UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Title: COMMISSION BRIEFING ON CASK DESIGNS FOR SHIPPING AND STORING OF NUCLEAR MATERIALS

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[PUBLIC MEETING]

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Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland
WEDNESDAY, OCTOBER 19, 1988

The Commission met, pursuant to notice, at 2:00 p.m., the Honorable LANDO W. ZECH, Chairman of the Commission, presiding.

COMMISSIONERS PRESENT:

LANDO W. ZECH, Chairman of the Commission
THOMAS M. ROBERTS, Member of the Commission
KENNETH ROGERS, Member of the Commission

STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

S. Chilk	W. Parler
V. Stello	B. Bernero
C. MacDonald	L. Rouse

PROCEEDINGS

CHAIRMAN ZECH: Good afternoon, ladies and gentlemen. Commissioner Carr will not be present with us this afternoon, he is on official travel. The purpose of the briefing this afternoon is to discuss issues related to cask designs for shipping and storing nuclear materials. This is an information briefing which was requested by the Commissioners during the August 10, 1988 Commission meeting on the status of nuclear materials transportation.

As many of you know, under the Nuclear Waste Policy Act, the Nuclear Regulatory Commission is responsible for reviewing and certifying DOE cask designs for shipping and storing nuclear materials. Today's briefing will cover an overview of the NRC's program for the review of casks, specifically the status of applications received and those expected.

At the August meeting, Commissioner Carr suggested that we seize the opportunity to standardize storage cask designs and certification. The staff was requested to discuss these issues related to standardization.

The Commission also asked to hear about any potential problems which can be foreseen in this area, specifically regarding resources to review the different cask designs. The Office of Nuclear Materials Safety and Safeguards will brief the Commission today on this subject.

Do any of my fellow Commissioners have any opening comments to make before we begin?

[No response.]

If not, Mr. Stello, you may proceed.

MR. STELLO: Mr. Chairman, we'll turn very quickly to Mr. Bernero to get on with the briefing. Your summary of why we are here is very accurate, including the comment of trying to seize on the opportunity to deal with standardization to the extent we can. We have taken that charge very seriously and are going to include in our briefing the problems that one has in trying to decide today, because of various constraints on the system, a standardized approach to using cask designs. And unfortunately, it does not appear that that is a very meaningful way to go. We will end our briefing with what proposed future actions we would suggest we take with respect to this issue.

We will identify through the briefing some natural forces that are in place within the utility industry which I think will produce the end results the Commission is looking for; that is, coming down on several designs. But there really is a need for a number of them, for different reasons, and Mr. Bernero will be explaining that during the briefing.

With that, Bob, let me ask you to begin.

MR. BERNERO: Thank you, Vic. Good afternoon, gentlemen. Here for the briefing today -- I will give the

presentation, but on my right is Leland Rouse, Chief of our Licensing Branch for the dry storage or field storage at the casks; and on Vic Stello's left is Charles MacDonald who is Chief of the Transportation Branch which handles the certification of packages for the shipping of the spent fuel. So that we have the expertise here at the table to respond to any questions you might have of a specific nature.

May I have the System slide, please.

[Slide.]

What we're talking about here is a System, and we're going to be talking a little bit about system engineering in the broad sense, in the sense without the "s" on the end where we're not talking about electrical systems or fluid systems. We basically have here a system for the handling, the storage, the shipping and ultimately the disposal of spent reactor fuel.

Now, as you will see a little later on, most of the fuel will follow this path: from the reactor into the spent fuel pool for some rather lengthy period of storage, and ultimately to the repository or the MRS. I do not separate the repository or MRS. As you recall, the 1987 Amendment to the Nuclear Waste Policy Act made the MRS so constrained to the schedule of the repository that it might be one and the same. The MRS might merely be the head end of the repository. So at this time I will repeatedly refer to the repository or MRS as if it were a single entity.

Later I will show you that most of the spent fuel goes to that path. Some of it separates out and goes into temporary storage for those reactors of earlier vintage which don't have as much temporary storage in their pools, as much space even with the re-racking and other means of compaction, and the result is that they need additional storage capacity -- -- and later on I'll show roughly how much that is.

This system has no system manager. The Department of Energy has the jurisdiction by law now for the repository and MRS and the transportation of the spent fuel to the repository or MRS. Each utility, where it might be the owner of a single plant or someone like Duke Power that has three nuclear stations, seven reactors, each utility is the manager of its own system. And this is a crucial point to understand because their focus is different as to the system, the base of optimization that they look at and the time scale. The utilities are looking at their internal system, as they must; they are looking at the short-range time scale to a very great degree because Duke Power at Oconee in their application points out to us that in just over a year if they don't have additional storage at that site, they will not have full core off-load capability; they will begin to encroach on their operational margin.

In a similar way, DOE, with its responsibilities, is looking at a different system. They have the repository, they

have decades of responsibility, and they have the responsibility to take possession of the thousands of spent fuel assemblies that are being generated by these reactors for disposal.

So the result is if you look, we don't have a single system manager but oddly enough, NRC has a regulatory jurisdiction over this whole system.

For today's briefing what I'm going to do is talk about the fuel so that you can have a more specific understanding of the variations in fuel, and I will throw in a few words here and there about variations in plant parameters that affect handling the fuel. I will then talk about the transport of fuel. This is where we are simply trying to move the fuel from one site to another in a Type B cask, a transport certified cask. I will then talk about the separate dry storage of fuel and the applications associated with it. Then I hope to give you some ideas on final disposal considerations that affect our thinking when we look at the temporary storage or the transportation of the fuel, and the possibilities of perhaps getting it into a final form earlier in the game.

May I have the next slide, please.

[Slide.]

In the projections of spent fuel it is now customary and appropriate that everyone uses the DOE numbers. The central responsibility for analyzing the spent fuel generation

and accumulation condition rests with DOE, and we base all of our estimates on their figures and here on this slide, I am giving you the estimated storage requirements in the year 2003. That's the nominal schedule for the first repository to go into operation; this would be the Yucca Mountain year of opening.

Geared to that schedule -- if you look, the total fuel in storage is 54,000 metric tons of heavy metal. But of that 54,000, fully 80 percent of it, 43,000, is expected to be stored in the pools. Only 20 percent, 11,000 metric tons, is expected to be in temporary storage or dry storage as we are calling it now. These casks or bunkers or modules that are going to be in the yard.

It's a very important point. Not only is it only about 20 percent, the rate of generation of spent fuel in that year, 2,300 metric tons per year, means that if the repository schedule slips somewhat the picture won't change overnight. There won't be an abrupt shift to a 20/80. It would take years before the amount in temporary storage would approach or later exceed the amount in cool storage. So keep this in mind, that in the system we are dealing predominantly in spent fuel with fuel in the pool, and only a fifth or so in the temporary storage.

May I have the next slide, please.

[Slide.]

Let's look at some typical spent fuel, or new fuel

for that matter. This is what it looks like when it goes in the reactor. The first assembly, you have a photocopy of it in your handout, this is a Westinghouse 17 by 17 fuel assembly, and this unit here, if you look at it, it's 17 fuel rods or fuel pins wide and the same square, giving you over 200 fuel pins. Now, this device up at the top here is actually a cluster of control rods, and that cluster of control rods is moved as a gang, as a group, and they occupy fuel pin spaces. And this is PWR fuel, Westinghouse reactor fuel.

If you look at the similar or competitive fuel by other PWR vendors, by Combustion Engineering or by Babcock and Wilcox or other vendors, the hardware differs somewhat but the characteristics are basically the same. You have the control rods entering it as a group from the top, and this is what comes out of the reactor at the end of, let's say, three cycles. Typically in a PWR there are three fuel cycles before the fuel is taken out as removed.

If I could have the next slide, please.

[Slide.]

This is a representative boiling water reactor fuel assembly. This one here is a BWR 6, that's the latest model BWR, and it's an 8 by 8. Boiling water reactor fuel assemblies are generally smaller in size, smaller in number of pins than pressurized water reactor fuel. This is 8 pins by 8 pins, notably different from PWR fuel because over here the control

blade -- it's a cruciform -- it enters the core from the bottom. Boiling water reactors are built upside down, and the control blade comes in from the bottom --

CHAIRMAN ZECH: I'm not sure everyone would agree with that.

[Laughter.]

MR. BERNERO: The control blade comes from the bottom and therefore there are no control rods in the fuel assembly itself, and the top of the fuel assembly has a lateral tie or a bale, -- some people call it a bale, it looks like a handle, just a simple handle on the top for picking it up.

[Slide.]

To give you an idea of the variation, I made up this table where I'm using the characteristics of the fuel you have just seen in the photographs as a typical dimension. Those are the fuel elements that are typical of a large, late model PWR or BWR. And in parentheses after each dimension, whether it be the inches of width or the feet of length or the weight in pounds, I have put the range of that dimension that you will find as you go from one reactor station to the other.

Now that range may look awfully broad; it's not as bad as it looks. It's skewed somewhat by a few strange examples or exceptional cases. Big Rock Point is a very small boiling water reactor, a very early model, and it constitutes this short fuel here, 6.8 feet long. Similarly, if you go to

this very high end, the 16.6 foot length in a PWR, that's South Texas. South Texas has exceptionally long fuel for U.S. PWRs.

So for the most part, what you have here is the spent fuel is not quite standard. We wish it were a little more standard, but basically they are clustered near this typical range for the most part. But whoever handles the spent fuel, whoever manages either a narrow, local system or a broad system for handling spent fuel has to take into account those variations in dimension.

There's one other dimension I'd like to single out and that is this MTHM, metric tons of heavy metal. You will generally see spent fuel projections always rendered to that common denominator, and it's useful to you to see I think that you have less than a half of a metric ton of heavy metal in a PWR assembly and only about a sixth of a ton in a BWR fuel assembly.

For perspective, just recall that a large PWR, Oconee size or a little bit bigger than Oconee, something on the order of 1000 megawatts, a pressurized water reactor in its 40-year life will irradiate or generate about 2000 spent fuel assemblies. Just to give you a sense of scale. And we're talking about 100 or more reactors so we're talking about an awful lot of fuel assemblies when you recognize that a boiling water reactor generates a higher number of fuel assemblies per megawatt or per thousand megawatts.

