can be used for spent fuel storage or transport and talk a bit about the proposed casks that are in either the dual or multipurpose arena. We have several other single purpose casks that are in active application, but I'm not going to talk about those in particular.

Finally, I want to close with three technical issues that seem to receive a certain amount of outcry, either inside or outside the industry and I wanted to give you our perspective on those topics.

(Slide) So, the first slide is displayed and it talks really kind of about the principal safety functions that confront a reviewer of either a storage or transport cask. If you were to look at the safety analysis report or SER, you'd see that the bulk of the discussion was on those four topics there. They're of keen concern to us as we look at the design before we approve it.

(Slide) Now, could we have the next slide, Mike?

We have, of course, codified our requirements in two regulations, 10 CFR Part 71 for transportation package review and then 10 CFR Part 72 for the storage review. Part 72, incidentally, can also handle pool storage as well as dry storage and was used in the most recent license renewal for the one pool we have independently licensed, which is GE Morris, Illinois.

In any event, on transportation requirements -- incidentally, for both of these there's an appendix in the back of the handout that I won't go into that was the principal regulatory guides that support the rule. But at any rate, what I've tried to display here are the accident conditions that a transportation package suitable for handling spent fuel must be able to withstand. An interesting thing about this is the requirements include a sequence of tests and these could be either actual tests or pilot or calculations. But a sequence of test conditions, including a 30 foot drop onto a so-called unyielding surface, a 40 inch drop then into a pin, that's the puncture test, and finally the 30 minute fire at 1475 degrees.

The two immersion tests are conducted or can be conducted on a separate test package if actual testing is done.

COMMISSIONER REMICK: Are the immersion tests following the fire tests or independent of them?

MR. HAUGHNEY: Independent.

COMMISSIONER REMICK: Independent.

MR. HAUGHNEY: Okay. At any rate, the regulations then specify that after that test sequence the package still have enough integrity that it meets a leak rate criteria. That value A_2 shown on the slide is really meant to indicate a tabulation of isotope specific quantities that are in the rule and also correspond with international atomic energy requirements for the same value.

Basically, looking at the basic for that number, it's a bit old in terms of its derivation, but it was designed to look at an assumption that about 10^{-3} of the quantity would be released and then about 10^{-3} would be inhaled or ingested and would then produce a dose of about three rem to the individual. Now, as near as I can determine, this is about a 30 year old analysis and calculation. But nonetheless, it's the one that's been adopted internationally and still is in our regulation. I might also mention there is some consideration of updating those. But at any rate, it's an isotope-specific source term basis.

COMMISSIONER ROGERS: Just a question on that, Charlie. Does that really mean the full amount of material under the loaded cask could be released --

MR. HAUGHNEY: No, it's a 10^{-3} are released after the leak.

MR. THOMPSON: I think it's just a very small amount.

MR. HAUGHNEY: That's right.

COMMISSIONER ROGERS: Well, this A_2 though, A_2 in the regulations is a quantities of curies, right?

MR. HAUGHNEY: That's correct.

COMMISSIONER ROGERS: And this says, "may not exceed A_2 per week." Does that mean that full amount of curies could be released in a week?

MR. HAUGHNEY: Well, that's the leak rate.

COMMISSIONER ROGERS: Well --

MR. THOMPSON: I think the question is how many weeks are you going to let this --

MR. HAUGHNEY: Oh, how long can it go on? I don't know.

COMMISSIONER ROGERS: My question is should there be a coefficient in front of A_2 there of 10- something or other or is it the full amount could be released in a week? Any release may not exceed A_2 per week.

MR. EASTON: It is A_2 per week.

COMMISSIONER ROGERS: So, the full content then could be released in a week.

MR. THOMPSON: Do you want to identify yourself?

COMMISSIONER ROGERS: Yes. Could you just clarify that? I just didn't understand how to interpret that.

MR. EASTON: That is an A_2 quantity per week, but if you're talking about spent fuel, you're talking about 30,000 A_2s or something like that. An A_2 is a very small quantity. It's the dividing line between where you need an accident-resistant package and a non-accident resistant package based on health effects. If you have below an A_2 quantity in a package, you don't have to have an accident resistant package, the assumption that it's not that dangerous a situation. But when you're talking about spent fuel, it may be many, many, many thousands of A_2s.

COMMISSIONER ROGERS: Okay.

COMMISSIONER REMICK: Would you please identify yourself for the record?

MR. EASTON: Earl Easton. I'm in Charlie Haughney's branch, Transportation.

MR. HAUGHNEY: The last two bullets on that page show an external dose rate criteria and also the subcriticality must still be maintained, of course, after the accident.

So that's the accident design criteria for the transportation requirements.

(Slide) Next slide, please.

COMMISSIONER REMICK: What is typically used in the cask to assure the subcriticality? I assume they're poison material. What form is that in usually?

MR. HAUGHNEY: There may be poison material in the basket assembly for the spent fuel. It could be borated stainless steel. It could be that there is no particular intentional poison like that and that the geometry and the fuel array are such that subcriticality is maintained. I'm going to talk a little more about the criticality conditions and analysis a little later. We're expecting a new application that will have the intentional poisons installed.

At any rate, the storage rule. There's some differences in the basic underpinning of the storage rule. Here you'll have, after the initial fuel handling and loading, a very static condition for a very long time, as opposed to a transportation cask which could be either on the public highways or rail and experiencing structural jostling, as it were, as it moves over the transportation medium, whatever it's in. And those trips are relatively short as compared to the few number of decades or so that we may see the storage casks in use.

So, one of the first things you see are the considerations of site natural phenomenon which, in practice, we use the same site natural phenomena criteria for the reactor itself. If we had a separate siting consideration, we would use the same regulatory guides and analysis to come up with the site tornado and earthquake, flood and that sort of thing.

The fires and explosions that we look at tend to be site specific. We will look at, for instance, the fuel loading on the particular site. A good example of that is the Fort St. Vrain case where there's some natural gas well and pipelines sort of on the property around both the reactor and the spent fuel storage vault. We've had to consider those conditions.

Then, of course, we also look at transfer accidents in storage. They are typically less severe than for transport because the lifting heights are limited by mechanical stops or design features of the handling equipment. But because of the mass of the cask, these drops can induce rather high G loads. In fact, the drop and tip over are typically the limiting structural condition that we encounter in the review.

Right in Part 72 is the dose criteria and it's a bit more straightforward than in Part 71. It's simply five rem per accident to a person at the site boundary. For normal operations, the rule specifies the EPA 40 CFR 190 value of 25 millirem per year.

Finally, you would see in a typical review some site specific considerations of such things as emergency planning and security. They'd either be in the site specific license or the licensee must change them if they go through the general license route.

At this point, I'm ready to shift away from the regulatory requirements that we use and talk a little bit about status.

COMMISSIONER REMICK: Are there any major inconsistencies between our requirements for transportation casks and storage casks?

MR. HAUGHNEY: I would tend to characterize them as, for the most part, intentional appropriate differences. But we are going to talk about some of those later on. I think there's some examples I have later that will show that.

COMMISSIONER REMICK: Okay. But I read from what you say that they're not in conflict.

MR. HAUGHNEY: I don't think they are, but they may appear that way at first blush.

MR. BERNERO: I would just say that there are justifiable differences such that being approved for storage doesn't ensure being approved for transport, but there is nothing that would be required to be approved for storage that makes it difficult or impossible to be approved for transport. I think Charlie spoke of the environment, the static environment versus the dynamic transport environment. In general, the transport requirement is more demanding. It just basically works out that way.

COMMISSIONER REMICK: Thank you.

MR. HAUGHNEY: Just another one that came to mind while the question is fresh, and that's the fact that if we have an accident with a storage system, it's on-site. You've got the existing plant personnel there, a fire brigade, security guards. They're all right there. The operators. They can trigger their own emergency response. Contrast that with a situation where you may have a relatively high speed transport accident out in the public domain. It could be either rural and remote or it could be in a major population center, either of which would cause particular problems.

So, in certain cases, I think we have to consider the environment very carefully as we do our reviews and set the requirements. We will see an example of that later.

(Slide) I've got two slides that depict the status first of existing transport casks that can handle spent fuel and then storage systems. We just--while you're thumbing through those in your handouts, what I thought we might do is show some pictures of some actual components. I don't have a picture for everyone that's on the table and I'm not trying to taut one particular company or vendor, but nonetheless I've picked kind of a representative sample of these.

The first is a transport cask that's a truck cask, so called NLI 1/2. I think that is on your handout. It's capable of handling either -- I believe it's one pressurized water reactor fuel bundle or two boilers. Now, it's interesting to think for a moment if that were the only transport cask how many shipments we'd have to make to fill up the repository. But nonetheless it is certified. It is available for use.

Let me show the next one, which is --

COMMISSIONER REMICK: What was the apparent cover hanging over top of it? What was that?

MR. HAUGHNEY: Well, I didn't see that. I saw their impact --

COMMISSIONER REMICK: Could we have the previous slide?

MR. BERNERO: Yes.

MR. HAUGHNEY: That looks like a tarp. That will do two things. It keeps people away from it. The principal reason is the physical temperature and then somewhat the dose rate. Then it's a little bit of a rain cover. You see like the larger disks at the end? Those are the impact limiters.

MR. BERNERO: I just add, that series of casks, they had a big one, a 10/24 for rail shipment. They are very hot at equilibrium if they have fresh fuel in them, hot enough to burn. That is burn the hand, not burn combustion.

