The next I wanted to highlight one of the things that we've done which is developed a fairly effective program of electronic communications and interactions with the states. This is our website (http://www.hsrd.orni.gov). There's a host of information on this site dealing with our program and in dealing with the states. There are state directories.

There are all of our letters and other information that is there. All of the program reviews. Copies of all of the reports and the letters are there. There are related links to documents. Sealed source and device registry. We maintain copies of all the sealed source and device registry sheets and so on. I wanted to just highlight this. It's a good source of information on the program. That covers the area that I wanted to cover here in terms of maybe giving you a broad overview of the program. I will be pleased to answer any questions.

VICE CHAIRMAN WYMER: Thank you very much, Paul. That was a specific overview. Most of this has been in effect since the early 1980s. Is that approximately right?

MR. LOHAUS: The program went into place in the early 1960s in terms of the agreement state

program. Our IMPEP program has been effective since 1995 timeframe I believe. It started in 1995. Prior to that time we had a different process. We had 30 very prescriptive indicators. What we tried to do was make this program outcome and performance based. So we're looking at the performance and if we find problems in the performance we're going to go behind that and look at why they are experiencing performance problems.

VICE CHAIRMAN WYMER: I must say we have a much better understanding now of this program is then we had when we first drafted our letter. I'm glad we have it. Are there any questions here?

MEMBER GARRICK: I just have a simple one or two. Is that okay?

VICE CHAIRMAN WYMER: No, John. You can't do that.

(Laughter.)

MEMBER GARRICK: I was very interested in your discussion about the technical assistance and the form that it takes. Can you give the Committee a sense of the magnitude of the effort in some parametric way such as the number of FTEs that are pretty much consumed in providing technical assistance to the states and then the other number that I would

be very interested in is the total effort in terms of FTEs in support of the state because a lot of it probably procedural and meetings and conferences and these working groups that you talked about and what have you and not really as much technical?

MR. LOHAUS: What I can do is provide that information to you. I can give you a sense today but in terms of the actual let's say what we budget for the program I don't have all that information here. But I want to differentiate between what I might want to term direct licensing or inspection technical assistance and we've only had occasional cases where we've done that.

So that's an area I just don't see it because generally what the states will do is that they will look at it from a standpoint of fee reimbursable they have alternate mechanism to obtain that assistance. They may contract for example themselves or they may have expertise within other state departments or areas where they will go and gain that expertise. This may be for example dealing with groundwater modeling or something like that where they may need some expertise for a particular action and they may not have that.

But if it deals with let's say regulatory

interpretation, I'll put in this category review of their regulations for example, addressing questions on our guidance and things like that, my sense would be as we're talking of about a total of several FTE per year, in that area. NMS budgets some effort for that. There are some within my program and it's all covered within both the materials arena and the waste arena. But you're talking about maybe three to five FTE range but what I can do is I can get you the actual budgeted figures for that.

MEMBER GARRICK: Several years ago this Committee wrote a rather lengthy letter that if you don't remember it I would understand that on what constitutes an adequate low level waste program for NRC. If you do remember that, I guess I'm very curious as to your own opinion as to what fraction of that program do you think is actually being implemented. As I say if you don't recall the letter I would understand that. I don't recall it very well myself but I know it was pretty thorough and quite detailed and one of our longer letters.

MR. LOHAUS: I have to apologize. I can't really answer that question in that manner but I can do is maybe give you a sense of how we deal with the states low level waste programs and maybe start with

regulations. They are required to have a rule that is compatible with our Part 61 regulation. That includes for example the performance objectives. Those have to be essentially identical.

The waste classification system for example has to be essentially identical so there cannot be variation there. The uniform waste manifest that we have that has to be essentially identical so that's uniform across the nation. The technical requirements, the citing design operations requirements have to have the essential objectives of those requirements. They could be more restrictive and they could have different requirements provided they don't go out of bounds. What we use as an out-of-bounds factor in our policy is that the requirements that they might adopt become so stringent that they would preclude a practice that is in the national policy. Let's say approve the citing of a facility.

In terms of program implementation, they are expected to have and follow procedures that are similar to our procedures and what we would use as our 1199 and 1200 guidance as a basis for supporting the envelop that you would expect to see in the state program. When we do reviews of those programs what we

do is we have a technical specialist from the waste management program who is a member of the review team. That's what we normally do for a review of a program let's say like Texas for example that has a low level waste program. We've had that individual as a member and they would look at the state's program in a manner consistent with how we would handle the program.

In some cases when you look at our reports you'll find a state like Nevada and others that there will be a section that says Nevada does not have a low level waste program. They are not a host state. They don't have the expertise, the license and facility but there is no intent in that program to do that. Therefore we would not look at that or overlay that particular indicator on that program. As I mentioned there are those noncommon indicators. In this case that would be an area that we would not look at their programs. They really don't have a program if you will. But if they were to receive an application then our expectation would be is they would have to adopt regulations and a program that would be enveloped and be compatible and provide the same level of adequacy as our program here.

MEMBER GARRICK: And one final question. Does the fact that the states have the ability to

establish their own requirements in terms of how a regulation is complied with it albeit consistent with our own regulations but they can establish levels of compliance. The rubblezation example comes to mind when a northeast utility was considering the rubblezation option for the handling of certain low level waste but the state imposed such a severe requirement that it didn't become a practical alternative. Does that present problems to the agency? That kind of thing?

MR. LOHAUS: The area of compatibility of regulations is a challenge and will continue to be a challenge. One of the things that we've tried to do and I think this has helped but we still see this as an issue on both sides, both with the NRC and within the states if you look at our policy what we've tried to do is to define a small area of regulation that has to be essentially identical. Radiation standards. Definitions and anything that have transboundary implications. Transportation. Sealed source and devices and things of that nature.

When you get into some areas such as constraints that may be established from a dose level, there may be ability for a state to set a more restrictive limit or more restrictive standard.

That's not precluded by the policy or implementing procedures but at the same time, there is some bounds that we try to set in there so that it would not become sufficiently constraining that it would affect our ability to review programs, collect data, preclude practices in the national interest, practice being a licensed activity or something of that nature.

But there is tension and there will always continue to be tension there on the states side. They want to have a greater role, a greater say in establishing the requirements and what the degree of compatibility is. Clearly by law, by policy and our procedure, the Commission has the final determination. They consider input from the states. On the NRC side, we're constantly wrestling with how much flexibility and latitude can we provide in this suite of requirements. And we apply our policy. We apply the procedures and they work well but yet there is still judgement involved. We try and involve the states in reaching those decisions.

But I agree with you. This is going to be a constant area of tension. It's probably healthy though because out of that process is going to hopefully going to come the best approach or the best answer if you will. I look at it as healthy but it's

going to be there.

MEMBER GARRICK: But there is a level of restriction below which the regulations themselves don't make sense in some cases.

MR. LOHAUS: Yes.

MEMBER GARRICK: Okay. Thank you.

VICE CHAIRMAN WYMER: Anybody else? You've made a specific point, Paul, of mentioning that these agreement state program is not delegated. It's relinquished. Yet in fact there are a lot of strings that hang on to it.

MR. LOHAUS: Yes.

VICE CHAIRMAN WYMER: So it isn't totally relinquished.

MR. LOHAUS: The responsibility and the authority is relinquished but the assurance of let's say a national level of consistency in adequate protection of public health and safety across all the programs does reside --

VICE CHAIRMAN WYMER: That cannot be attached now so it still resides with the NRC.

MR. LOHAUS: Yes, that's right.

MEMBER RYAN: Ray, that's kind of an artifact I think because you can't just change state laws.

MR. LOHAUS: That's correct.

MEMBER RYAN: You have two choices. Let them have the program or take it back in essence when it's all said and done. You can take the agreement back.

MR. LOHAUS: That's correct.

MEMBER RYAN: So if it's a contract the NRC can cancel it and take the authority back or leave it with the states.

VICE CHAIRMAN WYMER: Well, it's a little more than that. That they retain a little more control it sounded like to me than --

MEMBER RYAN: Well, all their oversight and requirements are based on the conditions of keeping the agreement like compatibility and all that that has to be met, the performance under the program and all that.

MR. LOHAUS: Again I keep contrasting with earlier. If you go back prior to 1995 we basically had two levels of process. We had send a letter to the state and say here's some things that we found. We think you need to pay attention to these. Or terminate or suspend the agreement. What we have tried to add and that's what is shown on that one slide is a series of additional mechanisms that we

tried to make them cooperative to you in terms of bringing focus within the program to address issues short of suspension and termination.

VICE CHAIRMAN WYMER: That's really what I was getting to. This goes a little bit beyond just saying you either do it or we take it back.

MR. LOHAUS: Yes, there's that blend in there of heightened oversight, probation and other things before we would actually take them out.

MEMBER RYAN: It's really not a flip of the switch.

VICE CHAIRMAN WYMER: That's right. It's a dimmer. Anybody else have anything? Thank you.

MR. LOHAUS: Thank you very much.

CHAIRMAN HORNBERGER: Okay. We are going to switch gears and we have a presentation on waste issues related to advanced reactors. Milt Levenson is the cognizant member so I will turn the meeting over to Milt.

MEMBER LEVENSON: There he is. Let me just say that my understanding that this is for information only primarily and the program is really at a very early stage. So we shouldn't expect to get a lot of details or specific things. It's more your concept of what you are planning.

MR. FLACK: That's right. That's pretty much of it in a nutshell. The presentation is really to inform the Committee about our activities specifically with respect to nuclear materials and waste. This is part of the advanced reactor research plan. That is really the purpose of this meeting here today.

To my left is Don Carlson. Don is part of the Advanced Reactor Group and works specifically in that area of nuclear material safety and waste material safety. There is also Bill Ott I believe somewhere here. He is the branch chief of a branch within the office of research that deals with radiation detection and environmental risk. That's part of the division of Regulatory Effectiveness which I am a branch in itself. I am the branch chief of regulatory effectiveness in the human factor's branch. But within that branch there is the Advanced Reactor Group of which Don is part of.

What I'll do today is briefly talk about the plan. I guess we have about an hour on the agenda. Is that right? Give you some background as to what the purpose is and then some of the objectives of the plan and then specifically look at issues at least we can see are being generated as part of the

Advanced Reactor activities in the areas of nuclear materials and waste. Some examples of some research or activities that we have anticipate it and then some follow-up on some future actions.

So with that in mind, just to mention a few things in the form of a background to the plan, the plan itself is about 110 pages long. I guess everyone has a copy of it. There are many authors to the plan. Specifically it follows the structure of the different arenas, the reactor arena, the waste arena and so on.

But the primary focus of the plan is on non-light water reactor activities because that's where we see our largest infrastructure need. There is a lot of infrastructure in place now for light-water reactors which we capitalize on. There are some as you'll see that we touch upon but most of it centers on non-light water reactor infrastructure needs.

There are some additional designs that we are now considering which will be put into the plan which are now coming out of preapplication review. So we will be adding those and I'll mention those as I go along. There is a great deal of discussion at the beginning of the plan as to what research's role is in

all of this and what's the applicant's role in all of it.

Basically we see ourselves as a organization that pretty much pokes and probes the outer limits of the safety margin. To large extent licensee applicants responsible for demonstrating that their plant meets the licensing basis and so on with some margin and basically we go beyond that as an office exploring the outer reaches and so on looking at the issues and in a sense providing confidence in the decisions that will ultimately need to be made.

A large part of the plan and an important part of the plan is the collaborations that we are establishing throughout the world in the advanced reactor arena. Our budget doesn't allow us to do everything so it's very important that we reach out and find out what's going on in the world. So as you go through the plan in different areas you will find that there are discussions of collaborations primarily internationally where we see a lot of this activity going on.

Finally the plan itself does not prioritize the work. The prioritization basically takes place using two processes. One is called the PIRT where we bring together where we identify and

rank the phenomena and then decide for example in the fuels what are the important issues to deal with first, second and so on. Then there is the other part of the prioritization process which deals with our strategic plan. That's an officewide prioritization process that takes place every year.

So with that as a background let me move ahead and discuss the objectives of the plan. Again basically it's to institute an advanced reactor research infrastructure, to basically document the areas where we need to do more developments in the form of expertise, tools, methods and so on.

It is not necessarily issue driven. It is more expertise driven. What is the expertise that we need to ask the right questions basically? What the methods, codes and data that we are going to need to do the analysis that will provide us answers to those questions?

However when you start to do that kind of building looking to see where you need this infrastructure you do identify issues. So in fact part of the plan does bring out those issues that we see as we go along and in that context identify the gaps and the methods and the tools that will be needed to address those issues.

The plan is also intended to identify the research projects and links to the regulatory process. Basically the structure that was laid out in trying to answer three questions: why, what and how. Why do we need to do this work? What it is we need to do? And how do we plan to use these results? So if you look at each of the sections in the plan under each of the different research areas it follows that format.

With respect to products, I would say the most important product that gets generated by the office is the first one which is really in the sense contributing to and identifying the technical basis for decision making and how much confidence you'll end up in that decision is going to based on the technical basis on which it is built. So much of the work that we do in the office is the first one to a large extent.

The office also does independent current confirmations of applicants, calculations and so on. We identify safety issues as we go along in reviewing the applicant's submittal over whichever area that might be in and pathways to resolutions of those areas.

Policy issues is another thing that we bring out. There is a policy issue paper. We went

before the Commission letting them know that there is going to be policy issues coming at the end of the year. But we planned to submit to the Commission a policy issue paper and options for resolutions of those policy issues that we see coming out of the advanced reactor program, things like the containment question, source term and so on.

Another product of course is the technical reports that come out to support safety evaluations and generally regulatory guidance, methods and tools for regulatory use. So that in a nutshell is pretty much the kinds of products that we expect to generate.

The scope of the plan, the revision that you see today really covers four types of designs. The pebble bed of course was a real hot topic for a while as they had come under preapplication review Exelon but is subsequently pulled that preapplication out. So a lot of the infrastructure has been generated around our review and understanding of what the preapplication was really after.

We do have in now a gas turbine-modular helium reactor (GT-MHR) which basically uses the same fuel. I'll go through that at least at the microsphere level. I'll go through that in a few minutes. The other plans covered by the scope are

water reactors, the IRIS, the International Reactor Innovative and Secure. They have just submitted a letter requesting a preapplication review and, of course, the Westinghouse AP-1000. But again a lot of the infrastructure discussion centers around the first two items.

The more recent plans that have come in are under the preapplication review or are planning to come in is CANDU design, the AECL ACR-700, advanced CANDU reactor, the ESBWR and the SBWR and we will have a separate section on Generation IV as we know those plans they are starting focus on. So that's pretty much the scope of the plan.

The next viewgraph is busy and I really didn't want to spend much time on it. Although when I had presented this to the Advisory Committee I never got past this viewgraph because there were so many questions. But basically it's how we laid out the plan, the research that we intended to do. As you can see on the top the ultimate objective is to have an effective and efficient regulatory process of which a framework that would be risk informed that may be different than the one we see today. In fact it would be for these types of plans is one of the major activities in the advanced reactor research which we

plan to do.

From there down, we started with the arenas. Here we have the reactor safety arena and that's basically centered around the four cornerstones of safety that the NRR staff uses in a reactor oversight process. Over here is where we will be talking about today is this side of the plan which involved the nuclear material safety and nuclear waste safety. Basically there we are looking at the cornerstones as being a ALARA and accident protection and covering the full cycle from beginning, operational and end of fuel cycle.

The safety and safeguards part of the plan is pretty much a place holder at this point. We'll see what we will need to do there to support the Office of Homeland Security.

MEMBER GARRICK: John, what are you assuming about the fuel cycle?

MR. FLACK: In what respect?

MEMBER GARRICK: Well, in terms of the type of fuel cycle that would associated with each of these reactor types. Are you assuming current conditions based on current laws or are you looking at the differences?

MR. FLACK: Differences, right. The plan

basically focuses on the delta, the difference between where we are now and where we would want to be years from now.

MEMBER GARRICK: Yes and that would include perhaps moving it toward closed fuel cycles.

MR. FLACK: Yes, it could even though that's not part of the plan at this point but it very well could be at some future date.

MEMBER GARRICK: It certainly is in Generation IV.

MR. FLACK: Yes.

MEMBER LEVENSON: On the reactor side the only place you have material is as part of the barrier. Is that the only place it's included because different materials like graphite play a significantly different role many places than in the barrier?

MR. FLACK: Underneath material analysis, there are really two key areas. One is the graphites as you pointed out. The other is high temperature materials as the research areas that are in the plan explicitly.

MEMBER LEVENSON: But what I'm saying is that they have impact more than as a subset to barrier.

MR. FLACK: In the role I guess as we

envisioned it here the way it's being laid out is considered the barrier in the sense of the primary system as a barrier to release. Also the containment as a barrier to release. And structure will be a part that as well.

MEMBER LEVENSON: I understand it. But what I'm saying with these different concepts, material plays a significantly different role and possibly accident prevention and mitigation with different issues than just as an inert material or as part of a barrier.

MR. FLACK: Yes, I thinks that's a good point.

MR. CARLSON: I think he may be referring to conducting the decay heat away through the graphite and things of that nature.

MEMBER LEVENSON: No, just things like graphite under stress erodes differently in helium than it does when it's not under stress so it can impact structurally and cause accidents. There's all kinds of things which are different than part of a barrier.

MR. FLACK: In fact, there's another diagram in the --

MEMBER LEVENSON: I'm sorry. That's not

part of this Committee. I'll take it back.