[Slide.]

Now we have some existing spent fuel shipping casks in this country. We've made a little table here of these casks and we caught a typographical error at the last minute, you see it marked on the slide up here. That TN-8L cask weighs 80,000 pounds, not 50,000. These casks are ones that are now certified, and you see there are a modest number of them in existence, but to my knowledge no more are being built.

COMMISSIONER ROBERTS: Who owns these?

MR. BERNERO: Different companies. For instance, a utility owns one of these IF-300's. Carolina Power & Light, they use it for trans-shipment. Different shipping companies and in at least one case a utility owned them. These casks are what you might call first generation casks. Notice that they're very heavy for the number of fuel assemblies they carry. Later on when we see the next table of the DOE expectations you'll see a much better weight to payload ratio.

The reason these casks are so heavy is they were optimized for a reprocessing cycle. This was in the days when people expected to hustle right out to a reprocessing plant and therefore they were going to carry in these casks fuel that was only four to six months out of pile. They were thermally constrained, activity constrained; and therefore, this optimization is no longer useful to us, because now we're dealing with fuel that is much, much older.

This is an obsolete set that is around for some use, and here's a picture of one, if we can turn to the next picture.

[Slide.]

This is an IF-300, the one I mentioned that one utility owns. It's a large cask, it holds seven pressurized water reactor assemblies or eight boiling water reactor assemblies, and here you see it on a crane hook about to be set down onto its railcar. Before shipment, that cask will be covered with an overpack and it looks basically like sort of a boxcar when it goes down the road because it has like a dirt shield and things like that, cooling box over it. And its shipping weight is 70 tons.

Now, I mentioned at the outset that we ought to note some differences from plant to plant. Not all plants have railroad sidings, not all plants could bring that cask in and load it at their pool. Some plants don't have a railroad siding, they have only truck cask access, or some way to move a rail cask down a road a little piece and get it on a barge. But they don't have an up-to-date railroad siding.

COMMISSIONER ROBERTS: But would it be fair to say that all plants either have rail or barge?

MR. BERNERO: No, I don't think so. I think you have some cases where they have --

COMMISSIONER ROBERTS: Truck is the only?

MR. BERNERO: Truck, rail or barge. Truck may be the only -- there's one in particular I'm thinking of like Palisades.

The thing is also that they don't all have 100-ton cranes. To life up one of these 70-ton casks or 80-ton casks -- and you know, they're really getting up in round numbers very close to 100 tons -- it involves a very heavy crane and not all plants have that. So there is part of the system problem.

[Slide.]

So DOE, as I said, has this long-range responsibility. They're trying to develop a transport fleet. Their focus is on the majority of the fuel. They're working 80 percent of the problem first, 20 percent of the problem later. They have a competitive process going on with companies like GA Technologies, Westinghouse, Nuclear Assurance and so on, and they are developing a spectrum of casks, truck and rail/barge casks, but notice -- much higher payload to weight ratio. The weight constraints you can infer from the previous slide which gave you the scale of 50 to 100 thousand pounds. And here, what you're talking about is because it's five and ten-year old spent fuel that you're dealing with, you can get more spent fuel assemblies in because you don't have quite the shielding requirements and you certainly don't have the thermal load requirement.

So the optimizing for DOE is of a transport fleet

that can take by standardized shipping wherever possible, standard rail shipments, standard barge shipments, nothing exotic, winter or summer, optimized to be a highly efficient transport fleet so that each one of these casks can be used over and over again. It's a transport device, it's a completely different thing than when we talk about the dry storage casks that may be shipped.

[Slide.]

Now if a reactor needs additional storage capacity, there are basically only three alternatives that they can face at this time. One is trans-shipment. Now, trans-shipment has been used. At one time or another the NRC has authorized Duke Power Company to ship from the Oconee station to the McGuire station. We authorized Carolina Power & Light to ship from the H.B. Robinson station over to the Brunswick station. So if you went out to Brunswick today you would find in the boiling water reactor pool, you would find pressurized water reactor fuel from the Robinson station.

Now that really is a temporary solution, of course. You can just get yourself a little flexibility, but it isn't a long-range solution. A few reactors were able to ship their fuel to the G.E. Morris facility. You know, the General Electric plant in Morris, Illinois, right across the road from the Dresden station is a large spent fuel pool now virtually full.

So that given that trans-shipment has taken care of essentially all it can, then the reactor owner looks at consolidation. Now consolidation means to reconfigure to a more compact design. Reconstitution of fuel is going on right now at Browns Ferry. You may have been briefed on that. There have been some problems with it and they're basically re-assembling fuel assemblies at the pool. But they're not squeezing them into smaller holes; they're still trying to get the fuel to go right back in the reactor and operate.

Consolidation is to take it apart so that you have the fuel rods or pins in one bundle and the hardware pieces in another, in a can of some sort. A few reactors have experimented with this, PWRs, and one is authorized to do this with their spent fuel but it's a rather slow operation, it's rather tedious, and in the long range I doubt very much that you'll see this as a standard solution because of the inherent difficulty, and I'll talk about that a little later.

And the last solution is dry storage, and here we see the basic solution for that 20 percent of the spent fuel between now and the beginning of the next millennium.

[Slide.]

So let's go into the dry storage. We are reviewing dry storage by means of topical reports so that licensees can apply referring to these topical reports, and we would have then a basis for our safety evaluation and findings. It's a

much more efficient way to do our licensing work and a more efficient way for them to do their applications. Now I'm going to talk about three samples and give you a perspective on the Castor V, which is a potentially dual-purpose cask, not only storage but later shipment; a NUTECH NUHOMS-7 which is a small, concrete bunker with a small canister in it, relatively small canister; and the Foster-Wheeler modular vault. Now all of these are approved safety evaluation reports with an SER.

[Slide.]

The first one we'll look at is at the Surry Nuclear Station, it's called the Castor V and it is a large cask. Here you see one on a transporter. It's basically a cast iron cask, sealed up so that the spent fuel is dry, blanketed with inert gas and held for storage over a 20-year period and you could renew that another 20 years. We've got confidence that this is very stable storage.

You see that it is packaged at the reactor, moved with this transporter and merely standing on a concrete pad. This is a security-covered area, there are security fences around it, and the reactor guard force is easily able to cover this. It's about a half a mile away from the plant. And with these robust casks, the spent fuel is amply protected from any mishap whether it be natural or a small plane crashing or something like that. The stuff is really solidly held in this cask. This is a cask that holds 21 PWR fuel assemblies, and

it's filled, sealed, stored all at the site, at the Surry site.

[Slide.]

This next one is a variation where the cask is not a single piece, it's not a single device; it is basically a concrete bunker or module and you build that somewhere in a flat spot in your yard and you put into it a canister holding spent fuel. Now this one here actually exists at the H.B. Robinson site, a PWR, and each one of those holes accepts a metal canister in which would be sealed seven PWR fuel assemblies. And the design that goes in it is called the NUHOMS-7 for the 7 PWR assemblies.

Now, that canister is just about the size of the filler that goes into a rail cask, and in fact, this company owns a rail cask, the GE IF-300 that you saw hanging on the crane, and they use it as a handling device here.

[Slide.]

In your slides you have a depiction, a cartoon series that shows you how these devices are filled and transferred, and I'll just very quickly walk through that. Basically, a shielding cask starts out at the pool and you put the spent fuel in it; in this case, seven fuel assemblies. The next thing that's done is to take that shielding cask, which is strictly temporary, and evacuate the water and all residual moisture and fill and seal that cask so now the spent fuel is dry and under inert gas cover; it's a sealed case.

Now that you've sealed it, you put it on some sort of local transporter -- in this case you can use a truck or if you have a railroad siding and access to the module you could use that. But for a local movement you can handle this with a big earth-moving truck. And then you take it out to the module.

You take it out to the module, on the bottom side of that cartoon you can see it, where you park next to the concrete module and there is a hydraulic ram actually that reaches through the module and pulls the canister into the concrete bunker. And you can re-use the transfer vehicle then; you just close the bunker up and you've got the canister in there.

At the end of the storage period when you take it out, you use the same ram assembly and push it out into a shipping vehicle or a transfer vehicle and you're prepared to go off either back to the reactor for rehandling into a conventional shipping cask or to have this be a shipping cask, and later on we'll talk about that for this particular model.

For your perspective I have also included an isometric drawing of the modular vault. This is the Foster-Wheeler design. There's no need to put that up on the screen. It's basically a spent fuel pool without the water in it. It's dry storage and one would transfer spent fuel from the wet pool at the reactor over to the dry pool, store it for the needed length of time and then at the end of that period transfer it

out into a cask and ship it to the repository or MRS.

May I have the next slide, please, on topical reports.

[Slide.]

Now we will still have some under review and I want to single out one of them because it's very important to a couple of applications we have. This is another NUHOMS design, only look at the number on this one, it's 24. This is what is called the NUHOMS-24P.

[Slide.]

And that 24-P you see is a canister that holds 24 pressurized water reactor fuel assemblies, and it's large. In fact, it's close to being a little too large to ship. Certainly one can debate that. There's no existing cask that accepts this envelope as there is for the NUHOMS-7. The NUHOMS-7, as I said, physically fits into an IF-300 cask.

This one here has a shielded plug on the end, and that might make it a little too long when you look at the total weight of shielding and the total shipment weight, so later on we'll talk about this one. But for the time being let's consider this one as not shippable. That's not a guarantee but right now there's no known solution.

[Slide.]

And if you look at this slide, you will see the module into which it goes is a variation on the same theme. It

is an air-cooled, concrete bunker, typically built in an assembly of four. So four canisters per bunker or per module, but everything works from one end. There's a blind end and an active end, and the whole hydraulic ram business works from one end only. And this is the Duke Power Company Oconee application; this is basically what they have applied for.

[Slide.]

We have talked about these license applications and I think it important -- in fact, the status even changed today for us. We have an application from Oconee and we received that in April of '88. We're on the verge of completing our environmental assessment. Oconee has formally asked us in writing if they can proceed with earth-moving starting next Monday without prejudice to their application. This is not construction. Oconee is not a prairie site, and they have to do some landscaping in order to prepare the flat areas for this. So Oconee has an application before us and I would expect our final licensing action will probably be just after the first of the year, although the environmental assessment should be done even this week.