Excuse me. Charlie said something that I'd just like to emphasize. He said this holds one PWR assembly or two BWR assemblies and if you had to ship a lot of fuel just think how long it would take. This is a very important point. Given the current environment, there aren't many places to which you can ship spent fuel. But if you do have such a place to ship, there are very few devices available in which to ship it. It takes a long campaign shipping one at a time or even seven or 18 at a time as the IF-300 cask might do, because there are so few machines in existence.

COMMISSIONER REMICK: I know one university that spent about eight or ten years trying to get rid of some fuel and still hasn't because casks aren't available.

MR. HAUGHNEY: (Slide) All right. The next picture will show a rail cask. This is the so-called IF-300 design. Again, there's only four of those, according to our count. This one is loaded on a rail car and it's ready for transport over the rails.

(Slide) I've got another picture of this tipped in the vertical condition. It's just been loaded in the spent fuel pool at H.B. Robinson and is being lowered down to ground level. Carolina Power & Light owns an IF-300.

(Slide) I'll show you another way they use this. It may have been the same cask actually. They have dry storage at H.B. Robinson, the NUHOMS concrete system, and they made up the IF-300 to the port on the shielded vault and moved the fuel into the vault in that fashion.

(Slide) Now, the next one shows a different way of loading the NUHOMS. This has an on-site transfer canister that was designed by the vendor themselves, by Pacific Nuclear. Here you can see the shield door being lifted just prior to mating up that connection there. Here, this is at the Oconee site, they're ready to discharge the fuel from the transfer cask and place it in that vault.

The Oconee system will hold 24 pressurized water reactors, reactor fuel bundles. The Robinson was a seven assembly design. It was at the early one, almost a prototype size.

Yes, sir?

COMMISSIONER REMICK: That cask that we see there does not go inside the storage module. There's a container inside, is that it, that gets pushed in?

MR. HAUGHNEY: Well, right now that container should be inside the transfer cask and it will be -- there's a hydraulic ram that's connected and will push it into the vault. There's like some tracks on the vault. We may have a shot of that on this next one.

(Slide) This is sort of inside the vault looking out towards an empty transfer cask and then the connection from the ram has been removed and we see a person with a hard hat there at the end. But you get an idea of the thickness of the concrete shielding. Inside then the fuel will be cooled by natural convection flowing through passages inside the vault and up and out the top.

Yes, sir?

MR. BERNERO: Excuse me. I'd like to interject. We're running into nomenclature problems and along with DOE we are trying to evolve standard nomenclature. The metal container in which the fuel is embedded or loaded, bolted or seal welded shut, we're calling a canister and then it has an over pack, an over pack for whatever purpose, transport, storage or disposal. The over pack may be a cask or, in this case, the over pack is for storage a concrete bunker of some sort. So, we generally will refer to the inner container as the canister and the outer container as a cask or an emplacement of some sort.

COMMISSIONER REMICK: Or over pack?

MR. BERNERO: Yes, or an over pack.

MR. HAUGHNEY: (Slide) All right. There's another section of a sketch from the SAR, it looks like, showing that RAM system.

(Slide) Let me show an overview. We've got a picture of a model that was built for Calvert Cliffs which also uses the new home system. You can see where they have a couple of rows of these vaults and then room for further expansion. This one shows you security lighting and the double fences around it. These on-site storage systems are inside the protected area. They may have to sort of build an edge around, but it's at that level of security protection.

(Slide) Okay. I'd like to show you some metal casks that are in use at the Surry station. The first one is a basket from a Westinghouse MC-10 design and there's, I believe, one of these in use at Surry. That's just prior to preparation for loading. You can get an idea of how much space there is for fuel in there. Now, I have to check, but I don't believe this one has any installed poisons in it, other than the inherent poisoning of the basket material itself.

(Slide) Next one.

This is a Nuclear Assurance Corporation cask and it's also at Surry. You can see it's on-site cradle there and there's two of those in service at that station, loaded and sitting on the pad.

(Slide) This is a cutaway view of the NAC design and this one is of interest because this is a design that is in review right now for dual certification and I'll talk more about that later and the status of that review.

(Slide) Here's a picture of the Surry pad and the cask you see closest to us have -- there's 16 of those on-site. They're called Castor 5s. They'll hold 21 assemblies and, of interest, they are made out of the so-called nodular cast iron material which I'm going to talk about later in the briefing.

COMMISSIONER REMICK: You're into storage casks now.

MR. HAUGHNEY: That's right. Yes. We shifted just after the IF-300. I should have pointed that out. I'm sorry.

(Slide) Now, here you have pictures that we just received from Palisades Plant in Michigan. These are the vertical concrete casks. I believe those two are the two that are actually loaded there now. There's two on-site. You can see -- actually you can see both the inlet port and then the outlet ports at the top and bottom for the convective air flow. If I had to make an educated guess, that operator is checking the thermocouple monitoring system for outlet temperatures.

(Slide) Okay. Let's look at the next one, which I think is another -- yes, that's the Palisades cask being moved by the on-site transporter.

(Slide) I have one final slide. This is an artist's rendition of a possible MRS, monitored retrievable storage. That's not representing any particular site.

COMMISSIONER REMICK: From here it doesn't represent too much specifically.

MR. HAUGHNEY: We have a model of one of those, again it's purely conceptual, on the sixth floor and if any of you are interested in looking at that we could --

COMMISSIONER REMICK: Are any of the current transportable or casks for transportation currently certified for storage also?

MR. HAUGHNEY: No. We don't have any dual purpose licensed yet.

MR. BERNERO: Well, except that -- let's take an IF-300, which is certified for transport. If you chose to load an IF-300 and park it on a railroad siding on your site, it is presumably certified for such storage. It's not a logical alternative that someone would choose because they are rare, they're hard to find. But technically it isn't licensed for such storage, but I see no reason why it wouldn't be acceptable for such storage for reasonable periods of time. You know, if it were to sit there for 20 years, then we would demand, well, you've got to have a surveillance program and things associated with storage, but not for temporary parking.

COMMISSIONER REMICK: Have any of the transportation casks been in accidents? And if they've been in accidents, what has been the result?

MR. HAUGHNEY: With spent fuel in them?

COMMISSIONER REMICK: Yes.

MR. HAUGHNEY: I don't think --

MS. LUSARDI: I can answer that one. We've tracked accident data since 1971 and we have -- there have been four accidents that have involved four loaded spent fuel casks. They've ranged from minor mishaps to one where the cask was actually thrown from the trailer, but there have never been any releases in any of those incidents.

MR. HAUGHNEY: Well, at this point I'd like to shift into the next topic, which is to talk about the dual and multipurpose casks and where they stand. There's three of them that we're considering, two of which we are either reviewing or about to review.

MR. BERNERO: We're on slide 9 now.

MR. HAUGHNEY: (Slide) Okay. Let's shift to the next one.

COMMISSIONER REMICK: I was just trying to decide if you're being consistent there with your definition of canister and over pack. Do we talk about multipurpose casks or do we talk about multipurpose canisters? I'm a little confused here.

MR. BERNERO: When you see it, I think you'll see it is a multipurpose canister with three different over packs.

COMMISSIONER REMICK: Yes. Okay.

MR. BERNERO: Yes.

MR. HAUGHNEY: Okay. But at any rate, the interest in these is to minimize handling, radiation exposure, changes of incidents, presumably to reduce costs and perhaps end up with one cask when you might have had two or three. At any rate, there's three separate parts of our regulations which apply.

(Slide) Next one. Next slide, please.

I'm going to talk about each of these three in a little bit of detail, but the Nuclear Assurance Corporation cask is in-house for review for both storage and transportation certification. We're expecting next month to get an application from Rancho Seco supported by Pacific Nuclear for a modification to the NUHOMS system. We've been having some meetings with the Energy Department on the multipurpose cask. We don't have an application yet for that.

(Slide) Next slide.

Now, the NAC cask really is a variation on their earlier theme where they took a storage cask and added some impact limiters to handle the heavier loads of the transportation accidents. You can see the application dates and there's been quite a bit of I'll say perhaps false starts on that. Most of the difficulty has been involving the structural loading of the basket, whether it could really take the more severe impacts.

At any rate, just this summer and fall we've held some discussions with the vendor that I think have brought us conceptually to closure on these structural issues. They have, I think it was a week or two ago, submitted on the docket a substantial revision which we are just now beginning to look at. Personally I have some optimism that we will be able to conclude this review based on these changes. But we're not far enough into it to make a definitive statement.

Yes, sir?

MR. BERNERO: Excuse me, Charlie. I'd like to add something.

Some of you may have heard from the Spanish authorities for waste management, NRESA. Senor Lopez was here. We had lunch with him not long ago. They have a strong interest in this cask for their national system, that this would be a dual purpose cask for their national system.

MR. HAUGHNEY: I think that would be the actual first sale of this. So, at any rate, I think in the coming months we'll be making significant progress on that one.

(Slide) Next slide.

Now, the NUHOMS system has been licensed on a specific basis at three sites and we also are anticipating going into rulemaking to make it eligible for the general license use. But because of Rancho Seco's interest in this cask system and their interest in decommissioning the spent fuel pool, there's been an examination of a way to modify that NUHOMS canister so that an over pack can be installed and it can become transportable. So, if they have some need to move or otherwise handle that fuel, they're not confined to the site.

