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NUCLEAR REGULATORY COMMISSION

In the matter of:

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Advanced Reactors Subcommittee

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

ADVANCED REACTORS SUBCOMMITTEE

Nuclear Regulatory Commission
Room 1046
1717 H Street
Washington, D. C.

Wednesday, September 25, 1985

The subcommittee convened, pursuant to notice, at 8:30 a.m., J. Carson Mark, Acting Chairman, presiding.

ACRS MEMBERS PRESENT:

J. C. MARK, Acting Chairman
C. SIESS

ACRS COGNIZANT STAFF MEMBER:

M. EL-ZEFTAWY

NRC STAFF AND PRESENTERS PRESENT:

T. KING
F. GAVIGAN
K. HERRING
C. ALLEN

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PROCEEDINGS

MR. MARK: This meeting will now come to order.

This is a meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Advanced Reactors.

I am Carson Mark, acting as Subcommittee Chairman. The other ACRS member present today is Chester Siess.

Max Carbon, who has been the Chairman of this Subcommittee, regrets that he can't be here because he has had some business in China recently.

The purpose of the meeting is to discuss the proposed policy for the regulation of advanced nuclear power plants.

Medat El-Zeftawy is the cognizant ACRS staff member for this meeting on my right.

The rules for participation in this meeting have been announced as part of the notice of the meeting previously published in the Federal Register on September the 10th, 1985.

A transcript is being kept and will be made available as stated in the Federal Register notice. It is requested that each speaker, particularly Mr. King, first identify himself or herself and speak with sufficient clarity and volume so that he or she can readily be heard.

We have received no written statements from

members of the public and no requests for time to make statements at the meeting.

Before proceeding with the meeting, I would suggest that members of the staff, and particularly anyone planning to speak, might be more comfortable if they would grab one of the chairs on the far side of the table over here so that we can see each other.

(Mr. King joins the ACRS members at the table.)

I believe we are going to hear something about the work of the fast reactor group in NRC, the advanced reactor group, and also about some work that is going on in other agencies. But our primary purpose is to hear and possibly make comments on the announced policy that the Commission is presumably about to consider.

In the draft policy as we had it from, and I have forgotten just how long ago, February, on that there were I think it was comments from various sources. These generally objected to the original proposal to say advanced reactors will be safer than present reactors. That I think has been modified at least in the revised policy.

They also seemed fairly uniformly to complain about a tendency, or which they took a tendency of being somewhat prescriptive, and urging that the final policy not have such a property.

I guess in reading through what people said and in

looking at the policy as we have it, I was a little questioning that there was no reference at all to the Commission's plan to issue a safety goal and that advanced policies would be expected to conform to that, advanced reactors would be expected to conform to that, and that that perhaps would have been a way of saying how safe things need to be rather than dictating that they necessarily be safer.

I mention that only so that you I believe, Mr. King, can have it in mind when your comments come down to discuss the policy itself.

Do you have any comments, Dr. Siess?

MR. SIESS: Yes. As I understand it, the advanced reactor group -- is that the proper name?

MR. KING: Yes.

MR. SIESS: --- will be, at least for some time to come, the portion of the NRC that would be implementing this policy.

MR. KING: Yes.

MR. SIESS: I understand also, and please correct me, that the advanced reactor group has not played an active part in developing this policy.

MR. KING: I don't think that is totally true.

MR. SIESS: You have?

MR. KING: Yes, we have.

MR. SIESS: Okay. That may simplify things, because as I read the policy I find a lot of words that I just don't understand. That is, there are words like "simpler," there are words like "more reliable," "inherent safety margin" -- and these are all good words if I could look at the definitions in the dictionary.

But one thing I am interested in is what those words mean to the people that will be implementing the policy, and I would hope that you can give us some examples of what, or define those in some concrete way, an inherent safety margin, and how that differs from a non-inherent safety margin, or how it differs from a PRA safety margin.

And, frankly, I don't understand from reading the policy statement what is an advanced reactor. And, again, I think you could give some examples of what is an advanced reactor and what is not an advanced reactor. Now is Fort St. Vrain an advanced reactor, is PIUS an advanced reactor, is Clinch River an advanced reactor, is WAGR an advanced reactor?.

Do you think you can do this in the process? Otherwise, I just have a problem. There are words here, and I read the public comments and I saw about as many interpretations of the words as you could get. I am not quite sure what a policy statement means in the NRC. It is just a piece of paper until somebody starts doing something

with it.

We have spent in the committee a great number of man-months in connection with the policy statement on severe accidents chiefly trying to find out what it means, and I guess trying to project some concrete examples of what the policy means, and I think here we have somewhat the same thing, except on a different time scale I guess and maybe even a different philosophical level.

So to the extent that you could work some of this into your presentation, it would be helpful, and the other is I think I will have some questions as you go along.

Could you tell us briefly somewhere of what input the advanced reactor group and other people in the NRC staff have had as input?

MR. KING: Well, maybe I ought to give you the history of the policy statement.

MR. SIESS: Let me explain my problem. We see policy statements of various kinds. The severe accident policy statement of course is being developed clearly within the EDO's staff, and we have give and take with the EDO staff, NRR and Research on what they are doing and so forth.

But policy statements that come out of OPE, we don't know how they are being developed because OPE doesn't talk to us. They talk to the Commission. That is their

mission as I understand it. So here we are sort of in the dark as to the background. We see a piece of paper and have no idea of what the input has been, and to this point in time the ACRS has had none. So we don't see the policy statement until it gets to a certain level, and yet we are supposed to comment on it. So again a little background helps, or at least it would help me.

MR. KING: All right. Would you like the background now or when we get to that subject?

MR. SIESS: Whenever the Chairman permits.

MR. MARK: As it would best fit in your plans.

MR. KING: All right.

MR. SIESS: Do you want to give some previous -- whatever you want.

MR. KING: I was going to in the first part of the presentation to sort of update you on what we have doing and where we see ourselves going in the advanced reactor area and then come to the policy statement.

MR. MARK: It is just fine for you to proceed as you like.

MR. SIESS: Whatever chronology that will help make sense and be most intelligible.

MR. MARK: And include items of that sort when you get to the statement and what you picture as the interpretation of that statement.

On Dr. Siess's point as to what is an advanced reactor, there is certainly an open question from the words that we have as to when or whether a light- water reactor might be viewed as an advanced reactor even though there are reactors for the immediate future very probably.

There is also no reference in connection with anything I noticed of a heavy-water reactor as to whether that is advanced or in mind or anything else.

So I guess with those questions in our mind, it would be best for you to go ahead, Mr. King, and follow your own plans. There is only two of us. So it won't take you more than twice as long to present a sentenced as you had thought.

(Laughter.)

I forgot to mention that if you would be more comfortable talking from the table, but you are okay with the viewgraphs, you are probably better off up there.

MR. SIESS: I haven't look at your viewgraphs, but at some point would you tell us who constitutes the advanced reactors group in terms of numbers of people and disciplines, and also where you are going to end up in the reorganization?

MR. KING: All right. Why don't I start off by doing that.

Currently the advanced reactor group consists of

four professional staff people, myself as the Branch Chief. My background is mechanical engineer by degree. I spent most of my time in the liquid metal fast breeder reactor area working for DOE, first at headquarters and then out at Hanford on FFTF and then came to NRC three years ago on the Clinch River project.

The other three professional members of the group are Cardis Allen, who probably most of you know, Pete Williams, who has a long history of experience in the gas-cooled reactor area, and Stephen Sands, who is the junior member of our group who has experience at FFTF working for Westingthouse. He came from the nuclear Navy and has a little bit of experience with Fort St. Vrain.

In the new organization we are going to end up as a section in the division headed by Themis Speis. Our Branch Chief will be Carl Neil. I don't know what the name of the branch is going to be or the name of the section, but we will retain our function as advanced reactor activities.

MR. SIESS: You are over in the Division of Technology and not in one of the ---

MR. KING: Currently we are in the Division of Safety Technology.

MR. SIESS: But you are not in one of the project directorates?

MR. KING: No, we are not in one of the vendor divisions.

I expect our number of people in the advanced reactor area won't increase and won't decrease. It will stay about the same level of people. Now we draw on other members of the staff as necessary when we get into areas where we need their expertise, and we have had meetings already with the advanced reactor designers where we have brought in other members of the staff from engineering or the Division of Systems Integration or wherever we need help.

The first part of the talk is going update you on what we have done since February, which was the last time we talked to the subcommittee. And we have got a better definition how of where we are going and what the concepts look like that currently we are calling advanced reactors and that we have committed to do some interaction with those designers. So I thought I would just bring you up to speed in those areas.

The first part, I will be talking about what we are done since February of '85.

(Slide.)

Our major milestones have been in March the Commission issued the proposed policy statement on the regulation of advanced reactors. That was issued for

public comment.

We received from DOE a formal plan and schedule for review of an HTGR. We received that in April, and we received a similar request for liquid metal reactors on July 1st.

We have answered both of those requests. The HTGR, we have responded in July and we just recently responded this month on the liquid metal reactor committing to interact with DOE and follow that plan.

The other milestone on this slide is in August the HTGR folks transmitted formally what they call their top-level regulatory criteria, and I will talk about those in a little more detail as to what they are. That is sort of the first formal submitted we received in starting down this process of interaction. We have had a lot of discussions and meetings and briefings, but that is the formal one.

(Slide.)

As far as briefings on issues, we have had on the HTGR in May a briefing on their concept selection status and their method for selecting design basis accidents.

Then in the latter part of July there was another briefing on how their concept selection methodology, which is how they have gone through. They started out with four concepts. They were looking at how they have evaluated

those and they are narrowing it down to the one concept I will present a little later.

On the liquid metal reactor side we have had two technical briefings, one on the station blackout criteria they plan to apply to their plants, and the second for the SAFR plant, which is the Rockwell design, what they would propose to use for their tornado design basis.

We have also had discussions on, not formal meeting, but some sort of informal discussions on trying to identify the key issues we would like to interact on in FY-86 in looking at their PSID outline. That is their preliminary safety information document, which is the primary document they are going generate and we are going to review here as part of looking at conceptual designs and future plans and schedule, sort of some working meetings in that area.

MR. MARK: Is their idea of a tornado design basis in any way different from the way tornadoes are viewed at present?

MR. KING: Yes.

MR. MARK: Do they have more wind or less wind?

MR. KING: They want less wind. What they would like to do is the way tornadoes are applied to light-water reactors. The country is broken up into three regions and, depending on what region the plant is in, they have to take

the tornado that has a frequency of occurrence of 10 to the minus 7th and apply that wind and that translational speed to the plant.

What they are proposing to do is they want to stick with the 10 to the minus 7th, but call it instead of the frequency of the tornado, call it the frequency of exceeding 10 CFR 100 guidelines, which would then take a tornado of more frequent probability, a less severe tornado, and then add to it the frequency of causing damage to the plant and releasing radioactive material that would exceed 10 CFR 100 guidelines.

The staff had trouble with that.

MR. MARK: I can see that you might.

MR. KING: We gave them a number of alternatives and considerations to think about and they are going back and thinking about those.

MR. SIESS: That just seems strange to me that somebody is coming in with an advanced reactor design and they want to hassle around with tornado criteria.

MR. KING: Well, we asked that question, you know, why are you doing this. And they said well, it is to save money. How much are you saving? They said well, one percent of the plant costs they figured.

MR. SIESS: Oh, that is ridiculous.

MR. KING: And we said is that really worth it,

and they felt it was. That issue is certainly still open and there will be further discussion on it.

MR. MARK: Well, very interesting. Go on.

MR. KING: All right.

(Slide.)

HTGR top-level criteria. I mentioned we got a formal submittal in that area ---

MR. SIESS: Incidentally, would the advanced reactor policy help you at all on the tornado issue?

MR. KING: No. That is one area where we called in other members of the staff because my staff has no expertise in tornadoes.

I mentioned we had received a document on HTGR top-level criteria. What the HTGR designers are proposing is trying to extract from the current body of regulations that NRC uses those criteria that really are the most important or the things that the other criteria are trying to strive to meet, and they primarily deal with radiation releases and protection to the public.

What they are proposing is highlighting the guidelines, the criteria of 10 CFR 20, 10 CFR 50, Appendix I and 10 CFR 100, site boundary dose guidelines, the EPA protective action guidelines and the safety goals. They would like to use these to help guide their design and would like us to agree that, yes, these are the most

important things in your design and all the other features or systems of your design are really focused toward making sure you stay within these top-level goals or criteria.

That is not to replace the existing body of regulations, but it is to try and focus when we get into a safety issue or design review, to focus on what we are really trying to accomplish. And they want us to agree that, yes, this is what we are really trying to accomplish.

We have that document under review now and we expect to get an answer.

MR. SIESS: In that list, the part 100 item, that then is essentially the present DBE dose limit approach?

MR. KING: Yes.

MR. SIESS: Now I guess to use the word "source term" here doesn't have too much meaning if we talk about HTGR's and LMR's because the current source term doesn't really apply to those, does it?

MR. KING: No. What we use is an issue that has to be decided.

MR. SIESS: But in addition to the part 20 routine releases and the part 50 ALARA, you have now got, not only for advanced reactors, but for existing reactors, we have got the design basis accident approach and the severe accident approach, the later not being quite as well defined.

MR. KING: Yes.

MR. SIESS: And if you think that is an understatement, it is. The proposal is to maintain that dual health and safety basis, design basis accidents at one level and severe accidents at some other level?

MR. KING: No.

MR. SIESS: No?

MR. KING: In the HTGR the proposal is to include in the design, include in the selection process of design basis accidents all those accidents that they feel need to be analyzed. In other words, there wouldn't be a look at anything beyond that.

MR. SIESS: My point is that the DBE approach is, and I guess prescriptive isn't the word, but ---

MR. KING: It is deterministic.

MR. SIESS: It is non-mechanistic, deterministic, fairly straightforward, clear-cut and you end up with certain features in the plant which are necessary to limit the DBE doses, et cetera. But if you go safety goals with the PRA type approach, you don't find the same requirements.

MR. KING: That is correct.

MR. SIESS: Now are you saying that the safety goal risk type approach will dominate over the DBE approach?

MR. KING: In the HTGR area what the designers are proposing is a probabilistic selection process for design basis accidents. In fact, I have got a viewgraph coming up on that in a little bit. And we have only had a very cursory presentation on that subject. But basically what they plant do is through a PRA type approach select accidents, anything that has a frequency of 5 times 10 to the minus 7th or greater the plant will be designed for.

MR. SIESS: But the acceptance criteria will be what, safety goal type stuff or core melt?

MR. KING: The acceptance criteria will be this list. As it turns out ---

MR. SIESS: I know, but the 10 CFR 100 ---

MR. KING: As it turns out, the protective action guidelines seem to be the thing that is most restrictive. What the HTGR folks want to do is not exceed the PAG's at the site boundary for any accident that is in their design basis envelope, and they are hoping if they do that to minimize or eliminate the need for offsite evacuation planning.

As it turns out, trying to meet that requirement is more restrictive than trying to meet any of these others. So that really turns out to be the limiting thing, at least in the presentations we have seen so far.

MR. SIESS: And where does probability comes into

that?

MR. KING: Probability comes in in selecting the accidents.

MR. SIESS: In selecting the accidents. And once you have selected the accidents, then you will have prescriptive guidelines?

MR. KING: Yes. And then you will have dose limits that you have to meet, fixed numbers.

MR. SIESS: See, I can think of examples in light-water reactors where requirements to meet part 100 site boundary doses for DBE's turn out to be unimportant if you look at the last two things there. But you have still got the site boundary doses up there as one of the top-level criteria.

MR. KING: Yes. These overlap. These aren't all mutually exclusive. But those are the ones that seem to ---

MR. SIESS: Actually the third and fourth bullets are just two ways of looking at doses?

MR. KING: Yes. Now the liquid metal side of the house has taken a different approach at least from what we have heard to date. They are going the more deterministic mechanistic way, the traditional way of selecting design basis accidents and not doing it on a probabilistic sense.

MR. SIESS: The present way is non-mechanistic.

MR. KING: Or non-mechanistic.

(Laughter.)

MR. MARK: The people to whom you refer as "they" are DOE or DOE plus the gas-cooled ---

MR. KING: It is DOE plus their contractors, which includes Gas-Cooled Reactor Associates, GA Technologies ---

MR. SIESS: GCRA is working through DOE.

MR. KING: Yes.

MR. MARK: Now when you come to the liquid metal, it will be again DOE plus Rockwell?

MR. KING: Yes. Two designs are being pursued in the liquid metal area and both funded by DOE. One is a Rockwell design, primary lead, and the other is General Electric. Later on there are some viewgraphs that list all the participants in those particular designs.

MR. MARK: Yes. Anyway, it is DOE plus such a group, and the difference in approach to accidents or design basis accidents, the one being probabilistic, which is what is referred to here. Is that a difference amongst people in DOE or a difference amongst as between the contracting groups?

MR. KING: My understanding is it is more a difference between the contracting groups.

MR. MARK: The Gas-Cooled Associates think that is how they would like to see it done.

MR. KING: Yes.

MR. MARK: Them plus whoever else. Okay.

MR. SIESS: Do you have any intent or hope of getting the top level criteria down to one set rather than dealing with two different sets?

MR. KING: What do you mean by two different sets?

MR. SIESS: Well, you said the LMR people are coming up with a different approach. Is there any hope of ending up with a single approach to public health and safety?

MR. KING: I have talked to DOE about this a little bit.

MR. SIESS: I mean in the end it is going to be NRC that sets the criteria for public health and safety and not DOE.

MR. KING: That is right.

MR. SIESS: And my question I guess was then does NRC expect to take one of these two approaches or a third approach and end up with a single approach to criteria for public health and safety, or are you just going to deal with whatever the applicant comes in with?

MR. KING: At this point we are going to deal with whatever the applicant comes in with. That is our plan.

MR. SIESS: It seems to me that that is a policy matter that is probably more important than anything I see in the advanced reactor policy.

MR. KING: As part of the policy they are encouraging this early interaction and encouraging innovative ways of doing designs and looking at regulations.