Calvert Cliffs has told us they're coming in very shortly and we just received a press release today which indicates that they have selected a virtually identical design; the NUHOMS-24 modified only to fit their fuel, which is a Combustion Engineering reactor rather than a Babcock & Wilcox

reactor. So there would be five reactors would are dealing with basically one design.

We also have, for these two indicated here, Robinson 2 and Brunswick, Carolina Power & Light, the same company owns them, and they are proposing to resume licensing or use of the NUHOMS-7, that smaller one you saw earlier. That's the one they've used already. And at first, they will go to their Brunswick site and pick up the PWR fuel that's there and make more room in the BWR pool, and then later on they intend, we believe, to use the same design for the BWR assemblies, although you'll get more of them per canister because they're smaller fuel assemblies.

So all of these cases are very active, and we expect to be dealing with these licensing cases in the coming year as we proceed.

[Slide.]

Let me go away from the dry storage for a minute and talk about permanent disposal considerations. Remember ultimately, this stuff is going to go to a repository or MRS, and this is the end of the system path. Now there are some basic considerations here that are very important to any attempt to standardize or regularize what you do in the storage and transport end.

First of all, the final waste form has not been selected. It's not clear whether it will be fuel assemblies in

some sort of matrix that are buried, or it will be consolidated fuel rods which are buried. Most people think it will be consolidated fuel rods but it hasn't been selected yet, and there is concern about effective use of the repository space.

In some of the briefings on Yucca Mountain you may have heard that there are potential geometric limitations to the use of space because of different geological barriers and things like that.

In the use of that repository space it's a major consideration to look at the thermal loading. Basically, you're going into a long time scale process, you're going to let this fuel sit there in the ground with potentially alien chemicals around it, and there is a great need to control corrosion or reaction rates with other materials by careful design of the waste package to be as compatible as possible with the geologic materials.

Now there's a phrase that comes right out of our regulations, 10 CFR 60.113. It is that there shall be "substantially complete containment." One of the key elements of disposal safety -- and you go into our regulations and you'll find it, that whatever you put in that can should be trusted; we should have the confidence that it's going to be in that can, substantially contained, for 300 to 1000 years. So the confidence of safe disposal is what is at stake here.

Now, they will probably consolidate this fuel into

some bundles. The next slide, please.

[Slide.]

I just want to give you a little comparison of at-reactor consolidation versus at-repository or MRS consolidation. They are quite different. These operations are not alike.

If you go to a reactor, they've got a pool, they don't have a hot cell. You have an open pool underwater, and the people are working with some sort of grapples or manipulators in that environment, and what they've done so far is they've taken -- remember they're dealing with a rack that has square holes in it -- they've taken two holes and put cans in them. So they have empty cans in two of the rack holes, and then they go to two fuel assemblies somewhere adjacent to it and start breaking the latches, breaking the hardware apart so that they can pull out the fuel rods one or two at a time, and then you can fit all the fuel rods into one can and all the bits and pieces will about 10 percent fill the other can. This is at-reactor consolidation. It gets you roughly a factor of two in space utilization. It's unsealed for cooling in the wet pool, it's a canister necessarily shaped to fit the fuel rack.

At the repository or MRS, DOE is talking about a wholly different operation. They're talking a hot cell operation, and they're talking about something where you might take -- in fact some of their studies have drawn pictures of

this -- as many as 12 fuel assemblies into 1.1 cans, only the cans don't look alike. They're big, probably cylindrical, very large containers for spent fuel. They would be sealed for being the ultimate disposal package, and of course their design, their materials would be optimized for final disposal for that substantially complete containment.

So consolidation at a reactor pool is a temporary measure; it doesn't stand as a solution for the repository.

I'll skip the next slide, it's merely a list of the six alloys that are being considered right now for us in the final can by DOE. May I have the next slide on the staff analysis, please.

[Slide.]

In doing the environmental assessment for the Oconee application, we were trying to explore the environmental impact of requiring shipping certification of some sort. So what we did is we took the facts from the Oconee application and available information from other sources and we said, Let's take this application and look at two alternatives; a shippable dry storage container and an unshippable dry storage container. So we used the three Oconee plants, and it so happens their temporary storage requirement is just over 2000 fuel assemblies in their application, and we assumed ten-year old fuel before you pull it out, which is reasonable, and storage for 20 years, which is also reasonable.

We selected the IF-300 shipping cask because it exists, it's a known quantity, and it is of a fair size, and we did our risk analysis -- and this is risk of handling heavy loads in the reactor pool. There was a generic issue, A-36, that looked at this heavy load handling and we relied entirely on the analytical method and techniques of that so that we could have a common basis to understand how much extra risk is there suffered if you have an unshippable container and have to go back in the pool to reconfigure.

We took the Carolina Power & Light design, NUHOMS-7, and since it fit in the IF-300 cask we asserted that this thing is shippable. Now, Charles MacDonald here hasn't certified it and he'd be the first to tell you that, but for purposes of analysis we assumed it. We also assumed that the 24-P, that's the one that Oconee asked for, that Duke Power asked for, we said we assume it's unshippable, even though that's not yet established either.

So then we said, what is the impact difference between the two. And if you go to the next slide --

[Slide.]

-- you see the results again asserting that one is shippable and the other is not shippable, and what you find is that the unshippable one actually results in less personnel exposure, and if you go through the detailed analysis, and believe me this is down to the step-by-step analysis of what fraction of a

person rem do you get for putting the fuel in it, for seal welding it and so on, there is an economy of scale that you actually save dose -- although these are small numbers for over 2000 fuel assemblies -- from 532 person rem down to 204. And the risk figure -- and this is a rather artificial figure, it's very low -- if you look at this little symbol here, it should be P greater than 6.25 rem. That NUREG-0612 which did the heavy load analysis calculated the probability of exceeding a fraction of the Part 100 dose at the site boundary. Just a technique of analysis. And to have a 2 in a million or a 3 in a million chance of doing that is a very, very small risk. And so a 50 percent increase is not really particularly significant because the level of risk is so small, and this 50 percent increase comes from the additional handling.

The key variable is the cost. The NUHOMS-24P just about cuts the cost in two, and here again it's economy of scale. These dry-sealed canisters are stainless steel and they're rather ornate; you save a lot of money by going to a 24P. So in the Oconee case, the result indicates to us that it is not worth our pursuing the case with Duke Power saying hey, you'd better ship this thing, or, revert to the NUHOMS-7 or something like that.

The real message is that the process is already fairly ALARA, fairly close to as low as reasonably achievable. There is not a large health and safety risk at stake here;

there is a big cost risk, a big cost factor. So with that in mind, we looked on and we tried to draw some conclusions.

[Slide.]

If we look at what we see about the whole spectrum of activities in this system, the first conclusion we would draw is, as I said at the beginning, most of the spent fuel is going to go from the reactor pools to the repository, so it won't even get into the dry storage question. The majority of it is strictly going to be transported in a straight cask.

The fuel variety and site variety is going to dictate cask variety. Now, DOE is keenly aware of that and so are the utilities and they're working that end of the problem. That's why you see more than one truck cask and more than one rail/barge cask, and the fact that there is a truck and a rail barge.

In dry storage options, there are only modest safety ALARA benefits available. Not a whole lot from our jurisdiction, you know, health and safety, not a whole lot to be gained.

In the final disposal, there's a lot at stake from our health and safety point of view. Confidence in best disposal. The 300 to 1000 year substantially complete containment. It's probably going to be repository-specific. Now, we don't know that we're going to license Yucca Mountain, but the decision on what kind of a can and what alloy of the

can and so forth for that repository shouldn't be rushed. There is a health and safety stake there.

So we conclude that NRC ought to review a variety of cask designs, that just in the interest of the taxpayers and ratepayers, we ought to seek some modicum of standardization to have compatibility to a reasonable degree between storage and shipment wherever possible. But there isn't the stake there for us to force it.

[Slide.]

So if we look at the range of future actions, we've got three rulemakings that are involved here -- these are existing regulations -- only one of which is active with respect to these issues. Part 71 is the transport certification. This is for the transport casks and all the requirements thereto.

Part 72 is the separate storage licensing, the dry storage options, and that covers the MRS as well you know. We have a revision in process, in staff development, for a general license. By that I mean that the Congress told us that we should go out to get a better regulatory process for this additional storage, that we shouldn't end up with these cumbersome petitions for amendment to an operator, a Part 50 license, and that very cumbersome procedure. And what we are preparing and have essentially complete now is a technique whereby the staff would have reviewed a topical report in the

light of a Part 50 licensee using that device, that dry storage cask, and provided that you're a present Part 50 licensee with the necessary health physics staff, security staff, et cetera, et cetera and provided that you meet the constraints specified in the general license, you've got a license. You register and use that certified design, if you will. We have an amendment that we haven't yet brought forward to you that goes in that direction.

Now Part 60, we have a whole bunch of rulemaking in process on that and you know we just sent up a paper on that subject, the rulemaking strategy for sharpening and clarifying that, but none of those rulemakings speak to this compatibility or standardization issue.

And then of course we have these licensing cases that we've spoken of. Now what I would suggest that will stand as our range of future actions is we will bring forward to you this Part 72 license where acceptable designs for temporary or dry storage can be regulated in an effective way, and we will proceed with these licensing cases with the appropriate dispatch. But put simply, we won't force standardization.

That completes my presentation.

CHAIRMAN ZECH: All right, thank you very much. Questions from my fellow Commissioners. Commissioner Roberts? Commissioner Rogers?

[No response.]

CHAIRMAN ZECH: Well let me ask you a little bit more about standardization. First of all, why couldn't we have in those -- on the last slide I think it was you showed us the range of future actions. Why couldn't we have those rulemakings discuss standardization?

MR. BERNERO: Yes, we can. The Part 72 as presently drafted actually makes -- we use the term compatibility, as I recall, in the draft -- that the applicant for the design must make a showing that the issue of compatibility has been addressed to the extent achievable. Sort of as compatible as reasonably achievable.