MR. FLACK: But now you can see why we didn't get too far with the ACRS with this screen. But in fact it's an integrative process as you are pointing out because this could turn out to be a barrier. Of course this could turn out to be a initiating event. So there is a constant and there's another figure which I don't have with me but it's in the plan that draws lines between these and the accident analysis. So we see that it's a feedback kind of situation.

A lot of it centers around the reactor analysis of course that predicts what temperatures and so on that one would reach in the plant under the various accident conditions but you are right we are really here to focus on this piece over here. But your point is well taken as being more than just a barrier on materials. It could in fact be the accident initiator.

MEMBER LEVENSON: Yes, and there's a lot of things that change. I mean structural analysis for a water type system is not necessarily directly relevant either. I guess things in the research plan that ignore some of those kinds of issues too. But let's not get into that.

MR. FLACK: Well maybe we can talk off-line a little bit about it because it is an interesting area to talk about. Again the plan is trying to generate what changes and differences there would be from where we see our regulations today as we treat light water reactors today to where we would be going for advanced designs. But in any case it did offer a way of structuring our research in a sense of looking to see what needed to be done. It resulted in eight rather key areas.

These are the eight areas which are in the plan and it's structured about. The one is being the framework and that again is using some risk decision, making decisions using risk information, performance information in a different context or pushing the envelope in a way we use it today. Then we have accident analysis which is really the part of PRA, the human factors and instrumentation control that is addressed under that section, reactor plan analysis which includes thermal hydraulics, nuclear analysis in severe accidents. The fuel analysis which is very important for these gas cooled designs as they use a special kind of fuel.

Material analysis which includes the big gaps that we find in the high temperature materials

that are needed for these gas cooled designs and the graphite as we were just pointing out. Structural analysis including seismic events and concrete performance. Consequence analysis and what changes need to be made to those codes based on these new plans. Here we are at nuclear materials and waste safety and there is a part in the plan that is intended to look at that as to what are the new issues that we might see coming down the road there. Then nine being the safeguard and security area.

Now I don't know how familiar the Committee is with the Pebble bed and the new types of fuels that are being put out so I thought what I would do in the back of your handouts are all these viewgraphs and I thought I'd just spend a minute going through that to show the differences between the kind of fuel that we are seeing with these high temperature gas cooled designs and light water reactors. Please fill in, Don, if you have --

MR. CARLSON: I forgot to bring my pebble but they are the size of a cueball.

MR. FLACK: About the size of a cueball. What's embedded in these graphite pebbles or cueballs are these microspheres and it's about roughly 15,000 microspheres in one. Each of these microspheres if

you cut them open you will find these different layers. This is your TRISO fuel-coated particle. And you have a silicon carbide layer which basically acts as a barrier to releasing of the fission products inside. Then there's these buffered layers to catch fission products as they come off and gases and so on.

But the main thing that is this silicon carbide layer that is really acting as the containment function in retaining the fission product. The first thing of notice is that these spheres actually in volume would be resulted in about 10 times the waste of light water reactors. So we are scaling up our product there. Of course you have this other additional materials, the graphite and the fuel and then it's what that consists of as part of the fuel cycle and ultimately -- You do have it.

MR. CARLSON: Alex Murray brought his pebble in and we're also going to pass around --

MR. FLACK: A microsphere.

MR. CARLSON: A pellet for comparison.

MR. FLACK: So that's what the fuel looks like that is different than light water reactors. This next viewgraph just shows the pebble bed and how those pebbles are fed through the reactor system. At one point, and they've changed, in the middle they had

envisioned graphite pebbles as being in the center and then you had your fuel pebbles on the outside and then this would be your inner reflector. The pebbles would be come in at the top and exit at the bottom. A very simple diagram of that is shown here. (Indicating.)

Here we see the solid fuel coming into the pebble bed, graphite also coming in at the top making up that center reflector. As they flow through the damaged spheres would be taken aside, graphite would go back in and the fuel would be checked at some point to see how much of it had been burned up. it was still within an acceptable range it would go back into the reactor. If it wasn't then we would be adding more fuel at the side and any spent fuel would come down below.

So you see it's a rather sophisticated fuel handling system that's envisioned. Each module would have these as well. These are smaller modules up around 100 to 120 Megawatt electrical. It would be envisioned that there would be 10 of these at a site. I think I do have a viewgraph on that.

The other HDTR (PH) is the pellet. It's the gas turbine modular helium reactor. That's why GA and that uses this pellet instead of a pebble. They are embedded in a fuel element that looks like this.

(Indicating.) Again you use the same microspheres as we see in the pebble in the same structure with different layers and so on. So there's a little difference there with the fuel type.

MEMBER LEVENSON: There's a basic difference in the form of the uranium, isn't it? The other one showed as the core being uranium oxide and this one is uranium carbide.

MR. CARLSON: Oxy carbide.

MR. FLACK: That's right. Although the coatings would be similar in nature, the kernel would be different. Right?

MR. CARLSON: The coating layers are essentially identical.

MR. FLACK: Essentially identical. What we have here is a three dimensional view of the pebble bed reactor. You can see the fuel handling system on the side and this is one module right here, a reactor vessel. (Indicating.) So it gives you a scale. This is roughly around 60 feet, right? The size of this vessel so this is rather a lot of volume in a sense.

So that gives you a flavor for the types of plans that are coming in. If we go back to where I was before. So the three areas basically that are in the plan under nuclear materials and waste cover

the cycle. The front end's focus primarily is the differences in the fabrication between the types of fuels that we just looked at and light water reactors. The operating cycle, of course, the fuel handling, the storage and ALARA issues and then the back end of the fuel cycle, the processing, the transportation and the disposal.

In going through that, I've summarized on the next two viewgraphs the kinds of technical issues that seem to be evolving from the plan which is documented in the plan but that we see as we are looking at these advanced designs. The first is that they are going to higher enrichments generally greater than five percent and as high as 20 percent. This leads to issues that would involve criticality in its manufacturing and in its transportation, in fact throughout the fuel cycle, these higher enrichments. Radionuclide inventories that would be different that could lead to different decay heats and different radiation sources. And higher burn-ups going to for example 80,000 Mwd/t and how much credit we would give for burn-up at that point. So these are three of the issues we are seeing coming up as being possibly substantially different than the light water reactor fuels that we are dealing with today.

On the uranium enrichment and fuel fabrication looking at new manufacturing facilities and the hazards that are associated with those at these kinds of enrichments. Transportation and storage. Basically the physical size which we were just mentioning and the differences radiologically between the fuel types.

MEMBER LEVENSON: If your enrichment goes up potentially as high as 20 percent, your burn-up only goes to 80,000 Mwd/t. You're only burning about one-third as big a fraction. That means that your spent fuel is even going to be much higher enrichment than present new water reactor fuels. Is that right?

MR. FLACK: That's a good point.

MR. CARLSON: The 80,000 Mwd/t burn-up applies to the eight percent enriched fuel that would be used in the PBMR. For GTMHR they are going to more like 120 Mwd/t and that's a mixture of natural uranium particles and 19.9 percent enriched particles.

MEMBER LEVENSON: One of the factors that's important is after a couple of cycles you build up a lot of uranium 236. That kind of kills you.

MR. FLACK: Yes. That is an extra too. In the GTMHR, it ranges from I guess five to 20 percent enrichment.

MEMBER LEVENSON: I think the point is it isn't only on the front end that you have higher enrichment problems. I think you're going to have higher enrichment on the back end.

MR. CARLSON: Yes, for burn-up credit, criticality safety analysis at the back end it certainly carries over there.

MEMBER LEVENSON: It isn't a burn-up credit. I mean if you don't take burn-up credit, the actual enrichment is going to be higher.

MR. CARLSON: Sure.

MR. FLACK: Okay. Actually that's where we went with this next one. The waste disposal and what basically could be different there where you end up with --

MEMBER GARRICK: Are you going to talk about the waste form?

MR. FLACK: Well, I guess we could if there are questions to it. I believe there are quite a few from NMSS here and they could also answer the questions. But I was raising this more in the context of what were the technical issues that we are seeing coming our way as differences in waste streams and differences in the physical and chemical conditions of the fuel as well as the source term and

decommissioning and entombment I guess as part of that as being things that were different. But, John, is there something specific that you want to talk about?

MEMBER GARRICK: No, go ahead. We'll come to it.

MR. FLACK: Okay. Then finally ALARA we've seen at the moment for example silver as being an issue that tends to migrate out of that fuel to the coating. So that and of course graphite dust being added to the mix. As we're reviewing these new plans as they are coming in we can see that there are similar issues that are coming up as well.

VICE CHAIRMAN WYMER: My understanding is that it's not so much silver. It's what's called the amoeba effect that chewed their way through the silicon carbide layer. You see cross sections of these microspheres and you see that the rarers are in fact penetrating the silicon carbide coating rather the silver did primarily.

MR. FLACK: That are getting through. I guess there's not a good understanding or feel for why that is the case at this point in time.

PARTICIPANT: (Off microphone.) Broken particles.

MR. FLACK: Well, that will do it.

MEMBER LEVENSON: Or microcracks in the coating is a --

MR. FLACK: That can cause them to leak, yes. Okay. So that's really a quick summary of what's in the plan as far as the issues that we were seeing. The next couple of viewgraphs talks about research activities that are either on-going or could be on-going to support the user office in addressing some of these issues.

MEMBER LEVENSON: Let me just go back to a follow-up to John's question.

MR. FLACK: Sure.

MEMBER LEVENSON: It has to do not with the mechanics or the details but a perception. Is it your perception that the waste form is the spent fuel as it comes out of the reactor or that something will have to be done to it to make it a stable enough material to be considered a waste form? This is a classic question of is graphite stable under the definition of only stable materials are suitable for waste form.

MR. CARLSON: The work that we've been following to date considers the pebble as the waste form or the graphite blocks from the --

MEMBER GARRICK: The cueball or the fuel

block.

MR. CARLSON: There is this discussion of a further development of the U.S. -- Green type fuel technology of removing the fuel compacts from the graphite block to reduce the volume of high level waste.

MEMBER GARRICK: Yes.

VICE CHAIRMAN WYMER: It's easier said than done. It hasn't been done to date for a good reason. It's not easy.

MR. CARLSON: The Japanese version of HTGR technology has pin and block design where you really can move the compacts with a pin form from the block.

VICE CHAIRMAN WYMER: After radiation they weld themselves.

MEMBER GARRICK: Yes, there's going to be a little bit of fusion.

MR. CARLSON: But for the American they certainly would weld themselves in.

MEMBER GARRICK: Yes.

MR. FLACK: And this viewgraph is just to point out the different activities for infrastructure that's in research today in the office that could be applicable to the materials of the waste arena. Certainly the work that's going on in the risk

informed performance based methods area is nuclear analysis, methods and libraries that apply to reactors could equally apply to nuclear materials, out of core, severe accident, source term activities and information that we are generating as part of those studies or those studies that will start to take place, human factors, methods and expertise that we have that could be applied to fuel fabrications, facilities and so on.

The materials and structural work that's going on in the office could equally be extended to issues that deal with storage of nuclear waste and international agreements and collaboration which is an important part of the planning activity from which we could capitalize on other work going on worldwide in these areas.

Some examples and some of this is probably redundant but the nuclear data libraries which is part of the nuclear analysis work on cross sections for reactors could be applied. Criticality models and validation as some of the tools and methods that we will be using and applications of these to burn-up credit. Decay heat models and radiation sources studies and characterization of spent fuel and waste streams, the work you could possibly do in that area.

And of course extending the framework to also include beyond the reactors the nuclear materials waste safety.

VICE CHAIRMAN WYMER: You're probably get to it eventually but I would say again that when you get to the burn-up credit uranium 236 plays an important part.

MR. FLACK: Plays an important role.

VICE CHAIRMAN WYMER: Yes.

MR. CARLSON: But that's not one of the burn-up credit players that's currently considered by NMSS.

VICE CHAIRMAN WYMER: But it's real. It's a neutron gobbler.

MR. FLACK: Is that right? Okay, well I went through this rather rapidly on my final viewgraph so I was just going to mention where we go from here with the plan. What I think you received is this first revision of the plan. It will be revised again before it goes to the Commission which will be this fall. We will also include these other reactors I've mentioned including Generation IV as at this point probably appendices to the report rather than going back and changing the whole report to reflect those new plans.

We will be expecting additional stakeholder interactions. We have working groups set up. We have been working with NMSS. We have been working with NRR in trying to understand the issues and how we as an office can support resolution of those issues. The plan will again be transmitted to the Commission and then we will continue to keep the plan as a living document and update it from time to time. So that's pretty much it in a nutshell.

MEMBER LEVENSON: Let me ask a question. The water reactors are obviously water reactors but one slight question is the version of the CANDU that is being considered or proposed --

MR. FLACK: In fact they are talking about it right now upstairs.

MEMBER LEVENSON: -- is does that have different materials, waste, fuel, etc. issues or problems than the American light water reactor?

MR. FLACK: I think Don might be able to answer that.

MR. CARLSON: It would tend to be similar but we're aware of the differences. It uses slightly enriched uranium. That would mean up to two percent enrichment.

MEMBER LEVENSON: I was thinking more of

materials and of fuels and of cladding and so forth.

MR. CARLSON: The cladding is quite similar. It's a zircaloy type cladding. It's uranium oxide fuel pellet. They are using dysprosium (PH) as a fixed poison in the central fuel elements in the channel.

MEMBER GARRICK: The stored energy is a little different.

MR. CARLSON: Higher.

MEMBER GARRICK: Yes.

MR. CARLSON: Higher than in the old CANDU design and I guess about more similar to what it is in the current light water reactor.

MEMBER GARRICK: Right.

VICE CHAIRMAN WYMER: I don't know how extensive you are going to go into the fuel cycle part of this study but if you do go into that with the CANDU reactors then you probably want to consider the rather complicated fuel cycle that the Canadians are considering with respect to their work with South Korea. Are you familiar with this?

MR. CARLSON: Oh, yes. They are -- cycles.

VICE CHAIRMAN WYMER: Yes, because this idea is just you take it CANDU reactor and put it in

the light water reactor and you don't do any reprocessing. You just simply heat it up and drive off the volatile high cross section gases and then stuff it back in the water reactor.

MR. CARLSON: Yes, take the light water fuel and put it in the heavy water.

VICE CHAIRMAN WYMER: Okay, you are on that.

MEMBER GARRICK: The current regulations and the whole analysis infrastructure pretty much revolves around thermal hydraulic kind of problems. The reg guides and the regulations of course are accordingly geared for those kinds of problems. Is what you are trying to do here is to anticipate the changes that are going to have to be made in the regulations in order to accommodate a license application for these advanced reactors? The non-LWR reactors? What is the endpoint here?

MR. FLACK: Well, I think it could. I think part of it is when we go through a series of interactions with an applicant first being the preapplication review and the question is can we license this plant under the current regulations that exist today. That's really the purpose of preapplication review is to find out if we are looking

for changes how are we going to go about first identifying and then implementing whether they involve policy issues with the Commission. So I think at this point it's a pretty open question.

MEMBER GARRICK: Yes.

MR. FLACK: I mean when people come in they could easily request --

MEMBER GARRICK: Well, the commonalities are much more evident globally than they are in the fine structure. I mean in the accident analysis of the PBMR is going to be very different than an accident analysis of any LWR.

MR. CARLSON: At this point.

MEMBER GARRICK: You're going to do PRA and you're going to construct scenarios and you're going to do evaluations but when you get down to the point where the reg guides come into play, it's going to be very different. And as part of this exercise to try to ferret out what the NRC will have to do in order to make the details of the regulations applicable, the policies and the principles are one thing. But the real understanding of the safety and risk issues are going to involve entirely different models and entirely different materials. Most of the reg guides that I can think of just won't be

applicable.

MR. FLACK: And in fact that piece of the framework that we were talking about before.

MEMBER GARRICK: Right.

MR. FLACK: That is exactly the issues. If there are going to be changes, how these changes are going to be made in a risk informed performance based arena? Then how do you go about implementing it once you decide that these changes need to be made and so on? It's not an easy process to change as you know.

MEMBER GARRICK: Right, yes.

MR. FLACK: But that's really where the framework is headed. I mean that's the initiative there.

MEMBER GARRICK: Thank you.

MEMBER LEVENSON: Let me ask this. You know neither the CANDU nor the pebble bed or the HTGR is a brand new concept. In the mid '50s, each of those had a rather major review as to what it would take to get it licensed in the U.S. under what at that time were the regulations. Do you have access to those reports because they were very good and very thorough?

MR. CARLSON: I was involved in the work

during the early '90s on all of those designs when I was previously in research in those days. So we have NUREG-1338 which is the preliminary safety evaluation report for the MHTGR. We have a number of major CANDU research products from the early '90s that I was involved in. We have tried to maintain our knowledge base from the licensing Peach Bottom in Fort St. Vrain.

MEMBER LEVENSON: I don't think any of those identified some of the rather basic safety issues in the study done in the mid '70s. It was probably one of the highest powered review groups. It's one of the things which probably led to the cancellation of the 12 or 15 HGTRs in this country that had already been purchased.

MEMBER GARRICK: And that was about the same time, Milt, that they really were starting to do some serious accident progression analysis as they called it rather than PRA at the time although it was PRA.

MEMBER LEVENSON: But it was basic engineering issues that were covered in that study.

MR. FLACK: Now the fuel back then is quite different than the TRISO fuel level.

MEMBER GARRICK: Right.

MEMBER LEVENSON: But it was -- No, it was TRISO fuel.

MR. FLACK: It was TRISO back then.

MEMBER LEVENSON: But it wasn't related to the fuel.

MEMBER GARRICK: There were differences.