MR. SIESS: Well, that is design, but we are talking top-level criteria, which is something the industry has proposed. And as I understand top-level criteria, it is a sort of a performance criterion set, which is what this is, and NRC is going to be evaluating designs and approving designs and issuing licenses based on some set of criteria relating to public health and safety that presumably they can explain to the public. I don't quite see how NRC can end up with two sets of criteria.

MR. KING: Well, maybe I gave a bad answer to that when you said that the first time. We are not going to come up with two sets of criteria.

MR. SIESS: It is your intent to end up with one.

MR. KING: Our intent is to end up with one and a develop a framework that would be consistent.

MR. SIESS: Now you are willing to look at what anybody proposes, but when you end up you are going to have one set.

MR. KING: We are going to have one set. Now, as I said, these criteria are not being proposed to replace what is currently the NRC process or criteria that we use

in reviewing a plant. They are really proposed from the standpoint of trying to get agreement that this is really what we are shooting for in terms of the ultimate goal of the design.

MR. SIESS: Well, I have no objection to some criteria that would replace what we have got because the set we have got now has gotten to be pretty messy. It has evolved and, you know, part 20 goes back God knows how far, and part 100 in the EPA guidelines is two ways of looking at the same thing. The safety policy and safety goals and severe accident policy is another way of looking at stuff we thought we had built in.

MR. KING: Our intent is not to ---

MR. SIESS: In fact, I don't see anything holy or much less good about the present set of criteria because because we have them.

MR. KING: Our intent is not to throw those out though and not to start with a clean sheet of paper and develop some new regulatory process of criteria. It is to build upon ---

MR. SIESS: This is a great time to do it though. I mean here you have got a bunch of prescriptive criteria, and that may be an overstatement, but there is a bunch, I know that, and they are fairly prescriptive.

Now if you really wanted performance criteria, you

would look at your prescriptive criteria and say now what level of performance do these prescriptive criteria achieve, and say that is either acceptable or not or maybe we want it better or maybe not. I think the decision is that level is okay, we don't want them safer necessarily. And then say, all right, if this is what all of our prescriptive criteria have achieved, can't we state that achievement as a performance criteria and let people work at it from there. Now that is what performance criteria are, isn't it?

MR. KING: Yes. I have no objection with what you said. I don't look at our ---

MR. SIESS: But you say you really don't want to change the current part 20 and part 50?

MR. KING: These type of criteria we consider are applicable to any plant, whether it is an HTGR or liquid metal reactor. We have no intention of coming in and changing these.

The thing we are going to change are the prescriptive criteria that have been developed for light-water reactors that now don't apply or need to be changed for a different type of plant. That we figure is our main mission to go and identify those and week them out and put in something that makes sense for a liquid metal plant or an HTGR.

MR. SIESS: Now when you used the word "prescriptive criteria" there you meant in terms of design?

MR. KING: In terms of design.

MR. SIESS: And I am talking about criteria. Well, let's go ahead and I will try and focus my comments somewhere else.

You see, just the fact that you said one of those governs suggests that they don't all necessarily still need to be there. The EPA protective guidelines will protect the health and safety of the public and maybe we don't need part 100.

MR. KING: One of them governs if you choose to apply that in a certain way. If you choose to say my site boundary dose guidelines are never going to exceed the EPA PAG's, then that governs, and light-water plants don't choose to say that. But the HTGR folks ---

MR. SIESS: I am talking about what you choose and not what they choose when you end up with your final set of top-level criteria.

MR. KING: If we chose to say that you have to meet those, then they would govern.

MR. SIESS: Why is that a top level and we talk about the bottom line on a PRA? It seems to me they are the same thing. One is at the top and one is at the bottom.

MR. KING: Maybe this is a circular process and they come back to the same thing.

(Laughter.)

MR. SIESS: I will buy that. We are back where we started from I think.

(Laughter.)

(Slide.)

The HTGR top down approach. This is just a short description of how the HTGR folks have gone through their design selection process. They started with four concepts a year ago and they are now down to one. They way they evaluated those concepts and end up with their one is basically starting with top-level goals on their design, things like availability, the cost advantage they want to meet, the frequency of probability of a loss of the plant, meeting certain dose guidelines and enveloping 80 percent of the U.S. sites in terms of tornado and earthquake and that kind of thing.

MR. SIESS: Did they give up on California?

MR. KING: I am not sure what they give up on, but their SSE is .3 G. So there are probably parts of California that they are going to give up on.

MR. SIESS: Maybe part of the eastern, too.

MR. MARK: Maybe they are going to keep out of the tornado zone.

(Laughter.)

MR. KING: But, anyway, they went through and looked at their designs from the standpoint of how well they meet these top-level plant goals that they have and ended up selecting the one which we will get here in a few minutes.

MR. SIESS: Now the 10 to the minus 5 loss of plant, that is dictated by economic considerations?

MR. KING: Yes.

MR. SIESS: And not by considerations of the health of the system?

MR. KING: That is right. It is not public health and safety, but economic loss.

MR. SIESS: No, I didn't mean public health and safety. There is some thinking I sense that our core melt probability for light-water reactors should take into account the fact that another TMI would shut all the plants down, and it would be an economic loss far beyond the single plant.

MR. KING: Yes.

MR. SIESS: Now is that thinking at all in here, do you know, or is that just simply the loss of investment to one utility?

MR. KING: That is the loss of investment to one utility. That is the number that they have arrived at that

they feel is acceptable.

MR. SIESS: And not the trauma of the public.

MR. KING: Not the trauma of the public.

MR. MARK: Nor of the industry.

MR. KING: Nor of the industry>

MR. SIESS: One causes the other.

(Slide.)

MR. KING: We have already hit on this, the HTGR method for selecting design basis accidents, a probabilistic approach where they have a cut-off in terms of probability and uncertainties are factored in by looking at the uncertainty range on the frequency, and if the uncertainty range causes it to fall below the cut-off, then it gets included in the design basis accident envelope.

MR. SIESS: Now this is the frequency of an accident and not of an initiator? This is what, frequency of a core melt?

MR. KING: No, frequency of an initiator.

MR. SIESS: This is the frequency of an initiator?

MR. KING: Yes.

MR. SIESS: And it only deals with frequency and not with consequences?

MR. KING: Well, consequences are looked at ---

MR. SIESS: Could you give me an example?

MR. KING: Maybe I should have brought another

viewgraph. When they look at the initiator and they look at the sequence that leads to a release, they calculate what that means in terms of site boundary dose rates as far as staying below their protective action guidelines at the site boundary.

MR. SIESS: I thought you said earlier that this was selecting the accidents, but calculating the consequences to where they met the protective action guidelines was another step. This was a substitute for selecting DBE's.

MR. KING: This is a method that they are using to select their design basis accidents.

MR. MARK: And "X" is tentatively pointed at as 5 times 10 to the minus 7th?

MR. KING: That is the number we have heard verbally. We have received nothing formally on this. That is why I put an "X" in there.

MR. SIESS: But I am still confused because one thing I hear you saying is that the plant will be designed and sited in such a way that there is less than 5 times 10 to the minus 7th probability of having an accident that will exceed the protective action guidelines. Now that would be a top-level criteria.

But this says selecting accidents and the other is a bottom line. This is the beginning when you select the

accidents.

MR. KING: I don't think I said before that one of the top-level criteria was the 5 times 10 to the minus 7th of exceeding PAG's.

MR. SIESS: You didn't, but explain again what this means. I said does it include consequences, and you said yes. This says includes all accidents which have a frequency of say 5 times 10 to the minus 7th or greater. Now if there are 20 such accidents that have that frequency, then the probability of an accident that would exceed the protective action guidelines is 20 times -- well, I am trying relate the selection of the accidents to the acceptability criteria, and I don't see what the relation is. I am missing something.

MR. KING: I will explain it as I understand it. They will go through a PRA type approach and identify a number of accidents.

MR. SIESS: A PRA on a plant design.

MR. KING: On a conceptual design.

MR. SIESS: Okay, difficult, but I will buy it.

MR. KING: All right. And there will be a range of uncertainties associated with it in terms of probability of each of those. Any of those accidents that are 5 times 10 to the minus 7th, or whatever the final number is they choose, or more frequent they will include in their design

basis.

MR. SIESS: Now suppose you can change the design slightly and eliminate an accident and now what happens?

MR. KING: Then it will drop out. I am assuming it will drop out, but we haven't gotten to that point yet.

MR. SIESS: So it is no longer a design basis accident that you designed for.

MR. KING: If you do something to the design that now makes it less probable, it is no longer a design basis accident.

MR. SIESS: So everything that is left is a design basis accident?

MR. KING: Everything that is left is a design basis accident. Now when they take ---

MR. SIESS: And somehow I can get from that to the probability of exceeding the PAG's?

MR. KING: Well, when they take that accident and they calculate what the consequences are, they look at that and see does that exceed the PAG's or doesn't it exceed the PAG's. If it exceeds the PAG's, then they know they have to do something in their design to make sure it doesn't either by changing the accident frequency or mitigating the release. In that sense it brings in consequences.

MR. SIESS: I guess what I am confused with is right now design basis accidents is something you take as a

basis for design and after you design you analyze it.

Anyway, okay.

MR. KING: What this viewgraph represents is probably a half hour or an hour presentation on this subject that we have received.

MR. SIESS: Which we will get sometime I guess.

MR. KING: We eventually are going to get a formal submittal on this. We are going to get further briefings on it, and in fact one of the questions I am going to have for you is what are the issues that you would like to get plugged in on later on, and this may be one of them.

MR. SIESS: What is the second item up there?

MR. KING: Oh, that is our uncertainties. Like I said, there is an uncertainty range when they come up with a frequency of an accident. There is an uncertainty associated with that. If the uncertainty causes that accident to fall within the band of 5 times 10 to the minus 7th, then that accident is included.

MR. SIESS: Five times 10 to the minus 7th in the band, and I assume that the 5 times 10 to to the minus 7 is some kind of a point estimate.

MR. KING:

MR. SIESS: So what I don't know is that once I have stated a point estimate what I then do with uncertainties. Now if you are saying that the 5 times 10

to the minus 7 is a 90 percent confidence limit, then that is affected by uncertainties, but the point estimate isn't. The point estimate is a point estimate.

MR. KING: Is it a point estimate with a band of uncertainty around it.

MR. SIESS: I don't know how uncertainties are included.

MR. KING: All I am trying to say is that when you come up with a number for the probability of an accident, there is some uncertainty associated with that number. If you take the extreme end of the uncertainty band and it causes that number to be less than 5 times 10 to the minus 7th, then it is included in ---

MR. SIESS: Now wait a minute. The extreme end of an uncertainty, if it happens to be log normal, is infinite at one end, if it is normal, it is infinite at both ends, and in either case you have to know the distribution and nobody has come up with a distribution yet. They have just come up with estimates of a distribution. So you can't talk about the extreme ends. You can talk about five percentile if you know the distribution.

MR. KING: Yes.

MR. SIESS: And then 5 times 10 to the minus 7th at 95 percent confidence is tremendous, but ---

MR. MARK: It is definable.

MR. SIESS: It is definable, but incredible. There is something missing there.

MR. MARK: I was going to remark on the same point, but not as deeply as Chet has, that we are going sometime, if that viewgraph remains as it is, to need a half hour or an hour presentation on Item 2.

MR. KING: I suggest we schedule a session sometime on this whole subject of how they are selected and how the certainties are treated.

MR. SIESS: Well, that is a major item and the other major item is the uncertainty of a PRA based on a conceptual design. It has uncertainties on top of uncertainties. We have enough trouble with PRA's when they have got an actual plant sitting out there.

MR. KING: Yes.

MR. MARK: Or a tornado.

MR. KING: Well, the main reason I made this viewgraph up was to let you know that there is a different method they are using to try and select design basis accidents. I didn't intend to defend it or explain it in detail because it hasn't been explained in detail to me yet. But the concept that they are using the probabilistic approach is what I wanted to get across.

MR. SIESS: I think you hit a point that very clearly we would like to hear more from somebody on later,

and I don't think an hour is going to be long enough.

(Laughter.)

MR. SIESS: Depending on who is here, the unsophisticated are going to tend to take longer and the sophisticated will take even longer.

(Laughter.)

MR. MARK: If you have both Okrent and Lewis here, you had better give it two hours.

(Laughter.)

MR. KING: All right. We will schedule some time in the next year. In fact, it might be fairly soon since this is one of the first topics that we are going to hit.

MR. SIESS: It is an important issue.

MR. KING: It is an important issue.

MR. SIESS: It is philosophical in its policy and it can help a lot in our thinking about these things.

MR. MARK: And it is not clear that it is wrong. It is just clear that it is difficult.

MR. SIESS: It is not wrong.

MR. KING: It is different. That is the point I wanted to get across.

(Slide.)

All right, LMR station blackout criteria. We had two technical sessions on liquid metal reactors. One was on what they proposed to use for station blackout

criteria. I listed the five main ones here.

What they are proposing to use is consistent with what the staff has developed in terms of the policy in a draft reg. guide for station blackout. We didn't find any problem in the station blackout area with the liquid metal reactors with what they are proposing to use.

MR. MARK: What do they mean by blackout? Do they mean blackout or loss of offsite power?

MR. KING: Loss of offsite and onsite AC power.

MR. MARK: Loss of all AC power.

MR. KING: Loss of all AC power, except credit is given if there is a dedicated diesel or power supply that is not connected in with the normal emergency diesel generators. The staff gives credit for that as well in their application of this to light-water reactors. But with the natural convection capability of liquid metal reactors, they can go well beyond eight hours, which is the maximum the staff is requiring in light-water plants.

MR. MARK: You are counting on batteries?

MR. KING: Batteries are assumed to be available.

(Slide.)

MR. SIESS: This is simply looking at the differences in what has to be accomplished in the blackout period in the LMR versus an LWR?

MR. KING: Yes.

MR. MARK: Yes.

MR. SIESS: And the eight-hour figure in the last bullet is one of the carryovers from the light-water reactors?

MR. KING: That is the requirement that is applied to light-water reactors. The LMR's were evaluated to see that they could meet that requirement. They could go well beyond that.

MR. MARK: But this does imply convection cooling?

MR. KING: Natural convection cooling.

(Slide.)

Tornado design basis, we already talked about that with the SAFR people. We are trying to explore different ways of applying the tornado, and that is still up for discussion.

Now I just want to take a few minutes on the status of the DOE HTGR and LMR concepts.

(Slide.)

Back in February you heard a status report on these from the DOE and their contractors. At that time in the HTGR area they were looking for at four concepts. They have now selected their concept, a 350 megawatt thermal modular design, which I will describe in a little more detail here in another viewgraph.

MR. SIESS: They are now down to just that one?

MR. KING: Down to just that one.

MR. SIESS: PCRA has dropped the big one completely?

MR. KING: The big ones have been dropped completely.

DOE is looking at two liquid metal reactors, one they call the power reactor inherent safety module prism, for short, a 425 megawatt thermal modular plant, and the second one is the sodium advanced fast reactor, and that is the Rockwell.

MR. SIESS: Do you call that SAFR?

MR. KING: That is called SAFR.

MR. SIESS: That meets the policy statement.

(Laughter.)

MR. KING: By definition. That is a 900 megawatt thermal modular design.

MR. MARK: In the HTGR and perhaps in the small liquid metal there is quite a bit of factory kind of construction.

MR. KING: We are trying to get as much factor type construction as possible.

MR. SIESS: That is the essence of modular.

(Slide.)

A little more detail on the HTGR concept.

The designers organizations are listed at the top,

GA Technologies with Stone and Webster, Bechtel, Combustion Engineering and GE supporting them. GCRA is not really a design organization. They are sort of the utility voice in the whole thing. So I didn't list them up there.

It is a 350 megawatt thermal and 140 megawatt electric modular design with the reactor vessel and steam generator located below grade.

It is a steel reactor vessel concept.

It has a steam generator external from the vessel.

It is an annular core with prismatic fuel blocks, which would be very similar to the Fort St. Vrain fuel blocks.

One steam generator and one loop per module.

One turbine generator for every three or four modules.

They are proposing a confinement building only and no containment. I think that is an issue we may want to have a separate session on someday.

A passive decay heat removal system.

We are proposing a non-safety grade balance of plant, and exactly where we draw the line between safety and non-safety is not too clear yet, but things like the steam system and feedwater system we are proposing would not be safety grade.

And a 40-year module lifetime.

MR. SIESS: Now have they settled on the prismatic?

MR. KING: Yes.

MR. SIESS: And they have dropped the ---

MR. KING: They have very recently dropped the pebble bed.

MR. MARK: Has Fort St. Vrain got a containment or confinement?

MR. KING: A confinement.

MR. SIESS: But the ACRS said the next one had to have a containment because it was expected to be bigger and not as good a site. I will have to go back and look at that letter sometime. It is a different committee now.

(Slide.)

MR. KING: This is just a cross-section of the modular concept with the reactor vessel over here and the steam generator separated from it, the circulator, the shutdown circulator, the control rods coming from the top, a prismatic fuel design, all below grade.

MR. SIESS: Walk away from it.

MR. KING: Pretty much walk away. We haven't seen yet what the response would be to an anticipated transient without scram. I can't really say that that is walk away because I haven't seen how the design behaves under those

conditions. But for decay heat removal and station blackout, for example, it is pretty much a walk away design.

MR. SIESS: Are they proposing a backup scram system like Fort St. Vrain has?

MR. KING: Yes. The balls or something equivalent to the balls drop.

MR. SIESS: It is redundant and diverse.

MR. KING: Redundant certainly. How diverse, we haven't gotten to that level of detail.

MR. SIESS: Fort St. Vrain is pretty diverse.

MR. KING: Fort St. Vrain's is manual and that is pretty diverse.

MR. SIESS: Well, it wouldn't have to be, but I mean it is diverse.

MR. KING: It is diverse, yes.

(Slide.)

This is their core design. It is an annular concept with the center section just graphite blocks, the fuel out here in the shaded section and then more graphite reflector around the outside and the control rods just inside the fueled region. Then these are the reserve shutdown system, and that is the backup where the balls go in.

MR. SIESS: What led to the annular, coolability?