Remember, DOE casks are not fixed designs yet and they won't be for about two or three years at a minimum, and the situation is still very fluid. We now have Oconee 1, 2 and 3 and Calvert Cliffs 1 and 2 coalescing into what I would call a single design. The natural economic forces are sort of bringing standardization, and so I would expect to see some sort of substantial progress toward developing a shippable container for this NUHOMS-24P or P prime, whichever, you know, this thing.

And we would intend in the Part 72 licensing to pursue it in that spirit, as compatible as we can make it in the taxpayers' and ratepayers' interests.

CHAIRMAN ZECH: Well, it seems to me that -- have you looked at the advantages and disadvantages of standardization?

It would seem to me that you've presented in your presentation a number of the problems. We all recognize the different sizes of fuel elements and so forth, but have you looked very carefully to see if there are others, at the advantages and disadvantages of standardization?

Frankly, it looks to me like we're suffering from the custom-built plants that we've been living with for a number of years, and a lack of standardization. Here we have at least an opportunity, even though it may be very difficult, to gain the advantages of scale and other advantages of standardization, and I just think that it's something that should be seriously considered.

But I'd like to hear a little bit more about what you've considered as far as the advantages and disadvantages of standardization.

MR. BERNERO: Let me ask for the third slide from the end, the one with results on a shippable and unshippable canister. We're pursuing a line in this regard that may illuminate the subject for you.

This one here, if we go back to these results, it's the one that gives the person rem and the risk and cost results. Number 24 I believe. If you look at those results and you say I recognize that the dose goes down with the larger cask or canister. If I look at that and then I say, what if someone developed a shipping capability for this canister. Now

think about it for a moment. The transport fleet that DOE is working on is a transport fleet that has to go summer, winter, spring and fall; it ought to go in regular trains not special trains, it ought to have all the bells and whistles that make it standard transport.

But these things if they are ever shipped are only shipped once. That big cask in the yard at Surry, the so-called dual-purpose cask. It's not intended to be shuttling back and forth between the repository and the reactor. No. It would be filled for storage and shipped once, if ever.

In that vein, we have been talking to people in industry who are working on this toward the possibility of standardizing at least a dual purpose cask, and maybe one of these large shipping devices or two of them, toward a possible certification for limited shipment. Could be special train, could be special season or something like that. And that's part of the "as compatible as reasonably achievable" initiative we would like to pursue.

But we can see in this particular case if you just take the numbers up there and certify a shipping container for the NUHOMS-24P, you would cut this person rem by another factor of two. You would cut this risk by a factor of two by eliminating certain handling. You won't change that cost necessarily because now you're in a different cost regime -- what does it cost to develop that shipping container and how

many times will it be used, there are other factors we don't have a handle on, -- but it will probably be a benefit. So that if there are some ways to ship this one as well as this one [indicating], we will have achieved a good deal of standardization for the power industry and we would have saved a fair amount of money.

But again, the health and safety, we're down in the tail of the curve, we're essentially ALARA.

CHAIRMAN ZECH: It would seem to me, though, that with a little imagination and innovation that we could perhaps come up with a better rationale that would show that for standardization there are significant advantages.

For example, if you design a cask for your longest and your widest fuel assembly, naturally that can fit them all. Now that's not necessarily practical because you'd have too much empty space, but you could maybe put fillers in it. So in other words, if we really force standardization, and from a safety standpoint in particular I think, we could say it's going to be safe. But maybe that's not the right thing to do because we're going to take it from the spent fuel pool perhaps to an MRS and then eventually to the repository; and of course the ideal situation would be something that would fit right into the repository.

So if you start backwards, if we knew what the repository was like -- and we don't. Is that correct?

MR. BERNERO: Yes. And that's where the most safety is at stake.

CHAIRMAN ZECH: I understand. But that I think is the problem we have. So if we could put a logic sequence that way and start from the repository, building backwards to the power plant, and if we could design a cask that would be transportable, I presume you'd have to have an outer cask, the transportable cask --

MR. BERNERO: A sleeve or something.

CHAIRMAN ZECH: -- which would enclose the inner cask. But in any case, what I'm trying to say is it seems to me that with that kind of a logic train we should do what we can to make, first of all, the cask safe -- that's the ultimate and prime consideration -- but in addition to that, make sure that it could be fit in the transportation cask and also fit, of course, the different reactor sizes. Now that doesn't mean we need one and only one cask, I don't have that in mind at all. And we might need several kinds. That means, though, that we'd have to have a repository that could accept the various sizes that we might accept.

So I just feel that if we allow all kinds of different cask sizes and shapes and forms at this stage, -- we're still making decisions on this -- if we allow that to happen, then down the road a piece several years from now we're going to have a real problem at the repository and have to

design the whole repository for custom-built plants. I'm trying to see if we can't avoid that. I think we'd end up with a better repository, a safer repository really, if we have a lesser number of different combinations and permutations.

MR. BERNERO: Mr. Chairman, let me respond to you. You recall we discussed this issue on August 10th at this very table, and judging from the telephone conversations, meetings, letters and everything else we've seen since, I think that 80 percent of the U.S. industry has read the transcript of that meeting -- the DOE, the various appropriate industry groups and the individual utilities involved, they have not only read the transcript, they have heard us, they understand the issue, they understand the question, and some of them are even here in this room listening to this meeting because of that intense interest.

We met with the Electric Power Research Institute and two utilities just last Friday on this subject. We have a very active dialogue not only with the license applicants but with the other agents that can and I believe will bring around this standardization, this minimization of designs. We don't want a proliferation of solutions. And I was quite pleased. I just received that press release today as I came into this room on the Calvert Cliffs selection, which basically says, we want to standardize to the same thing Duke Power has.

And I think the forces are there. The interest of

this Commission and the willingness to pursue the subject has them listening and has them acting. And there has even been specific dialogue between the Department of Energy on their transport fleet and this NUHOMS-24P. Remember I mentioned the big shield plug at the end? If there's a way to noodle with that design a little bit and still serve a good, solid, reliable dry storage function and yet fit the transport cask and minimize one further step, minimize one further proliferation of design.

CHAIRMAN ZECH: Well, I appreciate the interest of the utilities and other parts of the industry in this regard and what I would like to do is to challenge them to assist us in trying to come up with standardized casks. It seems to me that they have talent to bear on this that could perhaps assist us in making a better decision perhaps than we made 30-some years ago when we just didn't think of standardization at all apparently, or if we did it didn't turn out that way.

So I think it is good, and I would encourage the utilities and the industry to give any thoughts that they could to this very important problem because we're really involved in storage for very long periods of time, as you've mentioned. The public health and safety is involved.

I think if we come up with a cask or casks that have the confidence that we want, that we demand and that the public wants, we're going to be an awful lot better off. And I would

rather not see a proliferation of design applications for casks.

First of all, it's not only going to task your ability to review all those applications, and our resources are involved to a degree and that's important of course, but more importantly I think if we can come up with a cask or casks that show some discipline and trying to come up with casks that can be used by different types of reactors hopefully, I think we'll be simplifying the whole process. And again, I think that if we can simplify it, standardize it, we will be contributing to safety factors because it will at least preclude us from making a completely different design at the far end -- by that I mean at the repository.

I think there are advantages to it, and I would hope that we can continue to pursue those.

COMMISSIONER ROBERTS: May I ask a question that relates to that? Slide No. 7, existing spent fuel cask, you said one of them was owned by CP&L. These different model numbers, I'd like to know who designed and manufactured these, or if two different entities, one designs and somebody else manufactures -- what entity would you identify Model NL-1/2 with, and IF-300 and so forth?

MR. BERNERO: Chuck, could you answer those?

MR. MacDONALD: The NL-1/2 and the NL-10/24 were designed by NL Industries, and they were designed to service

the Agnes, the Barnwell facility. They are now operated on lease to Nuclear Assurance Corporation.

The TN-8L and the TN-9 were designed by Transnuclear in New York. They also have companies in Europe and outside the United States. Those casks were fabricated in France by Robotelle. During the fabrication the NRC did inspect in France the fabrication of those casks. The NLI casks were fabricated in Wilmington, Delaware.

The IF-300 was designed by the General Electric Company, and its design was primarily to serve the G.E. Morris facility which was an early reprocessing facility which is now used for storage. Three of those casks were sold -- well, all four have been sold. One a utility owns, the other three are owned by Pacific Nuclear Systems. These casks were fabricated by I believe Stearn Rogers in Denver, Colorado.

COMMISSIONER ROBERTS: That answered my question, thank you.

CHAIRMAN ZECH: Commissioner Rogers?

COMMISSIONER ROGERS: Well, just one point. It seems to me that one could separate the question of standardization of those casks which are to be shipped and which might be the actual cask that is stored in a repository -- standardization of that type of device from standardization efforts for on-site storage to meet the temporary needs of a particular situation such as apparently is developing, where the utility is willing

to take the risk that that particular design may not be certifiable for transport or useful beyond on-site storage. And it seems to me that perhaps we could separate the priority of standardization, the degree of priority we assign to standardization, in those two different applications.

I agree with the Chairman very much that it seems to me that those casks which we look forward to being used to transport and ultimately store the spent fuel, it would seem to be very desirable to try to push for standardization as much as possible there. Obviously, you're hampered by all the factors that you've mentioned of the particular site and fuel designs; also, that nothing is known really about the other end, the final resting place in the repository.

But I am a little concerned that we hold up any consideration of on-site storage to meet acute needs for standardization of those if the utility is willing to say they're prepared to accept the fact that they may have to use a totally different cask for transport and ultimate storage and would bear the cost of that.

MR. BERNERO: The utility in question, for instance, Duke Power, their application actually is based on the inability to ship the NUHOMS-24P. All of their analysis, and that was part of our Environmental Impact Assessment, -- their analysis all assumes it goes in the yard for the 20 years and then comes back into the spent fuel pool, is cut open and the

stuff is transferred to a transport fleet cask.

Nonetheless, they are interested and they have already had some dialogue with DOE on it. Now, DOE is interested; they have an economic incentive (a) to have a standardized shipping fleet or transport fleet, and (b) wherever possible, to pick up, now that there are five reactors using this 24P, it just accelerates that incentive.