MEMBER LEVENSON: That's why I said the idea that you can use the same codes for pressure vessels for water that you could -- It has nothing to do with temperature. You can adjust it for all of that. I have to stop and think for a minute because when I read the damned report it was under proprietary conditions. I have to be careful about what I can say and think for a second.

Basically something like a configuration H where you have a reactor cylinder and you have a cylinder with either power system and a connecting pipe. Your study plan says the pipe is not going to be treated as a pipe. It's going to be called a vessel. You are going to analyze three independent vessels. I think you would find in that original report evidence that that doesn't work.

At that time, there was almost no known way to design that properly because of the transition point where in a conventional pressure vessel some

things are in tension, they suddenly are in compression and you have very peculiar -- All I'm saying is that this is not relevant to this Committee but there's some very serious differences in these things that really need to be looked at very carefully.

MR. CARLSON: We've talked about the issue of a cross vessel versus a cross pipe or cross duct but I'd be very interested in applying some of these older reports that may have escaped my attention.

MEMBER LEVENSON: The one I'm referring to was an international group which was put together including people from the U.K. and France who were very knowledgeable in gas cooled reactors. It was really a high powered study.

MR. CARLSON: That's very interesting. With NRC involvement?

MEMBER LEVENSON: No, it was proprietary. It was private. It was done by Shell. The question was whether they would put money or not into the HDGR program.

MR. FLACK: Thank you for that tidbit of information.

MEMBER LEVENSON: But I think that for the small piece that is the responsibility for this

Committee, I think we'd be very interested in seeing how seriously are the concerns and looks at graphite. I know there are some people that would argue that graphite won't burn. I think both Windscale and Chernobyl must not have read the documents because they did burn.

The first method of analysis that was done for Fermi's group in Westans (PH) they didn't have any method of analyzing impurities in graphite at that time so Johnny West took a full sized block of graphite out of the reactor, put it into a big glass pipe and burned it down to ashes and analyzed the ashes. Lots of reason to believe graphite will burn particularly highly radiated graphite probably ends up with a reasonable amount of stored energy that can change its properties. I think there's a lot of questions that need to be asked about these systems.

MR. CARLSON: In some of the discussions that we've been having with our NMSS counterparts we've noted that for transportation accidents the fire issue becomes different when you have graphite present versus today's fuel materials. This is something we will be keying on.

VICE CHAIRMAN WYMER: Let me add that it's true that graphite burns but when you are trying to

reprocess it and you are trying to burn it, it's very hard.

MEMBER GARRICK: It burns erratically. The back end of that fuel cycle for a closed fuel cycle is really unresolved.

VICE CHAIRMAN WYMER: George? John?

MEMBER GARRICK: No, I'm fine.

VICE CHAIRMAN WYMER: Mike?

MEMBER RYAN: No.

VICE CHAIRMAN WYMER: Anyone else? Staff? Questions?

MR. CAMPBELL: Has anybody done an analysis of graphite materials in terms of source term or a waste stream, the behavior of graphite in the environment as opposed to the nice well controlled environment? If we start looking at the pellets or the cueballs of whatever you want to call them as a waste stream in and of itself, then you have to look at how does graphite behave over long periods of time and the differences in the source term. I assume there are significant differences. Is there any information about that at this time?

MR. FLACK: Well, at this point actually we have an individual who is now being brought up as a graphite expert on the staff. He's not here today.

He will be spending some time in England towards the end of the year at the University of Manchester. Part of his mission to England is to find out exactly as much as he can about graphite, the experiences they have with it and how they plan to dispose it and so on. But at this point I don't have that information unless, Don, do you have information on that?

MR. CARLSON: Well, we've been talking with the European Commission about some of the cooperative efforts that we could engage in. That kind of work is being planned in that European Commission effort and hopefully we will participate in that.

VICE CHAIRMAN WYMER: Let me add one more note here with respect to burning graphite and the fuel cycle associated with it if there is a fuel cycle. That is you have a carbon 14 problem. It's from the nitrogen that's in the graphite. It's not surprising if you know what the item of carbon 14 is. But to most people it's surprising. Then carbon 14 can exceed permissible discharge limits.

MR. CAMPBELL: Well, Ray, that was part of my issue with the source term. The CANDU reactors have a carbon 14 issue. We know from our experience at Yucca Mountain at the Technetium and the iodine

because of the mobility become significant players in the source term and in the CANDU reactors, carbon 14 is a significant player because of the nitrogen in the derated water and actually the reactions that can occur in there. They have been studying this for a long time. It is an issue because of its mobility and the ease of incorporation into biosystems. It's not a trivial problem.

VICE CHAIRMAN WYMER: That's right. It is an issue.

MEMBER LEVENSON: I guess I'll just turn it back to you, Mr. Chair.

CHAIRMAN HORNBERGER: Thank you very much. Okay. At this time we are going to take a break and we will go off the record. We are finished with the recorder for today and we will reconvene in 15 minutes and then continue on with our preparation of AC and other reports.

(Whereupon, the above-entitled matter concluded at 3:16 p.m.)

CERTIFICATE

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

Name of Proceeding: Advisory Committee on Reactor Safeguards

Docket Number: N/A

Location: Rockville, Maryland

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

/s/ Rebecca Davis

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

CRCPD Assistance with Disposition of Unwanted Radioactive Material

A Service of the
Conference of Radiation Control Program Directors, Inc.

www.crcpd.org

Pub. June 2000
Revised April 2002

The CRCPD is a nonprofit organization of individuals that regulate and control the use of radioactive material and radiation sources.

The CRCPD Program

Do you have radioactive material for which you have had trouble finding an acceptable outlet?

The Conference of Radiation Control Program Directors, Inc. (CRCPD) offers assistance in finding the most affordable, legal disposition for radioactive material through:

- Adoption by an individual.
- Reuse by a device manufacturer.
- Reprocessing of the material.
- Acceptance by federal or state government.
- Commercial storage.
- Storage for decay.
- Disposal of:
  - Diffuse NORM waste.
  - U or Th as mine or mill tailings.
  - Low-level radioactive waste.
  - Transuranic waste.

Two aspects of the CRCPD radioactive material program are:

- Publications describing various resources available to the custodian of an orphan radiation source or otherwise unwanted radioactive material.
- Assistance in obtaining help to secure and assess the material and finding suitable outlets for it.

CRCPD Staff Assistance

Any loss, theft, or discovery of radioactive material should be immediately reported to radiation control authorities. The phone number for the appropriate authority may be obtained from CRCPD or from the state's emergency communications center.

CRCPD staff will identify contacts at government agencies and commercial services for on-scene assistance with securing and assessing radioactive material.

The CRCPD will assist with finding, and in some cases funding, an outlet for radioactive material or related equipment such as radiation detectors or shielding.

The CRCPD staff typically respond to each request within one working day, by providing advice, offering contacts for on-scene assistance, or sending forms and information, as appropriate.

Where appropriate, CRCPD staff will assist in locating manufacturers and individual licensees that might accept the material, or for U.S. Department of Energy acceptance, and will provide other assistance where needed.

These CRCPD services are provided to both the general public and regulatory agencies without charge.

CRCPD Committees Involved

The *CRCPD Committee on Resource Recovery and Radioactivity* advocates the installation of radiation monitoring at scrap metal collection and processing facilities, and at municipal waste handling facilities. The Committee has established a standard procedure for responding to detected radioactivity. It is the Committee's position that discoveries of radioactivity be reported promptly and dealt with efficiently, without undo financial or administrative burdens on the person reporting.

The *CRCPD Committee on Unwanted Radioactive Materials*, working with officials of the U.S. Environmental Protection Agency, the U.S. Department of Energy, and the U.S. Nuclear Regulatory Commission, is developing a national system for prompt and economical management of orphan radiation sources and other unwanted radioactive material.

The CRCPD encourages, and will assist with, state-wide or national roundups of radioactive material. Roundups are best done for a particular device, such as gauges containing radiation sources that can be refurbished, or a particular waste material, such as NORM scale.

Waste disposal is more economical if items are consolidated to meet the legal limit for a package, and still more economical if collection is by a government program or through return to a manufacturer, rather than a separate package and burial permit for each contributor.

Information Available

CRCPD's Web Site: www.crcpd.org

CRCPD's web site offers resources for dealing with unwanted radioactive material, including:

- Phone numbers for radiation control programs.
- News of CRCPD's "Orphan Source Project."
- CRCPD's "Orphan Source Report Form."
- *Dealing with Discovered Radioactive Material*, an outline of cases and resources.
- Department of Transportation exemptions for municipal waste and for scrap, and related information on their use.
- Directories of commercial services for assistance with radioactive material and contaminated facilities.

Other sections of the web site are:

- A section for news and discussions among government radiation control program staff.
- Links to other web sites having related information.

Among the CRCPD directories of commercial services continually updated and available on the CRCPD web site are:

- *Manufacturers of Fixed Radiation Monitoring Instruments.*
- *Manufacturers of Portable Gamma Ray Spectroscopy Instruments.*
- *Radioactive Site Investigation and Decontamination Firms.*
- *Radioactive Waste Brokers & Processors* (Most of these firms also perform decontamination of equipment, buildings, and grounds of modest scope).

CRCPD Document and Video

- *Dealing with Stray Radioactive Material*, a CRCPD video (distributed by CopyMaster Video, Telephone: 630/279-1276), and *Detection and Prevention of Radioactive Contamination in Solid Waste Facilities* (a booklet prepared by and available from CRCPD). This video and booklet discuss radioactivity found in municipal waste and scrap metal and provide information and guidance for facility operators.

To Report Unwanted Radioactive Material

E-mail: tdevine@crcpd.org

Fax: 502/223-7026

Telephone: 502/227-4543, Ext. 2223

CRCPD's mailing address is on the other side of this brochure.

Announcement
A National Orphan Radioactive Material Disposition Program
Sponsored by the Conference of Radiation Control Program Directors, Inc.
October 2001

At their annual business meeting in Anchorage, Alaska, the Conference of Radiation Control Program Directors, Inc. (CRCPD) Board of Directors announced to their members the approval to implement a National Orphan Radioactive Material Disposition Program. Funding has now been secured to support this national program as described in Attachment 1.

Purpose: To financially assist, and provide technical guidance to, state radiation control programs in the disposition of discrete orphan radioactive material. CRCPD will work with the state radiation control programs (RCP), where funds are not otherwise available, to provide financial assistance for the following provided it meets the criteria noted below:

- The disposing of orphan radioactive discrete material at a licensed disposal facility, or
- The transferring of orphan radioactive discrete material to a licensed recipient.

Goal: To reduce the number of discrete sealed radioactive sources and devices that are abandoned or improperly disposed of and thereby reduce the risk of unnecessary radiation exposure to the public and/or contamination of the environment.

Objective: To identify, recover, and manage the proper disposition of reuse, recycle and dispose of unwanted discrete radioactive *discrete* sources and devices material

Criteria for Acceptable Material: Discrete sources or devices containing radioactive material recognized under the Atomic Energy Act (except such material reserved for control by the U.S. Nuclear Regulatory Commission), and including radioactive material defined as Naturally Occurring or Accelerator Produced Radioactive Material (NARM), or both. Such sources or devices must be unwanted by the person possessing the sources, and there must be inadequate funds available to both the state agency and the person possessing the material for the disposition of such sources. Not acceptable under this criteria are *diffuse* radioactive materials such as contaminated soil, building rubble, scaled pipe, and metal turnings.

Responsibility of CRCPD: To determine eligibility of the material for funding under this program, and to

- To act solely as a cost reimbursement source for the state RCP where other funds are not available for the proper disposition of discrete orphan sources and devices.

Responsibilities of a State RCP:

- To identify the discrete orphan radioactive material.
- To identify, or participate in the identification of, an entity (i.e., manufacturer, disposal site, etc.) that will accept the orphan material, and to solicit bids from an entity (i.e. broker, disposal company etc.) to handle, package and ship the material to its final destination.
- To determine eligibility of the material for funding under this program
- To enter into an Agreement with CRCPD *(see Attachment 2a "Agency Reimbursement Agreement" and 2b "Company Reimbursement Agreement").*
- To submit a request for funding to CRCPD *(sample letters are shown as Attachment 3).*
- To obtain the services as identified in the funding request, and to ensure that CRCPD's liability/indemnification clause is included pursuant to the Agreement.
- To notify CRCPD when the material has been safely disposed of or transferred to a licensed recipient in accordance with the State's rules and regulations, and to request reimbursement pursuant to the Agreement.

For further information, contact Terry Devine, CRCPD Technical Assistant, via email at <tdevine@crcpd.org> or by phone at 502/227-4543 ext. 2223.

136th Meeting

of the

Advisory Committee on Nuclear Waste

Advanced Reactor Research Plan

July 24, 2002

John H. Flack
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission

Outline

- Background
- Plan Objectives, Scope, and Structure
- Materials and Waste Arenas (Technical Issues)
- Examples of Research Activities
- Future Actions

Background

- Primary focus: non-LWR infrastructure needs
- Additional designs in next update
- Consideration of NRC vs. applicant's responsibility
- International collaborations are key
- Basis for prioritization (PIRT, PBPM)

NRC Advanced Reactor Research Plan

Overall Objective: To institute an advanced reactor research infrastructure

Plan Objectives:

- document areas of advanced reactor research
- identify technical issues and associated research activities
- identify gaps in methods, tools and expertise
- identify research products and link to the regulatory process

Research Products

- Technical basis for decision-making
- Independent confirmation of applicant calculations
- Identification of safety issues or enhancements
- Identification of policy issues and pathways for resolution
- Technical reports that support safety evaluations
- Regulatory guidance, methods or tools for regulatory use

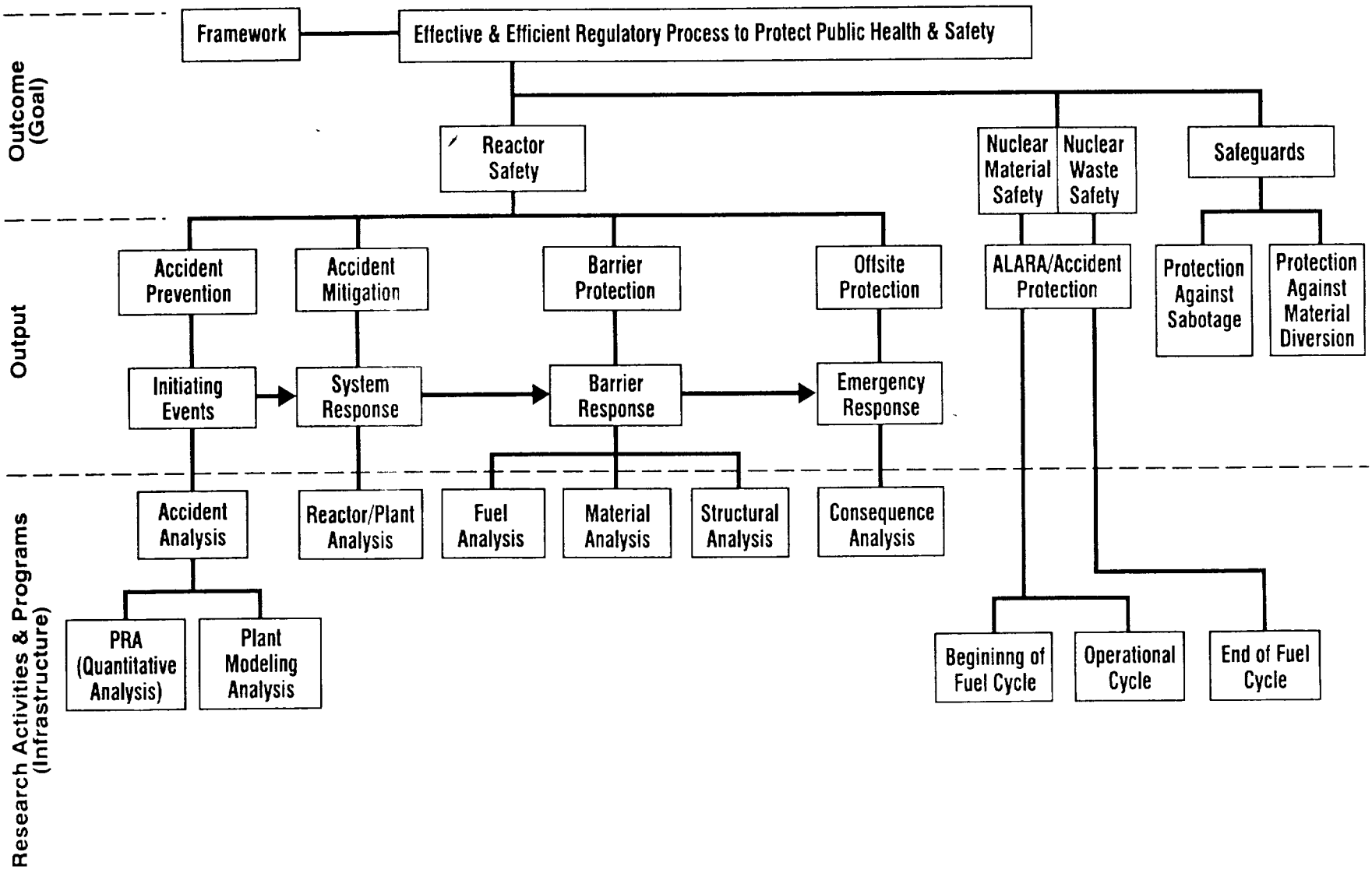
NRC Advanced Reactor Research Plan (Scope)