MR. KING: Maybe I ought to let DOE answer that. It was a combination of looking at the economics. The annular allows them to put in a higher power density so they can get for the same sized vessel more power out of it that led to better economics. There are tradeoffs on refueling. Pebble bed has online refueling, but it is complicated and a lot of piping versus the normal refueling.

MR. SIESS: How much of it is safety related then? Is was mostly economics.

MR. KING: I was not involved in the selection process.

Frank, can you say how much of the design was selected for safety reasons versus ---

MR. GAVIGAN: My name is Frank Gavigan from DOE. I manage the LMR designs and the HTGR designs. We just made the selection of the prismatic fuel, DOE made the selection with the cooperation of GCRA and the reactor designers.

The major reasons for selecting prismatic fuel versus the pebble bed were at least three.

One was cost, on the basis of cost. Our cost estimates prepared by all the members of the team showed that the prismatic fuel would come in at something like, oh, a considerable margin over pebble bed, $100 to $200 per

kilowatt.

The second reason was again some of the major accidents we considered, especially in leakage of water. The prism had a major advantage over the pebble bed. The shutdown margins were far larger and it was able to respond to major accidents in a better way>

A third reason was that in DOE we are now getting involved in what we call a prioritization or evaluation process where we are trying to limit in the next couple of years the number of converter concepts that we will be funding and reviewing and developing.

That requires us to set a deadline for when we will make that decision and presently it looks like 1988. That means that if one were to move toward the pebble bed decision, we would have to put in place agreements with the Germans on obtaining their technology, anticipating that would take one or two years to get an agreement and considering the patent rights and royalty rights it would take a long time for us to get it in place.

MR. SIESS: The question was why did you choose the annular core, and not why did you choose the prism.

MR. GAVIGAN: Oh, sorry. I don't know the details on why we chose the annular core.

MR. SIESS: The question was is it safety related?

MR. GAVIGAN: No, I don't think so. I think it

was power density related, as Tom said, and cost related.

MR. SIESS: I thought it might radiate decay heat a little better to the outside.

MR. KING: I think the annual tends to keep down the cente line fuel temperature, the temperature distribution across here versus ---

MR. SIESS: Yes, that is what I was talking about.

MR. MARK: What is the uranium enrichment in this fuel?

MR. KING: Seventeen percent or 18 percent, low enriched.

MR. SIESS: Is there still a converter?

MR. KING: Yes.

(Slide.)

This is just a rough idea of decay heat removal on this design. The ultimate means of decay heat removal is radiation conduction and radiation of the heat out to the reactor vessel, which is then radiated to a reactor vessel cavity cooling system which is cooled by natural convection of air. It is a totally passive system where air comes in and comes down and outer annulus and then up an inner annulus next to the vessel and out a stack at the top.

MR. SIESS: How far have they gone on selecting the insulation?

MR. KING: I can't answer that.

MR. SIESS: I mean that is Fort St. Vrain's biggest problem, is insulation that takes up water.

MR. KING: That is in the vessel. See, their problem is insulation between the PCRV liner and the reactor, which is inside the reactor vessel.

MR. SIESS: But you have no internal insulation?

MR. KING: No internal insulation, and I don't think there is even going to be external insulation.

MR. SIESS: Good. It has nothing to do with safety, but it helps to get them operating.

(Slide.)

MR. KING: All right, to the liquid metal reactors, the prism concept.

Here the lead designer is GE, and they have helping them Bechtel, United Engineers, Byron-Jackson and Foster-Wheeler.

The prism concept is a 425 megawatt thermal and 133 megawatt electric modular design, pool type LMR with the reactor vessel located below grade.

It is a homogeneous core design with oxide fuel, but they are still evaluating metal fuel, and that decision hasn't been finalized yet.

It is one loop per module.

It has got one turbine generator for three modules.

One novel feature is it uses the guard vessel not only as a guard vessel but as part of their containment boundary. These plants do have containment, but it is a novel. It is a different shape than the normal containments that you are used to in a light water reactor.

It has passive decay heat removal and shutdown systems.

It is non-safety grade balance of plant, and again where you draw the line there has not yet been defined.

It has got a 40-year module life.

This concept utilizes the idea of a demonstration test to facilitate licensing and private sector acceptance. As part of their plan they want to build one module and actually run it through its paces, not just for normal operation and economics, but safety tests as well.

MR. SIESS: All the way to LOFT type demonstration?

MR. KING: The test program hasn't been defined yet, or at least I haven't seen it. I don't know whether it is going to go to the point of actually losing the plant like LOFT did or whether it will stop short of that. They will do enough that you can demonstrate that these inherent safety features work and you will actually gain some experience as far construction costs and operation.

(Slide.)

The plant layout typically looks like that. They have got three of them grouped together that feed to a steam generator building and a turbine building. They are figuring for a 1200 megawatt site and nine of those modules, and the reactor is down here. This little circle is where the reactor is down below grade and they have a common refueling machine that runs back and forth. You have got one down being refueled and the others are running.

MR. SIESS: Do they have to have nine to make it economical?

MR. KING: I don't know. Do you know, Frank? Do they have to have nine modules to make it economical?

MR. GAVIGAN: Obviously it is more economic with nine reactors, but there are utilities one foresees out there who would be interested in a clumping of three and then adding three in clumps in time.

MR. KING: There are a lot of economic arguments to go modular. You only have to build them a little bit at a time and not tie up all your capital. If you have one down for refueling, the others are still running and that kind of thing.

MR. SIESS: Inherent in that approach of course is complete and stable standardization.

MR. KING: Yes.

MR. SIESS: If you build three and five years later want to build another three and five years later want to build another three, they have got to be pretty much the same.

MR. KING: All of these plants, the HTGR and the two LMR's, their long-range plan is to request standard plant approval from the NRC and actually get that design certified by rulemaking process and then just build that plant, standardization.

MR. SIESS: Because if you are going to have a mobile refueling rig, you can't change some things anyway>

MR. KING: Right.

(Slide.)

A cross-section of the prism concept. The core down here is a pool concept. The pumps in the vessel are going to use EM pumps. And its ultimate decay heat removal again is passive with air inlets and outlets that come down an annulus and then up along the reactor guard vessel to cool the reactor which radiates its heat and conducts its heat out through the sodium pool and radiates it out through the vessel and guard vessel to this air cooling system, a totally passive system.

MR. SIESS: Can I interject a thought while it hits me. The advanced reactor policy doesn't address spent fuel or reprocessing, does it?

MR. KING: It certainly does not address reprocessing. It addresses spent fuel from the standpoint of you want to be able to cool it in walk away type and inherent type ---

MR. SIESS: The LMR concept, does it involve reprocessing?

MR. KING: The concepts that are being presented do not have onsite reprocessing associated with them at this point.

MR. SIESS: If not onsite, then the transportation issue has to be addressed somewhere.

MR. KING: Yes. Maybe I will let Frank say something about that.

MR. GAVIGAN: Both of these concepts are pursuing the idea of onsite reprocessing and offering to a utility the capability of building a reprocessing refabrication facility the the reactor itself as well as looking at an alternate offsite reprocessing furnished by the government. They are looking at it from an economic viewpoint, a proliferation viewpoint and marketing viewpoint, and that is the ---

MR. SIESS: When you say both, you mean the two LMR concepts?

MR. GAVIGAN: Correct.

MR. SIESS: What about the HTGR?

MR. GAVIGAN: HTGR is once through.

MR. SIESS: What do you do with the stuff that comes out of it?

MR. GAVIGAN: You store it until who knows.

MR. SIESS: Until somebody comes up with a policy on HTGR fuel.

MR. GAVIGAN: Perhaps.

MR. MARK: You say it goes in at 17 percent.

MR. KING: Yes.

MR. MARK: And what does it come out as?

MR. KING: I don't know. We are still in the preconceptual stage right now. We have moved from 16 concepts down to one. The next two years for HTGR's will be detailed development.

(Slide.)

All right, the last concept, the SAFR concept.

The lead designer is Rockwell with Bechtel and Combustion Engineering assisting in that design.

A 900 megawatt thermal 350 electric modular design, a pool type LMR. This one has the reactor vessel and steam generators above grade.

It is a homogeneous core design with metal fuel as the reference, and they want to retain the capability to also use oxide fuel. So they are really looking at two designs.

This has two loops per module.

One turbine generator per module.

Again, the reactor guard vessel also doubles as a containment boundary.

It has passive decay heat removal and shutdown systems.

A non-safety grade balance of plant.

And they are looking for a 60-year module lifetime.

MR. MARK: Why is this one above grade and others are below?

MR. KING: I think part of the reason is this one is not using a common refueling machine that has to go over all of them. Well, they are using a common crane that is going to go above all of them.

Maybe Frank would want to say something.

MR. GAVIGAN: I think the major reason was that most of the other concepts that go below ground intend to utilize seismic isolation approaches, especially the GE prism concept. For this one I believe they found out that that was too difficult a concept to count on and it was easier to go above ground and there was no real cost-benefit for going below ground versus above ground. This was a decision that was made just recently.

MR. SIESS: The prism and the SAFR have quite

different thermal efficiencies.

MR. KING: Yes.

MR. SIESS: What does that?

MR. KING: Part of it is the operating conditions that they chose. I think the prism is a lower temperature, outlet temperature, a lower temperature system. I imagine the rest may have to do with the number of feedwater heaters and all that that they have.

MR. SIESS: It is the balance of plant.

MR. KING: The balance of plant which I am not familiar with.

MR. SIESS: I mean the prism is working down in an LWR at 31 percent and the other one is up HTGR or LMFBR.

MR. KING: Part of the lower temperature concept is to have a lot of margin between where you are operating and where you get into sodium boiling or fuel temperature, fuel cladding temperature problems.

MR. SIESS: And they are both pools, pool type?

MR. KING: Both pool types.

(Slide.)

This shows a cross-section of the SAFR plant. The pumps are in the vessel, the core is located down here, they have a decay heat removal system again with the ultimate one that is cooled by air along the outside of the guard vessel, a natural convection passive type system.

That is all I wanted to say on where the concepts stand at this point. We really haven't gotten into reviewing these in any detail. We expect in FY-86 to start looking at the major issues and then in FY-87 the PSID's will come in.

We will talk here about the future plans and schedule next so you can see what the time frames are.

(Slide.)

DOE's overall plan is over the next two to three years to have us conduct a review of the conceptual designs.

That will include ultimately a review of the preliminary safety information document with when that review is complete us writing an SER and issuing what we are calling a licensability letter, that letter that will make a statement on what we feel about licensing these plants.

Then the long-term plans are in 1989 through the late 1990's. The are planning to pursue standard design approval and certification of the design through rulemaking.

All of our planning is concentrating on the first two to three years at this point.

(Slide.)

This is our near-term milestones that we have got

lined up.

For the HTGR on October 8th we have got a meeting on their design status and then we will get into more detail of their selection of design basis events, and that will be followed by a formal submittal in that area.

Liquid metal reactors, tomorrow we have got a meeting on the decay heat removal requirements, and then in October a meeting on their SAFR crane design. They have got a common crane that goes across all their modules that they want to talk about what should the requirements be for that.

And in November a meeting on the SAFR safeguards and security and their safety test.

The near-term things we have scheduled right ---

MR. SIESS: Leave that up there. It strikes me as a little incongruous that we are talking about fairly radically different designs, clearly advanced reactor designs at the conceptual stage and there are clearly some very interesting policy and criteria questions, and yet I see crane design. Now crane design is nothing new and nothing conceptual, and it seems to me that there are certain things that are just so simple and so straightforward that they ought to be able to get them out of the way, and why should they be that much different for an LMR than for LWR where we have been going through

cranes, single failure proof cranes, et cetera, et cetera now for about 15 years.

Is there any distinction in your review between these sort of simple, non-advanced reactor issues and the real advanced reactor issues, or are they just getting all mixed up and you are taking whatever comes in?

MR. KING: It is sort of a two-way street here. We have identified those issues that we feel are key safety issues that advanced reactors use that we want to talk about. Cranes was not one of those.

MR. SIESS: I would think not.

MR. KING: The designers have selected a number of things they want to talk about. Now a lot of our issues are the same, but there were a few that the designers selected because they had some particular concern in that area that they wanted to talk about, and cranes happened to be one of those for the SAFR design>

MR. SIESS: It sounds like a diversion.

MR. KING: I don't know whether it is a diversion or whether they really have something there. We haven't had the meeting yet, so I can't say what the issue is.

MR. SIESS: I can see that safeguards and security could be a different type of issue for these because of the different types of fuel. But the crane just struck me as being something that people ought to---

MR. KING: That was put on the list at their request.

MR. SIESS: All right, you are going to stick with your crane criteria and let's get on with the business of designing advanced reactors.

MR. GAVIGAN: This is a specific issue for the SAFR design. It is not a diversion. Part of the design requires a maintainability approach to remove components from one of the modules, and with an overhead crane it passes over the neighboring reactor systems, and the question is how is that handled in the licensing process, not the design of the crane, but the process by which the crane is used and what it does to the other modules.

MR. SIESS: But I don't really see how it is that much different from cranes in light-water reactors that lift heavy loads over all sorts of things.

MR. KING: Well, they want to be able to lift heavy loads over these operating modules, and normally a light-water plant or an LMFBR doesn't do that.

MR. SIESS: I can see the point.

MR. KING: Anyway, there aren't many that I would categorize as these sort of side issues.

MR. SIESS: Instead of single failure proof, you can make it double failure proof or triple failure proof.

The thing is if you get the right people on it,

that can be escalated to take more time than some of the other things.

MR. KING: And I hope that doesn't happen.

MR. SIESS: I know, but ---

(Laughter.)

MR. KING: Cardis is going to handle that one.

MR. ALLEN: We will get the right people.

(Slide.)

MR. KING: This is sort of an outline of the major issues that we are going to be interacting on and the tentative schedule for that for the HTGR conceptual design review.

The top-level criteria we have received, we hope next month to respond to that.

Bridging methods, that is submittal from HTGR designers that describes how they are going to go from these top-level criteria, the relationship between those and the standard NRC regulations and review process. We expect a submittal on that next month, and next month we also expect a submittal on what they call lower-level criteria, which would be their general design criteria.

Then the key issues we have identified that we want to interact on in FY-86 before the PSID comes in. Are there criteria for accident selection and evaluation, the question of module control and their decay heat removal

scheme, containment versus confinement question, the reactor shutdown design methods, their fuel -- I had fuel in there back when I thought things were on pebble bed, but now that they are going close to Fort St. Vrain, that may not really be much of an issue any more -- in-service inspection, water/air ingress accidents, of course core support structure design and the last one I call issues related to standard plant approval.

MR. SIESS: Let me ask you a couple of questions about containment versus confinement.

The confinement, I guess it is not as clear now as it once was in my mind what the difference is. A few years back containment meant that you held everything inside of containment period, and confinement meant you held it only temporarily and did some filtering, although Fort St. Vrain doesn't even have filters. It just lets it out.

MR. KING: Well, they have filters, but they also have blow-out panels if it gets too much pressure and they will just let it out.

MR. SIESS: Yes. But that distinction has gotten blurred as we begin to look at severe accidents because now our thinking says we have got the stuff out in there and at least in the BWR's we are talking about releasing it through a filtered path.

MR. KING: Yes.

MR. SIESS: And now it becomes simply sort of a degree. I have a difficulty separating the concept of venting from a BWR in a severe accident from venting from an HTGR in a severe accident. And yet one of those designs we would say has a containment and the other one we would say has a confinement.

So it seems to me that at one time we could say, oh, well, no matter what the PRA tells us, containment is defense in depth and we want a containment. And yet when I look at the severe accident approach, which is a form of top-level criteria, and it would be coupled to some kind of a safety goal, a quantitative one, the distinction is blurred.

So the words are not as simple as they were before.

MR. KING: I think you are right. They are heading toward each other in terms of what they ---

MR. SIESS: I can still argue defense in depth no matter what PRA or top-level tells me, but then that is not being consistent, you see.

MR. KING: I guess the thing with the containment is you have got that ability to bottle everything up if you so desire and you check the leakage periodically.

MR. SIESS: We are not even sure of that. As we look at severe accidents and approach higher pressures and

temperatures, the containment is going to leak. So it is not necessarily all bottled up in there, and some severe accident scenarios say the containment can't hold it and some of them say you couldn't build a containment that would hold it. As long as there is heat in there, it is going to produce pressure and you have got to cool it some way.

Again, you know, that decision, at one time I would say well, you could ignore your top level or you could add one that says defense in depth, which I am sure we are not going to throw out, not the words anyway.

MR. KING: No.

MR. SIESS: The concept has changed.

MR. KING: The scheduled for the submittal of the PSID is September of '86, and a PRA on the conceptual design will come in at the same time. And we have scheduled about nine months to review those documents and are hoping by September of '87 to be able to issue a licensability letter on the HTGR design.

MR. SIESS: Now you have got an item up at the top, lower-level criteria, including GDC's.

MR. KING: Right.

MR. SIESS: The decision has been made to develop GDC's for advanced reactors?

MR. KING: The designers would like to develop

GDC's for advanced reactors. The GDC's would be for the HTGR, the modular HTGR.

MR. SIESS: Why not for the LMR's?

MR. KING: There are going to be GDC's for the LMR's. We haven't gotten to that viewgraph yet.

MR. SIESS: Now the GDC's would derive then from the top-level criteria?

MR. KING: The GDC's would state requirements on the designs that are needed to meet those top-level criteria.

MR. SIESS: You see, we have got some GDC's on LWR's that when you start looking at PRA type things they don't seem to be as important as they were when you looked at design basis events. And I guess if your top-level criteria are going to be those five things you had at the beginning, you are going to run into the same type of issue. Maybe it will be clearer since you are developing them from all five of those top-level criteria, or whatever the top-level criteria end up being.

I am still not sure you could take all five of those. I guess you can envelope them.

MR. KING: They certainly overlap.

MR. SIESS: Now overlap isn't always good if it fuzzes up the criteria.

MR. KING: Excuse me?

MR. SIESS: I think the overlap fuzzes up the criteria rather. I would hope that top-level criteria could be simple, and I don't think they are going to be. Maybe that is just wishful thinking that they could be simple. We thought the safety goal was going to be simple.