We expect to get the application in this next month and I can't really comment on it. We don't have it. In the last year we've probably held three or four meetings with the licensee and the vendor and I think we've gotten good understanding of how the requirements would apply to their conceptual design. So, I think it should proceed favorably. This would be, I think, a rather popular dual purpose system potentially.

Finally, the multipurpose cask. There is a single canister which ideally would remain sealed after loading and then different over packs would be incorporated for the storage, transport and disposal environments. Originally, it's my understanding that the Energy Department received this concept as an unsolicited proposal from an industrial consortium led by Virginia Power. From our meetings with DOE, the designs are in the conceptual stage. We've got the rules in place to certify the first two legs of the triangle. Part 60 would be used to license the package as part of repository licensing. It's ready to do that regulatory action at this time.

COMMISSIONER REMICK: Would you repeat that statement? I'm not sure --

MR. HAUGHNEY: Well, Part 71 and 72 are regulations intended for cash certification and they're in use now. Part 60 isn't really a cask certification regulation, it's a repository licensing regulation. It's perhaps a fine distinction but what would be done, at least we would envision, is that the third portion, the third over pack in conjunction with the package would be licensed as a part of repository licensing.

COMMISSIONER REMICK: But not the canister necessarily?

MR. HAUGHNEY: Well, the canister would be part of that system. It's got a certain amount of mass, of course because of its inherent weight. The heat source, the radiation source, all those things are coming out of the canister. So, it's an interaction with whatever over pack or sleeve they put on and the host rock.

COMMISSIONER REMICK: But the canister would, presumably in simple form, slip into the over pack.

MR. HAUGHNEY: Yes, in each of these cases.

COMMISSIONER REMICK: So why would the canister necessarily have to be part of the licensing of the over pack?

MR. BERNERO: May I try?

MR. HAUGHNEY: Go ahead.

COMMISSIONER REMICK: What you call the waste package.

MR. BERNERO: Basically the situation is that the canister becomes the new unit of disposed fuel. In the previous concept, spent fuel in full assemblies is what might be called the unit of waste disposal, a spent fuel assembly, and in the licensing for Part 60 you have package lifetime requirements, engineered barrier system requirements and all of your findings are using that as the unit of spent fuel. Now it would be a different thing. It would be a set of those, a set of 24 or 21, whatever the number might be, in a canister that is in that Part 60 package, the over pack.

COMMISSIONER REMICK: The over pack.

MR. BERNERO: Yes.

COMMISSIONER REMICK: Which is called

waste package in Part 60.

MR. BERNERO: Yes. So, the waste package in Part 60 is really the over pack, it's not the canister.

COMMISSIONER REMICK: Right. Okay. And it's the waste package or the over pack that has the requirement to last the 300 to 1,000 years.

MR. BERNERO: Yes.

COMMISSIONER REMICK: But not the canister necessarily.

MR. BERNERO: No, not the canister necessarily.

COMMISSIONER REMICK: So, my point is why is it necessary to know the design of the repository? You have to know that for the waste package, but if you just know that the canister is going to go into the waste package, why are they necessarily tied?

MR. BERNERO: Well, having changed the unit of disposed fuel there are many system effects that you have to take into account. For instance, the present reference design for Yucca Mountain is sometimes called a hot hole design. It's thermally managed to have so many kilowatts per unit of waste package. This by geometric transport requirements, other system requirements, is now a bigger bundle.

That also gets you into a regime where you don't have perhaps as precise a control of the thermal loading and you have to take that into account.

In other words, the enlargement of the waste disposal canister has certain effects that you have to live with in the Part 60 licensing environment. It's ultimate geometry over time and a variety of other things. But per se you aren't trying to apply to it the 300 to 1,000 years of Part 60. But you have to look ahead and say will the repository in its various safety analyses and findings be able to make those findings adequately given that you have 24 fuel assemblies of varying thermal loading in this standard big package?

COMMISSIONER REMICK: Let me go a step further. If once the decision is made on the thermal loading for the repository, that then should define the number of fuel assemblies you could have in the canister. Once that is done, is there any reason why the canister itself could not be designed for multipurpose? I agree with you. I can say until the decision is made is it a cold repository or a hot repository and therefore the thermal load --

MR. BERNERO: Well, again, referring back to the little cartoon of the system, you get system requirements that will telegraph back up the chain and you get into some practical considerations. One of the factors that I honestly don't know how they can cope with it is if you have a recipe for the thermal loading of the canister, and let's say 24 fuel assemblies, you will have a standard canister that goes out to different PWRs for 24 fuel assemblies and the same canister presumably goes to BWRs for the appropriate multiple upward of BWR fuel assemblies. I would assert that if you go to Cooper Nuclear Station and Arkansas Nuclear 1 for your load, you're going to get vastly different thermal loads and you won't have an awful lot of choice about it either. That's all that's there. You will get high burnout PWR fuel or you'll get low burn-up BWR fuel and that raises a distinct system problem, how could I take one of each or two of each.

COMMISSIONER REMICK: That's understandable, Bob, but couldn't it be that at one plant you have 24 BRWs in the canister elements and the other half 23 because of the limitation -- once you know the thermal loading, it seems to me that --

MR. BERNERO: Yes. You could have an off optimum loading.

COMMISSIONER REMICK: Yes. Yes.

MR. BERNERO: You could have a canister that gets filled at Cooper Nuclear Station and only gets half filled at Arkansas or something like that. That's a degree of freedom. We don't know if they're planning that. It's possible.

COMMISSIONER REMICK: Yes. I'm just trying to understand --

MR. BERNERO: Hypothetically possible.

COMMISSIONER REMICK: I'm trying to understand why all this is tied to design of the repository. I can see where certain decisions in a repository have to be made, but I'm not sure that complete design --

MR. THOMPSON: Yes. I think that's an issue we could probably do a little bit more review on and respond back to the Commission on.

COMMISSIONER REMICK: Sure. Yes.

COMMISSIONER de PLANQUE: Is it the over pack that really becomes the critical item and that's putting all the pieces together, the requirements to the over pack when you're in the repository situation?

MR. HAUGHNEY: In repository.

COMMISSIONER de PLANQUE: Well, I have sort of the same problems with this. Are we running into a chicken and egg problem when it comes to setting the requirements at least for the over pack?

MR. BERNERO: I think yes, we are in a chicken and egg problem. The over pack is critical for things like packaged lifetime, et cetera, given repository conditions. The inner pack, the canister, is critical to the repository findings in order to see whether you can realize the given conditions of the repository. So, there is an interaction between the two. It is not clear yet in the MPC program whether that has been sorted out. That's part of the system analysis.

MR. HAUGHNEY: Well, that's all I had intended to mention with respect to the multipurpose canister.

COMMISSIONER de PLANQUE: You're not going to say anymore.

MR. HAUGHNEY: I'll get in trouble.

I've got three issues I wanted to close with today. Two of them really relate to criticality. It's the issue of so-called water ingress during an accident condition. I want to talk about that a little bit. And the fuel burn-up credit and finally cask materials. I'm really going to focus on the issue of nodular cast iron.

The first, water ingress. Here is a

difference between storage and transport and I want to talk about how they've arisen and why we feel that they're appropriate. Throughout the international transportation community there's always been an assumption that the package will end up leaking following one of these severe accidents and therefore it will fail. Or if you haven't submerged it you could have a problem from fire fighting. Sometimes the misting or vapors could even be more of an optimum moderation condition, depending on the other physics of the assembly.

At any rate, what you'll see in the surveillance for these packages are a series of sealed leak checks done either prior to shipment or periodically with the package. Even in spite of those which given us additional assurance, the assumption is made in the criticality analysis that you're going to fill it up. In some cases where we're trying to put more fuel in, of course, the reactivity is going up and so therefore there may need to be a design decision to try to add poison plates to the basket assembly.

In storage, we've got a different situation. In many cases, the particular site is flood free or the worst case height in the vicinity of the pad is such that you can pretty much demonstrate that water ingress is just not a credible condition. So, therefore, we don't necessarily require it.

The other thing is in storage you've got a rather modest movement at very low speeds with the on-site transporter. It's not like a package that may go thousands of miles and then be involved in an accident, or you could have seal degradation. Some of the designs, the canisters for all the concrete designs for storage are all double seal welded. So they don't even have mechanical joints as we have in all our transportation packages.

So here, I think, is an example of a difference, but one that because of the environmental conditions and the design configurations, it at least to me makes sense.

Okay. Any questions on that one?

All right. Now, burn-up credit is an issue that's -- it's really an ongoing issue.

(Slide) Can I have the next one?

I want to emphasize that. I think some people have felt that we've shut the door on this issue over the years and are not receptive to further discussions, but that's not the case. Here we've been consistent on both the storage and transportation sides. We haven't yet to date approved burn-up credit in the criticality analysis, but we might if we can see some more robust demonstrations of its acceptability. It's a very conservative assumption. The physicist in me just cringes at this thought. You know, about half the fuel is gone and you've created all these new poisons. But the problem is in the details of seeing just exactly what these effects are and being able to accurately calculate them with enough assurance that you don't have a problem.

COMMISSIONER REMICK: I forget what we do with spent fuel pools. What do we assume about burn-up? Anything?