You may be aware, we have a letter coming forward to you for the Chairman's signature. It's our comments on the DOE dry cask study, and that letter -- I've lost track, it's either up to you or will be up to you in a day or so -- in that letter we single out this issue and we say, you know, the system engineering, you really ought to accelerate or increase your system engineering here because that is the case. Their dry study didn't go into this quite as much as it should have. But we think they're listening.

Now as far as holding up the utility, we are not doing that. We're conscious of the operational safety considerations with the Oconee plant and with the others as they come up, and the utility is keenly aware of that, and there is every priority being given to avoid any such constraint. We don't want to impact on operational safety at all.

But I think, as I said before, 80 percent of them are going to read this transcript, too, and they're listening.

It's abundantly clear that they're listening.

The waste management group that the industry uses to follow this, we've had a letter from them asking for a conference on this; they're prepared to meet to pursue this, and again, it's toward the common interest of -- you can call it standardization or compatibility or optimizing of system management. That's really what it is. There is no single system manager, but everyone recognizes now the benefit of optimizing system management. So I think we all have the same objective now.

COMMISSIONER ROGERS: Are there any mechanisms in place to help to assist that approach?

MR. BERNERO: Well, the utility nuclear waste management group, which is the one that handles all of this, they have an annual capacity report process and you'd never guess that that is a subcommittee that looks at things like this; you know, where are we going and how are we getting there. And they have the mechanism by which to do this. Now they've got some sort of an affiliation through the NUMARC activity, but basically, on waste handling or waste management activities, these are the people we talk to.

And then they have activity going on through the Electric Power Research Institute and, the Electric Power Research Institute in turn has a link to the Japanese research program on dual purpose casks and things like that. And so the

mechanisms do exist and we're tied into those mechanisms. We're following this closely. And as I say, I think the general interest and the general objective is the same; optimize the system.

COMMISSIONER ROGERS: Is there any possibility that settling on a cask design would -- if any particular fuel designs just didn't quite fit that, -- is there any possibility that future fuel fabrication could tailor in any way, trim a little bit here or there? Is that totally frozen, fuel design, for each reactor, or is there no accommodation -- ?

MR. BERNERO: I would say as a practical matter it is. Actually, the South Texas plant didn't expect to be a maverick; it expected to be the first of a new set of standard plants. I think if you cut two and a half feet off the length of that fuel you'd pay in megawatts some way or another.

COMMISSIONER ROGERS: I wasn't thinking of anything quite that extreme, but you know --

[Laughter.]

MR. BERNERO: Well, in that case it's two and a half feet too long to fit in the can. No. I think the cases like South Texas or Big Rock Point at the other extreme --

COMMISSIONER ROGERS: We're talking about a couple of inches.

MR. BERNERO: Well, I honestly don't know whether -- they all differ in length by a couple of inches one way or

another, and I suspect you can exercise a certain amount of flexibility. I would be very reluctant to go into that.

We and DOE would both like to see an envelope that could take all of that variation or go to the outside, but whether you can take South Texas remains to be seen. But there will be some off-optimum shipments. You know, Big Rock Point is going to rattle in a big can, no question about it.

CHAIRMAN ZECH: Maybe I'll ask the General Counsel if he had a comment.

MR. PARLER: Mr. Chairman, thank you. This dry cask storage report by DOE that Mr. Bernero referred to is a requirement of the National Waste Policy Act as amended a couple years ago. The report was due October 1st, 1988, but if the Commission has any thoughts or suggestions, et cetera, that would be one of the places where the views could be expressed.

The other thing that perhaps I commented on at the August meeting, at least from my perspective, I've heard several times now that there's not one system manager, et cetera. I always thought that in the area of nuclear power and nuclear materials, if there was guidance, direction, strong suggestions, those things were supposed to come from this agency. That's one of its main reasons for being.

And it seems to me that if there is something like that to be given; that is, guidance, suggestions or direction, that we can do a little better than forcing people to read

transcripts of Commission meetings to make up their own minds.

Those are my thoughts. I thank you for letting me express them.

CHAIRMAN ZECH: Appreciate that. I, too, would just like to make a brief comment on that, it seems like nobody is in charge. I would like to think that at least we are taking the lead, and certainly in our area of public health and safety responsibilities. And one of your first slides shows the system and describes that. I recognize that utilities are involved, DOE is involved, other folks are involved, but I'm inclined to agree with the General Counsel that if it involves nuclear materials and involves public health and safety, that at least we'll take charge until somebody else does. So I'd like the staff to feel like you have the charge to take charge and to make sure, unless we're told that someone has the authority and has the cohesive intent to bring it all together, that we take the lead. And I think that's certainly something that should not prohibit us or inhibit us from making the decisions we think are necessary in accordance with the National Waste Policy Act.

It also just occurred to me that you know, you mentioned the waste management group in the industry. Is that a part of NUMARC or not?

MR. BERNERO: As I understand it, not exactly. NUMARC is closely coupled with them but they're not exact a

part of NUMARC.

CHAIRMAN ZECH: Well, it seems to me this is kind of a natural for NUMARC unless there's another waste group that they have deferred to in this area. But I would hope that we would get some utility group, some industry group perhaps that would be a focal point to assist us in this area. And I think they, too, could contribute to our responsibilities as far as public health and safety is concerned.

MR. BERNERO: Mr. Chairman, the staff has been assertive in this matter in the recent past and will continue to be assertive. Hugh Thompson and I have personally talked to NUMARC about this, to make sure that we have the full attention of the industry authorities on this.

We have talked repeatedly to DOE and as we said, we are now responding to DOE's comments. I might add that on that dry cask storage study, DOE got an extension of some sort, and our comments are due on October 28th, and not long thereafter, about two or three weeks later I believe you are going to have a briefing from Charles Edward Kay, Ed Kay of the Office of Civilian and Radioactive Waste Management, and it might be an appropriating thing to discuss with him at that time.

But rest assured the staff will press and will continue to be assertive in this to provide the leadership necessary to make sure that the system is optimized.

CHAIRMAN ZECH: All right, fine, that's exactly what

we should do until we've decided otherwise, as far as I'm concerned. Take the leadership role and pull the threads together, ask the utilities, the industry for their recommendations and others who may be involved and interested in it. I think we're trying to make an important decision regarding casks.

I do think if Commissioner Carr were here today -- and I know he regretted missing this meeting -- because of his keen interest in standardization, I think he would have echoed some of the comments and perhaps have made some other thoughts that he may have on standardization. He has a keen interest in it, too.

And my interest is really, I guess, kind of in a generic sense because we seem to do so many custom-built decisions and custom-built certifications that when we have a chance to get the benefits of standardization, to discipline our own system as well as perhaps contribute in a more significant way to a better product, better public health and safety, then we should do so.

So I think it would be useful also to have the staff provide the Commission a paper about the resources that you're intending to use for this subject of handling the license applications. I think that would be useful for us to see. The concern I have is that frankly, if we don't discipline our own system we'll find ourselves trying to certify a great number of

designs and get away -- not only get away from standardization but be a very great tax on our own resources.

So I hope that our review material that we have out that shows the criteria that we're expecting to have is explicit enough to give the guidance necessary for those interested in applying for the certified design, to show that we're looking for rather specific type criteria and perhaps that will help in standardization. If that's not the case I would ask the staff to take another look at that to be sure you're satisfied.

Any other comments?

[No response.]

CHAIRMAN ZECH: Thank you very much, appreciate it. We'll stand adjourned.

[Whereupon, at 3:20 p.m., the Commission meeting was adjourned.]

CERTIFICATE OF TRANSCRIBER

This is to certify that the attached events of a meeting of the U.S. Nuclear Regulatory Commission entitled:

TITLE OF MEETING: COMMISSION BRIEFING ON CASK DESIGNS FOR SHIPPING AND STORING OF NUCLEAR MATERIALS

PLACE OF MEETING: Washington, D.C.

DATE OF MEETING: WEDNESDAY, OCTOBER 19, 1988

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.

Suzanne Young

Ann Riley & Associates, Ltd.