- Pebble Bed Modular Reactor (PBMR)
- Gas Turbine-Modular Helium Reactor (GT-MHR)
- International Reactor Innovative and Secure (IRIS)
- Westinghouse AP-1000

Additionally:

- AECL ACR-700
- ESBWR, SWR-1000,
- Generation IV

Advanced Reactor Research Infrastructure
Key Research Areas and Areas for Examination



March 8, 2002

NRC Advanced Reactor Research Plan (Structure)

Structured around 9 Key Research Areas:

1. Framework
2. Accident Analysis (PRA, human factors, instrumentation & control)
3. Reactor/Plant Analysis (T/H, nuclear analysis, severe accident analysis)
4. Fuel Analysis (fabrication and performance)
5. Materials Analysis (high-temperature material, graphite)
6. Structural Analysis (external events, concrete performance)
7. Consequence Analysis (environmental impact)
8. **Nuclear Materials and Waste Safety (storage, transport, disposal)**
9. Safeguards and Security

Nuclear Materials and Waste Safety

Areas considered:

- Front-end of fuel cycle - fabrication
- Operating Cycle - fuel handling, storage, ALARA
- Back-end of fuel cycle - processing, transportation, disposal

Technical Issues

Nuclear Analysis for Materials/Waste Safety

- higher enrichments (>5wt% ^{235}U) → criticality safety
- radionuclide inventories → decay heat, radiation sources
- higher burnup (to 80,000 Mwd/t) → credit

Uranium Enrichment and Fuel Fabrication

- new manufacturing facilities (hazards)

Transportation and Storage

- physical and radiological differences

Technical Issues

Waste Disposal

- potentially new waste streams
- differences in physical and chemical conditions
- radiological source term
- decommissioning

Personnel exposure (ALARA),

- PBMR (e.g., silver [Ag-110] migration, graphite [C-14 dust])

Nuclear Materials and Waste Safety

Infrastructure applicable to materials/waste arena:

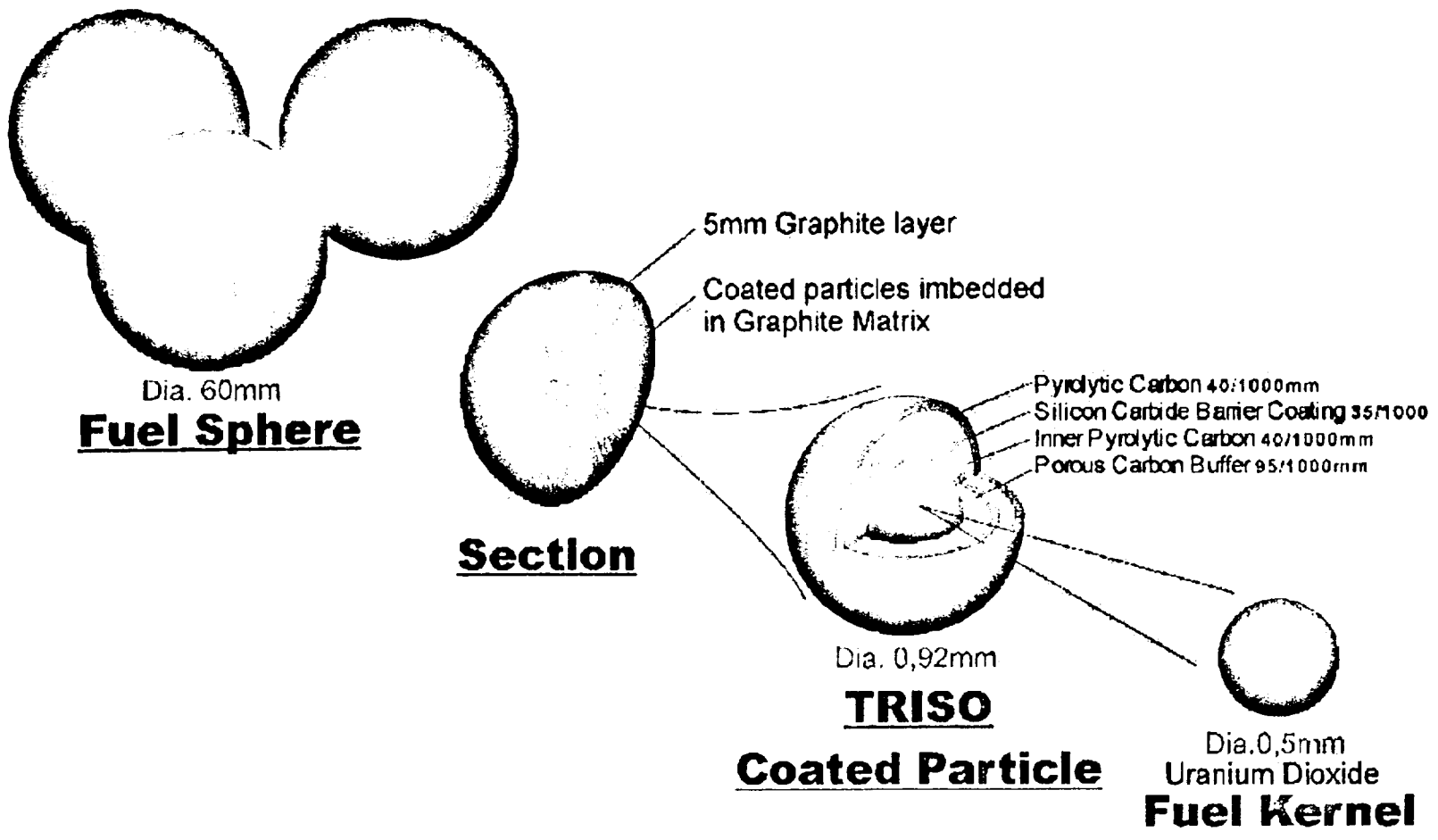
- Risk-informed and performance-based methods
- Nuclear analysis methods and library
- Severe accident and source term activities
- Human factors methods and expertise
- Materials and structural analysis activities
- International agreements and collaborations

Research Activities
(examples)

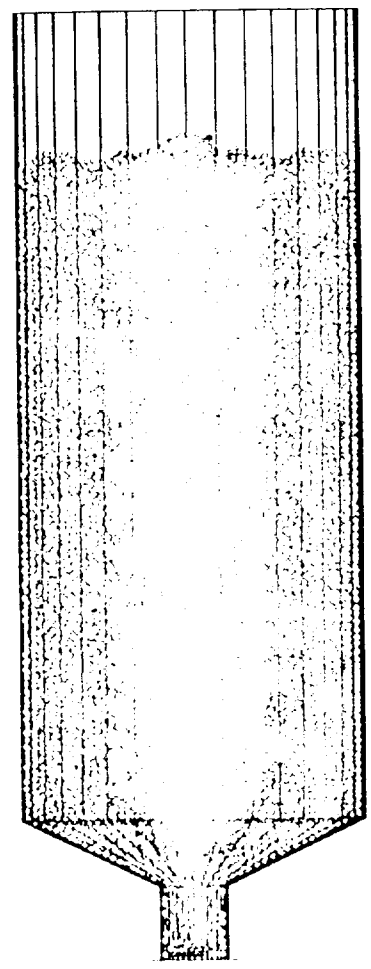
- Nuclear data libraries
- Criticality models and validation
- Application of burnup credit
- Decay heat models and radiation source studies
- Characterization of spent fuel and waste streams
- Framework

Future Actions

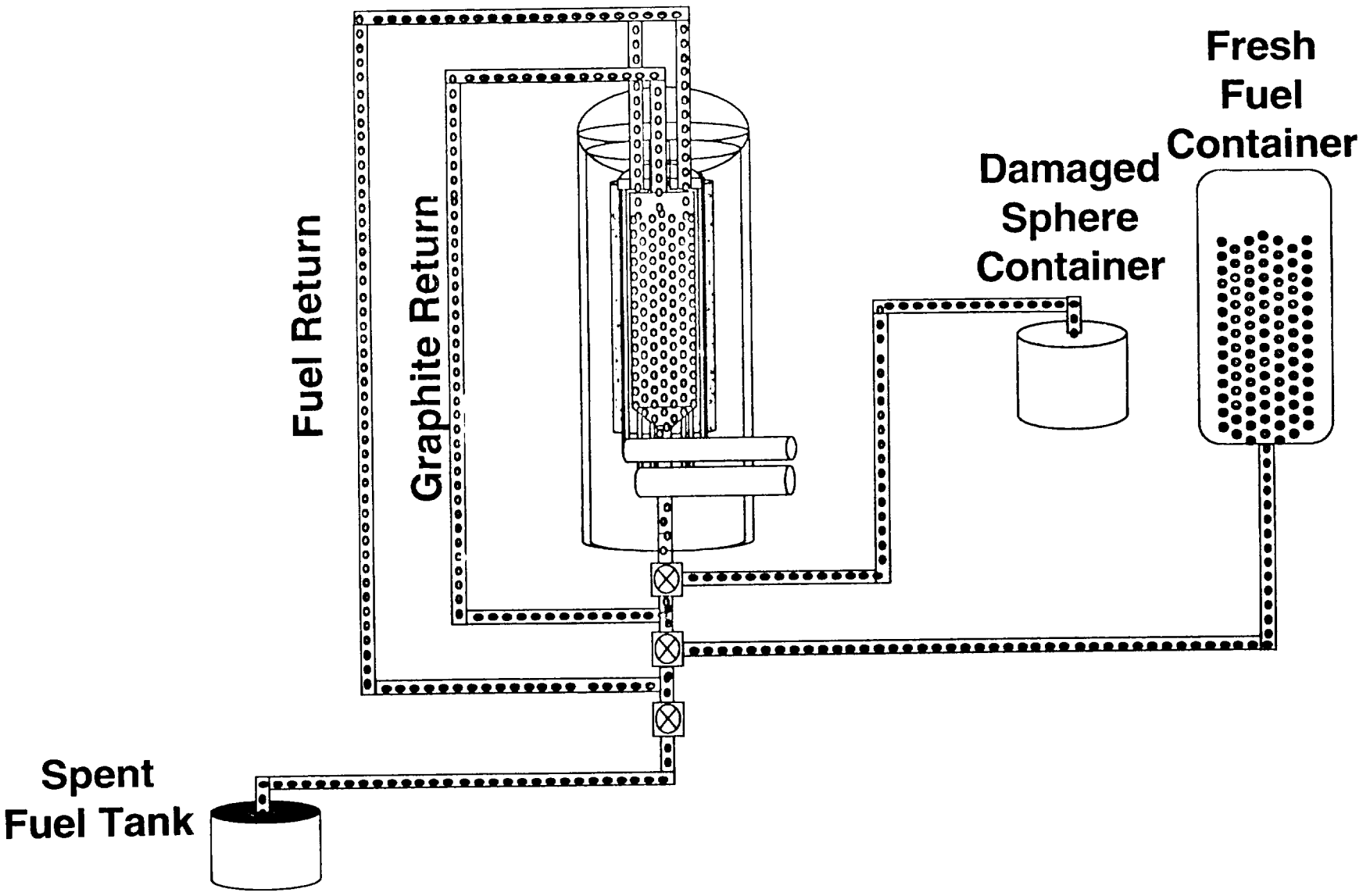
- Will update to include recent developments
- Expect additional stakeholder interactions
- Transmit plan to Commission in Fall 2002
- Implement and maintain plan as living document



PBMR Fuel Element and (TRISO) Coated Fuel Particle

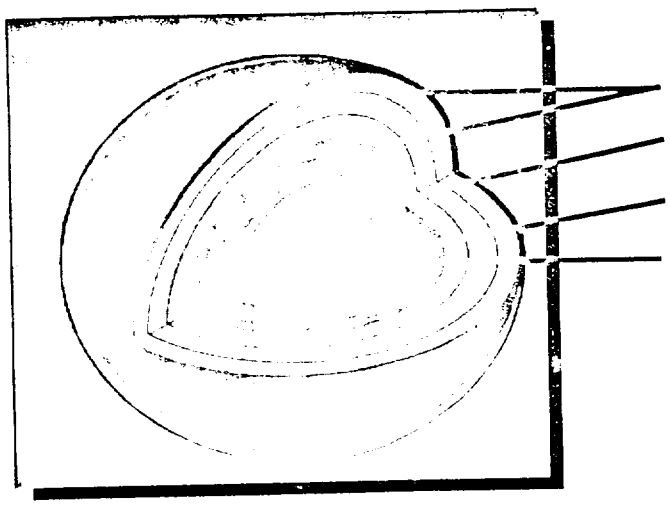


PBMR Annular Core With Center Graphite Pebbles

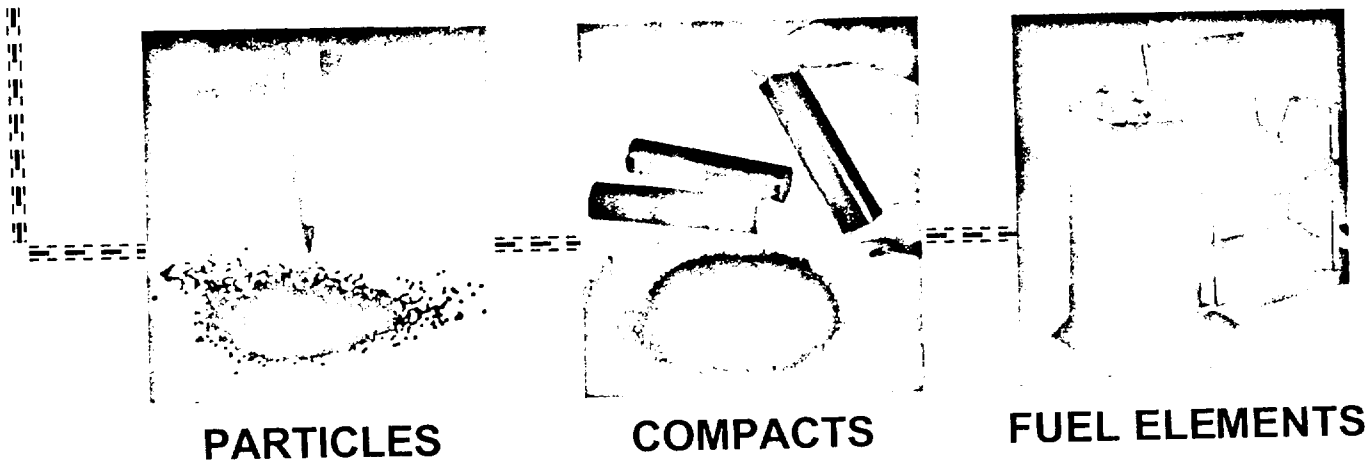


Fuel Handling and Storage System

CERAMIC FUEL RETAINS ITS INTEGRITY UNDER SEVERE ACCIDENT CONDITIONS



TRISO Coated fuel particles (left) are formed into fuel rods (center) and inserted into graphite fuel elements (right).



GENERAL ATOMICS

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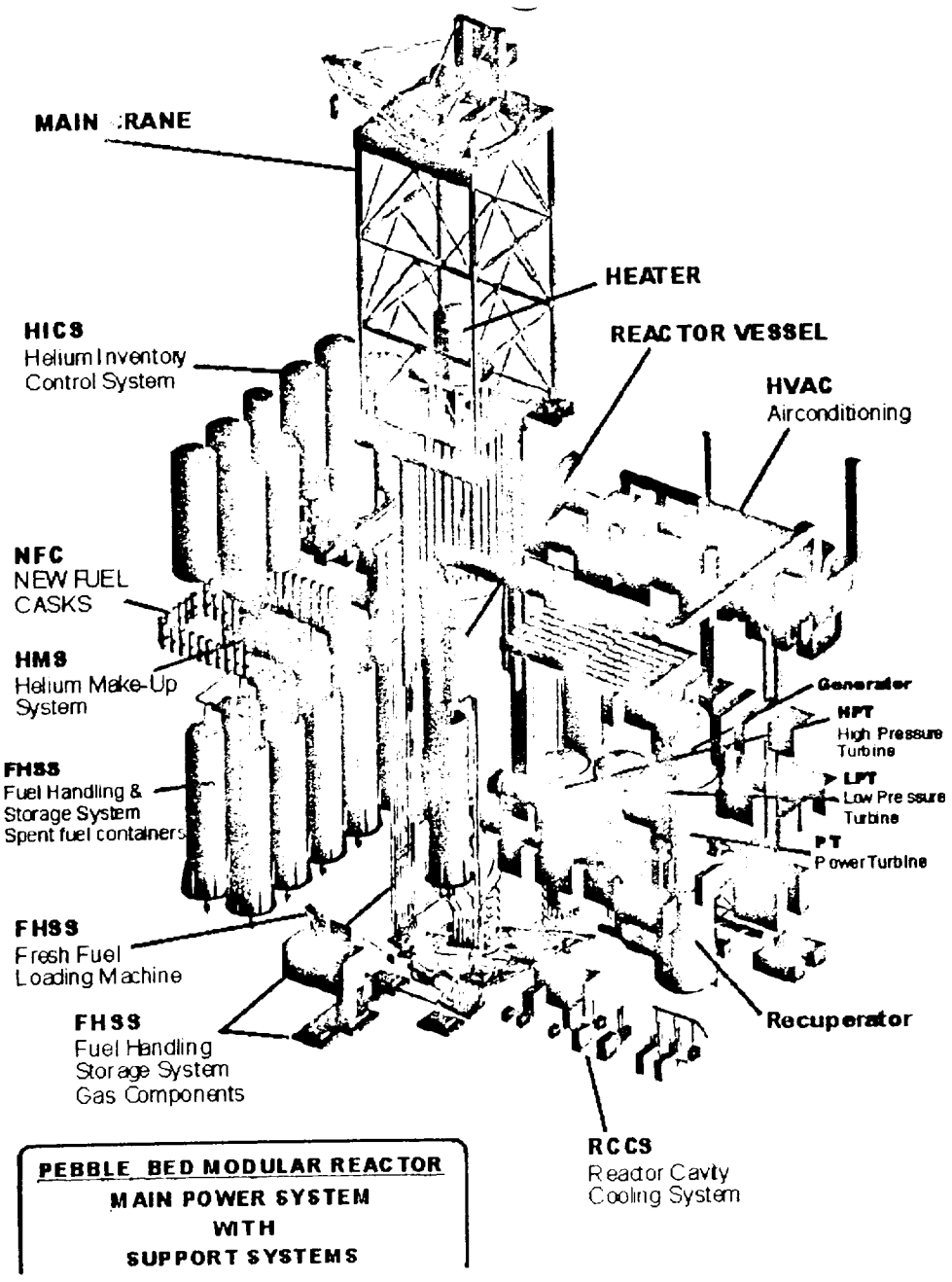


PBMR Main Power System with Support Systems

136th ACNW MEETING
July 23-25, 2002

AGREEMENT STATE PROGRAM

Paul Lohaus, Director
Office of State and Tribal Programs

GENERAL BACKGROUND

SECTION 274 OF THE ATOMIC ENERGY ACT

- Enacted in 1959.
- Initiative from the States to regulate atomic energy.
- Recognize interests of States.
- Established cooperative program.
- Provides a mechanism for transfer of certain NRC authority.
- Provides for coordination in development of standards.