MR. BERNERO: As I recall, there is sometimes burn-up credit. I'm not sure of that. It interacts with the boron, you know, the borated pools at PWRs. That's where I think -- it's either/or, as I recall, but I'm not sure of that. We could get back to you on that.

MR. THOMPSON: I know we do the K-effective calculations and I think we take into account some credit for burn-up.

COMMISSIONER REMICK: I don't remember. I would appreciate it if you got back to me.

MR. BERNERO: Yes.

MR. HAUGHNEY: Okay.

At any rate, I might mention that because this issue has come up with some repetition over the past couple of years we tasked Livermore under one of our existing contracts to take a look at this issue and see what its facets entailed. They've worked on it to the point where they've come in and held a half day long meeting with us to present their issues and they're starting to draft a report which I'm inclined to turn into a NUREG CR. This is not going to be a road map on how to solve this problem, but it's going to show what our concerns are and it's also going to show, I think, some areas where improvement can be made a bit more quickly. Some of these are more promising than others.

In particular, the second bullet, the issue of trying to take credit for both the uranium-235 depletion and the plutonium-239 build-up seems to be one that can be, in our view, addressed with greater accuracy. So far, everything has been coupled together and perhaps partitioning some of these problems would allow partial credit to be taken sooner.

In terms of the fission product poisons, we've been looking at about ten or 12 fission products that are either stable or very long half-lives and have a high microscopic absorption cross-section, and there's only a relative few of those. But one of them, Gadolinium-155, has a microscopic cross-section of about a quarter of a million barns, but its fission yield is so small that in a whole bundle it's some number like a gram and that's not known very well. So the problem is, if the uncertainty bars are such that it's anywhere from a tenth of a gram to ten grams you could have a big effect on your reactivity calculations because of that poison.

COMMISSIONER REMICK: What would be the relative importance of that to samarium?

MR. HAUGHNEY: There are several samarium isotopes that are also important and I don't have the macroscopic absorption cross-section numbers, but maybe I could get those for you.

COMMISSIONER REMICK: Not so much cross-section. I was just wondering, if gadolinium was in there, how would it compare with samarium which we do know is in there and presumably better knowledge of the quantity.

MR. HAUGHNEY: Let me see if I can get you some more information on that. I think we may have it.

MR. BERNERO: Excuse me, Charlie. There's one other aspect of it that is intriguing and that is, given the concept of a multi-purpose canister or cask system, you have the question of reactivity as a function of time over the time scale of a repository. We customarily think of reactivity over a period of years, you know, or the first few hours out of pile, but now you have to think in terms of tens of years, daughter build-up and decay and so forth over thousands of years, and also the issue of reactivity or subcriticality margin.

When you have a transport cask out in the public domain, you certainly want a very conservative margin of distance from criticality, K-effective of less than some relatively conservative number, .95, .92, something like that perhaps, whereas, if you're talking about a configuration 10,000 years hence in a repository deep underground, well-isolated, you might use a different margin. You might find it acceptable to have a K-effective of .98 or something like that.

These are issues that come in with this whole idea and they're on the table now.

MR. HAUGHNEY: (Slide) Now I think one of the more interesting ones is this issue of end effects and on our next page, show the next slide, we've got a graph that's a gamma scan from a fuel rod that came out of H.B. Robinson. The fall-off at the end of gammas in the fission products is quite remarkable. In fact, you can see a little bit of the reflection on the curves at either end and also the effect of the grid spacers at least cutting down on the gamma flux.

But looking at this sort of data, our contractors have come up with the fact that you could literally have essentially two uncoupled slab reactors at either end of a 24 assembly spent fuel basket. And just exactly now those things work and how we would quantify those to make sure we're properly shut-down, I mean, you could visualize a situation where you've got a very small leak in the seal and you only fill up the bottom, but you could get a criticality occurring there whereas your average situation is still subcritical.

COMMISSIONER REMICK: At a BWR, I assume that would be bellied-out toward the left-hand side. Is that right?

MR. HAUGHNEY: It should.

COMMISSIONER REMICK: So you could have much more unburned fuel at a BWR near the top than you would in the PWR. So in having two thin slabs you might have a larger slab, am I correct?

MR. HAUGHNEY: Because of the void up at the top?

COMMISSIONER REMICK: Yes.

MR. HAUGHNEY: That's right. It would seem that way.

MR. BERNERO: But still with the essential question -- if you would consider burn-up credit, is there a homogeneous model that you can use for that burn-up credit -- what sort of penalty do you incur for that slab at either end or both ends?

MR. HAUGHNEY: And just finally, we've been able to find no evidence that any critical experiments have been done with spent fuel to benchmark a criticality code and the critical experiment facilities are mothballed at this time, to our understanding.

COMMISSIONER REMICK: But if we have given credit for burn-up in spent fuel pools, it seems like we would have done some of that or somebody would have.

MR. BERNERO: Let us check that, because I wouldn't rely on that recollection.

COMMISSIONER ROGERS: When you do that, I'd be interested in whether the racking of fresh fuel or not very much exposed fuel is the same. I mean, if you're giving credit, how you deal with different life times of spent fuel?

MR. HAUGHNEY: All right.

At any rate, this is an open but very interesting question and we look forward to the answers to some of these problems.

Materials. Nodular cast iron is a good example. Here's a situation where we've approved that material for storage and we have not done so for transportation. I may have a sample of that material that I can show you, but I want to caution you. It's a lathe chip and it's a little bit sharp. This is off some machining for one of the casks.

COMMISSIONER de PLANQUE: A slinky.

MR. BERNERO: Super slinky.

COMMISSIONER de PLANQUE: Super slinky.

MR. HAUGHNEY: It takes a little bit of effort, but you can literally break that material with your hands. I again wouldn't particularly suggest that, because we -- I forgot to bring my work gloves, but it's not your normal ductile mild steel or stainless steel. The fact is, nodular cast iron can be designed and fabricated to meet the accident criteria in either regulation, Part 71 or 72. It can pass the 30 foot drop and the puncture test.

COMMISSIONER REMICK: You're talking about over-pack here?

MR. HAUGHNEY: Yes.

COMMISSIONER REMICK: That material is not used in canisters?

MR. BERNERO: It's casks, not canisters.

MR. HAUGHNEY: The point being, though, that an actual transportation accident could have loading that's not exactly in concert with a straight 30 foot drop. I always visualize a high-speed rail accident where there's derailment and tumbling and you have this tremendous amount of kinetic energy that you must dissipate and that's where the ductile material has a big lead. Bolts may stretch. You may even get some local yielding. You'll probably end up with some sort of a source path, but you're not going to get sudden catastrophic failure of the entire structural body, which you could get with a brittle material.

And again, thinking about the possible accident locations, we remain unconvinced that this type of brittle material is suitable for the structural components in such a cask. Again, we're required and we will listen to any other proposals, but I can tell you that on my watch I want to see ductile behavior in these severe accidents.

COMMISSIONER ROGERS: Charlie, just before we move on from that, you and I have talked about that question a little bit --

MR. HAUGHNEY: Yes, sir.

COMMISSIONER ROGERS: -- and it does seem to me that it's worthwhile considering a rulemaking on this in a public process where the proponents and opponents of this use of this material could come forward and make their case. I think that, while I can understand your concern, I'm uncomfortable with it simply being a staff decision that a material or a device that meets our regulatory requirements in Part 71 is not acceptable to us. I mean, that gives me a problem.

MR. HAUGHNEY: Right.

COMMISSIONER ROGERS: I think we ought to clean that issue up, either dispose of it one way or another, and I think the way to do that is through a rulemaking and my feeling is we ought to really give serious thought to rulemaking and let everybody come out, the opponents and the proponents of this material, in a proposed rulemaking.

MR. HAUGHNEY: Yes, sir.

MR. BERNERO: Commissioner Rogers, within the staff we have talked about the possibility of conducting further generic work, scientific work on our own, and we don't see the ability to fund that and put that into the generic fee basis and so forth. But what you propose on rulemaking, some sort of advanced notice of proposed -- some rulemaking mechanism to develop that is a reasonable one, we think, to explore and intend to go forward with that.

COMMISSIONER ROGERS: Well, it just bothers me that when we really have a feeling what the right thing is to do or not do and it's really somewhat inconsistent with our own rules, then we ought to fix the rules up.

MR. BERNERO: Yes. It's the hidden standard.

COMMISSIONER ROGERS: Yes, absolutely.

MR. BERNERO: It's a hidden standard, because we actually sort of did this in reactor accidents. Our regulations were class 1 through 8 design basis accidents, but there was a real interest in the severe accident as dominating the rest, and here it's a similar thing.

MR. HAUGHNEY: (Slide) All right. We've got a summary slide, allow us to close.

We do have some differences in how we do these reviews in the storage and transportation arena, but I can tell you even before the branches were consolidated in early July we'd actually begun to work on looking at ways that we could eliminate any inappropriate inconsistencies that may exist and to better share our resources and avoid sending conflicting signals to the industry. I'm not going to tell you here today that we're done with that, but certainly now that we're unified I think we'll be able to make even more progress in that regard.

MR. THOMPSON: That completes the staff's presentation. We're prepared to answer any questions you may have.

COMMISSIONER REMICK: Commissioner Rogers?

COMMISSIONER ROGERS: Well, on this issue of burn-up, in one of your SECYs I guess at some point you made a comment that you felt that a measurement would be much preferable to calculations if we're going to arrive at some system for giving credits for burn-up. Is there any research being done, supported, say by DOE or anybody else, on measurement techniques for pinning some of these burn-up questions down that might be applicable here?