MR. KING: Well, we are trying to take what the main criteria are today and find out which of those are controlling and use those to guide the design. I think that is the concept behind the top level criteria.

(Slide.)

All right. The long-term schedule for the HTGR is to submit their PSAR in 1989, requesting our preliminary design approval in 1991, FSAR in 1993, final design approval in 1995 and to request certification of the design in 1998. Those dates are from the DOE proposal.

MR. MARK: On that slide before this last one, the very final item was a final PRA or is that PDA?

MR. KING: PRA.

(Slide.)

Down here?

MR. MARK: That is what it looks like.

MR. KING: PRA.

MR. MARK: Now that means the design is going to be absolutely complete, including the nature of the breakers and the switches?

MR. KING: No, no. Maybe that is a bad ---

MR. MARK: What is a PRA then?

MR. KING: It is a PRA on the conceptual design. I put the word "final" in because we may get some preliminary versions of that before September of '86.

MR. MARK: Does it make any sense to do a PRA on a conceptual design?

MR. KING: I think it will give you some insight as to what the accident scenarios are, sort of a relative look at their probability and consequences.

MR. SIESS: The bottom line won't mean anything.

MR. MARK: It won't mean anything. A PRA uses numbers.

MR. KING: A PRA uses numbers.

MR. MARK: And a conceptual design doesn't.

MR. KING: What do you mean "doesn't"? I mean it will have numbers in terms of consequences and in terms of fuel temperatures. The numbers will have some uncertainty associated with them.

MR. MARK: Yes, indeed.

MR. KING: And the level of detail that the PRA can go into won't be as great because you won't have the number of breakers and that kind of thing worked out yet.

MR. MARK: I am glad I am not having to do it.

MR. SIESS: Well, I wouldn't mind doing it, but I

just wouldn't want to defend it.

(Laughter.)

MR. MARK: What is the reliability of a pump in a conceptual design, 100 percent maybe?

MR. KING: That depends. If it is a pump or a circulator that has been used before, you probably have some numbers on it. If it is something new, you are going to have to work up numbers.

MR. SIESS: I think you can get insights from it.

MR. MARK: Maybe you will get some insights ---

MR. SIESS: And they might be as good as the insights you get from a completed design.

MR. MARK: I expect to think about it in the same way that I think about present PRA's.

MR. SIESS: Yes.'

(Slide.)

MR. KING: All right. The liquid metal reactors. I have put one schedule together that covers both prism and SAFR because a lot of the issues are the same and the dates for submitting PSID and PRA are the same.

Again, in FY-86 we plan to interact on what we call the key issues. And for the LMR's, we listed those as station blackout, decay heat removal, sodium leak accommodation and the question of containment and confinement. Now in this case they are going with

containments, but they are low pressure and different design. We are going to look at that.

Reactor shutdown systems and metal fuel. We looked quite a bit at oxide fuel in the Clinch River review, but we haven't looked at metal fuel.

Multiple module control and their criteria for accident selection and evaluation.

Service inspection and issues related to standard plant approval.

Their safety test plan, and certainly for the GE design whose is planning to have a safety test facility.

And the PSID and the PRA are scheduled for a December of '86 submittal and we have a year scheduled to write an SER.

MR. SIESS: What is PSID?

MR. KING: Preliminary safety information document. It is sort of like a mini-PSAR.

MR. SIESS: Let me ask you a question that seems quite logical, but it must may not have an answer. The NRC staff has been through a safety review of two HTGR designs, one of them all the way to approval and the other one pretty far along.

The NRC staff has also been through a review of a liquid metal reactor design to a pretty advanced stage.

What do you see as the differences as you now

start the process over with these "conceptual designs"?

MR. KING: The differences in design?

MR. SIESS: Will we really be having different criteria? I get the impression we won't. There will be some new criteria.

MR. KING: There will be some new ones.

MR. SIESS: Safety goals, whatever that means, and protective action guidelines didn't exist when the HTGR reviews were made, but part 100 and part 20 did. This isn't a whole new process.

MR. KING: No.

MR. SIESS: Now what I am getting at is do you see major differences in how the reviews are going to be made and do you see that they are going to lead to significant differences, not in plant details, but in plant setups? These are different plants.

MR. KING: They are different plants and they are trying to do things in a more inherent passive nature, which I think will lead to less requirements for safety related systems and less requirements for onsite AC power and less requirements for active decay heat removal systems.

MR. SIESS: Less review or just less requirements? Are there going to be some things that maybe the staff doesn't have to look at?

MR. KING: Hopefully.

MR. SIESS: If the balance of plant is not safety related, do you think you can convince yourself somewhere that you don't have to look at balance of plant.?

MR. KING: I think we will have to look at balance of plant to convince ourselves that, true, it is not safety related and it doesn't feed back in and affect the safety functions of the plant.

MR. SIESS: The PRA ought to tell you something of failure modes and effects analysis and systems interaction.

MR. KING: We are going to have to look at those things. If we conclude the balance of plant is truly not safety related, it would be my intent to not go further and look at the design and pose requirements or do anything on the design the balance of plant, other than, you know, there may be some interface type requirements that we will have to put down because we don't want them to go change the balance of plant that will now affect the assumptions you have made on your safety systems.

But as far as getting into the details of the balance of plant, I would propose we wouldn't do that.

MR. SIESS: I think what they would like to do would be able to just draw a line and say nothing over on this side can have any effect on this side.

MR. KING: True.

MR. SIESS: Do you think that is possible?

MR. KING: I think it is possible. I do>

MR. SIESS: Do you think it is possible for them to do?

(Laughter.)

MR. KING: Well, we will find out.

MR. SIESS: I mean it has to be both possible and convince somebody.

MR. KING: Yes. But I think the idea is a good idea and I think it is possible. They are talking about a fence between the way the construct the non-safety grade and the way they construct the safety grade type materials. So it leads into construction type differences as well as design type differences is what they are talking about for utilizing the non-safety grade balance of plant.

MR. SIESS: It seems to me that that concept is probably the most important thing that is coming up here. Again, you said what things we might want to look at, and I think the top-level criteria on how they are going to be used and this basic concept of being able to draw a line and really separate out balance of plant, because I know this has given the ACRS and I think the staff real problems in looking at the standard designs that we are looking at now, like GESSAR II, of trying to understand the so-called interface question because balance of plant isn't easily

separated out.

MR. KING: Right.

MR. SIESS: The balance of plant in LWR's is frequently the initiator, and that concept at whatever levels, it can be brought to the ACRS and I think it could be extremely important.

MR. KING: Okay.

MR. SIESS: Because if that can be settled, it sure makes a big difference from there on out.

MR. MARK: But it will have to be clearer or put more clearly than it was in the case of GESSAR.

MR. SIESS: Yes. GESSAR has got a very fuzzy -- well, but GESSAR never claimed that balance of plant is not safety related. It is just that is going to be left to the individual applications, you see. They never claimed it is not safety related. So the problem persists all the way down until the plant gets built.

But if it can be demonstrated that there is a line that can be drawn and an envelope put around one system and say nothing outside of that can have any effect -- well, it could have an effect as an initiator as long as it doesn't have an effect on your recovery, right, or your walk away?

MR. KING: Right.

MR. MARK: Well, the interfaces will have to be rather clearly identified.

MR. SIESS: Oh, yes. It will have to be a solid line or plain or envelope there.

MR. KING: Hopefully it will be easier to identify that interface in these designs since they are starting out to purposely design them that way.

MR. SIESS: There are still going to be issues because their balance of plant can initiate an accident, and defense in depth says I may not want to ignore it. I am just talking about the way things have come up in the past.

So the balance of plant can initiate an accident, but you can walk away, and then maybe you can ignore the initiator. But, you see, what is being lost there is the defense in depth of not having accidents in the first place as well as not having them progress or protecting the public after they occur. So that is an aspect of balance of plant.

To say it is not safety related, is that for mitigation or for prevention, you know, that is a thought.

MR. KING: Yes. It certainly could be an initiator and its performance feeds back into the safety related system, and there are going to have to be some controls on the interface requirements because you don't want them to put anything out there.

MR. SIESS: Because defense in depth, among many

of its definitions, is an extremely non-mechanistic and almost subjective idea at times that says I don't care, I still want it.

MR. MARK: I have been struck by something here which I believe Chet has addressed more specifically. Staff review complete two months after submittal, all the way down the page. I think that is admirable.

(Laughter.)

How are you going to manage to do that? I guess it is because there are so few people in the advanced reactor group that you can move that fast.

MR. KING: Well, we are certainly going to have to call on some of these issues on outside help, whether it is contractors or whether it is other staff members.

MR. MARK: I hope you are not ---

MR. KING: This is a goal, let's put it that way. I can't guarantee it.

MR. MARK: That is a marvelous goal. I don't remember anything ever having been settled in two months on Clinch River.

MR. SIESS: Or anything else.

(Laughter.)

Anything, you name it.

(Laughter.)

MR. KING: That may be a naive goal, but

nevertheless that ---

MR. MARK: Oh, it is a great goal. I had felt that perhaps if there was only the four of you doing it, you might manage that.

MR. SIESS: I thought it was a typo.

(Laughter.)

MR. KING: In some cases it will be just the four of us and in a lot it won't be.

MR. SIESS: Some of us get cynical in our old age.

(Laughter.)

(Slide.)

MR. KING: The long-term schedule for the LMR's, again, late 1980's or early 1990's for the PSAR and going through the preliminary final design approval and requesting rulemaking to certify the design.

We are not concentrating so much on doing anything for that. We are concentrating on the first two or three years.

(Slide.)

Resources. Back in February we hadn't gotten to the point where we had identified in detail what our resource needs were. We didn't know what we were going to have in FY-86 in terms of resources. We are to the point now where we have identified the resources in detail.

The first line shows what we are estimating will

be needed for outside technical assistance in the fiscal years that the reviews will be going on.

We have received that money, and NRR will have that money as technical assistance money. Where we plan to allocate it is Brookhaven and Oak Ridge will get major portions of it, and the undesignated is we are planning to go out and see if we can get a few thinkers to help us.

MR. SIESS: You talk about conceptual review and that is why it tapers off.

MR. KING: Yes, review of the conceptual design over the next two or three years.

MR. SIESS: And then it picks back up. It is going down in '88. So it has to come back up somewhere.

MR. KING: Yes. This is just to review the conceptual design, the three that DOE have presented.

MR. SIESS: Now it says no support from Research. That is because you don't expect to be able to get it.

MR. KING: Currently Research advanced reactor money is zero in '86 and '87.

MR. SIESS: But does that mean that you wouldn't like to have it if you could get it?

MR. KING: Oh, I would like to have it if we can get it.

MR. SIESS: You could think up some good research projects.

MR. KING: I can think up some research. Basically our technical assistance money is going for review and analysis. We are not doing any research with that.

MR. SIESS: With your four-man staff, it is it even possible for you to start thinking of what research needs might be so somebody could start planning them?

MR. KING: It is possible to certainly think about those.

MR. SIESS: You haven't got very much time for thinking in there.

MR. KING: We won't have much time to think, but if research would get some money, I think we could certainly find some key areas where we could use that money.

MR. SIESS: It is better the other way, for you to think of the needs and then use that as a basis for getting the money. But that is not the way the Congress works.

MR. KING: And the manpower in NRR that we are expecting to use is listed here on the bottom.

(Slide.)

Okay. The next couple of viewgraphs are some detail on the guidance we are developing to give to Brookhaven and Oak Ridge in terms of what they will be doing with their FY-86 money in the next fiscal year.

It is probably not worth going through these in any detail.

(Slide.)

It is basically support the review of the designs, the base technology programs and do some independent analysis for us on the performance of those systems.

MR. SIESS: Is the HTGR fuel, the graphite and so forth generally similar to what ---

MR. GAVIGAN: Yes, as Fort St. Vrain.

MR. SIESS: So all of that previous work on the graphite -- it is a different enrichment, but a lot of the Oak Ridge and Brookhaven stuff applies there.

MR. GAVIGAN: Right.

(Slide.)

MR. KING: Now I will get to the final slide in this section, which is proposed interactions with ACRS.

We wanted to get some feedback from you on items you felt you would like to get involved in.

What I had proposed here on the slide in '86 was to schedule a session with you on the containment/confinement issue for both HTGR's and LMR's and have the designer present their design and their rationale, and that will include what the source term is that we are basing that containment upon, and then solicit your comments and feedback on that.

MR. SIESS: What is SSST?

MR. KING: Site suitability source term. That is what source term are they going to use for ---

MR. SIESS: Yes, I remember it.

MR. KING: --- for setting the containment designs.

Then the second item was the design basis accident envelopes for the HTGR and LMR's getting into this probabilistic approach for the HTGR's and then the the LMR's and talk about the approach that they are planning to use.

MR. SIESS: Now that clearly would involve the balance of plant.

MR. KING: That would include looking at the balance of plant.

MR. SIESS: But you don't have on here the top-level criteria.

MR. KING: No. If that is something ---

MR. SIESS: I think that ought to come in fairly early because of your GDC are going to develop from that and everything else is to develop from it.

MR. KING: Okay. I wrote three others down that I don't have on here for this morning's discussion, top-level criteria, the question of balance of plant for the designs, and I guess I do have the other one, which is the accident

selection process which I have already got on this slide.

MR. SIESS: That is on there.

MR. KING: That would make a total of four items that we should schedule sometime in FY-86 to talk about.

MR. SIESS: I am not sure they are independent, but that will come out as you as you get into it.

MR. KING: Yes, it is a living list and we can expand it or shrink it or whatever, but I would like for planning purposes to have an idea of what the topics are and then I can work with Med to schedule these. And I presume we are talking about the subcommittee and not the full committee on these issues at least for starters.

MR. SIESS: I can't speak for either the temporary Chairman or the permanent Chairman, but I would suspect that we wouldn't want to get through '86 without coming into the full committee at least once.

MR. KING: On these issues.

MR. SIESS: Yes. The main reason for the subcommittee is to sort of define the issues and see what is worth bringing up. But subcommittees are too small to get a full spectrum of input from the ACRS.

MR. KING: Okay. We should start with the subcommittee and then schedule the full committee.

MR. SIESS: Yes.

MR. MARK: Issues such as containment/confinement

and the selection of design basis accidents and the thing like the handling of tornadoes are all going to have to come in front of the full committee.

MR. SIESS: Yes. Well, the tornado thing might be at a lower level.

MR. MARK: Well, if it is to be a change, it will have to go before the full committee.

MR. SIESS: Yes. But the features here, the top-level criteria are very important because it is an attempt now to bring in severe accidents into the criteria in a more specific way and there will be PRA brought in more specifically.

The size of these reactors is important, the separation of balance of plant in a passive nature, the inherent safety features and all these nice things are going to be the important things, which is not the same as saying that that is what the committee is going to be concerned with, but that is what I think they ought to be concerned with.

I really think as soon as you start getting anywhere on top-level criteria in bringing these different approaches from the different groups, that is one thing the full committee has got to hear about.

MR. KING: Okay. I think probably October or November then we could schedule a session on top level

criteria and what they mean in terms of interfacing with the normal regulatory process.

MR. SIESS: I think that is policy. High-level policy decisions are involved in that. There is a lot more importance in what you do with top-level criteria in this advanced reactor policy statement.

MR. KING: It is policy, depending on how we use the top-level criteria.

MR. SIESS: Oh, yes, or what they are.

MR. KING: And what they are.

Okay. In FY-86 I primarily concentrated on the major issues that we just talked about.

'87 is when we will be underway with the PSID reviews. What I was proposing there was we would schedule some sessions where the designers and the staff would come down and describe the designs to you, the systems and the accident analysis and solicit your feedback, and then hopefully at the end of that process after the staff issues a report on the review of the PSID, to solicit a letter from the ACRS on the design that we would attach to our final response to DOE on the licensability of these plants.

MR. SIESS: You see, you are asking for approval of a concept, and I was trying to define what really is involved in the concept. Some of it is in here and some of it -- well, there are whole pages of concept type things,

but there are certain ones that are going to be the important ones. One clearly is the size and one clearly is the separation of balance of plant.

MR. KING: Hopefully in '87 in the nine to twelve months that we are doing the review of these PSID's we will have opportunity to present the design and if you raise issues we can schedule sessions on those and sort of parallel what we did on Clinch River in looking at the PSAR perhaps not in as much detail, but at least hit the major systems and the major safety aspects of the plant.

In '87 that would be complete for the HTGR and in '88 it would be complete for the two LMR's.

At this point that is what I am going to plan on for future interaction with the subcommittee and the full committee, and I will work with Med to schedule those.

Like I said, it is a living list and we can add to it and subtract from it as things go on.

Okay, that is all I wanted to say before we got into the policy statement.

MR. MARK: Let's let you sit down for a while.

MR. KING: Take a break, all right.

MR. MARK: We will start up at 20 to 11.

(Recess taken.)

MR. MARK: The meeting will continue.

Do you want to go ahead.

MR. KING: All right. The final section is to talk about the policy statement.

(Slide.)

I think maybe to set the stage, I will give you the background of the policy statement.

After the cancellation of Clinch River, certainly designs with inherent safety characteristics were started to be promoted, both HTGR and LMFBR and PIUS, and it got the interest or the attention of the Commission. They asked for a couple of meetings and briefings from the staff on what we were doing in the advanced reactor area. I think the first one was in November of '83 and the second one was around January or February of '84.

The staff went down and told them what we were doing in the Research side and the NRR side, and out of those two meetings came a request by the Commission to OPE to draft the policy statement on advanced reactors.

OPE did that, and after they drafted it, they sent a copy to the staff to look at. The staff made comments on it and OPE redrafted it, or a couple of cycles like that where we looked at drafts, and finally it went to the Commission. It stayed there for a long time before any action was taken on it.

Finally, the Commissioners took action, and they or their staff members personally rewrote several sections

of it and issued it for public comment in March of '85.

The comments were received and in approximately July of '85 OPE put together a summary of the public comments and asked the staff, specifically me, to redraft the policy statement and work up responses to the six questions that had been included at the end of the first policy statement.

So I did that this summer, gave it back to OPE and they circulated it to Research and it came back to the staff through normal channels for review. We got some comments from Research and we incorporated some of their comments.