Revised

COMMISSION BRIEFING

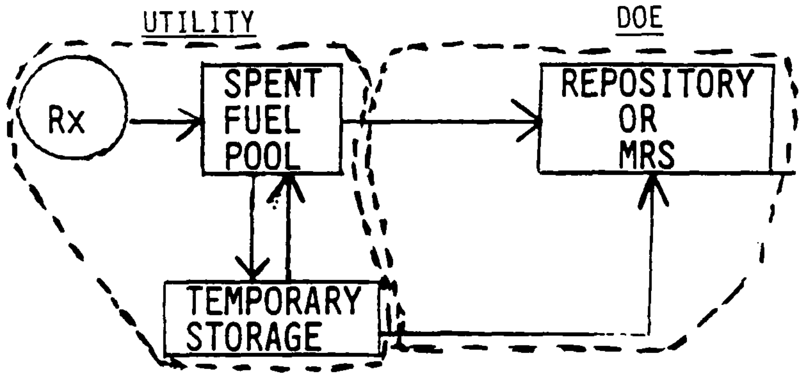
ON

CASK DESIGNS FOR

SHIPPING AND STORING OF NUCLEAR MATERIALS

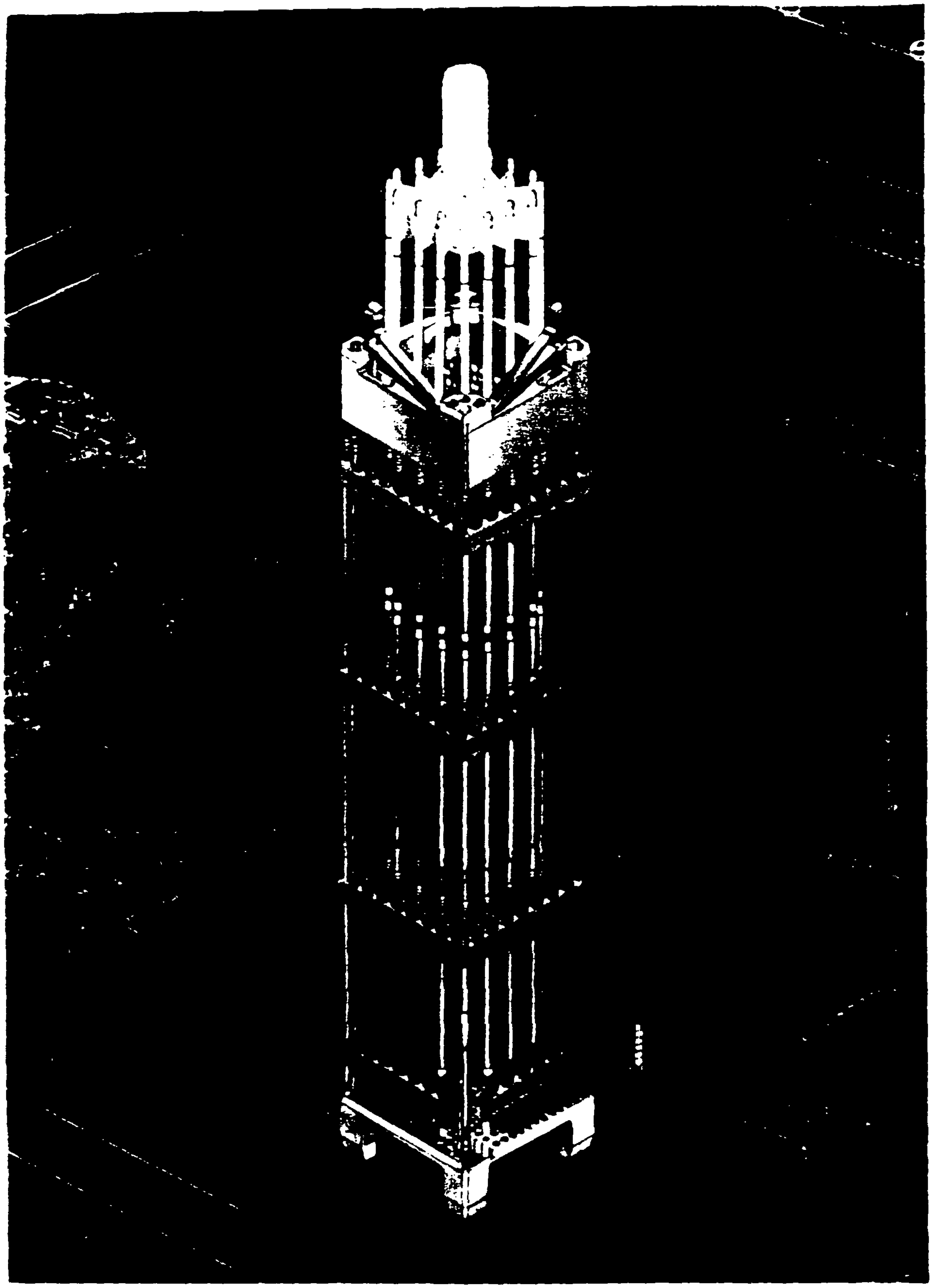
OCTOBER 19, 1988

THE SYSTEM


UTILITY
DOE
Rx
SPENT FUEL POOL
REPOSITORY OR MRS
TEMPORARY STORAGE

SPENT FUEL STORAGE REQUIREMENTS IN YEAR 2003

- TOTAL SPENT FUEL DISCHARGED: 54,000 MTHM
- MAXIMUM REACTOR POOL STORAGE CAPACITY (WITH RERACKING): 43,000 MTHM
- ADDITIONAL STORAGE CAPACITY REQUIRED: 11,000 MTHM
- SPENT FUEL DISCHARGE RATE: 2,300 MTHM/YR



[illegible] FUEL ASSEMBLY

BWR/6 FUEL ASSEMBLIES & CONTROL ROD MODULE

[illegible] GUIDE
[illegible]ANNEL
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SPRING

GENERAL ELECTRIC

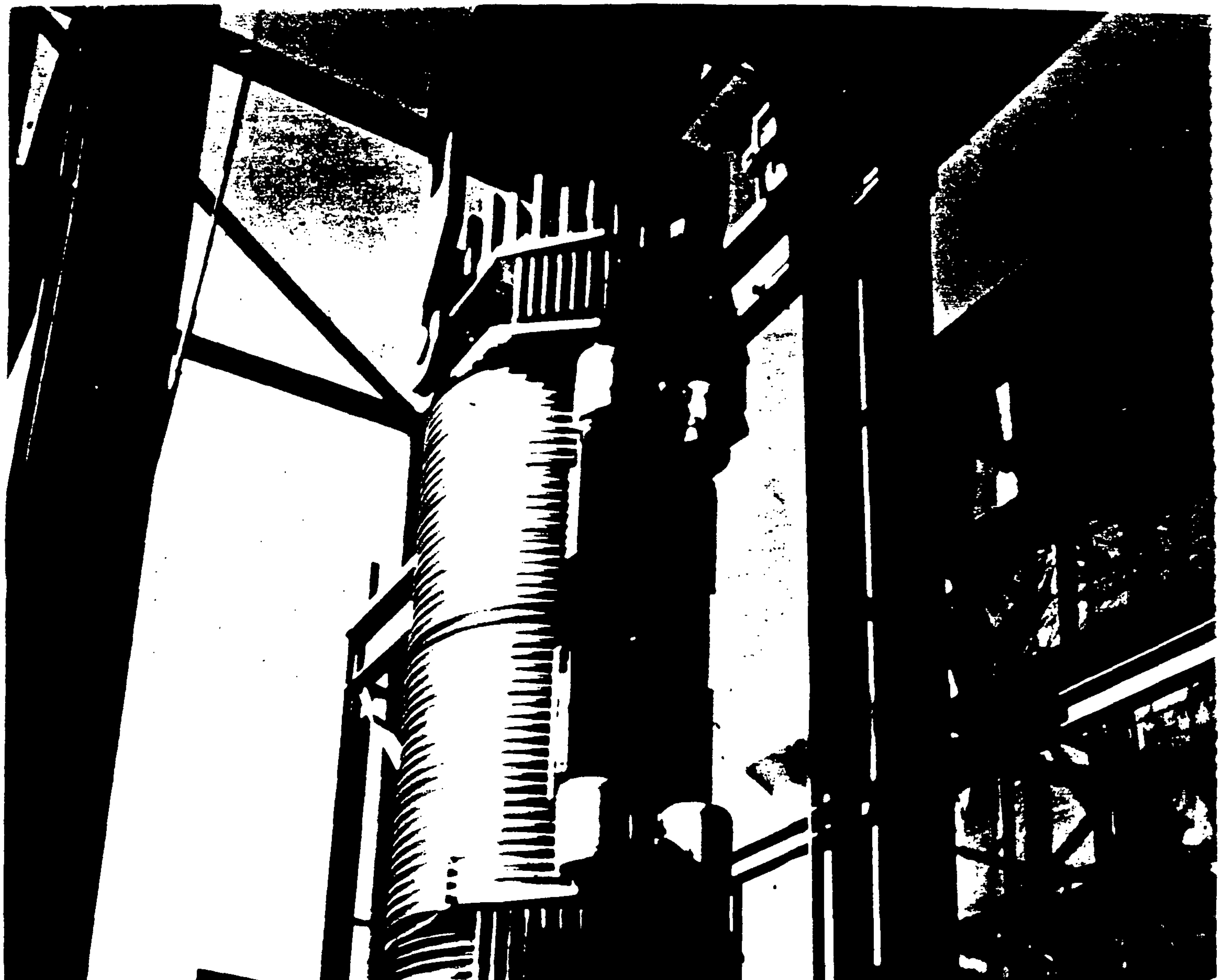
LWR FUEL ASSEMBLIES

PWR	TYPICAL DIMENSION (RANGE)
WIDTH	8.4 INCHES (7.6 - 8.5)
LENGTH	13.3 FEET (11.4 - 16.6)
WEIGHT	1,482 LBS (1,096 - 1,515) (0.464 MTHM)

BWR	
WIDTH	5.2 INCHES (4 - 6.5)
LENGTH	14.3 FEET (6.8 - 14.7)
WEIGHT	562 LBS (328-619) (0.174 MTHM)

EXISTING SPENT FUEL CASKS

Model	Capacity	Weight-lbs.	No. Built
NL-1/2	1-PWR or 2-BWR	50,000	5
TN-8L	3-PWR	~~5~~80,000	2
TN-9	7-BWR	80,000	2
IF-300	7-PWR or 18 BWR	140,000	4
NL-10/24	10-PWR	195,000	2



DOE OCRWM CASKS

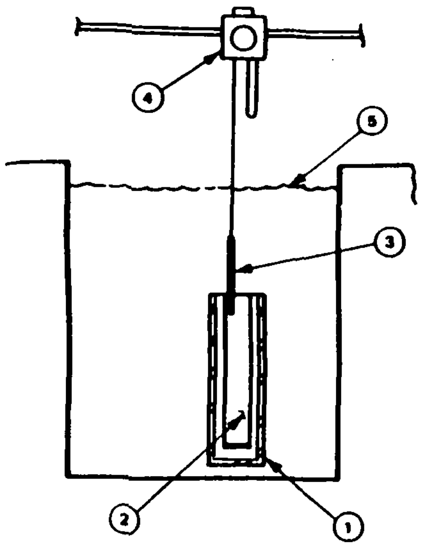
COMPANY	MODE	CAPACITY
GA TECH	TRUCK	4 PWR 9 BWR
WESTING.	TRUCK	4 PWR 9 PWR
NUC. ASSUR.	RAIL/BARGE	26 PWR 52 BWR
NUC. PKGG.	RAIL/BARGE	21 PWR 48 BWR
B&W	RAIL/BARGE	24 PWR 49 BWR

ALTERNATIVES FOR ADDITIONAL CAPACITY

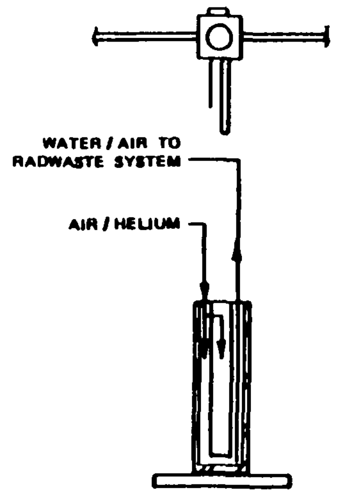
- O TRANS-SHIPMENT (INTRA-UTILITY)
- O FUEL ROD CONSOLIDATION (STORAGE IN REACTOR POOL)
- O DRY STORAGE