MR. HAUGHNEY: Yes, sir. We had had a meeting quite some time ago with the Department on this whole topic and they shared with us the fact that they had some R&D effort underway to come up with the suitable measurement techniques to then verify any calculations of reactivity or K-effective, whatever they're using. To date, though, they haven't come back yet to us with a description of an operational system. Frankly, I've had enough to do on some other tasks that I haven't actively pursued how they're doing, but it's my understanding that, at least as of a couple years ago, the research was underway.

MR. BERNERO: I'd like to emphasize a point that Charlie made. It does appear from the inherent accuracy of each procedure that, even though the analytical approach to calculating burn-up may have its uncertainties, the uncertainties associated with measurement of burn-up would be much greater. And therefore, as Charlie said, the use of the measurement would be more to verify the analytical product. You analyze a certain degree of burn-up and this is a way to verify it, perhaps even as crude as saying you probably have the right assembly in the grapple, but not a burn-up meter measurement that would give you a flux profile. It's a little bit doubtful that you could get that precise a treatment, but the door is open. We just don't have enough --

COMMISSIONER ROGERS: That point of view

didn't come through in your SECY, though. I mean, I got the flavor from the SECY that you really felt that measurements were better than calculations. I mean, you've got --

MR. BERNERO: Well, that has been a position for a long time, to rely on the analysis is not sufficient because we have all of these questions about the end effects and so forth. My most recent remarks are based on our last meeting with the DOE where we were talking about some of the work that they're doing and I'm getting that impression and that's why I just want to bring that out, that it could put us in the position of saying, after all, that if we're going to rely -- if we're going to have burn-up credit, we'll have to temper the credit or use care in selecting the degree of credit in accordance with the fact that it will be principally analytical and only verified or confirmed by a less precise measurement. But, that's a concern.

COMMISSIONER ROGERS: If you rely on the calculation, then you have to back that up with a very careful tracking of the history of the fuel.

MR. BERNERO: Exactly, and that puts us right back in the box, you know, what we said earlier in the briefing and as we say in the paper.

COMMISSIONER ROGERS: Conceivably, if you had a way of making a measurement, you could just make the measurement. You wouldn't -- I mean, make the measurement at the end. You don't have to keep historical track of the history of the fuel, where it was, how long it was in each position and so on and so forth.

DOCTOR PAPERIELLO: But there's a couple things you've got to do. You have to know the history of the fuel. It depends on whether you want to take credit for depletion and build-up of the plutonium, the fissionable isotopes, and how much credit you want to take for the poisons, because when you start looking at the predictions of the origin code against the various lab measurements for heat generation it's pretty damn good and for a lot of the actinides it's not too bad at all.

But when you start looking at fission products, particularly some of the more obscure ones when you go off the main yields and you get these small yields, you start getting large errors. So when you do the calculation you're going to have to propagate all your errors and when you predict the K-effective you're going to have to look at what the uncertainty is in that K-effective, and so you can take burn-up credit but it might leave you a fairly large uncertainty at the end. I think the measurement that they're looking at, they talk about a detector called a fork detector. A major value in that is to make sure a given bundle you put in is not far off from what your calculation is, but it's going to be an uncertainty. Of course you do have to make -- you'd better make sure you don't switch bundles when you load your cask.

COMMISSIONER ROGERS: All right. So you're' talking about a measurement really which is a sort of gross measure of some sort to kind of say where you would apply -- how you'd apply the calculation rather than really a full determination by measurement on the content.

DOCTOR PAPERIELLO: That's right. That's exactly right.

COMMISSIONER REMICK: If I just may follow up that, what type of detectors are they talking about for making measurements? Is this just gamma?

DOCTOR PAPERIELLO: Yes. We're using gamma detectors.

COMMISSIONER REMICK: So it would be very important to know the history of the fuel since it came out of the reactor too.

DOCTOR PAPERIELLO: Yes. They're not disassembling the fuel. They're measuring what goes through the cladding.

COMMISSIONER REMICK: I could only envision it would be gammas or possibly neutrons. I don't think that would be very feasible --

DOCTOR PAPERIELLO: It's neutrons and gammas. They are looking at neutrons and gammas, two detectors on a device that slips over the bundle and they scan the bundle.

MR. BERNERO: I would like to bring up an issue going back to the system analysis. Just as in the beginning, I said there are spent fuel assemblies that are bigger or smaller or lighter or heavier. The statements we're making here about burn-up credit and spent fuel are for analytical history of the fuel assembly as it was in the reactor and what it has done since it came out. There are fuel assemblies that are reconfigured and terribly complicating and they're not the typical fuel assemblies, but there are enough of them so that the population of what one might call the outliers goes up.

COMMISSIONER ROGERS: Just coming back to the transportation cask issue, are there any -- is anyone trying to get a cask approved that contends that there cannot be any water ingress and that they don't want to -- that they feel that that is not a requirement they should have to satisfy?

MR. HAUGHNEY: To my knowledge, we haven't had that sort of an insistence come up in terms of transport casks, where that's been a particular problem in the review.

COMMISSIONER ROGERS: So it's not in front of us now.

MR. BERNERO: Well, the subject comes up certainly in discussion of what does it take to have a -- I have had discussions with people when they're formulating what they're proposals might be and they're really exploring is there any room for us to discuss and that's one of the reasons you have burn-up credit on the table all these years. Is there any room for us to discuss burn-up credit in order to live with water ingress? We had a paper a member of the staff published perhaps four or five years ago that tried to treat this and it had burn-up credit. Of course, you know, it was an example model and it had a model that was some water ingress and when you picked up the cask by one end all the water went to the other end and there went K-effective.

COMMISSIONER ROGERS: Sure.

MR. BERNERO: So, we have had the issue on the table for a long time and it has been in a context that really relates to why can't I postulate water ingress and compensate for it by burn-up and poison, burn-up credit and poison.

COMMISSIONER ROGERS: This question of the coupling between the canisters, the casks and the repository design to me is a very important one. It seems to me there are a lot of questions out there that don't have answers to yet. What I'm really curious is as to what the process is that you see that can avoid the left hand not knowing what the right hand is doing in this business.

I'm very concerned about a notion that a cask or canister cask design, multipurpose design which may look very good somehow is proceeding along independently of the actual design of that repository. There are a number of issues about thermal loading and how that repository might run, at what temperature it might be designed to run that my guess is are very much dependent upon how you load it and is it conceivable that you get to the end of this thing that everybody is perfectly happy with what they've done and the two things don't fit together at all. I've seen it happen on major, major projects. It wouldn't be the first time. I just wonder what steps can be taken to try to avoid such an unfortunate outcome.

MR. BERNERO: Yes. Well, when the concept first came up that was a very evident pitfall. Since the concept first came up, we have tried to emphasize in our dealings the need for system analysis and someone doing this integrated system analysis. Now that the project has been taken over in effect, instead of a consortium proposing, it's now DOE developing. DOE is moving more and more into a system engineer role. I know I have had dialogue with Lake Barrett on this a number of times and urged him, and I think he fully understands it, the need for just that. In fact, I've used the Cooper Nuclear Station and Arkansas 1 analogies with him, that there goes your thermal control unless you're willing to bound the thing and go way off optimum.

So, that work is going on. We don't have any display of it in substance yet. But certainly as we go forward or as they go forward with any proposal, we will be asking the questions. We will be asking the questions because it's a very knotty one.

COMMISSIONER ROGERS: Yes. Well, I very much appreciate this briefing. I think it's been very helpful in giving us an oversight of the issues that have to be considered. Thank you very much.

COMMISSIONER REMICK: Commissioner de Planque?

COMMISSIONER de PLANQUE: My issues have already been covered. I thank you also for the interesting briefing.

COMMISSIONER REMICK: I agree very much with what Commissioner Rogers said. I hope we are not, and from what you said, Bob, we're not just saying, "Well, we can't consider a multipurpose canister until the repository is designed." We have to basically be asking, and I hope the Department is doing it, what is it we need to know so that you could consider the multipurpose canister and not just pushing it off until the final design of the entire repository. So, I'm happy to hear that that appears to be the approach.

On this question of poisons inside the canister, I guess I want to say here --

COMMISSIONER ROGERS: Whatever it is.

COMMISSIONER REMICK: What are the complications there? Is it cost? Is it brittle material? Why isn't it just a simple matter for people rather than to necessarily be worrying about burn-up and things like that Why not borated stainless steel, which to me has always been very appealing in contrast to some of the other poisons that have been used in spent fuel pools?

MR. HAUGHNEY: I think it really relates to your first two comments. Incrementally it's an extra material. It's a bit exotic. It's not in great production. So, it's going to add incrementally to the cost of the canister assembly. If a competitor can avoid that, then there's again a little bit of an edge, especially if they hope to sell some large number.

The other thing is the borated stainless steel, much like our lathe chip there, tends to be a brittle material and so it can't be -- we've had difficulty accepting it as a structural component. So, it's adding some extra material that is great from the physics standpoint but not from the structural engineering standpoint.