We finalized the draft and sent it back to OPE, and they in turn put it into the form of a SECY paper, 85-279 and sent it to the Commission, and that is where it sits today.

In redrafting the policy statement we tried to retain as much as possible, the wording that the Commissioners has put in the public comment version, and we made changes where we felt that they were legitimate due to the questions raised in the public comments or where we felt that things just needed to be clarified if they weren't worded too clearly in the original version.

So that is where it stands today. It is at the Commissioners, and I don't know what their current schedule

is for acting on it. They were supposed to have an affirmation vote last week I believe and that never came off and I don't know what the current schedule is for doing anything with it.

Ken Herring has been my contact at OPE on this, and I saw his just walking ---

MR. HERRING: Ken Herring, OPE. The only thing I would like to add to what Tom said was that we did not circulate it to Research. We went through the EDO's office and the policy statement itself was looked at by not only Research but also CRGR and anybody else that the EDO thought was appropriate. And what we got back after the EDO office worked further with Tom was a staff position signed off at the EDO level. So it wasn't just OPE going to just Research and NRR separately. What we got back was looked at by the EDO.

Right now it is up before the Commission.

MR. MARK: You also don't know what their intentions are as to schedule and when they are going to act on this?

MR. HERRING: It was put on for affirmation last week, but then Commissioner Bernthal and the Chairman are out of town and things like that for the next couple of weeks. So I haven't seen anything back in writing. I have talked a little bit to one of the assistants.

MR. MARK: But it is expected that within the next few weeks they will probably ---

MR. HERRING: I would guess from what I know right now, yes, that within the next few weeks we should know something.

MR. MARK: And they will either want to revise it or adopt it.

MR. HERRING: Right.

MR. KING: Okay, with that background, let me first talk about how we currently plan to implement the policy statement, assuming it stays close to the version it is right now and then talk about the public comments.

(Slide.)

For implementation there are two things I wanted to talk about, our plan for review and then the technical approach that we plan to apply to the review of the advanced reactors.

The plan for review is basically to become familiar with the concepts under evaluation. That is currently going on.

To interact with the designers on the criteria, the major issues and the supporting base technology program, and we see the primarily the designers are going to propose their designs, their criteria and their technology programs and we will review those, and that will

include independent analysis.

And the designer is responsible for developing a complete set of analytical tools and base technology.

We are going to document any criteria or guidance that comes out of the review of the major issues.

We are going to perform a safety review on a PSID and issue an SFR and licensability letter when that is all done.

That is our basic approach to the review.

(Slide.)

Technically we plan to build upon the LWR framework where practical. That means use LWR GDC's if they would apply to a light-water reactor and use things like 10 CFR, the applicable portions of 10 CFR 50 and 10 CFR 100.

Develop new criteria and guidelines for the concepts where that is needed to address the characteristics of the design which are different from LWR's and address unique safety characteristics of the design.

And as part of that we will consider giving credit for the inherent safety characteristics incorporated into the design.

We will back off on onsite AC power requirements, for example, if they are not needed for safety functions.

The general principle we are planning to apply is that advanced reactors must be at least as safe as current generation LWR's. That is certainly a judgment type evaluation that will be based upon things like looking at the equivalency of defense in depth of LWR's, previous experience, R&D programs, the application of TMI and USI issues if they apply and then comparison against the Commission's safety goals.

MR. SIESS: Excuse me. Let's leave that up for a minute. Could you give me your definition of defense in depth? That is not facetious. There are three around that I know of.

MR. KING: Multiple barriers to radiation release and multiple ways of performing a safety function is basically the way I look at it.

MR. SIESS: Okay. I had mentioned that earlier in connection with containment versus confinement. Have you thought much about whether containment versus confinement can be argued on purely defense in depth trials? That is multiple barriers.

MR. KING: Yes. I think it can be argued on those grounds. I think the biggest uncertainty will be how much additional containment or confinement capability do you want to put in to take care of unknowns. You can certainly argue the knowns, the estimated releases, the site boundary

dose rates and make a comparison of whether containment or confinement, which is adequate and which is the better way to go, and what do you want to do to take care of the unknowns I think is the biggest question I have in my mind right now.

MR. SIESS: What do you consider to be the safety goals, qualitative and quantitative? When you are making a comparison against a safety goal presumably you would be using the quantitative safety goals?

MR. KING: The Commission's safety goals.

MR. SIESS: The quantitative safety goals.

MR. KING: The quantitative safety goals.

MR. SIESS: Would the core melt criteria be applied here as a primary safety goal in the same way that they end up applying it for light-water reactors, which isn't settled yet, that whatever is done for light-water reactors would be applied here?

MR. KING: We would intend to apply it equivalent to the way it ends up being applied for light-water reactors.

MR. SIESS: Even though the consequences might be significantly different?

MR. KING: Yes, but the consequences we feel would be addressed in looking at the other societal individual risk goals that address consequences. Protective action

guidelines address consequences ---

MR. SIESS: Yes, but right now there is some thinking that no matter what the societal individual risk goals are, that something ought to be done about core melt probability. It is separate.

MR. KING: I think whatever is decided upon for LWR's, that is what we would intend to apply here in terms of a numerical probability of a core melt.

MR. SIESS: And if somebody came up with a design where the core could melt and there would be absolutely no risk to the public, you would still apply it as it would be applied for LWR cases where there is some residual risk to the public, or have you thought about that?

MR. KING: Well, I haven't thought about that extreme, no. I guess I would be surprised if somebody could come up with a design like that.

MR. SIESS: You think that maybe by the time you get that far the safety goals will be clarified?

MR. KING: I hope so and how they are to be implemented.

MR. SIESS: Oh, I hope so, too. You know, the policy statement has two aspects to it and I would like to keep them separate and you may have difficulty. But one thing the policy statement does is say how the NRC is going to approach the review, and to some extent the mechanics,

the early interactions, et cetera, et cetera.

The other part of the policy statement indicates what are desirable characteristics of advanced reactors.

MR. KING: Yes.

MR. SIESS: I wouldn't exactly call it a laundry list, but it is a list that has the phrase "some or all."

MR. KING: Yes.

MR. SIESS: Are you going to address that list at some point here? I haven't had a chance to look through your slides.

MR. KING: You mean what do we think of the list?

MR. SIESS: Yes.

MR. KING: I don't have any specific slide on that list, no.

MR. SIESS: You know, the "all" bothered me because I guess it is not quite clear to me how we can have I think the words are -- the least equipment is one item in the list where that phrase occurs, and then a little later I see redundancy and diversity.

MR. KING: I am not sure you can have all of those at the same time.

MR. SIESS: And yet the policy statement says "some or all" which at least implies that all would be better than -- that all is possible and there is at least some suggestion that all would be better than some.

MR. KING: Yes. There is certainly implied that the more you have the better it will be. I don't think there has been any attempt to sort those out as to which ones you can have and which ones you can't have at the same time. I think it was just sort of a list thrown out there to give an idea of the kinds of things we are thinking about without really getting into the details of how you apply them and which ones are sort of contradictory.

MR. SIESS: Now does the policy statement say that you have got at least one of those to be considered?

MR. KING: It says some or all, which implies at least one.

MR. SIESS: So if somebody came in and didn't have any of those, you would tell them to go home and come back again?

MR. KING: We would tell him he is not an advanced reactor.

MR. SIESS: He is not an advanced reactor, even if it was a gas-cooled or a liquid metal reactor?

MR. KING: I think if somebody came in with another Fort St. Vrain, we would not consider that an advanced reactor.

MR. SIESS: Okay. What about CANDO?

MR. KING: I don't know enough about CANDO to answer that.

MR. SIESS: What about a duplicate of the French-German LMFBR?

MR. KING: The SNR-300?

MR. SIESS: Yes.

MR. KING: That would probably be an advanced reactor.

MR. SIESS: And would it qualify in having at least one or some of these features?

MR. KING: As far as I know, it would. It would have an inherent property for decay heat removal, for example.

MR. SIESS: And CANDO you just say you don't know?

MR. KING: I don't know much about CANDO. So I can't answer that.

MR. SIESS: So really your main interest in the advanced reactor policy is in what it tells you of how you should go about your review?

MR. KING: I think there are two main things that come across to me in the policy statement. One is let's do this early interaction and let's not wait until a PSAR comes in. The other is to encourage these inherent safety characteristics be put in designs and using that list as examples of what we are talking about.

MR. SIESS: Okay.

MR. KING: Those are the two main things I see the

policy statement does.

MR. SIESS: "Encourage" is a good word. How does the NRC encourage something?

MR. KING: By saying all right, you are accomplishing your features or your safety functions in this fashion, and we can give you relief over here on these other requirements that we would normally apply.

MR. SIESS: In actual physical ---

MR. KING: Physical tradeoffs, correct.

MR. SIESS: Is there any sense of expedited review as a carrot?

MR. KING: Well, I think as a by-product the review probably will be expedited. If we get involved early and resolve a number of these issues early, that is going to speed things up later on.

MR. SIESS: Because innovation usually leads to extended review, unfortunately.

MR. KING: That remains to be seen.

MR. SIESS: You are encouraging innovation.

MR. KING: Yes.

MR. SIESS: And I guess if I was sitting out there and wanting to innovate, I would consider one of the major tradeoffs to be review time.

MR. KING: Well, I think that is part of getting involved in this process early. If it is an advantage to

the designer and he doesn't sink a lot of money getting to the preliminary design stage not know whether certain of his features are acceptable or not acceptable, it is more efficient.

MR. SIESS: That is why I wouldn't have tried an innovative approach to tornado design.

MR. KING: Well, maybe that is why he brought it up early in the game here.

MR. SIESS: Yes, I think so.

Okay, thank you. That is helpful.

MR. KING: All right. The policy statement ---

MR. SIESS: The thing that bothers me I guess is that defense in depth is awful nice, but it can also be used to cover anything you want. For anything you can't find an engineering or rational basis for, you say it is defense in depth. I don't object to that. Sometimes that is judgment and sometimes it is intuition and sometimes it is just orneriness.

MR. KING: There is a lot of judgment involved on this plan as well as probably on the other plan.

MR. SIESS: The important thing is that it be good judgment.

(Slide.)

I guess, as I said earlier, we redrafted the policy statement to provide better organization and

clarification in trying to use some of the existing words that were in the March version of the policy statement, but maybe reorganize them to be a little more clear and not jump around so much.

And then incorporated public comments where we felt they had a legitimate point and we needed to clarify or modify something in the policy statement.

And we provided answers to the six questions that were at the end of the policy statement.

That is basically what the redraft did.

The main points included in the redraft were to still encourage early interaction. We encouraged the list of features and characteristics. Those two things were in the original statement and they are in the latest version.

These last three things were things we added that weren't in the original version.

We encouraged early discussion on the use of proven technology or technology development programs and their effect on regulatory requirements. That came about because of some members of the staff were concerned that here were plants that want to proceed down the path of a standard plant design and approval. Yet, none of those plants have ever been built or operated before.

Should the NRC grant standard plant approvals for a plant where we have no operating experience ---

MR. SIESS: What would be an example of a technology that required a development program?

MR. KING: Reactor shutdown systems, for example, and how reliable are the control rods, the self-actuated shutdown systems, the inherent feedback characteristics and what technology programs are going to be done to show those things really work the way they say they are going to work.

MR. SIESS: Okay.

MR. KING: Our thought is we need to identify those areas and talk about what is being done to resolve concerns like that if we are going to go down the path of a standard plant approval prior to getting one or more of these plants on line.

MR. SIESS: It is a demonstration of effectiveness and reliability.

MR. KING: Yes.

MR. MARK: Speaking of new technology, in the HTGR module design, does it have water-cooled bearings?

MR. KING: I think the circulators are going for magnetic bearings. Is that right, Frank?

MR. GAVIGAN: We have developed a backup new reliable water bearing, but nevertheless we are going toward the development of magnetic bearings for this new design.

MR. MARK: And that will tend to keep down the

water that ---

MR. GAVIGAN: It will eliminate the water if you go magnetic.

MR. MARK: --- at Fort St. Vrain.

MR. KING: Right.

MR. MARK: It sounds good.

MR. KING: The next point we included in the redraft was making a statement that advanced reactors must provide the same degree of protection to the public and the environment as do current generation light-water reactors.

MR. SIESS: Let's take a minute on that.

MR. KING: Yes, let's take a minute on that.

MR. SIESS: The ACRS is on record, I am quite sure, in the last letter we wrote on the implementation of the safety goals as saying that we think future reactors ought to be safer than existing reactors.

Now I have to qualify that because I think it was said in the context of core melt probability, and what you have on the slide is very carefully worded in terms of the same degree of protection to the public and the environment. So they are not contradictory, that is the ACRS might be satisfied with a lower core melt probability, which might not be interpreted as being safer. I don't know.

But there certainly seems to be thinking in terms

of a top level criteria of a significantly lower core melt criteria and a core melt probability of 10 to the minus 4. That is what I gathered from what we discussed earlier this morning. Is that correct?

MR. KING: You would certainly end up with probabilities of core melt much lower than 10 to the minus 4 in these designs.

MR. SIESS: You have no objection to them being safer, but you are not going to require it.

MR. KING: That is true, and the reason we put this statement in the policy was the March version of the policy statement, nowhere in there did it come out and say that these plants had to be more safe than the current generation of light-water reactors.

They encouraged it and thought if you put in these inherent type features in the laundry list of features, that you would end up with plants that are more safe. But it never came out and said we are going to require it.

MR. SIESS: But I was much encouraged by the criterion that was proposed by the HTGR people, and I don't know whether it was in the LMR or not, that for protection of the plant investment they wanted 10 to the minus 5. Now is that also in the LMR proposal?

MR. KING: No.

MR. SIESS: Because now that automatically takes

care of ---

MR. KING: Maybe Frank wants to say something about that.

MR. GAVIGAN: The 10 to the minus 5 criterion that you saw for HTGR was declared by the government as what it is that we want that design to meet. We managed the LMR designs differently. Each of those designers comes up with his own criterion for investment protection. Each of them has a requirement somewhat like that, but they are slightly different, and I don't remember the exact numbers now.

MR. SIESS: Well, I thought that was encouraging because ---

MR. KING: That would say you are not going to have a core melt.

MR. SIESS: Yes. Well, if I owned a plant, I wouldn't want to have a core melt.

MR. MARK: I wonder is the core melt the same disaster in an HTGR that it is in a light-water reactor? It is harder to do it of course.

MR. KING: Yes, but if you get the temperatures that melt the core in the HTGR, you have got big troubles.

MR. SIESS: You haven't got much else in there.

MR. KING: You would have to get very high temperatures.

MR. SIESS: Well, severe core damage I guess is a

better term than core melt, anything that is going to cost you a billion dollars to recover from.

MR. KING: Yes.

MR. SIESS: And you wouldn't have to recover from it. You would just lose your plant investment. Yo could probably fill it up with concrete and walk away from it.

MR. KING: Yes.

MR. MARK: And that is what they have applied the 10 to the minus to in the HTGR specs.

MR. KING: Yes.

MR. MARK: So that would include core melts. You can't have core melts 10 times and still keep your investment or even once.

MR. SIESS: This is something that is going to have to be discussed by the ACRS to be sure we know what we meant.

MR. KING: But at the current time the staff did not see any guidance from the Commission that said advanced plants must be more safe than ---

MR. MARK: I can't find the thing in the policy statement just immediately where it says how safe they need to be.

MR. SIESS: The safety goal.

MR. MARK: It is in the policy statement somewhere.

MR. KING: Yes. I will find it for you.

MR. MARK: Does it say at least as safe?

MR. KING: It uses those words that are on the viewgraph.

MR. MARK: Well, in the viewgraph it doesn't say at least.

MR. SIESS: The same degree of protection to the public. That is at least as safe.

MR. KING: It is on page 4, right under the paragraph that entitled "Commission Policy."

MR. SIESS: Actually it doesn't say at least. It says the same. It doesn't say better would be acceptable, but I am sure that is not the intent.

MR. KING: Require the same degree of protection.

MR. SIESS: But you would accept more?

MR. KING: We would accept more. We would encourage more.

MR. SIESS: Those words are not what you mean. They must be the same.

MR. KING: If it has more, we are not going to tell them to take some out. That is true.

MR. MARK: Well, they are going to require the same degree. That really should say they should be at least as safe.

MR. KING: I agree. We should have put that

"least" in there.

MR. SIESS: Yes.

MR. MARK: Which is not requiring that it be more.

MR. KING: Right.

The last item was a change we made that states that the licensing guidance that we are going to develop for advanced plants will build upon the criteria and regulations developed for LWR's.

MR. SIESS: As applicable.

MR. KING: As applicable, that is correct.

MR. SIESS: And Fort St. Vrain can tell you what that means.

(Laughter.)

I am sure Pete is well aware of the problems.

MR. KING: Well, it is no different than what we did on Clinch River. We retain what we felt made sense to retain and we developed new ones where necessary.

MR. SIESS: The record is not quite as good on applying light-water reactor criteria to Fort St. Vrain.

MR. KING: I will ask Pete about that.

MR. SIESS: They have been trying to answer questions about light-water reactors for years now and are having trouble. They just tried to respond to the steam generator questions and had some difficulty.

MR. KING: They are tied up now in equipment

qualification problems.

MR. SIESS: Yes, I know.

(Slide.)

MR. KING: All right, let's talk about the public comments. Twenty sets of comments were received. Seven represented utilities, six from vendors, two from national labs and five others.

The main points raised in the public comments were, one, they would like to see a reduction in the prescriptive nature of the NRC regulations.

They want to just encourage greater inherent safety or safety margin than provided in LWR's, but not require it.

They would like to see GDC's developed for advanced reactors, and some people would like to see those less prescriptive and there were some comments on whether they should be a generic set or some felt a specific set for each reactor concept was the way to go.

They made the point that NRC should not favor any design or design feature or design approach over another.

And that the NRC should not require a prototype demonstration plant.

MR. SIESS: In that second bullet, inherent safety and safety margin are not the same thing and it wasn't intended to be.

MR. KING: They weren't intended to be the same thing, no.