SECTION 274 OF THE ATOMIC ENERGY ACT

- Reserves certain areas for NRC to regulate.
- Modified in 1978 to direct NRC to periodically review Agreement State Programs.
- DeConcini Amendment in 1980 authorizes NRC to suspend all or part of an Agreement in an emergency.

SECTION 274 OF THE ATOMIC ENERGY ACT

- Presently, NRC regulates about 5,000 material licensees. Thirty-two Agreement States regulate about 16,000 licensees.
- Three States currently pursuing Agreements:
  - Wisconsin, Minnesota, Pennsylvania
- One State, Utah, currently pursuing mill Agreement Amendment.

FUNDING AGREEMENT STATE PROGRAMS

- NRC, as matter of policy, does not provide seed money to establish Agreement Programs.
- NRC not authorized to provide operating funds.
- Beginning in FY 1997, NRC ceased funding for Agreement State staff training and travel.
- Direct technical assistance provided on a fee reimbursable basis.

CATEGORIES OF AGREEMENTS

- STANDARD AGREEMENT
  - Authority to regulate
    - Byproduct material as defined in Section 11e(1) of the Atomic Energy Act (material yielded in or made radioactive through the process of producing or utilizing special nuclear material),
    - Source material and
    - Special nuclear material in quantities less than critical mass.
  - All categories of licensees except uranium mills and low-level waste facilities.
  - At State option, sealed source and device evaluation authority may be retained by NRC.

CATEGORIES OF AGREEMENTS

- Uranium Mill Agreement
  - Authority to regulate byproduct materials as defined in Section 11e(2) of the Atomic Energy Act (tailings or wastes produced by the extraction or concentrations of uranium or thorium from ore).
- Low-Level Waste Agreement
  - Authority to regulate land disposal of radioactive waste.
- Full Agreement
  - Authority to regulate all of the categories above.

AREAS OF AUTHORITY RESERVED TO NRC

- 10 CFR Part 150 – Implementing Regulations
- NRC retains authority over
  - Protection of common defense and security
  - Federal agencies
  - Production and utilization facilities
  - Exports and imports
  - Disposal in the ocean
  - High-level waste handling and disposal
  - Transfer of materials to persons exempt from licensing (consumer products)
  - Large quantities of special nuclear material
  - Off-shore waters
  - Certain aspects of mill tailings management.

COMMISSION POLICIES AND PROCEDURES

- Policy Statement – "Statement of Principles and Policy for the Agreement State Program"
- Policy Statement – "Adequacy and Compatibility of Agreement State Programs"
- Policy Statement – Criteria for Guidance to States "on Agreements"
- Office of State and Tribal Programs (STP) Procedures (e.g., SA-700 "Processing an Agreement")
- Management Directive 5.6, "Integrated Materials Performance Evaluation Program (IMPEP)"

CRITERIA FOR STATES ENTERING INTO AN AGREEMENT

- Statutes and regulations
- Licensing program
- Inspection and enforcement program
- Adequate number of trained and qualified personnel
- Provisions for fair and impartial administration
- Event and allegation response program

ACTIONS NRC MUST TAKE FOR A STATE TO BECOME AN AGREEMENT STATE

- Must find the State Program compatible.
- Must find the State Program adequate to protect public health and safety.
- Must prepare staff assessment following STP Procedure SA-700 (Based on 1981 and 1983 Policy Statements).
- Must publish staff's assessment in the Federal Register for four consecutive weeks.
- Must arrange for orderly discontinuance of NRC jurisdiction.

POST AGREEMENT RELATIONSHIPS

- Exchange-of-Information
- Training
- Technical Assistance
- National Performance Goals and Measures
- State Involvement in NRC Rule and Guidance Development Activities
- NRC Oversight of Agreement States (IMPEP)

CURRENT ISSUES

- National Materials Program
- Response to terrorist activities
- Difficulty faced by number of States to hire, train and retain staff, affecting program performance

INTEGRATED MATERIALS PERFORMANCE EVALUATION PROGRAM (IMPEP)

- Reviews of State Programs conducted pursuant to Section 274j of the Atomic Energy Act.
- Common process for review of Agreement State and NRC Regional material programs.
- Routine on-site reviews normally conducted every four years; May be decreased from four years based on program performance.
- Reviews scaled to the size of the Agreement State Program.
- Reviews conducted by team of NRC Office (STP, NMSS, Regional) and Agreement State Staff.

IMPEP

- Five common performance indicators
  - Status of Materials Inspection Program
  - Technical Quality of Inspections
  - Technical Staffing and Training
  - Technical Quality of Licensing Actions
  - Response to Incidents and Allegations
- Non-common performance indicators, as applicable
  - Legislation and Program Elements Required for Compatibility
  - Sealed Source and Device Evaluation Program
  - Low-Level Radioactive Waste Disposal
  - Uranium Recovery Program
  - Regional Fuel Cycle Inspection Program
  - Site Decommissioning Management Plan
- Draft IMPEP report sent for State/Regional review

IMPEP

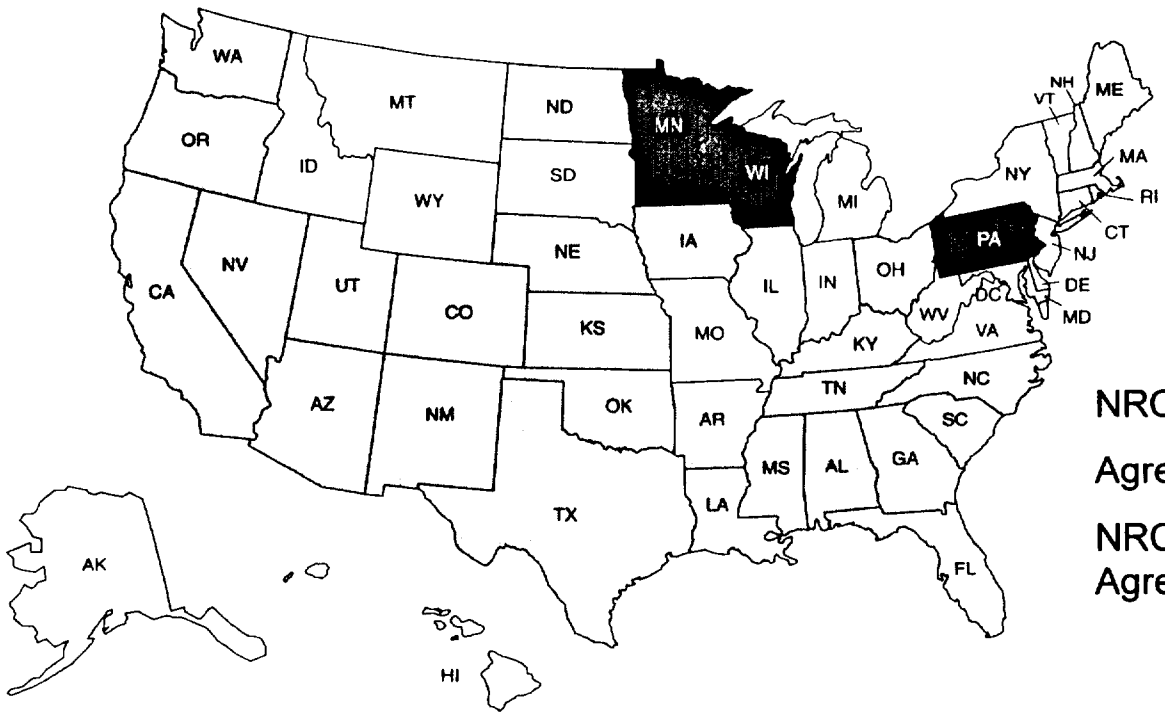
- Management Review Board (MRB)
  - Independent board which makes final determination of adequacy and compatibility based on IMPEP team's report and information presented by Region or State.
- Agreement State –Adequate and Compatible Finding
- Region – Adequacy Finding only
- MRB Members
  - Deputy Executive Director for Materials, Research and State Programs
  - Director, Office of Nuclear Material Safety and Safeguards
  - Director, Office of State and Tribal Programs
  - General Counsel
  - Agreement State Program Manager Liaison
- Periodic one-day NRC/Agreement State meeting in years between IMPEP review

PROCEDURES FOR AGREEMENT STATE PROGRAM IMPROVEMENT

- Letter accompanying final IMPEP report issued to State management (normally, no additional action is needed).
- Alternatives if a State program is experiencing difficulties:
  - Heightened Oversight (SA-122, under development)
  - Probation (SA-113)
  - Emergency Suspension (SA-112)
  - Suspension of an Agreement (SA-114)
  - Termination of an Agreement (SA-115).

THE AGREEMENT STATES

AS OF JULY 2002



NRC States (15) ☐

Agreement States (32) ☐

NRC States that have expressed intent to sign Agreement (3) ■

States	Date	States	Date
Kentucky	3/26/62	Arizona	5/15/67
Mississippi	7/1/62	Colorado	2/1/68
California	9/1/62	*Idaho	10/1/68
New York	10/15/62	North Dakota	9/1/69
Texas	3/1/63	South Carolina	9/15/69
Arkansas	7/1/63	Georgia	12/15/69
Florida	7/1/64	Maryland	1/1/71
North Carolina	8/1/64	Nevada	7/1/72
Kansas	1/1/65	New Mexico	5/1/74
Oregon	7/1/65	Rhode Island	1/1/80
Tennessee	9/1/65	Utah	4/1/84
New Hampshire	5/16/66	Iowa	1/1/86
Alabama	10/1/66	Illinois	6/1/87
Nebraska	10/1/66	Maine	4/1/92
Washington	12/31/66	Massachusetts	3/21/97
Louisiana	5/1/67	Ohio	8/31/99
		Oklahoma	9/29/00

* Idaho Agreement terminated April 26, 1991

STP INTERNET RESOURCES

STP HOMEPAGE:

http://www.hsrd.ornl.gov/nrc/home.html

- Directories: State Directors and STP Staff Contact Information
- NRC-State Communications: Agreement State Program Letters and Documents Involving Incidents & Events, Program Management, Training, Technical Topics, etc.
- Program Reviews: Agreement State Review Reports including State and NRC Correspondence
- Related Links: Special Documents, NRC Resources, State Web Sites, and other links
- Device Registry (SS&D) Index: Index of Radioactive Sealed Sources and Devices by Manufacturer and Model Number
- NRC Technical Training: Program Administration, Information for Agreement States, and Integrated Course Index
- Office of State and Tribal Programs Procedures: Guidance for the implementation and coordination of major office-related activities, including SA-200, "Review of State Regulations," and SA-106, "Management Review Boards"
- NRC Management Directives

United States Nuclear Regulatory Commission

NRC Activities to Enhance Control of Sources

Presentation to the Advisory Committee on Nuclear Waste

July 24, 2002

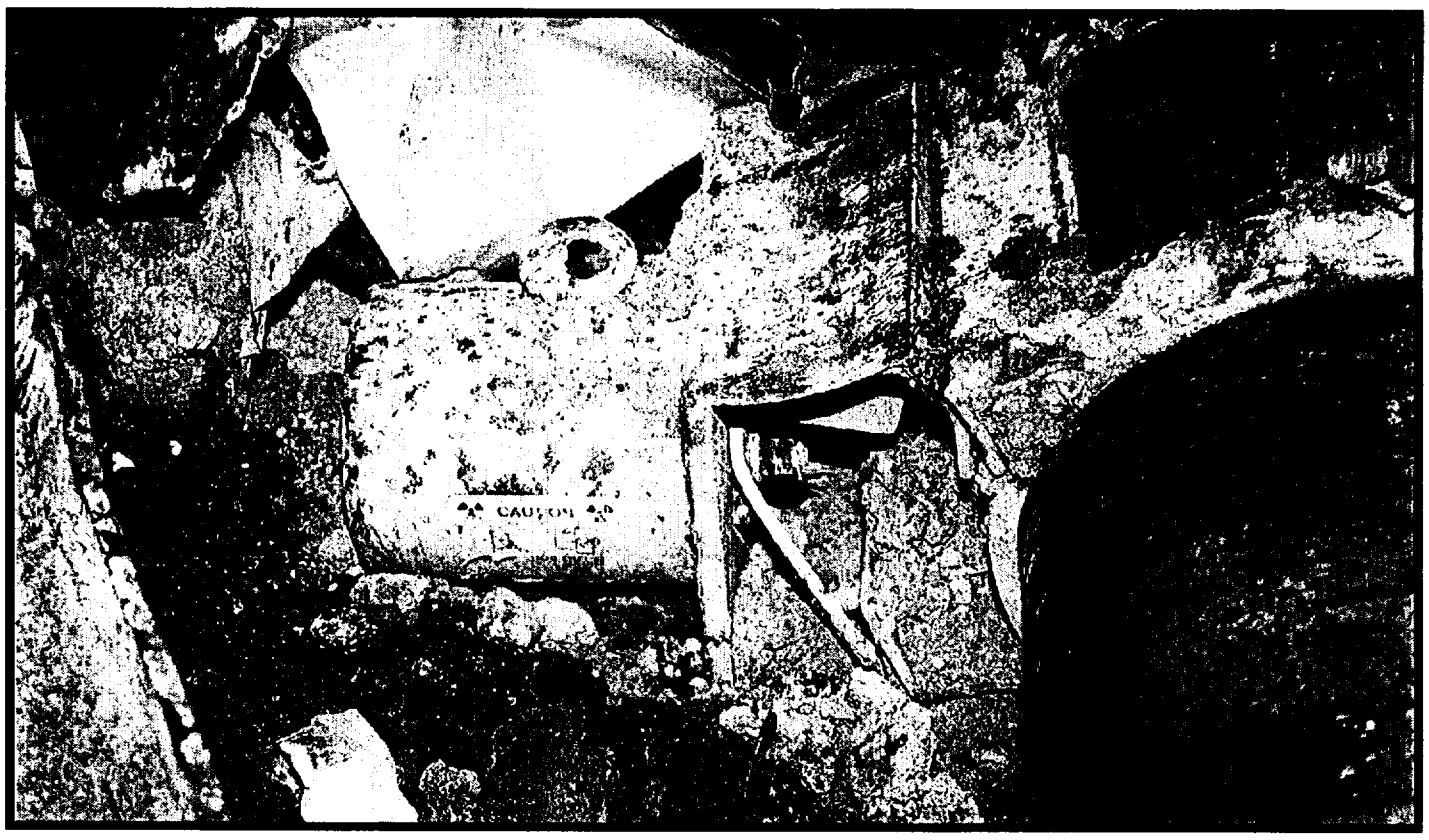
Douglas A. Broaddus
Division of Industrial and Medical Nuclear Safety
NMSS
U.S. Nuclear Regulatory Commission
Rockville, MD

Overview

- **Background**
- **NRC Efforts and Initiatives**
- **International Activities**
- **Post 911 Security Enhancements**

Gauge (Cs-137, 1 Curie) Found in Scrap Metal

United States Nuclear Regulatory Commission



Uses and Users of Sources in the US

- **~200,000 Licensees**
  - **180,000 general/21,000 specific**
- **~2 Million Devices**
  - **1-4 sources/device**
  - **Industrial (radiography, irradiators, gauges)**
  - **Medical (brachytherapy, teletherapy)**
  - **Educational and Research (laboratory equipment)**
- **Consumer Products**

Loss of Control Events

- **Nuclear Materials Events Database (NMED) Reports of Lost or Stolen Radioactive Material**

	Since 1/1990	Since 10/2001
Reports/Sources	2000/2700	183/226
Recovered	40%	51%

  - **20% of all reports, and 40% of lost/stolen sources involve Portable Gauges (2 sources/gauge),**
  - **Few high risk sources, and most recovered,**
  - **Over 20 melts at U.S. Steel mills; average cost $10 million.**

Loss of Control Causes

- **Loss of Accountability**
  - **Personnel Changes**
  - **Inattention/Time**
  - **Financial Constraints**
  - **Lack of Understanding**
- **Not Following Regulations/Procedures**
- **Theft**
- **Abandonment**