MR. BERNERO: Yes. I would like to emphasize a point, as Charlie just did, about cost management. The Commission should be aware that when dry storage first began the legislation mandated that DOE try to develop it. The Commission took the approach of being willing to review almost anybody's topical report, let 100 flowers blossom so that there could be vigorous competition. That vigorous competition, which cost a lot of reviews that led to no licenses, but nonetheless it resulted in a cost optimization that although we don't review cost data as part of our safety review, we have good reason to believe that the cost per kilogram or per ton for dry storage of spent fuel came down dramatically from the beginning until now.

As a result, what you see in all of the designs is a regular or recurring interest on the part of the buyer or the developer to say, "Do I really need this costly component or not?" Tbey want to get as many assemblies into as big a can as possible and as effective a storage system as they can.

COMMISSIONER REMICK: Well, I would also like to join in saying I found the briefing very, very informative and I thought the SECY document was exceptionally well written, very concise and to the point and quite interesting. So, I thank the staff very much for your presentation and your effort.

MR. THOMPSON: Thank you.

(Whereupon, at 3:21 p.m., the above-entitled matter was concluded.)

CERTIFICATE OF TRANSCRIBER

This is to certify that the attached events of a meeting of the United States Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING ON REQUIREMENTS FOR STORAGE AND TRANSPORTATION CASKS

PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: SEPTEMBER 30, 1993

were transcribed by me. I further certify that said transcription is accurate and complete, to the best of my ability, and that the transcript is a true and accurate record of the foregoing events.

Carol Lynch

Reporter's name: Peter Lynch

Transportation and Storage Requirements

Robert M. Bernero, Director
Office of Nuclear Material Safety and Safeguards

Charles J. Haughney, Chief
Storage and Transport Systems Branch

A Briefing for the Commission
30 September 1993

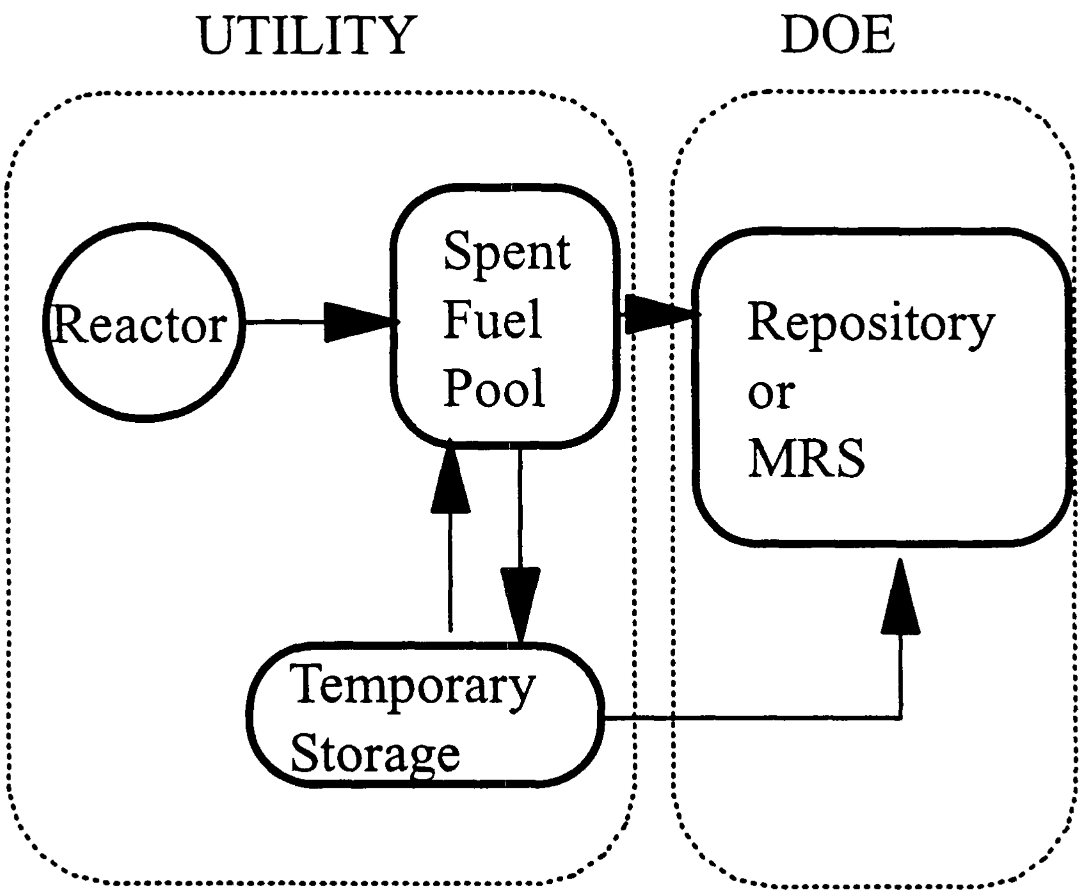
Purpose

- To outline the differences in NRC requirements for certifying a spent fuel cask for storage and/or transportation:
  - Cask Design Requirements
  - Approved Cask Designs
  - Proposed Cask Designs
- To discuss the technical issues highlighted during the review of a dual purpose use design.

LWR Fuel Assemblies

- PWR
  - Width
    - 7.6-8.5 Inches
  - Length
    - **11.4-16.6** Feet
  - Weight
    - 1,096-1,515 Lbs
- BWR
  - Width
    - 4-6.5 Inches
  - Length
    - **6.8-14.7** Feet
  - Weight
    - 328-619 Lbs

The System


UTILITY
DOE
Reactor
Spent
Fuel
Pool
Repository
or
MRS
Temporary
Storage

Primary Functions of a Spent Fuel Cask

- Shielding
- Containment
- Subcriticality
- Heat Removal

Transportation Requirements 10 CFR Part 71 *

- Accident Conditions
  - 30 Ft drop onto an unyielding surface
  - 40 Inch drop onto a 6 inch dia. pin
  - 30 Minute, 1475 °F Fire Test
  - 8 Hour immersion under 3 ft of water
  - 50 Ft immersion (undamaged specimen)
- Acceptance Criteria
  - Any release may not exceed A_2 per week
  - External exposure may not exceed 1 rem/hr at 1 meter from the surface of the cask
  - Contents must remain subcritical

* A listing of pertinent RegGuides for 10 CFR Part 71 is enclosed in the Appendix

Storage Requirements 10 CFR Part 72 *

- Accident Conditions
  - Natural Events
    - Hurricanes
    - Tornadoes
    - Earthquakes
    - Floods
    - Wind Driven Missiles
  - Man-made Events
    - Fire
    - Explosion
    - Transfer Accidents (drops, tipovers)
- Acceptance Criteria
  - Dose at site boundary < 5 rem
  - Cask contents must remain subcritical
  - Fuel cladding must be protected
  - Site specific criteria

* A listing of pertinent RegGuides for 10 CFR Part 72 is enclosed in the Appendix

Approved Spent Fuel Transportation Casks

Model No.	Certificate Holder	Capacity	Weight (lb) Mode	# Built
NLI 1/2	Nuclear Assurance Corp	1 PWR or 2 BWR	50,000 Truck	5
NAC-LWT	Nuclear Assurance Corp	1 PWR or 2 BWR	50,000 Truck	5
TN-8	Transnuclear Inc	3 PWR	80,000 OW Truck	2
TN-9	Transnuclear Inc	7 BWR	80,000 OW Truck	2
IF-300	Pacific Nuclear	7 PWR or 18 BWR	140,000 Rail	4
NLI-10/24	Nuclear Assurance Corp	10 PWR or 24 BWR	195,000 Rail	2

Approved Spent Fuel Storage Systems

Model No.	Licensee	Capacity	System
MVDS	Fort St. Vrain	Site Inventory	Vault
Castor V/21	Surry	21 PWR	Cask
MC-10	Surry	24 PWR	Cask
NAC-I28	Surry	28 PWR	Cask
NUHOMS 7P	H.B. Robinson	7 PWR	Canister Assembl y
NUHOMS 24P	Oconee Calvert Cliffs	24 PWR	Canister Assembl y
VSC-24	Palisades Arkansas* Point Beach*	24 PWR	Canister Assembl y

* Potential Users

Proposed Cask Designs

- Dual-, Multi-Purpose Casks
  - NAC-STC
  - NUHOMS-MP 187
  - Multi-Purpose-Canister (MPC)

Dual-, Multi-Purpose Casks

- Minimize Fuel Handling
- Potential Cost Reductions
- Any proposed design must satisfy regulations for each use
  - Part 71 for Transportation
  - Part 72 for Storage
  - Part 60 for Disposal

Dual-, Multi-Purpose Casks

- Current Status
  - One Dual Purpose Design Under Review
    - NAC-STC
  - Another application expected shortly
    - NUHOMS MP 187
- Staff is meeting with DOE to discuss the Multi-Purpose Cask Concept

NAC-STC

- A classic cask design with impact limiters for transportation
- Application for transportation certificate received Sept. 27, 1990
- Application for new storage certificate received April 25, 1990
  - Review suspended pending transport review modifications
- Transportation review should be completed early in 1994
  - Limiting factors involve structural design of basket
- Applicant to resubmit storage application after transport review is completed

NUHOMS-MP 187

- Canister system using a reinforced concrete Horizontal Storage Module (HSM) as an overpack
- Several pre-application meetings held with applicant
- Intended for use at Rancho Seco
- Application expected in early October of this year
- Applicant plans to request approval to use the transport overpack as a vertical storage alternative to the HSM

Multi-Purpose-Canister (MPC)