MR. SIESS: Most of the GDC's are not too descriptive. There are a few that are.

MR. KING: There are a few that are.

MR. SIESS: And I assume our experience with those would be taken into account. You are going through the process now of revising GDC-4 because it got to be a little too prescriptive by interpretation I think.

MR. KING: Yes. The GDC itself is fairly general and could apply to any plant.

MR. SIESS: But 55, 56 and 57 on isolation valves was an example of quite prescriptive ones that turned out not to be too good.

MR. KING: Yes.

MR. SIESS: But they did have an escape clause in them.

MR. KING: As necessary or ---

MR. SIESS: Other demonstrated basis or something. There has been a feel I think in the GDC's of non-prescriptiveness.

MR. KING:

MR. SIESS: And I think there was a pretty strong attempt.

MR. KING: But there are GDC's like, for example,

the GDC's require a containment building, and now we have a design that doesn't want to have a containment building, and that is an area where we would have to look at for change.

MR. SIESS: What I guess bothers me more about the GDC's than anything else is the number of them, which tends to be prescriptive in itself. If you had real top-level criteria, you wouldn't need 57 or whatever it is.

MR. KING: Possibly.

(Slide.)

Next I wanted to talk about ---

MR. SIESS: Wait a minute. One more thing on the GDC's. Was the comment of generic versus specific that idea that you would have GDC's that would apply to any advanced reactor and not separate ones for, say, gas-cooled and liquid metal cooled?

MR. KING: No, I didn't ---

MR. SIESS: Is that what they meant by generic versus specific?

MR. KING: Most of the comments were generic for a reactor type, for an HTGR of a generic set, an LMR generic set.

MR. SIESS: Fine.

MR. KING: The next few viewgraphs were to describe what the staff position was on the public

comments, the five main public comments that we received, the first one being they would like to reduce the prescriptive nature of the NRC regulations.

There certainly are prescriptive regulations and criteria. However, we feel that under the current system there still remains a lot of flexibility for accommodating different designs and giving credit for features where credit is due. I think Clinch River was a good example of that.

MR. SIESS: Are you thinking as far down as regulatory guides when you say that?

MR. KING: Yes.

MR. SIESS: You know, reg. guides started out being simply a codification of a staff position that had been developed over a period of time through multiple reviews and give and take with licensees or applicants, and that of course would have little application to this because we don't expect to have 20 years of licensing these things.

Later on of course reg. guides became something else. They became an expansion, amplification and "clarification" of regulations or GDC's, which then brought in that prescriptive aspect.

MR. KING: They all have that disclaimer in the front that says this isn't the only acceptable way to solve

the problem. This just happens to be the one the staff wrote down and decided was okay.

MR. SIESS: That is a cop-out.

MR. KING: Well, in one sense it is.

MR. SIESS: That is a loophole, but only if you have plenty of time to get the thing licensed.

MR. MARK: Not all applicants thinks the staff reads that part.

MR. SIESS: Well, sometimes it becomes how much time do you want to spend on it.

MR. KING: I think part of our job is to make sure the staff does read that part. I think part of our job is to recognize and help the rest of the staff realize that we are dealing with a different animal here, and not just hand them a report and say give me your comments, but to make sure they understand what this plant is and what the unique features of these plants are.

MR. SIESS: Well, if there are 14 people reviewing the same aspect of 14 different plants, you need that kind of stuff to get some consistency in the picture. But if you have got people reviewing one HTGR standard design and one LMR standard design, I am not sure you need that codification position. You simply reach it and express it in your SER or your license.

So I am just wondering have you serious concern

about the existing reg. guides being applicable to an advanced reactor even if the GDC was the same.

MR. KING: I agree.

MR. SIESS: Okay.

MR. KING: The GDC could apply, but the reg. guide may may.

MR. SIESS: I would not envision a new set of reg. guides coming out for advanced reactors, and I wouldn't consider many of the old ones being applicable in reactor specific areas. They might in siting the meteorology ---

MR. KING: Our intent is not to ---

MR. SIESS: I am thing of something I am going to be looking at next month.

MR. KING: --- not to write new reg. guides or new regs, whatever, for advanced reactors. We feel at this point it doesn't warrant that kind of resources.

MR. SIESS: You see that automatically reduces the level of prescriptiveness.

MR. KING: True. Like I said, we felt those portions of existing criteria and regulations which apply to the designs will be retained, and by the very nature that you would retain those, they are going to tend to be the non-prescriptive ones anyway. So we are going to end up with a set that we retain and they are going to tend toward the non-prescriptive nature.

And we are going to have to develop new criteria to address the unique features of these plants. The intent is to develop these criteria, one, for the design in question, the conceptual design in question and, two, in the GDC area for both HTGR and LMR we are going to look at the generic question of what should be the GDC's for HTGR modular HTGR and what should they be for modular LMR.

MR. SIESS: What is the opposite of prescriptive?

MR. KING: Non-prescriptive.

MR. SIESS: Okay. Well, some people say performance criteria are the opposite of prescriptive criteria, and I was pleased to see you see non-prescriptive, because that is not the same thing.

MR. KING: No. Reliability goals could be.

MR. SIESS: That is, if you say non-prescriptive criteria, then you will make some kind of, and I won't say ad hoc, but de novo review to decide whether the criteria have been met. Performance criteria say that a certain performance standard has to be met, and then you have to say how do you determine whether it is met.

MR. KING: That is right.

MR. SIESS: And that requires another body of rules somewhere to determine how performance will be met.

MR. KING: Yes.

MR. SIESS: So you don't necessarily mean

performance criteria when you say less prescriptive.

MR. KING: Not necessarily, no.

MR. SIESS: I am pleased at that because performance criteria has been tossed around a lot without people realizing just what performance criteria involve in showing that performance criteria have been met.

MR. KING: At this point we haven't really settled in on what we mean by non-prescriptive. We are hoping the designers -- in fact, they do have ideas as to what they would like to see as the criteria, and we would want to look at those, and eventually we are going to have to make a judgment. The idea will be to hopefully state the safety function and what you are trying to do, but not describe how you have got to do it.

MR. MARK: Chet, if you were taking on the job of writing a new set of general design criteria, would you not expect that the same statements that you might set up for the HTGR would cover the LMR?

MR. SIESS: I would have to look at all of the criteria. I am sure there are some that are pretty specific to LWR's that would be pretty specific ---

MR. MARK: That got in there.

MR. SIESS: Yes.

MR. MARK: But if you had an ideal set of general design criteria, why should they not apply to reactors

entirely across the board?

MR. SIESS: I think it is theoretically possible. I mean you could start with a safety goal and say that is your criteria. Now if you meet it, you get a license, but now you have to go, how do you meet it, and now you start getting more and more specific.

Prescriptive says if you do it the way I say, it will be assumed that you meet the criteria, and you have decided what it takes to meet it.

With performance criteria you have got to tell somebody not how to do it, but how to prove that they have met the performance criteria, and that frequently is more difficult. And with your prescriptive criteria, you don't have to prove you have met it. You do that by fiat.

MR. KING: Inspection.

MR. SIESS: Yes. So there is not all that much great advantage to performance criteria. I have dealt with the problem in regulating the safety of buildings and you come out with the same results either way. The British building code has one paragraph as the law on building safety, and it says buildings shall not fail under the loads to which they are subjected. It is a little more than that, but it is not much more. But then they write a 70-page code that says if you design the building this way, it will be deemed to satisfy the performance criteria, and

that is what people do.

In this country we simply write the code and say design it this way. And if you can see much difference in how things get designed, I can't. They look alike. So, you know, it is not that simple. It just gives more room for argument, and that is what you can afford to do with standard plants, is have more time to argue. So you can be more performance and less prescriptive and work it out once and for all on the standard plant.

MR. KING: And hopefully starting early will give us more time to look at this and come up with something before the designer gets too far down the road.

MR. SIESS: And it permits the innovation and it permits somebody to come up with a better answer than you have.

MR. KING: A large part of what we are encouraging is get the feedback from the designers and what do they think makes sense to use.

(Slide.)

All right. The second major public comment was they didn't want to require greater safety than is required in light-water plants. We have written that now into the policy statement that we are not going to require greater safety. We are going to encourage it, but not require it because we couldn't really come up with a basis for

requiring greater safety.

MR. SIESS: Could you come up with a basis for saying that at the same level of safety more of it should be inherent? I mean right now it says no basis to require greater safety or greater inherent safety. Now the greater modifies safety, but could you find a basis for saying that at the level of safety we want more of that to be inherent and less to be provided by operator action or additional equipment?

MR. KING: Again, we couldn't find a basis to say it has got to be done in a more inherent fashion. What we said was we think that is a good way to go and we are going to encourage that, but we are not going to require it.

MR. SIESS: That is one of the ways you would like to see it done, but if somebody comes up with another way and it is not inherent ---

MR. KING: We are not going to throw that out. We will look at that.

MR. SIESS: Okay.

MR. KING: And again the dose guidelines question, we are not proposing changes to 10 CFR 20, 50 or 100 safety goals.

MR. SIESS: But it does say it has to be different than what we have now, but it doesn't have to be safer.

MR. KING: To be considered an advanced reactor

it has got to be different, and we are encouraging the inherent way to go, but it doesn't have to be.

MR. SIESS: Now I guess you have answered one of the questions I raised at the very early stage, the advanced light-water reactors that are being looked at are not advanced reactors.

MR. KING: We don't consider them at this time to fall in the advanced category. The plants we consider right now that are included in my branch are the two LMR's, the HTGR and PIUS.

MR. MARK: PIUS is light-water.

MR. KING: PIUS is light-water. Its different.

MR. SIESS: And the result of that decision is that those new designs are being reviewed in the old way.

MR. KING: In the old way against each of the old requirements and by a different group. My group doesn't have anything to do with those. There are probably some that are in a gray area, too, that may come in. Maybe an advanced light-water design may be not quite so evolutionary and it may be more radical and it may end up in my group in the future. But at this point the three that I mentioned are the ones that are covered by the advanced reactors group.

All right, the third comment was about developing a new set of GDC's for advanced reactors. We are going to

develop GDC's, but we are going to build upon light-water GDC's where it makes sense to do that.

We will develop principle design criteria specifically for each of the three concepts, but we are also going to look at in a generic sense GDC's for a modular HTGR and for the LMR.

MR. SIESS: Do you expect ACRS interaction on that?

MR. KING: I envision when we get to the PSID stage we will be reviewing the PDC's for each of the concepts. Whether you want to review the generic set we come up with, I think we are certainly agreeable to that. I hadn't really thought that far yet.

MR. SIESS: I think that is something we ought to think about. The ACRS wants to be involved in the development of GDC's.

MR. KING: Okay.

MR. SIESS: I believe that the ACRS was involved in the development of the current set of GDC's, and I know we were strongly involved in a proposed set of GDC's for fuel reprocessing plants some years back. So I think historically there has been some, but that doesn't necessarily mean there would be in the future, but I think that is one of the questions.

MR. KING: Okay.

MR. MARK: It seems to me in this you have spoken several times of GDC's for one reactor type and GDC's for another reactor type. But you are also going to bring in with you some of the GDC's for LWR's perhaps exactly as they are written, but not all, not the whole list.

MR. KING: True.

MR. MARK: I think it would be an interesting question for you to at least have in mind to is to what extent could the design criteria that you think of be similar for both types? I think it is imaginable that you could write a set of GDC's that would apply to each type if they are not prescriptive.

MR. KING: Are you talking about one that would cover advanced LWR, HTGR and LMR?

MR. MARK: Possibly, and in any event, you see, you are going to take something from the past and move it forward, and then in adding things it would be at least attractive that they not be any more different than they need to be.

MR. KING: I think certainly probably a large number of the criteria if we develop a set for HTGR and LMR would be the same.

MR. MARK: Yes.

MR. KING: Some will be different. Sodium fires won't show up in the HTGR criteria.

MR. MARK: Is that a general design criteria, sodium fires?

MR. KING: Accommodate of sodium fires.

MR. MARK: I know you will need somewhere to discuss sodium fires. Whether it is in that package or not, I don't know.

MR. KING: I agree there might be a large percentage of them that might end up being the same or probably will be the same. We will have to see how that ends up.

(Slide.)

The fourth comment was NRC shouldn't favor any design or design feature or design approach over another.

Our intent is we are going to encourage inherent safety, but we are not going to favor one over the other. We don't intend to write a report that compares the two LMR's top the HTGR to PIUS or to anything else.

We are going to review each design on the merits of that design and how well it meets the criteria we come up with. We are not going to get into the position of endorsing one design or one feature over another.

MR. SIESS: Let me go back to this relative safety question. In the proposed policy statement in the first paragraph there are the words "defining an advanced reactor."

MR. KING: Yes.

MR. SIESS: First it says "significantly different, and to varying degrees provide more margin prior to exceeding safety limits and make more use of simplified inherent or passive means to reliably accomplish their safety functions."

Now if you want more margin, is that different from wanting safer reactors?

MR. KING: No. I think the intent is with this policy statement to push for safer reactors and encourage safer reactors.

MR. SIESS: So the policy statement does say in the definition of an advanced reactor that it is one that is safer and more about safety is provided by inherent or passive means.

MR. KING: Currently when we look at putting plants into the advanced category we look at do they accomplish their safety functions using there inherent or safer means. We fully expect that those are going to lead to safer plants.

MR. SIESS: Now this doesn't say that advanced reactors have to be safer, but it says -- I am sorry. It doesn't say that future reactors should be safer, but it says that to be considered an advanced reactor it should be safer. Is that a correct reading now?

MR. KING: Let me read the words here.

MR. SIESS: Did you find them?

MR. KING: Yes.

MR. SIESS: Those are all "and's" and not "or's".

MR. KING: We have the caveat in there to varying degrees.

MR. SIESS: Yes, I know, but ---

MR. KING: We fully expect the advanced plants will be safer. I agree this definition may tend -- you sort of have to make a judgment before you categorize it as to whether it is safer or not it sounds like.

MR. SIESS: Yes. You see, what I am getting is you said earlier in response to a comment that you could have no basis to require it.

MR. KING: That is right.

MR. SIESS: And certainly this doesn't require that they be safer in order to get a license.

MR. KING: Right.

MR. SIESS: It simply says they should be safer in order to be called an advance reactor. And, as I understand it, the definition, or the reason for defining advanced reactor is to specify those reactors which will be reviewed under the procedures that are outlined in here.

MR. KING: Yes.

MR. SIESS: Now if somebody came in with an HTGR

like Fort St. Vrain or Fulton or Summit and didn't have more margin than existing Fort St. Vrain or more inherent than Fort St. Vrain, and I am not comparing it with light water reactors now, that would not be considered an advanced reactor, which you said earlier.

MR. KING: Right.

MR. SIESS: And it could be licensed presumably.

MR. KING: It could be licensed presumably.

MR. SIESS: I sound like a lawyer, but something is bothering me here. Sounding like a lawyer bothers me enough, but ---

(Laughter.)

MR. KING: There may be some room for improvement on these words. I can see your problem.

MR. SIESS: Well, actually the problem, and I don't know whether you are going to solve it or not, but I am trying to decide what we are going to take to the full committee and whether we are going to tell the full committee that the Commission policy says advanced reactors don't have to be any safer than existing ones, or whether it says they do have to be safer, which I think will be sort of a major issue with the full committee.

MR. KING: I think later on it clearly says they don't have to be any safer.

MR. SIESS: Now could you find those words?

MR. KING: Yes. Those are on page in my copy, page 4, under the paragraph titled "Commission Policy."

MR. SIESS: Okay. And of course those are not inconsistent because this is what the Commission intends to require.

MR. KING: Right.

MR. SIESS: And the other only related to whether they were advanced reactors.

MR. KING: Yes. The other related to a definition, but I guess I can see the definition may sound a little contradictory, but it wasn't intended to be.

MR. SIESS: This foreign advanced reactors are going to require the same degree -- in fact, there is says to be an advanced reactor it has to have more. So they have got to have more to get into this category, and once in the category you won't require any more.

(Laughter.)

MR. KING: The intent was to require they do things in a different way ---

MR. SIESS: Maybe I have gotten into this wrong somehow, but that is what it seems to say now, and I think you need to think about it a little bit.

MR. KING: I appreciate your comment.

MR. SIESS: I am not sure which one to put to the full committee.

MR. MARK: As we discussed earlier, the phrase "at least" may very well be in this place we are reading from.

MR. KING: Yes, I agree.

MR. SIESS: I think we would all take a great deal of comfort from the fact that the industry has come up with a pretty good level to protect its investment, and that is going to take care of a lot of our concerns about the public health and safety.

(Slide.)

MR. KING: The last item had to do with a prototype demonstration plant. The policy does not require such a plant. It does say we consider that certainly to be an acceptable way to demonstrate the features, but it is not a mandatory way.

MR. SIESS: Just how much comfort would you get out of that?

MR. KING: How much comfort do I get out of that?

MR. SIESS: Yes. You know, if somebody built one and melted it down, or built one and cut off everything and walked away from it and it survived, you know, it wasn't usable, but it survived, would you be happy? I mean this is the way LOFT started out, you know, and 15 years later and a million dollars, that is the way it ended up, and there was an awful lot that went on in between.

MR. KING: I personally think the idea of a

demonstration concept is good, but it doesn't answer all your questions. You are only testing a certain specific set of accidents under a certain specific set of decay heat or radiation influence on the components and that kind of thing. You need to be about to extrapolate your data or somehow be able to translate that into looking at the whole life cycle of the plant and does it demonstrate the plant is safe for its 40 years or 60 years.

MR. SIESS: I mean you build one and test it that way and somebody will say what if.

MR. KING: You have got to ask the what if's and look at the test program to see if that addresses the what if's.

MR. SIESS: It just sounds like a good idea until you do it.

MR. KING: I think it certainly is better than just looking at a report that says everything is going to be okay, because you do get some hard data. In fact, on Clinch River we required natural circulation tests before we would accept their analysis. We did the same thing on FFTF. And now here they are talking about a whole dedicated plant. I think it is a good idea, but by itself it doesn't answer all your questions.

All right, that was the end of my prepared presentation. Now if you wanted to ask anything.