Historical Perspective
Control of Generally Licensed (GL) Devices

- **Designed to Minimize Potential for Exposure**
- **Require Minimal Radiation Protection and Knowledge**
- **Minimal Regulatory Oversight**
- **Tracked Through Vendor and GL Reporting**

Historical Perspective
Control of Specifically Licensed Sources

- **Minimal to Very High Risk Materials**
- **License Specific Requirements:**
  - **Oversight and Radiation Protection based on hazard**
  - **Security and Control (10 CFR 20.2201, 20.2202)**
  - **Licensee Responsible for Source Accountability**
- **Control Verified Through Inspection**
- **Licensees Tracked (Licensee Tracking System)**

Historical Perspective
"Orphan Sources"

- **Material Not Under Regulatory Control,**
- **Generally and Specifically Licensed Devices,**
- **Imported Materials,**
- **Legacy Material**
- **Response Programs Minimal or Inconsistent**

United States Nuclear Regulatory Commission

NRC Initiatives for Source Control

- **Studies of GL Accountability (1984 - 1996)**
- **Enhanced General License (GL) Oversight**
- **Orphan Source Recovery Program**
- **Enforcement Policy Changes**
- **Security Enhancements Since 911**

Control of Generally Licensed Devices New Requirements

- **New General License (GL) Requirements Effective February 16, 2001**
  - **Use (General Licensees)**
  - **Distribution (GL vendors)**
  - **Device design/labeling**
  - **Agreement State Compatibility - "essentially identical"**
- **Lost Source Enforcement Policy**
- **General Licensee Tracking System (GLTS)**

Control of Generally Licensed Devices
General Licensee Requirements

- **Allow Increased Contact With GLs**
- **Annual Registration of "Higher Risk" Devices**
- **Designate a Person Responsible for Compliance**
- **Clarify Other Requirements:**
  - **Authorized Transfers**
  - **Mailing Address Vs Location of Use**
  - **Reporting Requirements**
  - **Portable Devices**

Control of Generally Licensed Devices Vendor and Device Requirements

- **Revised/New Reporting Requirements**
  - **Distributions and Returns**
  - **Modified Devices**
  - **Deleted "replacement" exemption**
  - **Serial Numbers**
  - **Agreement State Compatibility in 6 months**
- **Disclosure**
  - **Inform potential purchasers of requirements and responsibilities, prior to transfer**
- **Additional & More Rigorous Warning Labels**

Control of Generally Licensed Devices
General Licensee Tracking System

- **Deployed in Late 2000**
- **Database Management & Registration System**
  - **Data on ~200 vendors, ~45000 general licensees, and ~600000 devices**
  - **Automated registration form creation and input of data on returned forms**
  - **Enhanced Report Generation, Searches, data input and validation**
- **Transfer Lost Device Data to the NMED**
- **Expandable to a "National System"**
- **Registration Program Begun March 2001**

Enforcement Policy Modifications
Interim Enforcement Policy

- **Effective March 9, 1999 – FY 2002**
- **Amnesty**
  - **Use Discretion to not cite past violations**
  - **Remove potential disincentive to report lost devices**
  - **Encourage GLs to identify and locate devices and come into compliance with new requirements.**
  - **Not applicable for NRC identified and willful violations**

Enforcement Policy Modifications
Lost Source Policy

- **Effective February 16, 2001**
- **Applicable to All Licensees**
- **Incentive to Ensure Proper Control, Transfer, and Disposal of Sources**
- **Civil Penalties (CP)**
  - **3 levels ($6,000, $15,000 and $45,000)**
  - **Based on ~3 times the cost of authorized disposal**
  - **Based on isotope/content, consistent with GL registration criteria**
  - **Use discretion to always impose a CP**

Orphan Source Initiative
Staff Efforts

- **DOE Assistance on "Emergency" Recoveries Since 1990 (OSRP)**
- **June 1999 MOU with DOE on Management of Sources**
- **Response to Commission Direction**
- **Participation and Support of CRCPD's E-34 Committee on Unwanted Radioactive Material**
- **Participation and Coordination With International Efforts**

Orphan Source Initiative
Commission Direction

- **Guiding Principle in April 13, 1998, Staff Requirements Memorandum (SRM):**
  - **"Non-licensees who find themselves to be in possession of radioactive sources that they did not seek to possess should not be expected or asked to assume responsibility and cost for exercising control or arranging for their disposal."**
- **February 3, 1999, Commission Paper**
- **April 21, 1999, SRM: Directed Staff to Fund a National Orphan Source Program**

Orphan Source Initiative
CRCPD National Orphan Source Program

- **Developed by the CRCPD E-34 Committee on Unwanted Radioactive Materials**
- **NRC Funding Initiated September 2001**
  - **Cooperative Agreement managed by the FDA**
  - **$225,000 per year for 2 years**
  - **Will consider additional funding after 2 years**
  - **Applicable only to Atomic Energy Act Material**
- **Funding From Other Sources for NARM**

Other Recent Activities

- **Information Notice 2001-11, "Thefts of Portable Gauges," - July 13, 2001**

- **Us/Mexico/Canada Trilateral Initiative:**
  - **Inaugural meeting on February 5, 2002**
  - **Agreed to develop a processes for notification when sources are lost or stolen near a common border**

International Issues/Activities

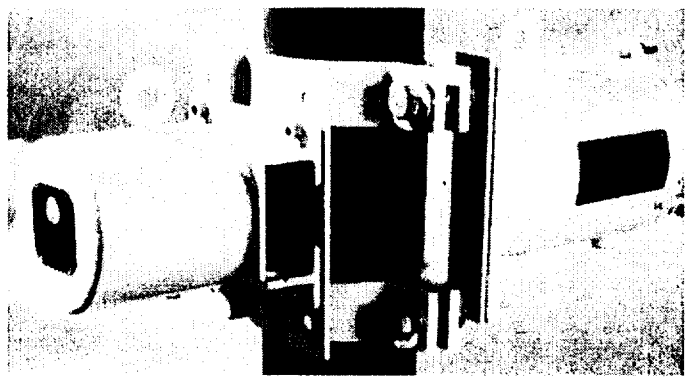
- **Illicit Trafficking in FSU**
- **Competing Priorities in Developing Countries**
- **Radioactive Materials in Recycled Products**
- **Used/obsolete Equipment and Devices (Poor Condition & Maintenance)**
- **Unauthorized Transfers and Uses**
- **IAEA Action Plan and Code of Conduct**

Response to September 11th Attacks

- **Initial Actions:**
  - **24 hr staffing of incident response center**
  - **3 Safeguards Advisories**
  - **Requested DOE accelerate recovery of sources Registered with the OSRP**
- **Interim Compensatory Measures**
  - **Transportation/Large Quantity Shipments**
  - **Materials Licensees**
- **Chairman's Budget Proposal: $10 M/10 FTE to Develop a Source Tracking System**

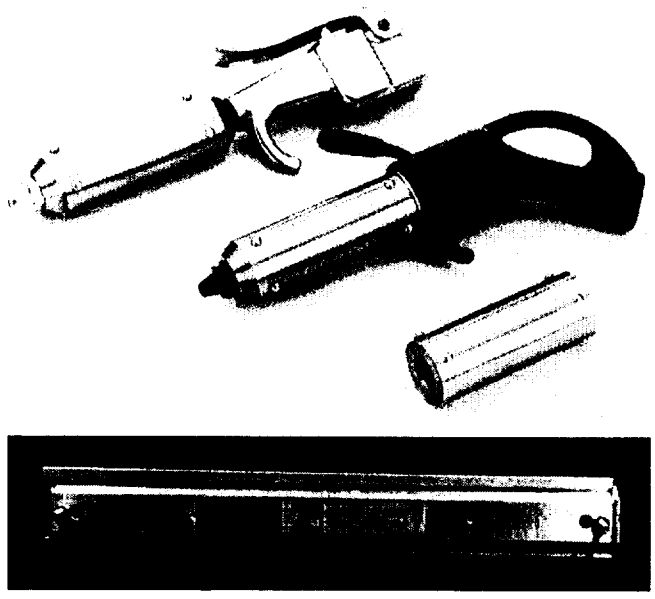
Source & Device Examples
Gauges

Portable

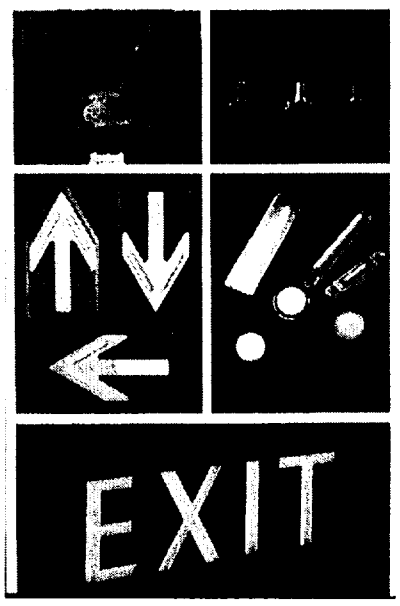


Fixed

Source & Device Examples Generally Licensed

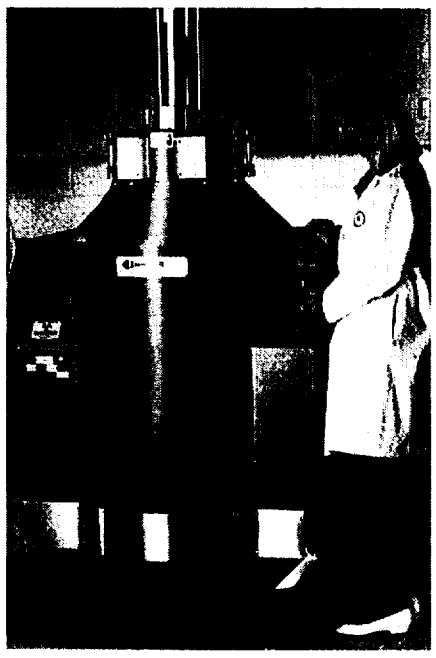


Static Eliminators

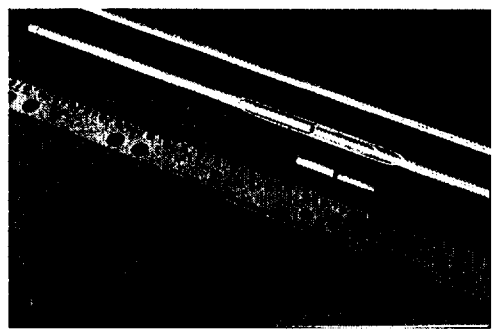


Tritium Lights

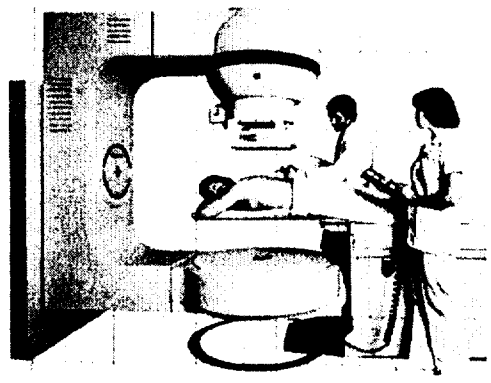
Source & Device Examples
Medical Uses



Research Irradiator

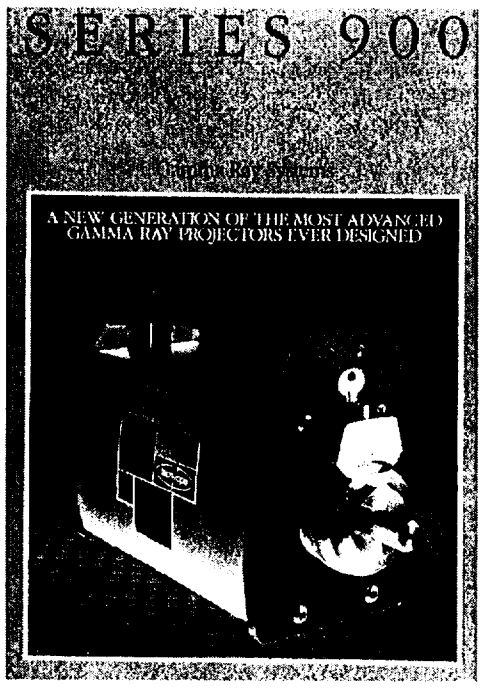


Irradiator Source

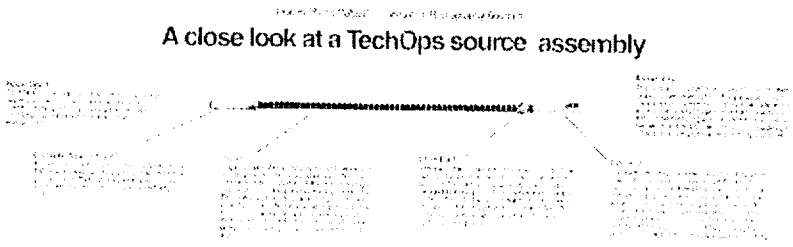


Teletherapy Device

Source & Device Examples
Radiography



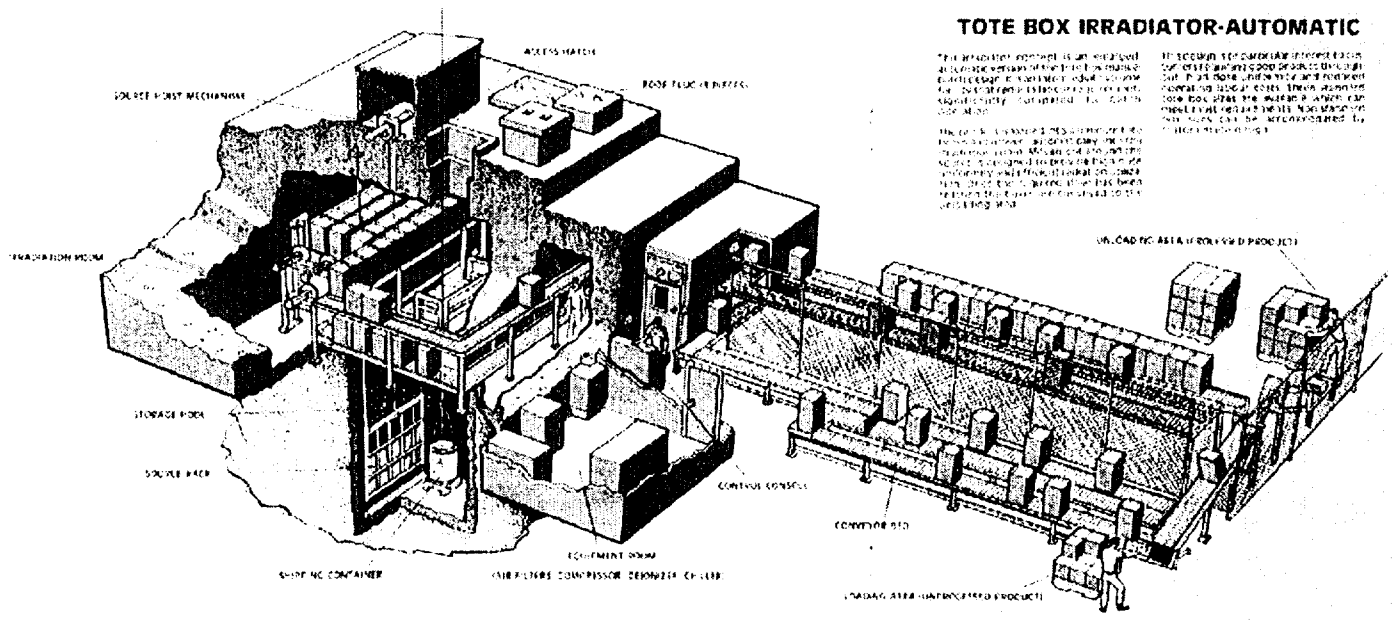
Camera



Source Assembly

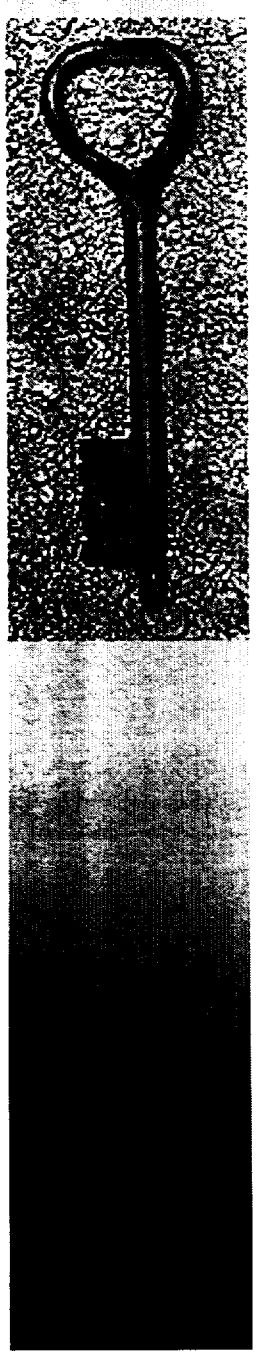
United States Nuclear Regulatory Commission

Source & Device Examples
Industrial Irradiator



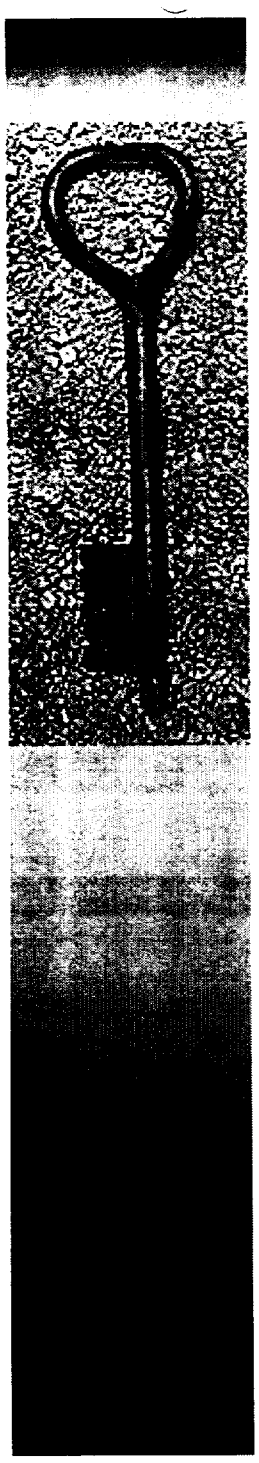
Radioactive Source Security

Border State Issues



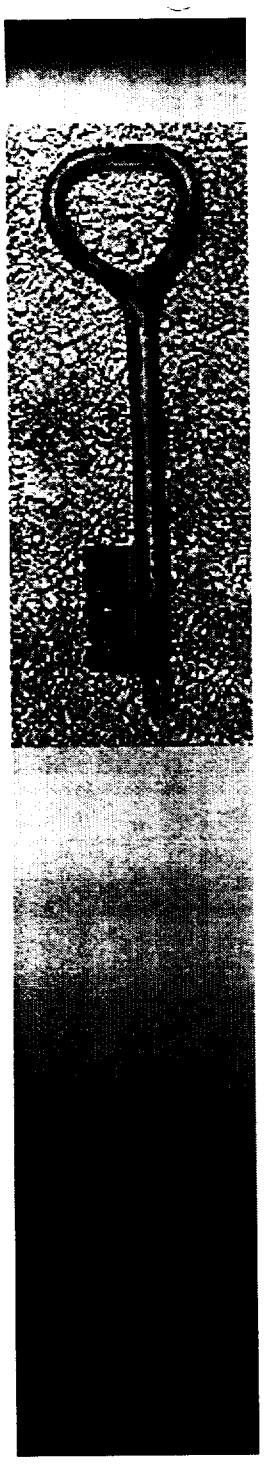
General Information

- The U. S. shares about 2000 miles of border with Mexico
- Texas has about 1000 of those along the Rio Grande.