DRY STORAGE TOPICAL REPORTS APPROVED WITH SER

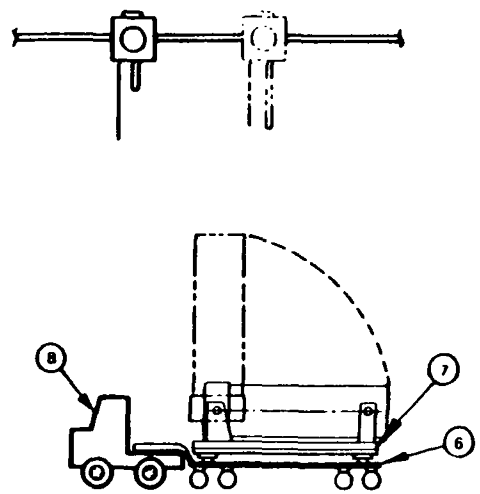
- O GNSI CASTOR V/21 NODULAR CAST IRON CASK DESIGN; 21 PWR ASSEMBLIES
- O WESTINGHOUSE MC-10 FERRITIC STEEL CASK DESIGN; 24 PWR ASSEMBLIES
- O NAC, S/T STAINLESS STEEL CASK DESIGN; 26 PWR ASSEMBLIES
- O NUTECH, NUHOMS STAINLESS STEEL CANISTER/CONCRETE MODULE DESIGN; 7 PWR ASSEMBLIES/CANISTER
- O FOSTER-WHEELER MODULAR VAULT DRY STORAGE, CONCRETE STRUCTURE; 83 PWR OR 170 BWR/MODULE



CASK LOADING

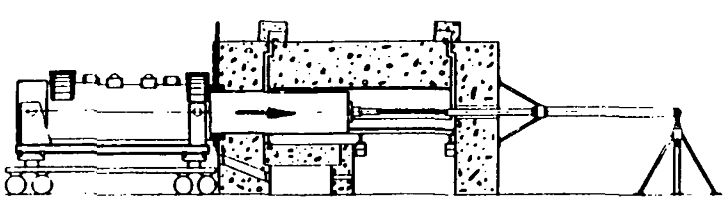


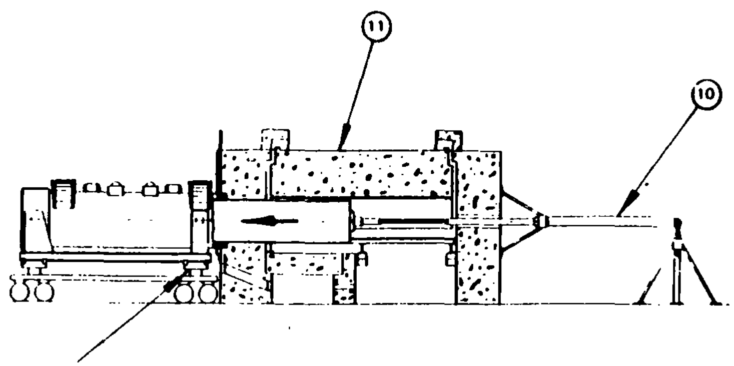
CASK / CANISTER DRYING AND SEALING



SKID LOADING

1. TRANSPORT CASK
2. DRY SHIELDED CANISTER
3. IRRADIATED FUEL ASSEMBLY
4. OVERHEAD CRANE
5. IRRADIATED FUEL STORAGE
6. TRANSFER TRAILER
7. SKID
8. TRUCK
9. HYDRAULIC POSITIONERS
10. HYDRAULIC RAM
11. HORIZONTAL STORAGE MODU
12. HORIZONTAL ROLLERS





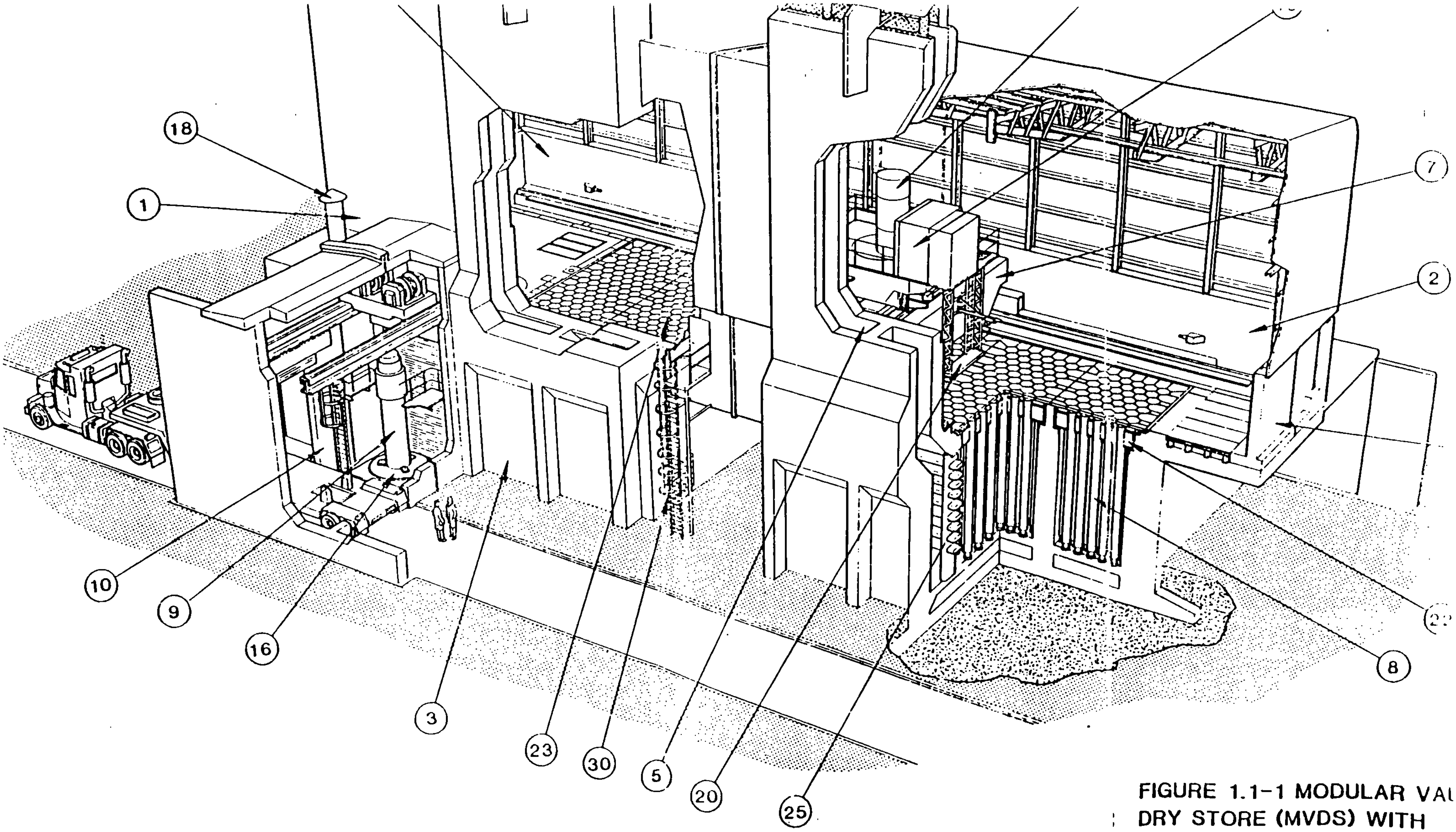


FIGURE 1.1-1 MODULAR VA
DRY STORE (MVDS) WITH
EXTENSION BUILDING

REVISION

DRY STORAGE TOPICAL REPORTS UNDER REVIEW

- O COMBUSTION ENGINEERING, DRY CAP FERRITIC STEEL CASK DESIGN; 24 PWR OR 60 BWR ASSEMBLIES
- O TRANSNUCLEAR, TN-24 FERRITIC STEEL CASK DESIGN; 24 PWR ASSEMBLIES
- O NUPAC CP-9 CONCRETE CASK DESIGN; 9 PWR ASSEMBLIES
- O NUTECH NUHOMS - SS CANISTER/CONCRETE MODULE DESIGN; 24 PWR ASSEMBLIES/CANISTER
- O OTHER: NAC CONSOLIDATED FUEL CASK DESIGN; 28 CANISTERS (RODS FROM 56 PWR ASSEMBLIES)