- A sealed canister with different overpacks for use during Storage, Transportation and Disposal
- Originally proposed to DOE by industry
- Design(s) in conceptual stage
- For disposal, the design would be approved as part of the repository licensing process
- Issues
  - The repository has not been designed
  - Disposal environment has not been completely characterized

Technical Issues

- Criticality
  - Water Ingress
  - Fuel Burnup Credit
- Cask Materials

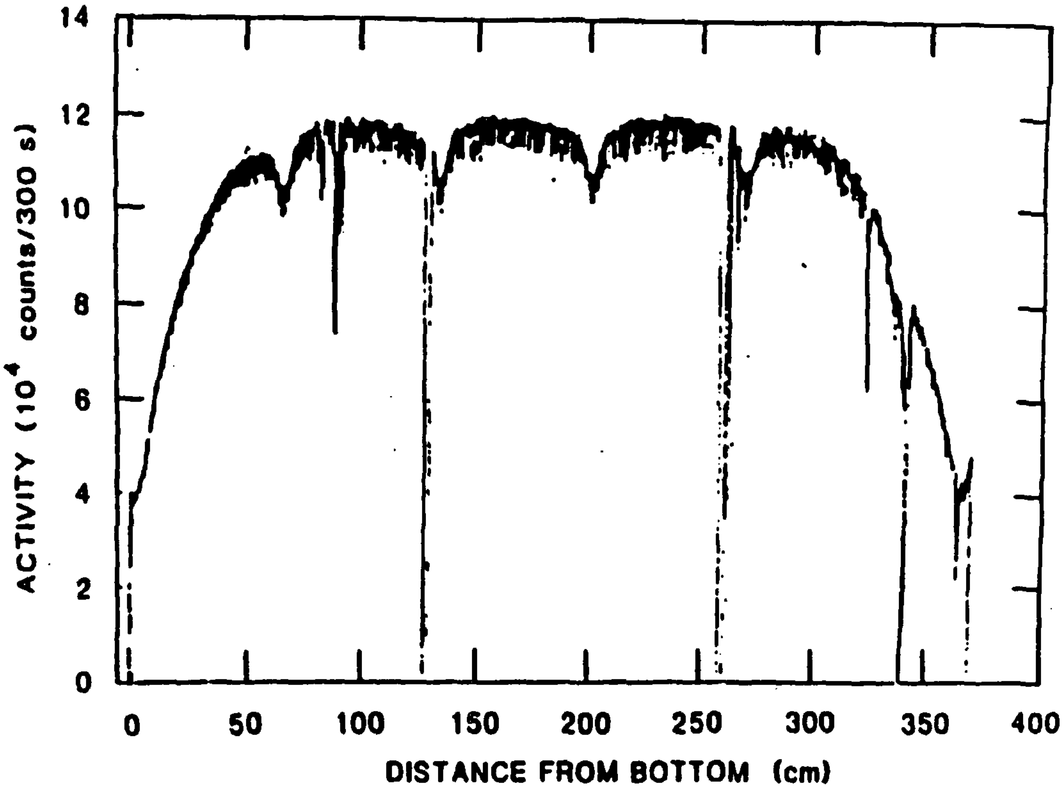
Criticality

- **Water Ingress**
  - **Transportation**
    - Assumption of water ingress is an international and domestic transportation requirement
    - Criticality potential from submergence or fire fighting exists if seal effectiveness is degraded during transport
    - Seal effectiveness monitored periodically and prior to shipment
  - **Storage**
    - No water ingress is assumed, if:
      - + Site Specific analysis demonstrates that it is not a credible event
    - No degradation of the seal is expected in a static environment
    - Monitor for helium leakage on mechanical seals

Criticality

- **Burnup Credit**
  - Transportation and Storage
    - Taking credit for fuel burnup during criticality analysis is <u>not currently approved</u>
    - Assumption of unirradiated fuel is conservative
  - NRC has a contract with LLNL to study burnup topics
  - Primary Issues
    - Neutron cross section data
    - Uranium depletion, plutonium buildup
    - Distribution of fission product poisons
    - Fuel assembly end effects
    - Burnup measurement technology

Measured Axial Burnup Distribution



Cask Materials

- Transportation
  - Large, uncertain dynamic loads possible during an accident
  - Accident in urbanized area,
    - Additional margin of safety appropriate
- Storage
  - Static, defined loads
  - Located on a controlled access site

Summary

- Water ingress
  - Different approaches for transportation and storage justified
- Fuel Burnup
  - Key technical areas must be better understood before a decision can be made
- Cask Materials
  - Insufficient data to justify change in transportation cask requirements; Different approach for storage is justified
- Staff open to proposals supported by technical data
- NRC transportation and storage staff combined
  - Eliminating duplication of Effort
  - Ultimate goal is a combined review

TRANSPORTATION REGULATORY GUIDES

- RG 7.4 (6/75)
  - Leakage tests on packages for shipment of radioactive materials
- RG 7.5 (5/77)
  - Administrative guide for obtaining exemptions from certain NRC requirements over radioactive material shipments
- RG 7.6 (2/77 or 3/78)
  - Design criteria for the structural analysis of shipping cask containment vessels
- RG (7.8 5/77)
  - Load combinations for the structural analysis of shipping casks

TRANSPORTATION REGULATORY GUIDES

- RG 7.9 (3/79 or 1/80)
  - Standard format and content of part 71 applications for approval of packaging of type b, large quantity, and fissile radioactive material
- RG 7.11 (6/91)
  - Fracture toughness criteria of base material for ferritic steel shipping cask containment vessels with a maximum wall thickness of 4 inches
- RG 7.12 (6/91)
  - Fracture toughness criteria of base material for ferritic steel shipping cask containment vessels with a wall thickness greater than 4 inches, But not exceeding 12 inches

STORAGE REGULATORY GUIDES

- RG 3.4 (1/89)
  - Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation (Water Basin Type)
- RG 3.48 (8/89)
  - Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation or Monitored Retrievable Storage Installation (Dry Storage)
- RG 3.49 (12/81)
  - Design of an Independent Spent Fuel Storage Installation (Water-Basin Type)
- RG 3.50 (9/89)
  - Guidance on Preparing a License Application to Store Spent Fuel in an Independent Spent Fuel Storage Installation

STORAGE REGULATORY GUIDES

- RG 3.53 (7/82)
  - Applicability of Existing Regulatory Guides to the Design and Operation of an ISFSI
- RG 3.54 (9/84)
  - Spent Fuel Heat Generation in an ISFSI
- RG 3.60 (3/87)
  - Design of an Independent Spent Fuel Storage Installation
- RG 3.61 (2/89)
  - Standard Format and Content for a Topical Safety Analysis Report for a Spent Fuel Dry Storage Cask
- RG 3.62 (2/89)
  - Standard Format and Content for the Safety Analysis Report for Onsite Storage of Spent Fuel Storage Casks

POLICY ISSUE
(Information)

September 22, 1993 SECY-93-265

FOR: The Commissioners

FROM: James M. Taylor
Executive Director for Operations

SUBJECT: ISSUES IN THE REVIEW OF A DUAL-PURPOSE CASK FOR TRANSPORTATION AND DRY STORAGE OF SPENT FUEL

PURPOSE:

To inform the Commission of the technical issues associated with the review of a dual-purpose cask design for spent fuel transportation and dry storage.

SUMMARY:

This paper discusses the differences in the U.S. Nuclear Regulatory Commission requirements for certifying a spent fuel cask (1) for storage and (2) for transportation, and the technical issues that arise when reviewing a cask design proposed for a dual-purpose use.

BACKGROUND:

For reasons of economy and greater efficiency in spent fuel handling operations, there is a move by industry to use a spent fuel cask designed for both transportation and storage.[1] Staff has received one application for a dual-purpose cask and expects to complete its review in early 1994. An application for another dual-purpose design is expected soon. In addition, the U.S. Department of Energy (DOE) is considering a cask design, referred to as a Multi-Purpose Canister (MPC), for NRC certification for transportation, storage, and, ultimately, disposal in the high-level waste geologic repository.

Contact: M. Lusardi, STSB/NMSS
504-2704

NOTE: TO BE MADE PUBLICLY AVAILABLE AT COMMISSION MEETING ON SEPTEMBER 30, 1993

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[1] Industry initiatives on a dual-purpose cask for storage and transportation are also supported by NRC dry-storage regulations that require consideration, to the extent practical, in dry cask storage design, of the cask's "compatibility with removal of the stored spent fuel from a reactor site, transportation, and ultimate disposition" by DOE. 10 CFR 72.236(m)

Because the requirements for transportation, storage, and disposal are different, a separate, independent, review is required for each type of cask design. DOE and industry have recently inquired about the similarities and differences in the requirements for each purpose, particularly in the areas of storage and transportation. In addition, some questions have been raised concerning the coordination of the different reviews. This paper addresses the technical issues associated with the differences in the transportation and storage requirements and the NRC review associated with each.

DISCUSSION:

Under NRC transportation and storage regulations, a spent fuel cask design generally must provide four primary functions. First, adequate shielding must be provided to ensure that external radiation dose rates do not exceed applicable limits. Second, adequate containment or confinement of the radioactive material must be provided to prevent harmful releases and dispersion of the material. Third, the radioactive contents must be packaged in such a manner that subcriticality is maintained. Finally, adequate heat removal must be provided to dissipate the decay heat produced by the radioactive contents and to protect the integrity of the fuel.