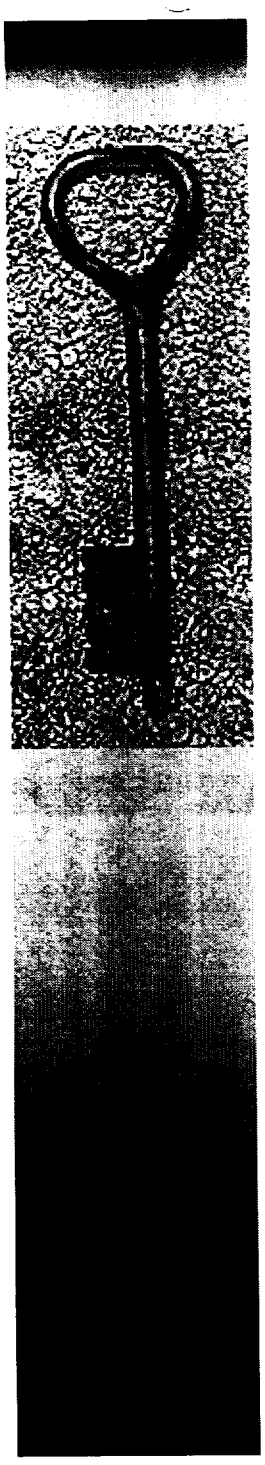
Texas Licensees

- Approximately 140 radioactive material licensees along the Texas border
- 48 are medical facilities
- 35 are portable gauges
- 3 are large irradiator facilities



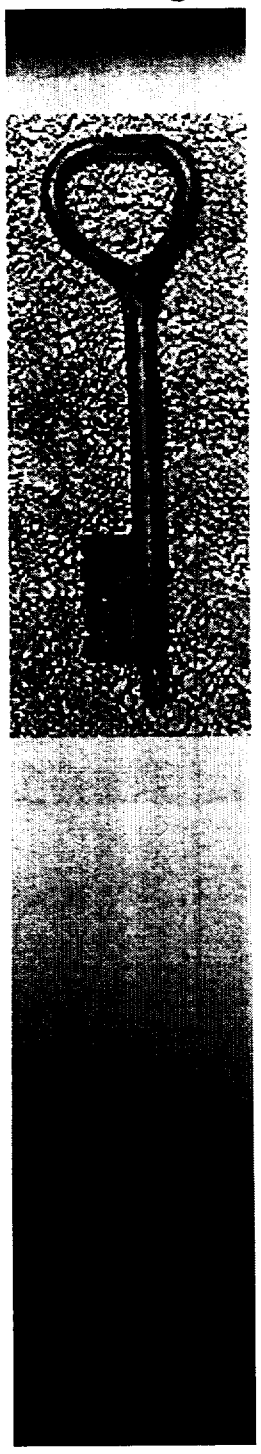
Border Organizations

- National Border Technology Partnership Program – Carlsbad Conference
- TNRCC Office of Border Affairs – Works with border organizations on environmental issues



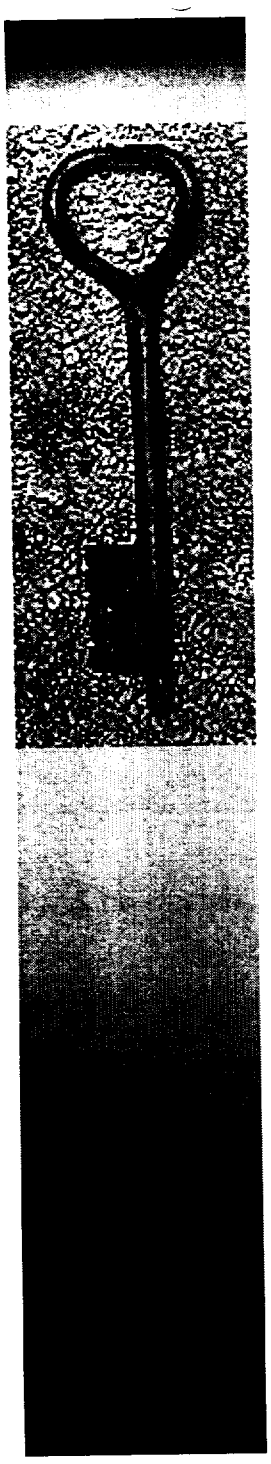
Texas Events

- About 250 events per year state wide
- 12 events along border over past 5 years
- Most were M/D gauges
- One industrial radiography device



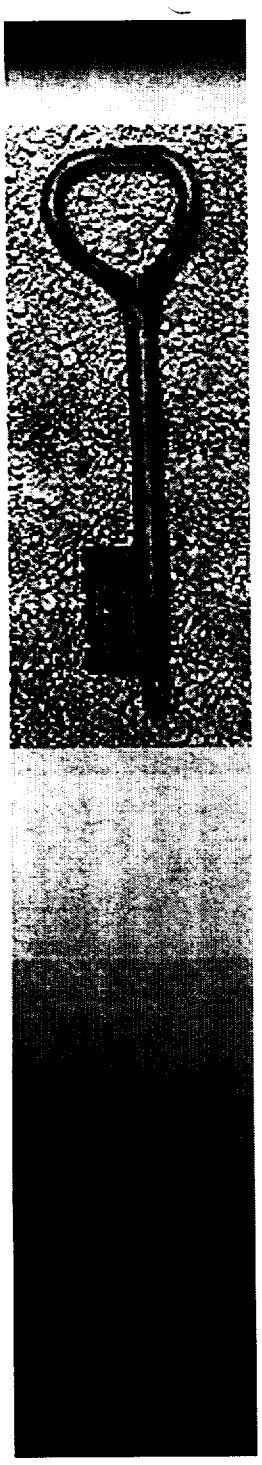
Other Border States

- California - 224 licensees
- New Mexico - 17
- Arizona - 61



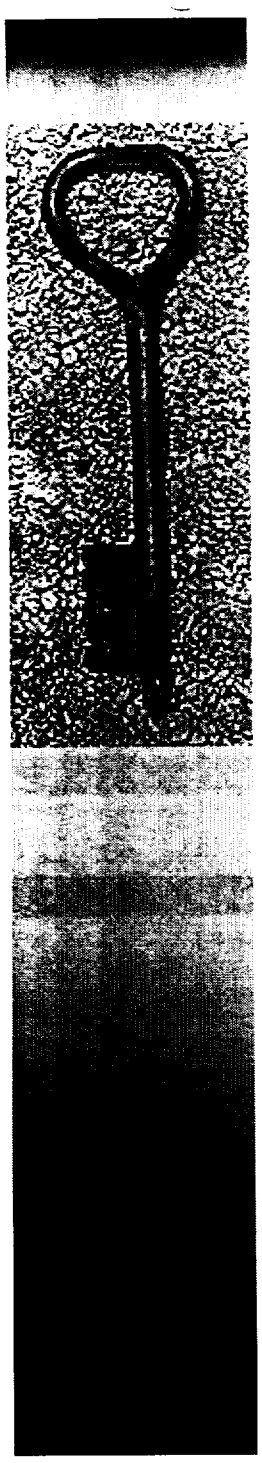
Border State Events

- No significant events in recent years
- California reports one event



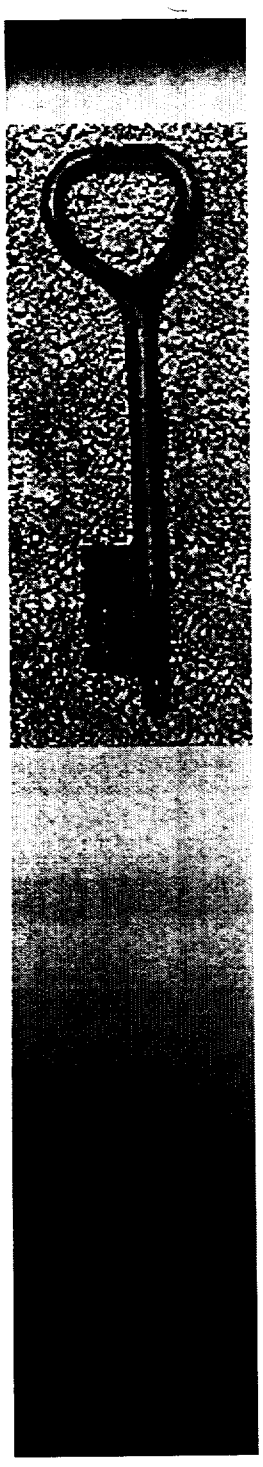
Border State Issues

- Concern for advance notice of potential threats
- Ability to Coordinate with Federal Responders, i.e., FBI, DOE, Customs, NRC, EPA
- Emergency Preparedness



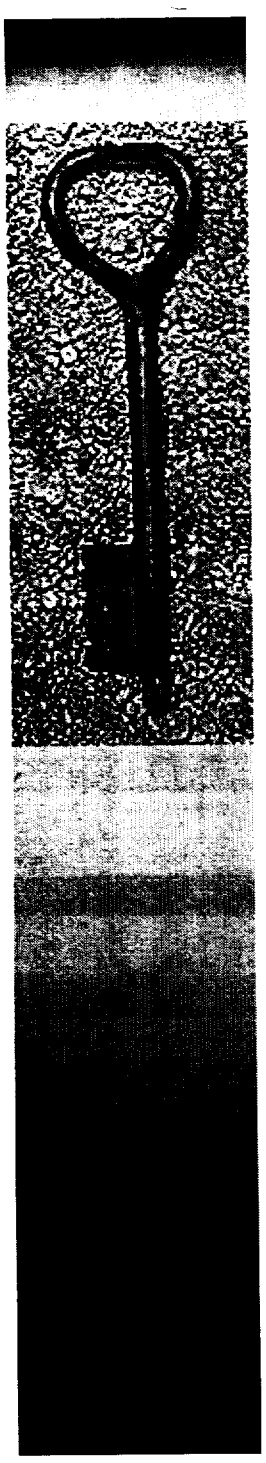
Source Security for Licensees

- Letter to licensees
- More Alert for unusual activity or unknown persons near storage/work locations
- Greater vigilance during mobile operations
- Dot interviews of transporters



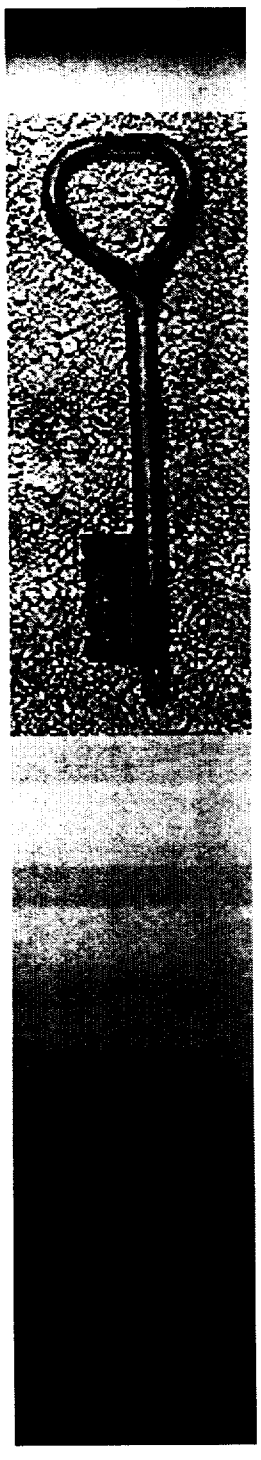
Security for Large Quantity Users

- Large Irradiators
- Hospital Security for Teletherapy Sources
- Waste Processors With Large Inventories



Local Govt. Concerns

- Concerns about the possibility of bringing radioactive materials into their jurisdictions
- Training for first responders, local officials
- Equipment – DOJ funding
- Support Contact and coordination with BRC, other state agencies



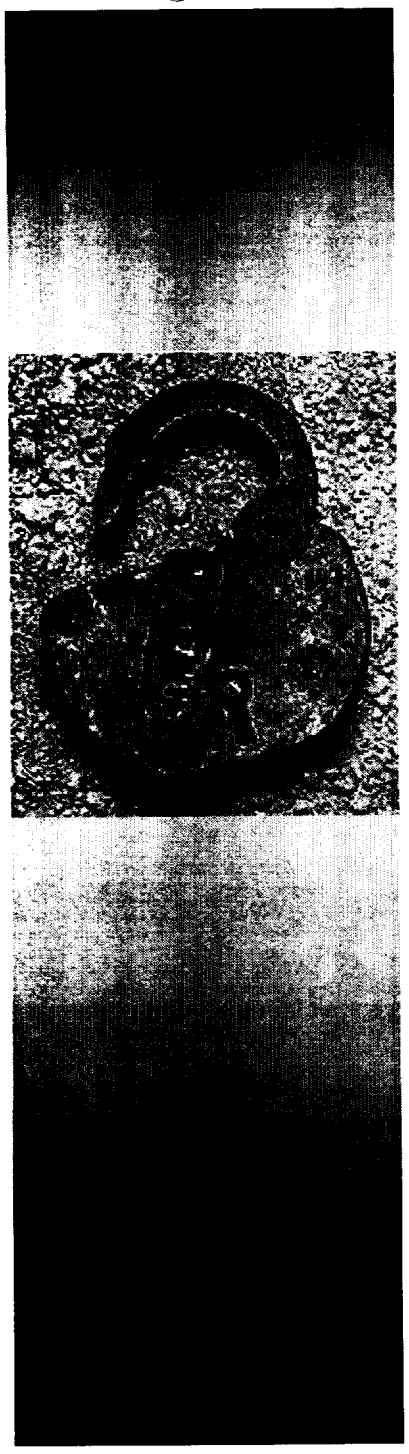
Emergency/Incident Response

- Update Emergency Plans
- Provide Training for Response Organizations
- Drills and exercises to test plans
- Equipment maintenance

Emergency Plans

State and local plans updated

Will need to adjust depending on Homeland Security Department



Training for Emergency Response

Texas provides training and instrumentation

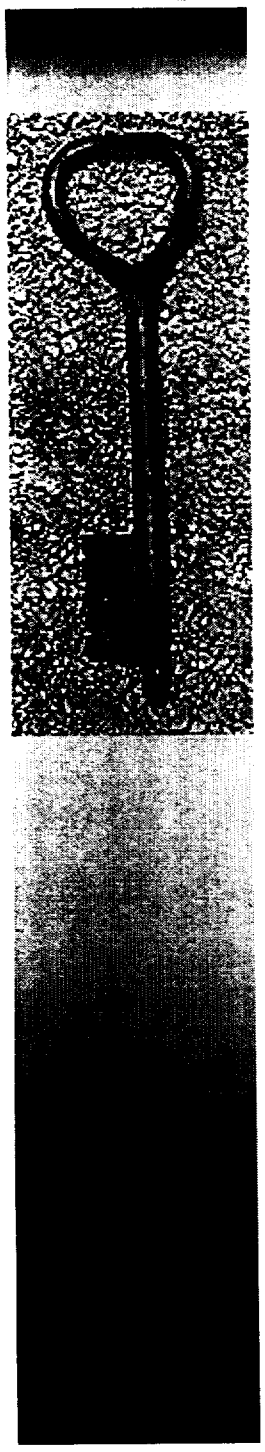
Other responders offered training

Drills and Exercises

Local jurisdictions provided planning and technical support

State sponsored drills

Nuclear power plant exercises



Equipment and Maintenance for Locals

- State provided equipment
- Equipment purchased with DOJ funds
- Maintenance issues

Control of Radioactive Sources in Illinois and the CRCPD National Orphan Radioactive Material Disposition Program

JOE KLINGER
Chief, Div. Of Radioactive Materials
Illinois Department of Nuclear Safety
Chairman, CRCPD E-34 Committee on Unwanted Radioactive Materials

How Do We Control Sources in Illinois

- Regulate possession, use, transfer, disposal, etc. from cradle to grave
- License and inspect facilities
- Licensing
  - Specific
  - General
  - Exempt
- Additional requirements for storage

Control of Radioactive Sources in the United States

- 157,000 Byproduct Material Licenses
- 22,000 Specific licenses
- 135,000 General licenses
- approx. 2,000,000 devices distributed!!!
- Estimated that 25% are unwanted and in storage!