MR. SIESS: Mr. Chairman, I think the presentation has been excellent. It has really covered the territory and I am out of questions.

MR. MARK: I have a couple of questions that came to mind on reading SECY-85-279. I will mention them if you are willing to put a little note in your copy.

I am worried on page 2 of the clean stuff.

MR. SIESS: Is that what you are looking at, the one called Attachment B?

MR. MARK: Attachment A.

MR. SIESS: Okay. I am sorry.

MR. MARK: ". . . going to keep the public informed of its judgment on the known and unknown safety aspects," and that strikes me as somewhat unclear.

MR. SIESS: What is Attachment A?

MR. MARK: Attachment A is the background I guess.

MR. SIESS: That is part of the Federal Register notice.

MR. KING: I think so.

MR. SIESS: And the policy is Attachment B, right?

MR. KING: The policy is Attachment B, yes.

MR. SIESS: That is the statement of considerations or something?

MR. MARK: Right.

MR. KING: I didn't write Attachment A.

MR. MARK: Well, whoever wrote ---

MR. KING: Is Ken here? There is Ken. Who wrote Attachment A?

MR. SIESS: Is that the policy statement or what? Legally what is it? Oh, well, I shouldn't ask it that way.

MR. HERRING: It is the introduction that goes in with the Federal Register notice, and the first short blurb that goes in front of it and then the policy statement would follow.

MR. SIESS: Does it tend to be a summary?

MR. HERRING: Yes, a very short summary and then the whole policy statement would follow that.

MR. SIESS: As far as policy it doesn't govern.

MR. HERRING: No, actually you will find that that is basically a cut and paste from what is in the policy statement anyway.

MR. SIESS: I didn't hear all of that.

MR. HERRING: That is a cut and paste from what is in the policy statement anyway. I mean it is not new thought.

MR. SIESS: Oh, okay, that is helpful.

MR. MARK: Well, perhaps I should be pointing at you then instead of poor Mr. King.

MR. SIESS: Well, if it is cut and paste from the policy statement, it must be in the policy statement

somewhere.

MR. MARK: I think it appears somewhere else, too. But I am really troubled. The judgment on unknown safety aspects, how are you going to develop it?

MR. SIESS: Where are those words?

MR. HERRING: Basically the way I read the policy statement, what that is referring to is there are certain things you are going to know about and you are going to dismiss as it goes along. And then there are certain unknown things that you know about them, but you don't know their behavior exactly. So you would just let the public know what are the unknowns that you still require further information on and that you are trying to sort out.

I mean I never read that the way I think you are reading it, if you don't know it, how can you say anything about it.

MR. MARK: I think it can be read that way and it shouldn't probably appear that way. And if you want to say informed of its judgment on all known safety aspects, you have covered the field as much as you possibly can.

I had another thing. I guess Attachment A is just the first two pages. Is it? No.

Oh, in the previous experience, which is page 3 now of still Attachment A -- I am not sure if I have got it on page 3, but somewhere in that section there is a

reference to the fast flux test facility as part of -- oh, yes, it is on page 3 in the middle paragraph, third line. Reviewed but not licensed.

MR. KING: Right.

MR. MARK: I understand that, but I think it would do with a slight explanation, however. it wasn't that it wasn't licensable. It was a DOE reactor which didn't require a license or an NRC ---

MR. KING: It could be read the wrong way that it wasn't safe enough and didn't get a license.

MR. MARK: It could be read that it couldn't get a license.

MR. KING: Okay.

MR. MARK: And that I think appears maybe again later, too.

Then just as a matter of taste, on page 7 of that same opus it sounds a little bit superfluous to say this early interaction may be in the form of meetings or written material. Why don't you just delete that sentence. It sounds kind of vacuous.

MR. KING: We could. I just wanted to give a little definition.

MR. MARK: You could add of course it might be on the phone.

(Laughter.)

MR. KING: No, I was just trying to put a little definition in of what interaction meant. It could be deleted and not affect the policy statement.

MR. SIESS: It hardly seems worthwhile elevating that to Commission policy.

MR. KING: All right. I can't argue with that.

(Laughter.)

MR. MARK: I think -- oh, yes, the not licensed comes up again in the underlined copy, which won't of course appear as it appears here.

MR. KING: The underlined is the same as the policy. It just shows how the changes were made.

MR. MARK: Yes. Well ---

MR. SIESS: I cannot find that reference to unknown safety problems in the policy statement itself.

MR. KING: I don't recall it being in there.

MR. SIESS: I think Ken invented that one.

(Laughter.)

Can somebody tell us what we can expect to see in NUREG "XXX"?

MR. KING: When you expect to see it?

MR. SIESS: What is in it and whether, for example, it is something that the ACRS should have before it comments to the Commission on the policy statement.

MR. HERRING: What we are proposing to do is to do

the same thing that was done, for example, in safety goals where all you publish in the Federal Register would be just that short blurb of the summary and policy statement, and the summary of the public comments and stuff would be contained in the NUREG as a separate document rather than publishing it along with the ---

MR. SIESS: So the NUREG will be this document, the public comments and the responses to them?

MR. HERRING: Well, it wouldn't include the whole stack of public comments in their entirety. It would be just a summary of the public comments and what the Commission thought about them and the policy statement, and then separate in the Federal Register would just simply be the policy statement.

MR. SIESS: We have that, don't we?

MR. HERRING: No. We are proposing that after the Commission decides what it wants to do with it ---

MR. SIESS: We don't have the summary.

MR. HERRING: Well, yes, you have the pieces, the basic pieces that exist, or you should have had it.

MR. SIESS: That is what I was looking for. I have got the public comments.

MR. HERRING: Okay. There was a memo dated I believe it was July 3rd or somewhere in there with the summary of public comments. That is another piece of it.

MR. KING: The SECY paper doesn't have that in there.

MR. HERRING: Right. We had already sent it to the Commission.

MR. MARK: The SECY paper has Attachment D.

MR. HERRING: Attachment D are answers to specific questions. That is another piece of it.

MR. MARK: And that won't be in the policy statement either.

MR. HERRING: Right. What we are proposing is that not be included. In the Federal Register notice will just simply be the policy statement and the background will be contained in the NUREG.

MR. SIESS: I don't think we need it.

MR. MARK: Well, I guess our meeting is over, isn't it, except we may want to chat for a minute with Mr. King.

MR. SIESS: I guess we need to decide what we want to do with the full committee.

MR. MARK: Yes.

The meeting is adjourned.

(Whereupon, at 11:58 a.m., the subcommittee meeting adjourned.)

* * * * * *

CERTIFICATE OF OFFICIAL REPORTER

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of: ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Name of Proceeding: Advanced Reactors Subcommittee

Docket No.:

Place: Washington, D. C.

Date: Wednesday, September 25, 1985

were held as herein appears and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission.

(Signature) Mary C Simons

(Typed Name of Reporter) Mary C. Simons

Ann Riley & Associates, Ltd.

NRR STAFF PRESENTATION TO THE
ACRS

SUBJECT: STATUS OF ADVANCED REACTOR ACTIVITIES

DATE: SEPTEMBER 25, 1985

PRESENTER: T. L. KING

PRESENTER'S TITLE/BRANCH/DIV: CHIEF, ADVANCED REACTORS GROUP, DST

PRESENTER'S NRC TEL. NO.: 301-492-7347

SUBCOMMITTEE: ADVANCED REACTORS

NRR ADVANCED REACTOR ACTIVITIES SINCE FEBRUARY 1985

MAJOR MILESTONES

3/26/85 - COMMISSION ISSUED THE PROPOSED POLICY STATEMENT ON THE REGULATION OF ADVANCED REACTOR FOR PUBLIC COMMENT.

4/26/85 - DOE FORMALLY TRANSMITTED TO NRC A PLAN AND SCHEDULE FOR REVIEW OF AN HTGR.

7/1/85 - DOE FORMALLY TRANSMITTED TO NRC A PLAN AND SCHEDULE FOR REVIEW OF TWO LMRs.

7/11/85 - NRC COMMITTED DOE'S PLAN FOR THE HTGR REVIEW.

8/16/85 - TRANSMITTAL OF HTGR TOP LEVEL REGULATORY CRITERIA FOR NRC APPROVAL.

9/13/85 - NRC COMMITTED TO DOE'S PLAN FOR THE LMR REVIEWS.

MAJOR TECHNICAL INTERACTIONS ACCOMPLISHED (2/85 - 9/85)

HTGRs - 5/31/85 - BRIEFING ON CONCEPT SELECTION STATUS AND METHOD FOR SELECTING DESIGN BASIS ACCIDENTS

- 7/31-8/1/85 - BRIEFING ON CONCEPT SELECTION METHODOLOGY (TOP DOWN APPROACH) AND CONCEPT SELECTION STATUS

LMRs - 8/8/85 - BRIEFING ON LMR STATION BLACKOUT CRITERIA

- 8/29/85 - BRIEFING ON SAFR TORNADO DESIGN BASIS

HAVE ALSO HAD DISCUSSIONS ON THE IDENTIFICATION OF KEY ISSUES, THE PSID OUTLINE AND FUTURE PLANS AND SCHEDULES.

HTGR TOP LEVEL CRITERIA

REPRESENT CRITERIA FROM THE EXISTING BODY OF NRC RULES, REGULATIONS, CRITERIA AND GUIDELINES WHICH DEFINE A STANDARD FOR PROTECTION OF THE PUBLIC. ALL OTHER RULES, REGULATIONS, CRITERIA AND GUIDELINES THEN HELP ENSURE THE TOP LEVEL CRITERIA ARE MET.

- 10 CFR 20 - PERMISSIBLE LEVELS OF RADIATION IN UNRESTRICTED AREAS.
- 10 CFR 50, APPENDIX I - ALARA.
- 10 CFR 100 - SITE BOUNDARY DOSES FOR UNRESTRICTED AREAS.
- EPA-520/1-75-001 - PROTECTIVE ACTION GUIDELINES.
- NUREG-0880 - SAFETY GOALS.

HTGR TOP DOWN APPROACH

START WITH TOP LEVEL PLANT GOALS AND USE THEM TO GUIDE SELECTION OF BEST CONCEPT. FOR EXAMPLE:

- 80% AVAILABILITY
- 10% COST ADVANTAGE OVER COAL
- $< 10^{-5}$ PER YEAR CHANCE OF LOSS OF PLANT
- MEET 10 CFR 20, 50, 100
- MAINTAIN OFFSITE RELEASES LESS THAN PROTECTIVE ACTION GUIDELINES
- ENVELOP 80% OF U.S. SITES

HTGR METHOD FOR SELECTING DESIGNS BASIS ACCIDENTS

THE METHOD USES A PROBABILISTIC APPROACH WHICH:

- INCLUDES ALL ACCIDENTS WITH AN ESTIMATED FREQUENCY OF "X" PER YEAR OR GREATER IN THE DESIGN BASIS.

- UNCERTAINTIES ARE INCLUDED IN THE ESTIMATIONS.

LMR STATION BLACKOUT CRITERIA

(PRESENTED IN A BRIEFING TO NRC ON AUGUST 8, 1985.)

UPON LOSS OF AC POWER:

- o AUTOMATIC SHUTDOWN AND MAINTENANCE OF SUBCRITICALITY.
- o AUTOMATIC INITIATION AND MAINTENANCE OF CORE AND STRUCTURAL COOLING.
- o MAINTAIN COOLABLE CONFIGURATION OF STORED FUEL OR FUEL BEING HANDLED.
- o CONTROL ROOM REMAINS HABITABLE.
- o MAINTAIN STABLE, SAFE CONDITIONS FOR AT LEAST 8 HOURS.

SAFR TORNADO DESIGN BASIS

SAFR DESIGNERS ARE EXPLORING THE ACCEPTABILITY OF APPLYING LESS SEVERE TORNADO REQUIREMENTS THAN THOSE APPLIED TO LWRs.

STATUS OF DOE HTGR AND LMR CONCEPTS

<u>ADVANCED REACTORS CURRENTLY UNDER CONSIDERATION BY NRC</u>

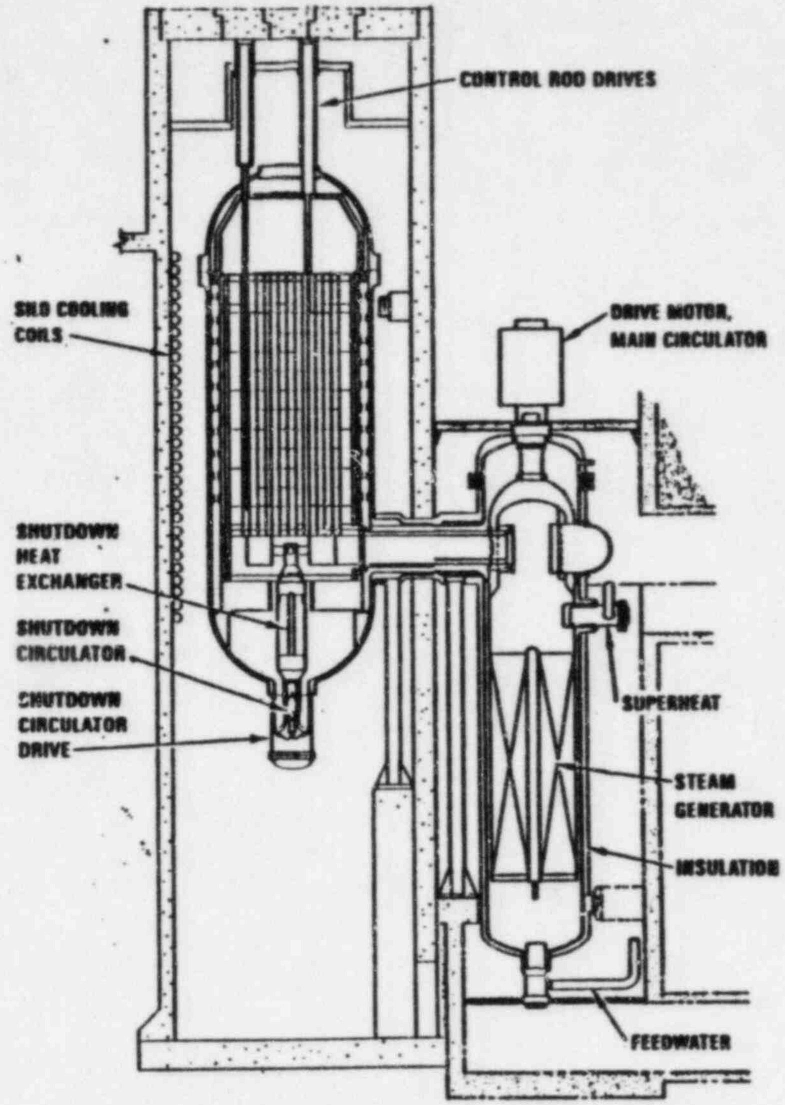
- ONE HTGR CONCEPT:
  - 350 MWT MODULAR DESIGN
- TWO LIQUID METAL REACTORS:
  - POWER REACTOR INHERENT SAFETY MODULE (PRISM), 425 MWT MODULAR DESIGN
  - SODIUM ADVANCED FAST REACTOR (SAFR), 900 MWT MODULAR DESIGN

HTGR CONCEPT

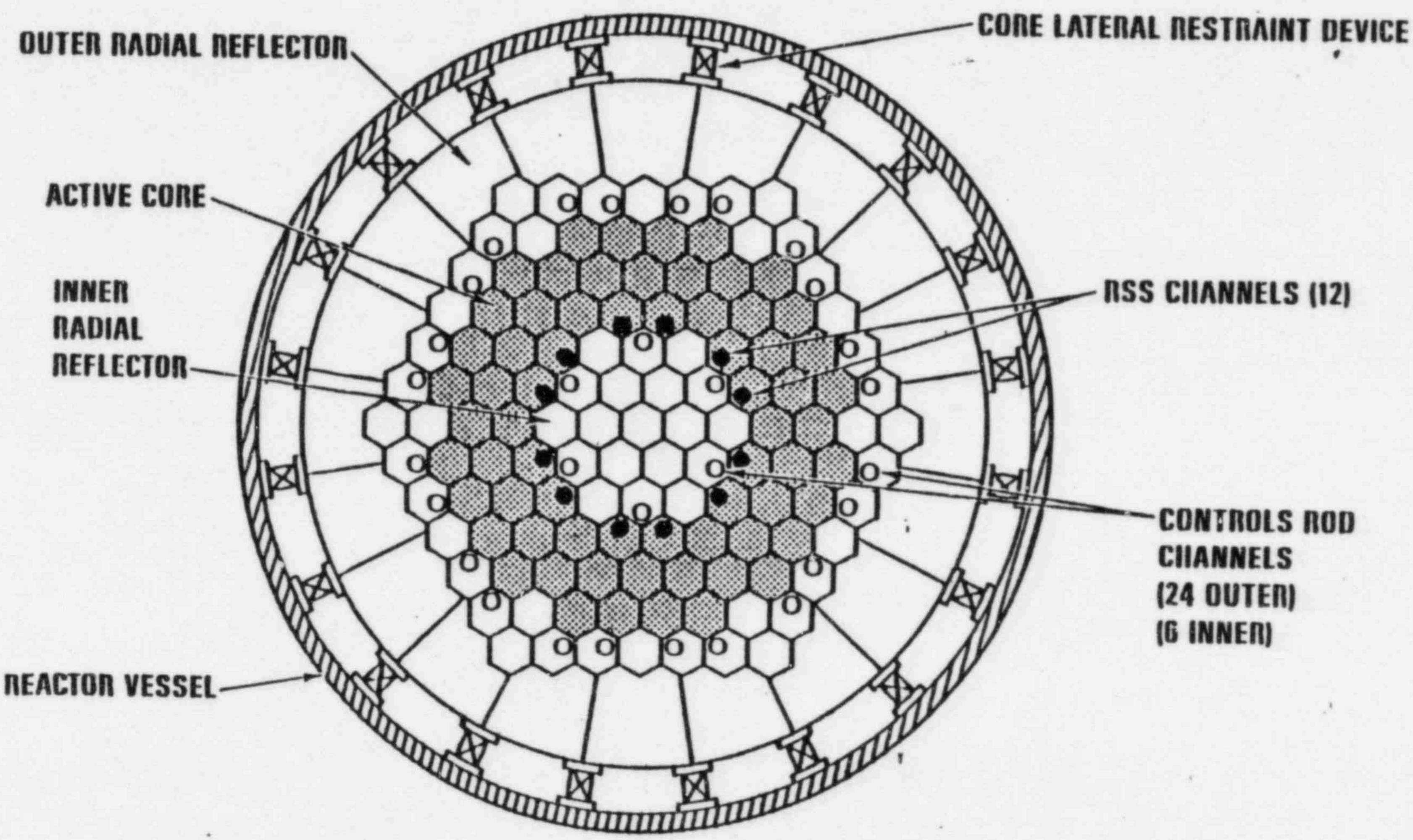
- DESIGNERS - GA TECHNOLOGIES/S&W/BECHTEL/CE/GE.
- 350 MWT (140 MWE), MODULAR DESIGN, WITH REACTOR VESSEL AND STEAM GENERATOR LOCATED BELOW GRADE.
- STEEL REACTOR VESSEL.
- EXTERNAL STEAM GENERATOR.
- ANNULAR CORE DESIGN WITH PRISMATIC FUEL BLOCKS SIMILAR TO FSV.
- ONE LOOP PER MODULE.
- ONE TURBINE-GENERATOR PER 3-4 MODULES.
- CONFINEMENT BUILDING ONLY (NO CONTAINMENT).
- PASSIVE DECAY HEAT REMOVAL SYSTEM.
- NON-SAFETY GRADE BOP.
- 40 YEAR MODULE LIFETIME.