Performance requirements are specified for both transportation and storage to ensure that a cask provides these four primary safety functions in the environments to which it may be subjected to under both normal and accident conditions. However, because the operating environments and use of a cask are very different for transportation and storage, the performance requirements for each are not the same. These differences are reflected in the regulations and evaluations performed for transportation and storage spent fuel casks.

For example, a transportation cask must provide the safety functions offsite in an uncontrolled environment, predominantly in the public domain. The cask is only loaded for a relatively short period, but it must provide protection against dynamic loads in severe transport accidents. As a result, the transportation regulations (10 CFR Part 71) include a series of postulated accident conditions which a cask must withstand.

For storage, a cask must provide the safety functions on a licensee's controlled site. A storage cask experiences a generally static environment, but must provide protection against potential environments and loads to which it may be subjected during its life. A storage cask has a long period of operation. Therefore, the storage regulations (10 CFR Part 72) specify a series of external environmental conditions a cask is required to withstand.

In addition, storage systems must be designed to adequately protect against degradation of their contents to ensure the integrity of the spent fuel when it is retrieved for further processing, storage, or disposal.

Under the regulations for both transportation and storage, an applicant must show that the performance requirements are met by full-scale testing, scale-model testing, engineering analysis, or a combination of these methods. No full-scale tests have been conducted on current NRC-licensed spent fuel casks for transportation or storage. In practice, engineering analysis, supplemented with scale-model testing, has been used to demonstrate that cask designs meet NRC regulations.

NRC has certified six transportation spent fuel casks. It is important to note that in the 35-year history of NRC regulating radioactive materials transportation, there has never been a release of radioactive materials from an NRC-certified transportation spent fuel cask either during normal operations or during an accident.

There have been seven spent fuel dry storage systems licensed or certified by NRC. Spent fuel storage casks have never been involved in an accident, and there has never been a release of radioactive materials from an NRC-approved spent fuel cask during normal storage operations.

Recent industry and DOE interest in proposing dual- and multi-purpose casks has led the staff to begin a careful look at the differences in requirements for storage and transportation. In reviewing these differences, three key issues emerge: (1) the role of water ingress in criticality analyses; (2) consideration of credit for burnup of the fuel in criticality analyses; and (3) the consideration of nodular cast iron as a cask material. Each of these issues is discussed below.

Water Ingress

NRC regulations (10 CFR Part 71) require that water ingress be assumed in evaluating the criticality safety of transport casks.[2] This design criterion has been codified in international and United States transportation regulations for many years, and is based on the premise of water ingress (cask flooding). Cask flooding could result from a cask falling into a body of water or from water spray from firefighters responding to an accident. Although transport casks are designed with lid seals to limit the leakage of radioactive material during normal or accident conditions, it cannot be assured that water ingress will be precluded under all conditions. For example, potential movement and shifting of the cask during transport could loosen the seals, diminishing their effectiveness.

The regulations for storage casks do not specifically require that water ingress be assumed for assessing criticality safety. Some of the currently approved licensed storage facilities have relied on an assumption of water ingress in its criticality analysis. However, water ingress need not be assumed where it can be shown that the arrangement of the casks on the site provides assurance against cask flooding. If prevention of cask flooding cannot be ensured, an applicant must consider water ingress in demonstrating

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[2] Under NRC's transportation regulations (10 CFR 71.55(c)) a cask could be approved without assuming water ingress, provided the applicant can demonstrate that the package incorporates special design features, such that no single packaging failure would permit leakage. However, demonstrating the adequacy of such features in a transportation environment is extremely difficult, and no applicant has ever asked for such an exception.

criticality safety. In addition, storage casks are designed with seals capable of maintaining a helium atmosphere within the cask. These seals are subject to continuous monitoring by the licensee and give additional assurance that water will not leak into the cask.

Both applications for dual-purpose casks (the one currently under review, and the one expected shortly) assume water ingress in evaluating criticality safety to satisfy the transportation function of the cask. Staff believes the existing regulations and guidance on this issue for transportation casks are adequate and appropriate for use in evaluating this safety aspect (i.e. water ingress) for dual-purpose casks.

Fuel Burnup Credit

Under the high-level waste program, DOE is considering relying on credit for burnup of the fuel in the criticality safety design of its containers for the transport and storage of spent fuel. Allowing credit for fuel burnup would provide for more spent fuel to be transported in a single cask, resulting in fewer shipments. The present analytical practice is to assume that the fuel is unirradiated. The staff continues to use this conservative assumption because it has identified a number of issues that need to be addressed and resolved to quantify justified credit.

The net effect on reactivity from fuel burnup is difficult to determine accurately. This difficulty is especially acute at the ends of the fuel rods; the amount of burnup decreases rapidly toward the ends of the rods. The ability to evaluate end effects properly must be improved. Other areas needing better understanding are: (1) the ability to calculate accurately the decrease of ^{235}U and the buildup of Pu and fission product neutron poisons, and (2) the detailed structures of the neutron absorption cross sections for key fission product poisons and their effect on the reactivity of the spent fuel. Also, there are no benchmark experiments which can be used to verify adequately the accuracy of criticality calculations for spent fuel.

In spite of these difficulties, the staff remains open to examining proposals from applicants with sufficient technical bases that would account for burnup credit, and has contracted with Lawrence Livermore National Laboratory (LLNL) to investigate the technical basis for burnup credit in transport casks and independent storage facilities. Staff will use the results of LLNL's work as input in making a decision concerning burnup credit. However, based on the difficulties in accurately determining fuel burnup, and, at present, based on its own work and preliminary discussions with LLNL, the staff believes that if the technology can be developed to verify the effects of burnup, such as uranium, plutonium, and fission products remaining, this would be preferable to relying solely on calculation. Staff has identified these issues to DOE in several meetings, and DOE has acknowledged the need to address these issues.

Cask Materials

More stringent criteria are applied to materials used for transportation casks than for storage casks because of the more potentially demanding loads and conditions to which transport casks may be subjected. In addition, it is desirable to have greater margins in material behavior for transportation casks because these casks are used in environments where public access cannot be controlled, and where the potential consequences of a cask failure are greater than for storage.

The transportation regulations encompass the conditions expected in most transport accidents. NRC has performed safety studies of transportation casks under severe accident conditions that are not encompassed by the regulations. These studies have shown that casks provide a high degree of safety, even in accidents that exceed the conditions in the regulations. One reason is that transportation casks are constructed of materials that behave in a ductile, plastic manner when subjected to high levels of stress and strain. If overloaded, the degree of failure would likely be limited and characterized by potential cracks and localized leaking. In contrast, non-ductile failure can be characterized as a sudden fracture and potentially total failure.

Nodular cast iron is a material that does not have the degree of ductility and toughness of those materials presently accepted. It has been used in Europe for transportation casks for several years and consideration of its use in the United States has been raised by industry. Casks constructed from this material could possibly pass the requirements in 10 CFR Part 71, depending on the size of potential internal flaws and the effectiveness of cask impact limiters in controlling stresses. However, the staff believes that the experience and data available for this material does not provide the assurance of sufficient margin, given the uncertainties of potential loads, uncertainties of the existence of flaws and the temperature to which it may be subjected. Also, nodular cast iron casks would not have the large tolerance for overload that is exhibited by present casks.

The material properties of nodular cast iron are sensitive to the fabrication process and are difficult to reproduce. As a result, a high level of quality assurance is required to control adequately the fabrication process. Nodular cast iron is not authorized in the ASME code for use in nuclear vessels, or for use in non-nuclear vessels that contain lethal substances.

The potential loads and conditions to which a storage cask may be subjected are less severe and more predictable than for transportation casks. Therefore, the potential for the type and severity of impact loadings that would place stress/strain demands on cask materials that might result in brittle fracture are less in storage than transportation. As a consequence nodular cast iron has been approved by NRC in applications for use in individual storage casks under Part 72.

NRC has published technical criteria for preventing brittle failure in transportation casks in regulatory guides. Staff is reviewing the appropriateness of adopting these fracture criteria in Part 71 to exclude, specifically, by regulation, non-ductile materials for use as structural components in transportation casks. These criteria would also apply for the transportation function of dual- or multi-purpose casks.

CONCLUSIONS

Because of the different requirements for storage and transportation, two separate, independent, but coordinated reviews are conducted for a cask designed for a dual-purpose use and two separate certifications are issued. As industry moves to develop dual-purpose casks, and DOE possibly moves toward an MPC, staff must (and will) be prepared to adequately integrate the reviews for each functional area.

The staff believes the current regulatory scheme is adequate to address dual-purpose cask initiatives. Industry is developing at least two different designs to serve the dual purpose of transportation and storage. Transportation and storage staff have been organized under the same management and are currently coordinating their independent reviews in support of certification in each area, with the ultimate goal of combining the reviews when justified. Staff will continue to review the technical issues and data associated with water ingress, fuel burnup credit, and nodular cast iron. However, at present, staff believes a technical basis does not exist to change the casks for transportation and storage of spent fuel. The review criteria for the disposal portion related to the multi-purpose canister must await further development of the repository design by DOE. Once the repository design is established, NRC can determine the technical review criteria needed to approve the canister for disposal.

COORDINATION:

This paper has been coordinated with the Office of the General Counsel, and it has no legal objection.

James M. Taylor
Executive Director
for Operations

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