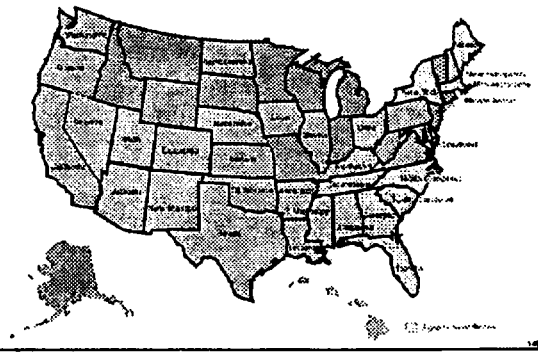
Control of Radioactive Sources in Illinois

- Illinois Department of Nuclear Safety
- Agreement State in 1987
- 750 Specific Radioactive Material Licensees
- Thousands of General Licensees
  - GL registration program
  - fees
  - Annual self-inspection
  - track by serial number

Control of Radioactive Sources in the United States

- 77% of Materials Licensees in Agreement States
  - 16,454 vs. 5,033 licensees
- By 2003–35 Agreement States (80 % of licensees)

NRC/Agreement States



Control of Radioactive Sources in Illinois (Continued)

- Headquarters in Springfield
- 200+ Employees
- Field Offices in West Chicago and Mazon

4500

Control of Radioactive Sources in Illinois (Continued)

- Emergency Response for all nuclear power plants and major nuclear facilities
- Register and inspect radiation-producing machines
- Technologist Accreditation
- Industrial Radiography Certification
- Radon
- Website www.state.il.us/idns

4500

Control of Radioactive Sources in Illinois (Continued)

- Wide Variety of Industrial Uses
- Medical Use
  - Diagnostic
    - Positron Emission Tomography
  - Therapy
    - Brachytherapy
- Research
- Broad Licenses

4500

IDNS Inspection Program

- 6 inspectors in West Chicago Office. 1 downstate
- Inspection frequency based on license category
- Ensure that all regulatory requirements are met
  - Statute
  - Rules
  - License conditions
- NOV, Mgmt Conference, Orders, Civil Penalties

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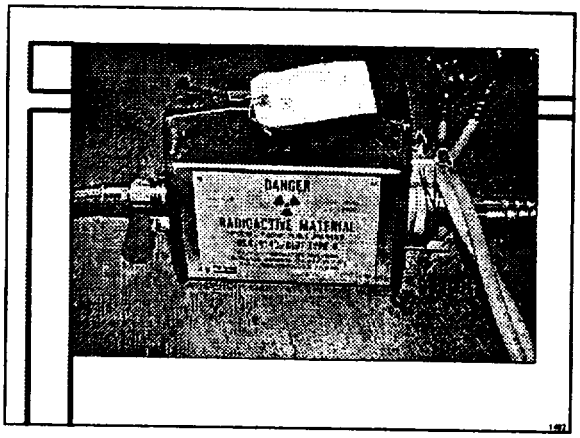
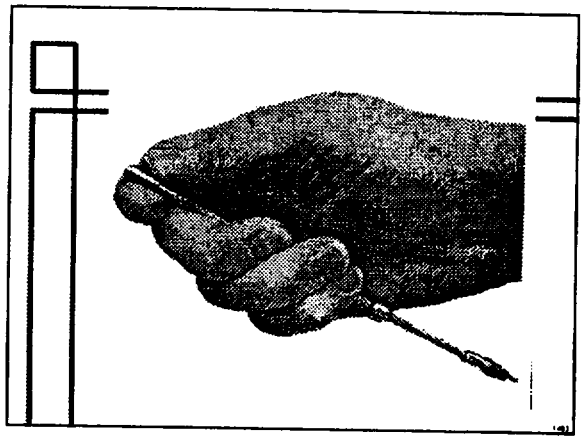
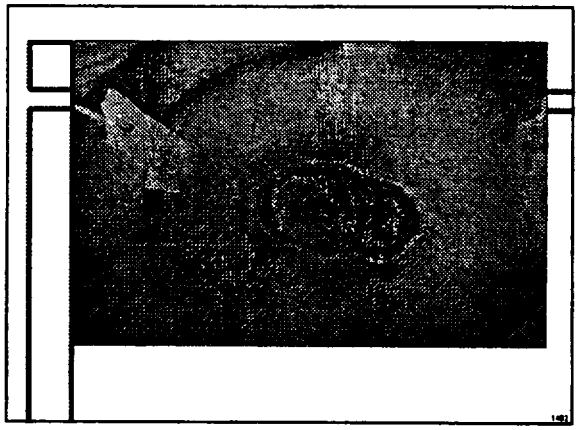
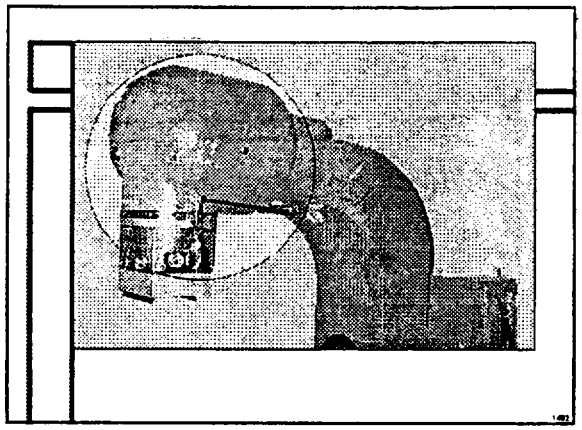
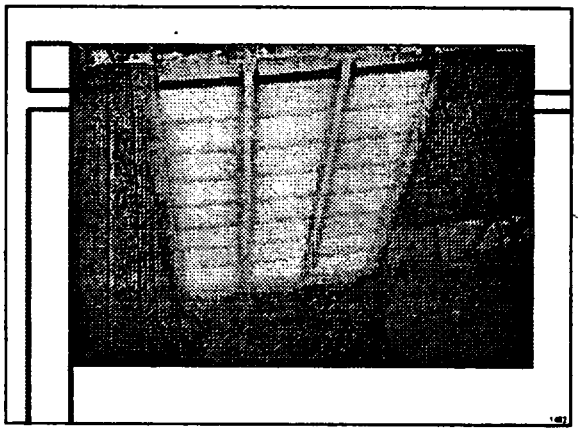
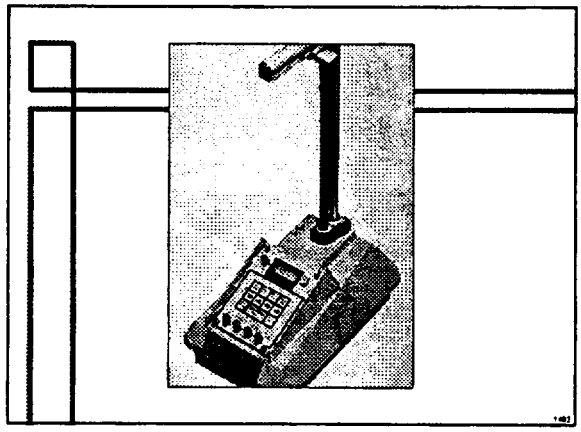


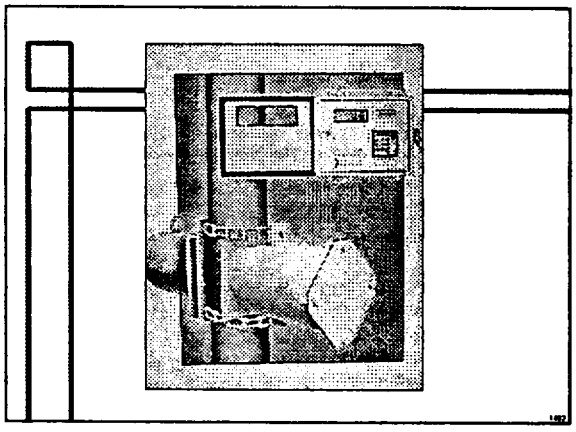


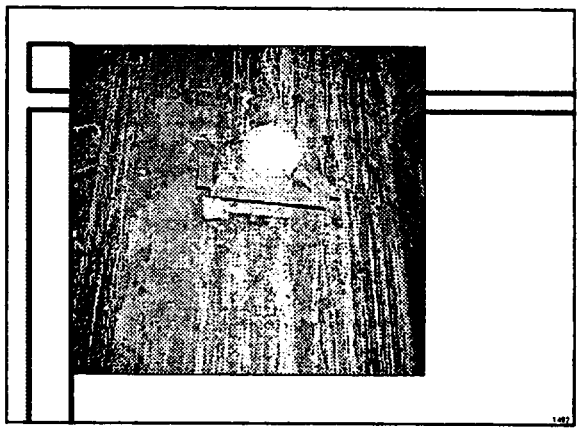






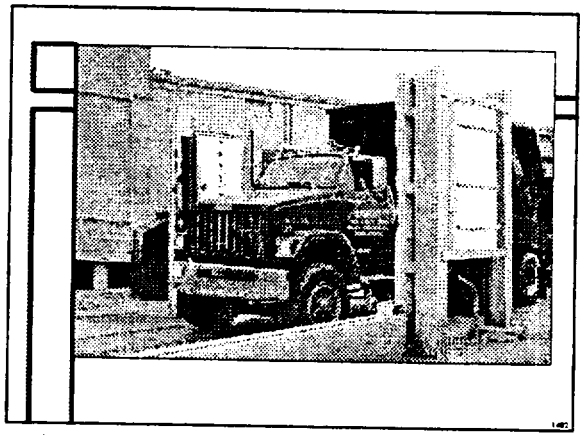






DO WE KNOW WHERE ALL THESE DEVICES ARE?

- If we did:



What is an Orphan Source?

- Orphan Source is defined as a Discrete source of radioactive material that is either:
  - Outside of proper regulatory control
  - In possession of unlicensed entity
  - In possession of licensed entity but security in question
  - Lost, abandoned or stolen

Orphan Source Findings

- 33 Meltings reported in the U.S. since 1983
- $10-12 E6/melt – $23 E6 max.
- Most recent–July 13, 2001 at Ameristeel in Florida
- Industry must buy expensive monitoring systems and get stuck with the sources found!!!
- >500 radioactive orphans found by monitors at U.S. scrap metal (13 unshielded, e.g. 150 GBq (4 Ci) Ir-192 medical source).

Findings Continued

- Industry is fuming!
- 375 Lost, Stolen or Abandoned Sources/devices reported by licensees each year. Tip of the iceberg

Why?

Need to know you have a source!
Need to know it's missing
Need to know to make a report
Need to make the actual report.

- If any of these are missing, then there is NO report of a lost / stolen / abandoned source!

Control of Radioactive Materials Abroad

- Since 1955: 266 individuals overexposed/39 fatalities!
- Ukraine: Many radioactive sources unaccounted for!
- 1987-Goiania, Brazil-Cs-137 teletherapy source 4 died, 249 exposed. Widespread public concern
- 1998-Spain-Cs-137 source melted by recycler. Radiation detected in Italy, France, Switzerland.

Control of Radioactive Materials Abroad (Continued)

- 2000 Thailand-Co-60 Teletherapy - junk yard-3 deaths, 7 others severely exposed
- 2000 Egypt-Ir-192 radiography source. Child finds. Father & son die 5 others severely exposed
- 1983-Juarez, Mexico-C0-60 Teletherapy
- **you could argue that the regulatory infrastructure in all these countries is weaker than it is in the United States.**
- **Can it happen here?**

Notable Orphan Source Accidents in the United States

Pennsylvania, 1992:

- HDR Ir-192 source breaks away from guide rod during treatment; operators ignore radiation alarms; operators do not survey patient.
- Patient returned to nursing facility, where she dies several days later; staff, others exposed.
- Dressings, etc., disposed as (infectious) trash; collected, mixed (but never surveyed), taken to incinerator where alarms sound;
- Load returned to transfer station; personnel exposed while looking through waste.

U.S. Incidents Continued

- Houston stolen radiography device
- 20 brachytherapy sources stolen in North Carolina

United States Response to the Orphan Source Problem

- CRCPD Orphan Source Initiative, E-34 Committee established and funded by USEPA in 1998
- Composition: 2 Agreement State Representatives, 2-Non, DOE,NRC,EPA,Industry as Advisors
- Meet approx. 2 times/year

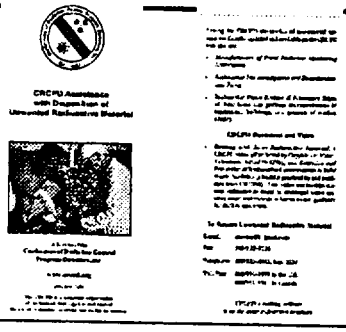
Goal

- Develop and facilitate implementation of a dynamic nationwide system that will effectively manage orphan sources

E-34 Accomplishments

- Created a webpage on the CRCPD website that provides all available information for orphan source dispositioning [CRCPD.org/Orphans.htm]

Provided to industry, state and federal regulators about the program.



E-34 Accomplishments (Continued)

- Demonstrated effective dispositioning of 30 Cs-137 orphan sources during CO Pilot Program.
- Based on the CO Pilot success and $225,000/yr NRC funding for 2 years and $100,000 from DOE:
- ON OCTOBER 24, 2001, THE CONFERENCE OF RADIATION CONTROL PROGRAM DIRECTORS ANNOUNCES ITS NATIONAL ORPHAN RADIOACTIVE MATERIAL DISPOSITION PROGRAM!!!

CRCPD NATIONAL ORPHAN RADIOACTIVE MATERIAL DISPOSITION PROGRAM

- GOAL- To reduce the number of discrete sealed radioactive sources and devices that are abandoned or improperly disposed of and thereby reduce risk of unnecessary radiation exposure to the public and/or contamination of the environment.
- Potential terrorist concerns as well as inadvertent actions.

CRCPD NATIONAL ORPHAN RADIOACTIVE MATERIAL DISPOSITION PROGRAM (CONTINUED)

- CRCPD = Provides technical assistance and acts as a 3rd-party provider of funds to states
- Current Agreements for orphan source dispositioning in Maine, West Virginia and Illinois.
- Awaiting Rhode Island, Massachusetts, North Carolina, Arizona, Pennsylvania, Maryland, etc.
- NEED ALL STATES (that need funding) TO ENTER INTO CONTRACTS!!
- – main stumbling block – limitation of liability

CRCPD NATIONAL ORPHAN RADIOACTIVE MATERIAL DISPOSITION PROGRAM (Continued)

- Thus far dispositioned one 9 mCi Cs-137 orphan device in West Virginia
- IL-10 Ci Cs-137 source and one 10 mCi Cs-137 gauge source
- Maine is about to disposition all its orphans (Ra and Co-60)
- 7-one Ci vials of Sr-90 Chloride in North Carolina
- Arizona–87 orphan gauges
- NEED CONTINUED FUNDING!!!

E-34 Accomplishments (Continued)

- Requested and obtained approval from NRC to fund NMED changes to track orphan sources
- NRC provides NMED equipment and training to Non-Agreement States also
- E-34 Committee participated in regional NMED training in PA, GA, CO, IL, and Oregon so far

NMED Training

- Goal is to provide NMED to ALL state radiation control programs, and get all states to use it.
- Advantages:
  - Proven, workable system.
  - Can be used for all events in states, not just those which relate to AEA materials (i.e., include medical accelerator misadministrations, etc.), so can also capture alarms at landfills or recyclers.
  - No need for separate, non-compatible databases.
  - Becoming more user-friendly.

E-34 Accomplishments (Continued)

- ✓ Wrote letters to Secretary DOE to support Orphan Source Recovery Program
- ✓ Program recognized by International Community
  - ✓ Establishment of International Radioactive Source Management Steering Committee (Coordinated through the U.S. Department of State).
  - ✓ NRC funded Cost-Free Experts to assist international efforts at IAEA in Vienna.

E-34 Accomplishments (Continued)

- Strongly encourage ***all*** regulatory agencies to improve their control over radioactive materials especially generally licensed devices– TO PREVENT FUTURE LOSSES! NRC's efforts are a great improvement.
- These efforts were ongoing long before 9/11

Future of CRCPD's E-34 Activities:

- Obtain funding to Continue the National Program and all efforts to assist nationally and internationally
- Over time we can gain greater control over sources of significance in US and abroad
- Interactive CD training –EPA grant

Future of CRCPD's E-34 Activities:

- Need to resolve problem with dispositioning
  - old Pu-239 (PuBe) industrial sources typically 5 Ci (approx. 80 g each)
  - Ra sources > 100 mg. Disposal sites wont take these sources
- One of these days maybe we can go over 1 year without having to respond to a monitor trip!