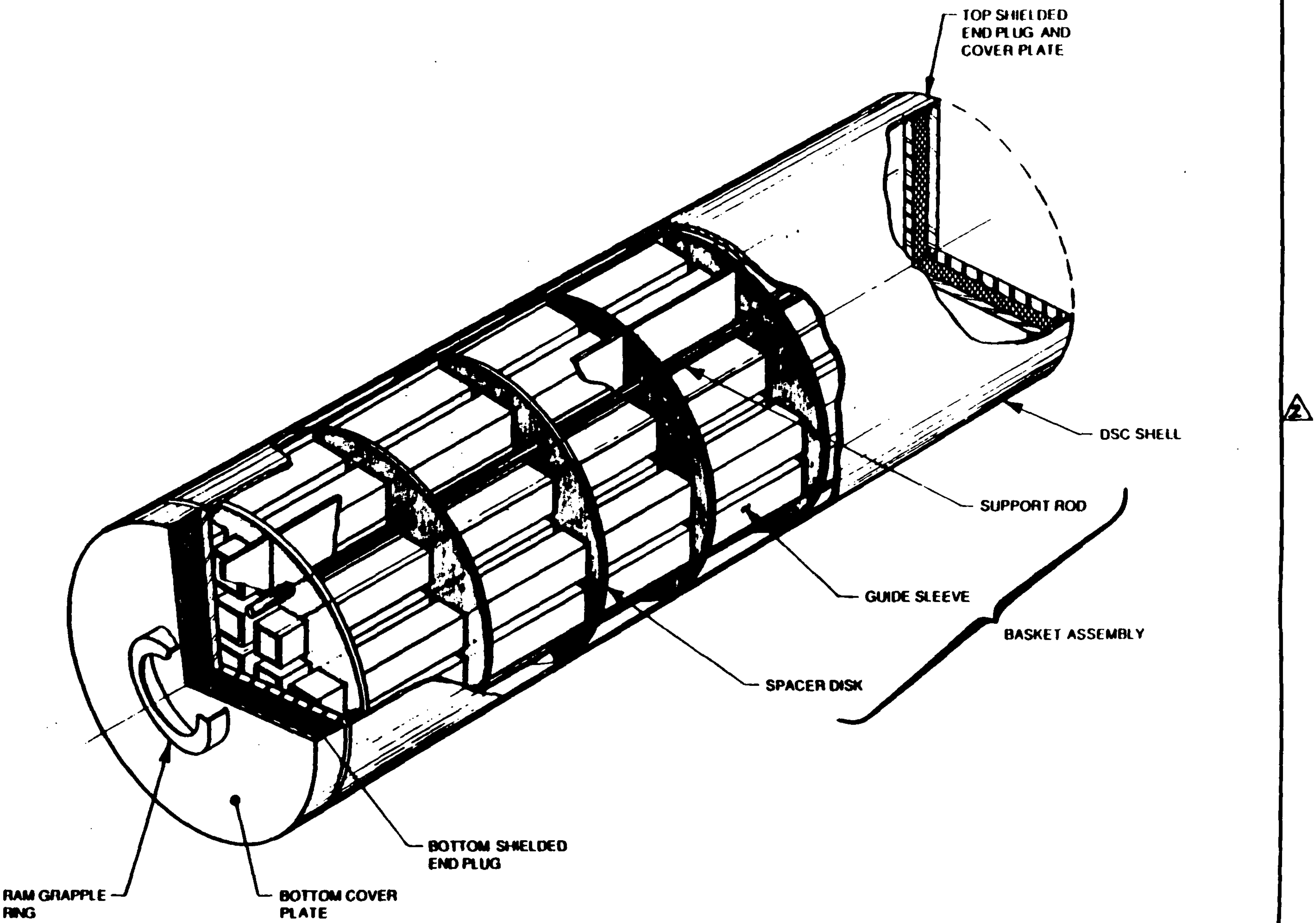


Figure 1.3-1

NUHOMS-24P DRY SHIELDED CANISTER ASSEMBLY COMPONENTS

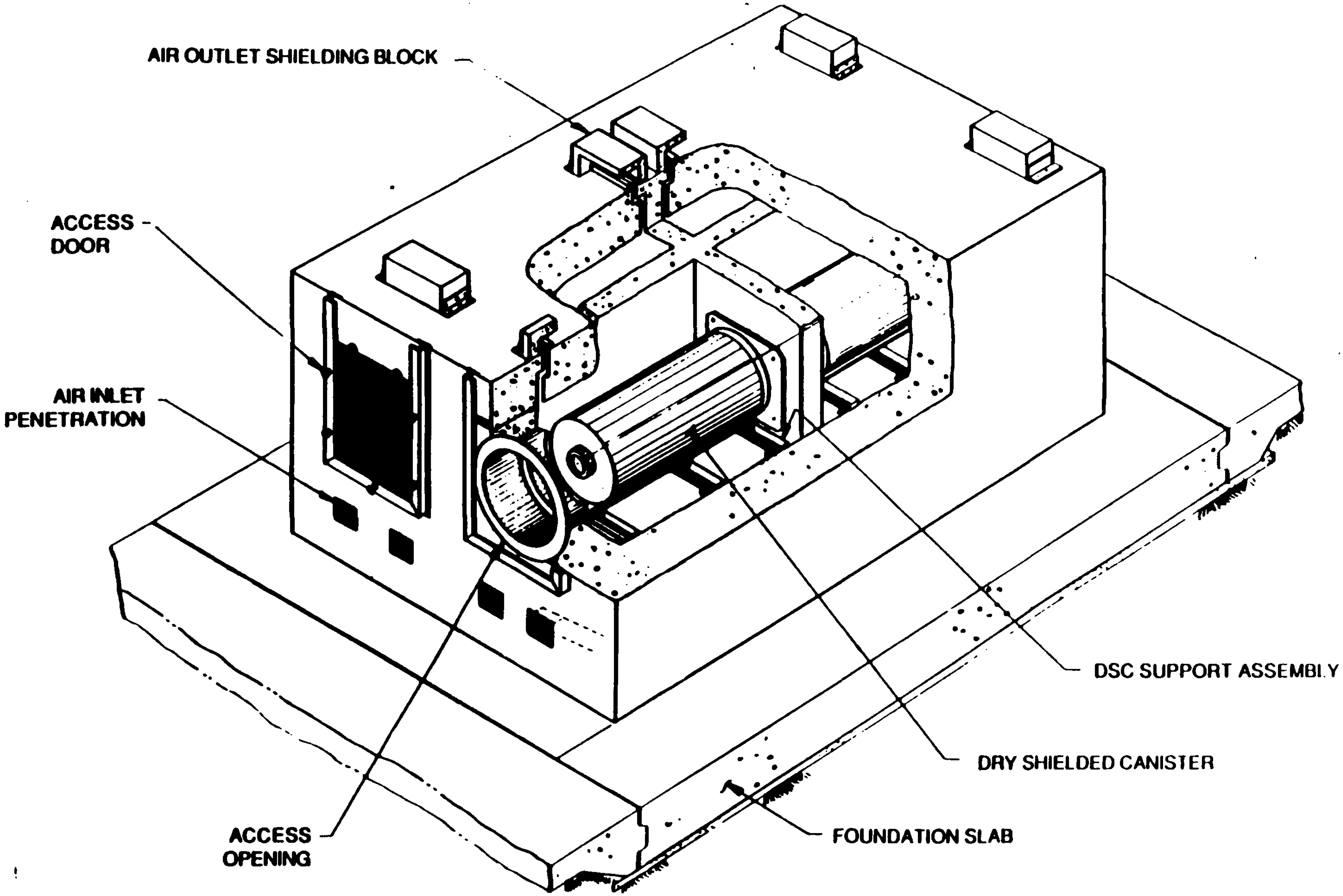


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Figure 1.3-1a

NUHOMS-24P HORIZONTAL STORAGE MODULE COMPONENTS

LICENSE APPLICATIONS

SITE	RECEIPT
OCONEE (DPC)	4/88
CALVERT CLIFFS (BG&E)	1/89
ROBINSON 2 (CP&L)	EARLY 89
BRUNSWICK (CP&L)	EARLY 89
PALISADES (CP)	1989
SEQUOYAH (TVA)	1992

PERMANENT DISPOSAL CONSIDERATIONS

- O WASTE FORM
  - FUEL ASSEMBLIES
  - FUEL RODS
  - EFFECTIVE USE OF REPOSITORY SPACE (70,000 MTHM AT YUCCA MTN.)
- O THERMAL LOADING
  - CONTROL OF CORROSION/REACTION
  - WASTE PACKAGE
  - GEOLOGIC MATERIALS
- O SUBSTANTIALLY COMPLETE CONTAINMENT
  - FUNDAMENTAL ASSURANCE OF SAFE DISPOSAL
  - PACKAGE MATERIALS
  - PACKAGE DESIGN

CONSOLIDATION COMPARISON

O AT REACTOR
- DONE IN OPEN POOL UNDER WATER
- 2 INTO 1.1
- UNSEALED FOR COOLING
- CANISTER SHAPED LIKE FUEL ASSEMBLY TO FIT POOL RACK

O AT REPOSITORY/MRS
- DONE IN HOT CELL
- ABOUT 12 INTO 1.1 (LARGE)
- SEALED FOR DISPOSAL PACKAGE
- PACKAGE DESIGN AND MATERIALS OPTIMIZED FOR DISPOSAL CONTAINMENT

CANDIDATE MATERIALS FOR HLW DISPOSAL PACKAGE

- O TYPE 304L STAINLESS STEEL
- O TYPE 316L STAINLESS STEEL
- O IRON-NICKEL ALLOY 825
- O CDA 102 (OXYGEN-FREE, HIGH CONDUCTIVITY COPPER)
- O CDA 613 (8% ALUMINUM BRONZE)
- O CDA 715 (70 CU-30NI)

STAFF ANALYSIS OF TWO ALTERNATIVES

- O BASED ON OCONEE APPLICATION
- O 3 PLANTS/2112 PWR ASSEMBLIES
- O 10 YEAR COOLED FUEL, STORED FOR 20 YEARS
- O IF-300 SHIPPING CASK
- O RISK BASED ON NUREG-0612 (GI A-36)
- O NUHOMS-7 ASSUMED SHIPPABLE
- O NUHOMS-24P ASSUMED UNSHIPPABLE

RESULTS	SHIPPABLE CANISTER	UNSHIPPABLE CANISTER
	NUHOMS-7	NUHOMS24P
DOSE	532 MAN-REM	204 MAN-REM
RISK (P 6.25 REM)	2×10^{-6}	3×10^{-6}
COST	$58M	$34M

CONCLUSIONS

- O MOST SPENT FUEL WILL TRAVEL FROM REACTOR POOLS TO REPOSITORY/MRS
- O FUEL VARIETY AND SITE VARIETY DICTATE CASK VARIETY
- O ONLY MODEST SAFETY/ALARA BENEFITS AVAILABLE IN DRY STORAGE OPTIONS
- O FINAL DISPOSAL CASK WILL PROBABLY BE REPOSITORY-SPECIFIC, RELIABLE COMPLETE CONTAINMENT AT STAKE
- O NRC SHOULD REVIEW VARIETY OF CASK DESIGNS - AS COMPATIBLE AS REASONABLY ACHIEVABLE

RANGE OF FUTURE ACTIONS

RULEMAKING

- O PART 71 - TRANSPORT CERTIFICATION
- O PART 72 - SEPARATE STORAGE LICENSING
  - COVERS MRS ALSO
  - REVISION FOR GENERAL LICENSE AT REACTORS IN PROCESS
- O PART 60 - HLW DISPOSAL

LICENSING

- O DUKE POWER COMPANY - OCONEE
- O CP&L - H. B. ROBINSON, BRUNSWICK