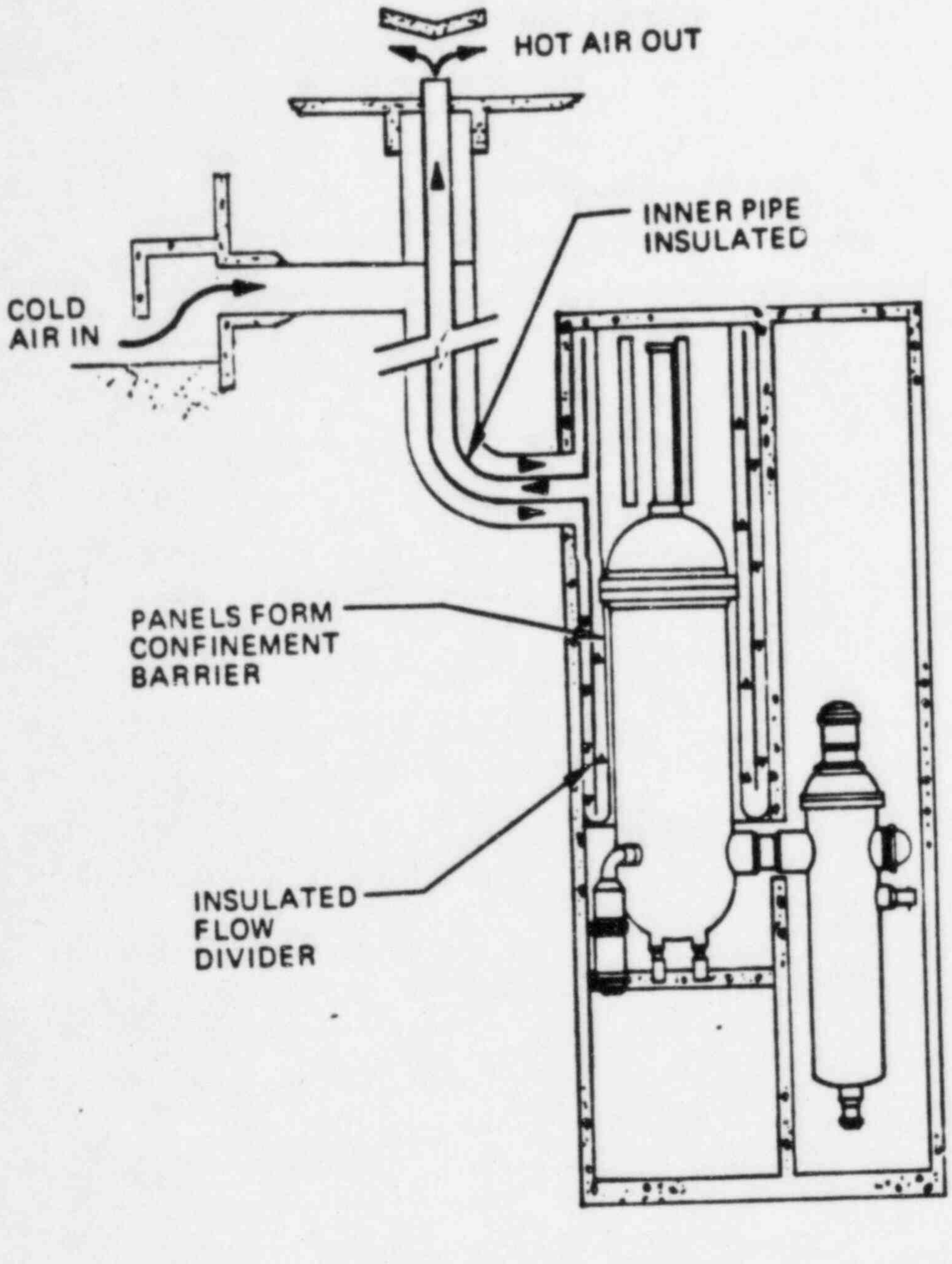
350 MW(t) MODULAR HTGR

SIDE-BY-SIDE PRISMATIC FUEL



350MW(t) PRISMATIC ANNULAR CORE FUEL BLOCK AND CONTROL ROD LAYOUT





FEATURES:

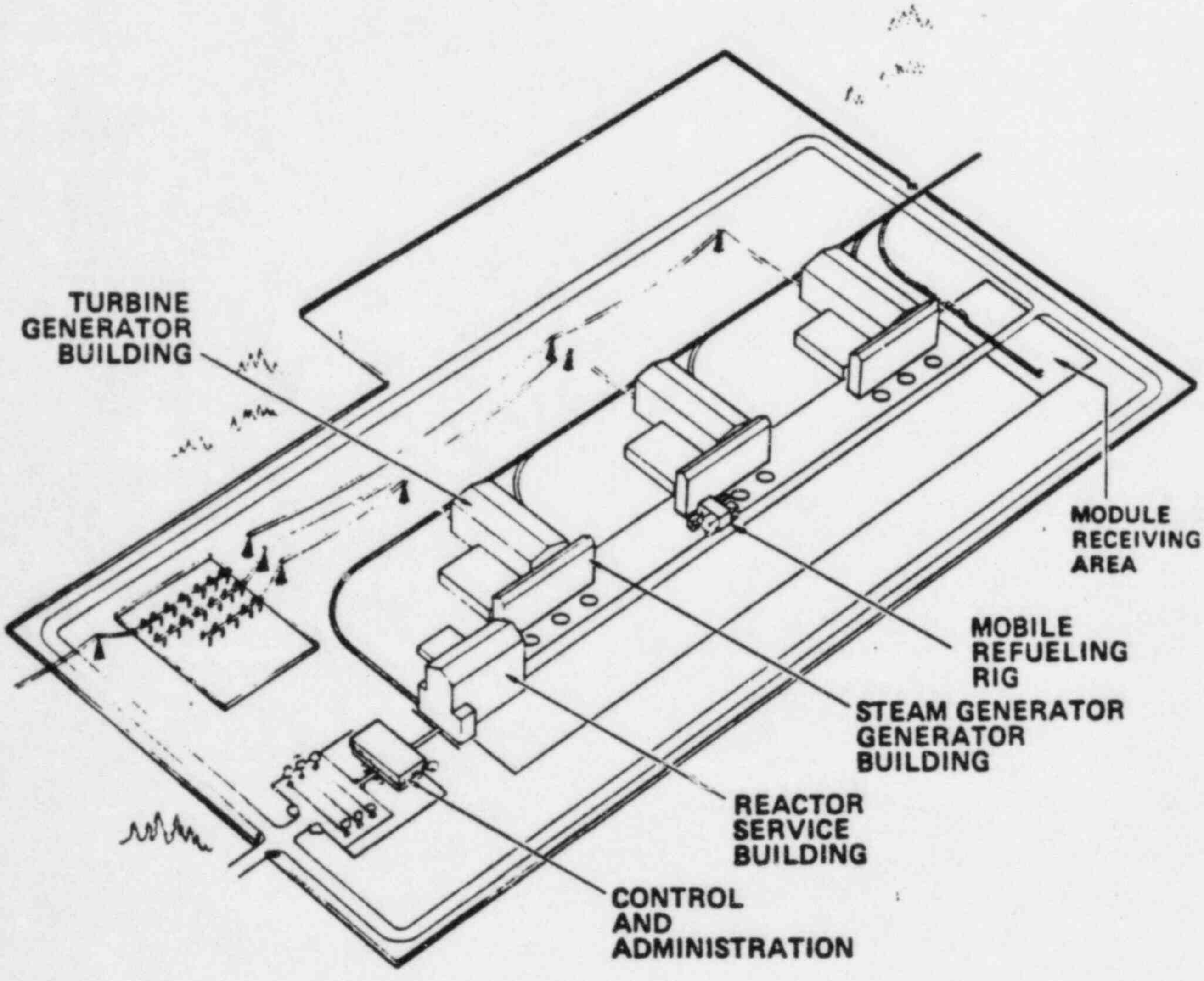
1. COOLS THROUGH CONFINEMENT BARRIER
2. OPERATES UNDER ALL MODES OF REACTOR OPERATION
3. SIMPLE TO OPERATE, VIRTUALLY MAINTENANCE FREE

AIR-COOLED REACTOR CAVITY COOLING SYSTEM

PRISM CONCEPT

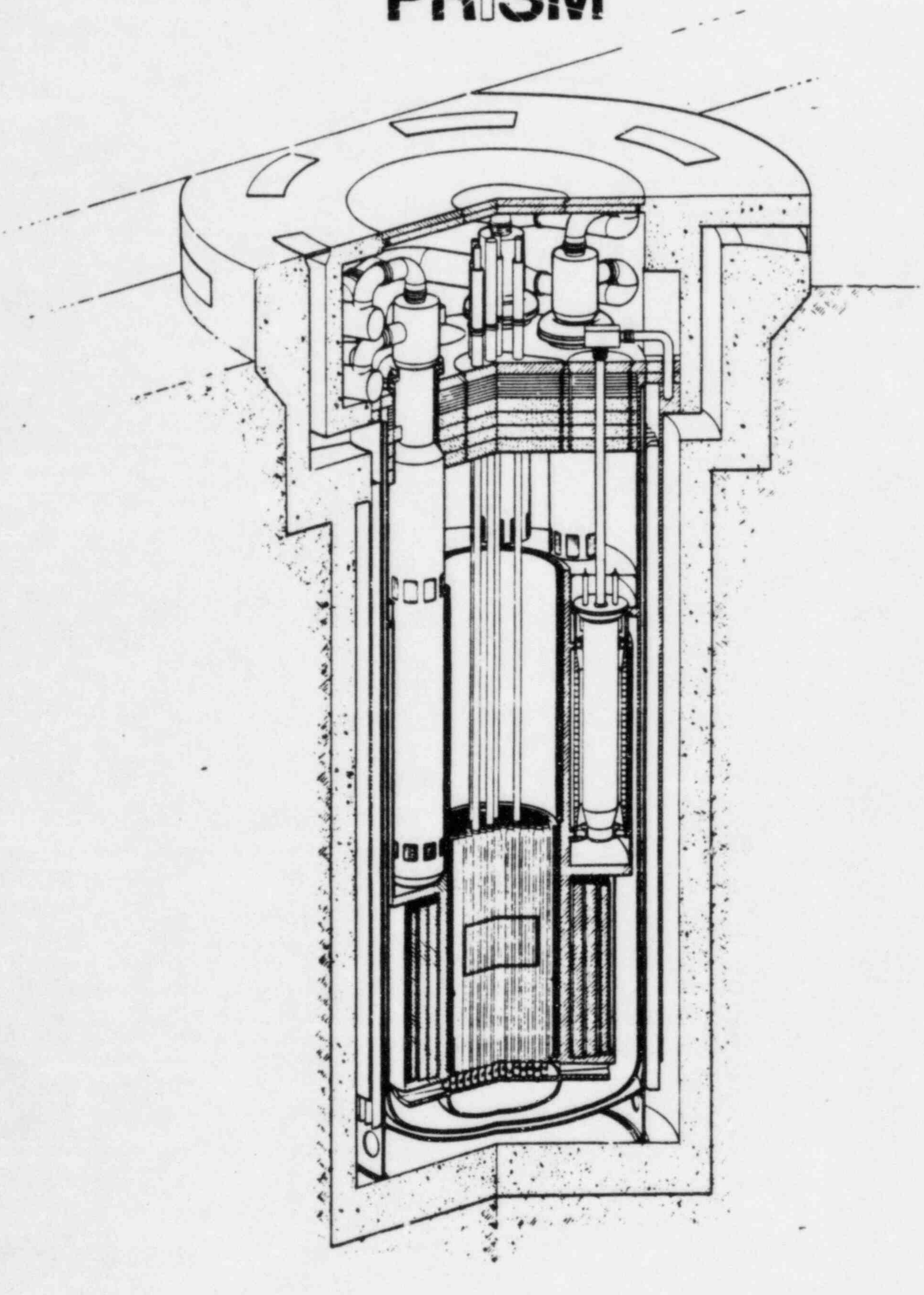
- DESIGNERS - GE/BECHTEL/UNITED ENGINEERS/BYRON-JACKSON /FOSTER-WHEELER
- 425 MWT (133 MWE), MODULAR DESIGN, POOL TYPE LMR WITH REACTOR VESSEL LOCATED BLOW GRADE.
- HOMOGENEOUS CORE DESIGN WITH OXIDE FUEL VS. METAL FUEL SITLL UNDER CONSIDERATION.
- ONE LOOP PER MODULE.
- ONE TURBINE-GENERATOR PER 3 MODULES.
- REACTOR GUARD VESSEL USED AS CONTAINMENT BOUNDARY.
- PASSIVE DECAY HEAT REMOVAL AND SHUTDOWN SYSTEMS.
- NON-SAFETY GRADE BOP.
- 40 YEAR MODULE LIFE.
- UTILIZES IDEA OF SAFETY DEMONSTRATION TEST TO FACILITATE LICENSING/PRIVATE SECTOR ACCEPTANCE.

COMMERCIAL PRISM PLANT



PRISM POWER PLANT	
REACTORS	9
POWER	1205 MWe

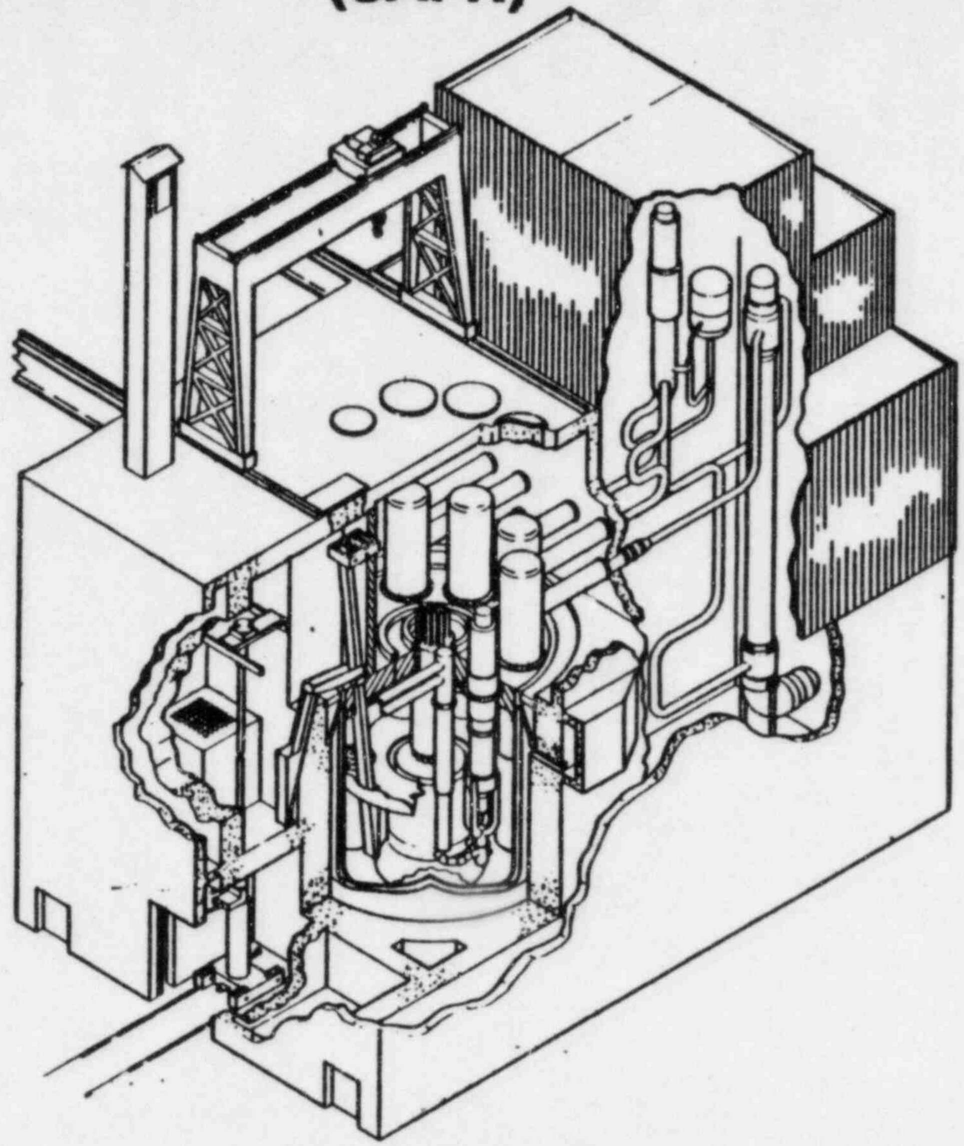
PRISM



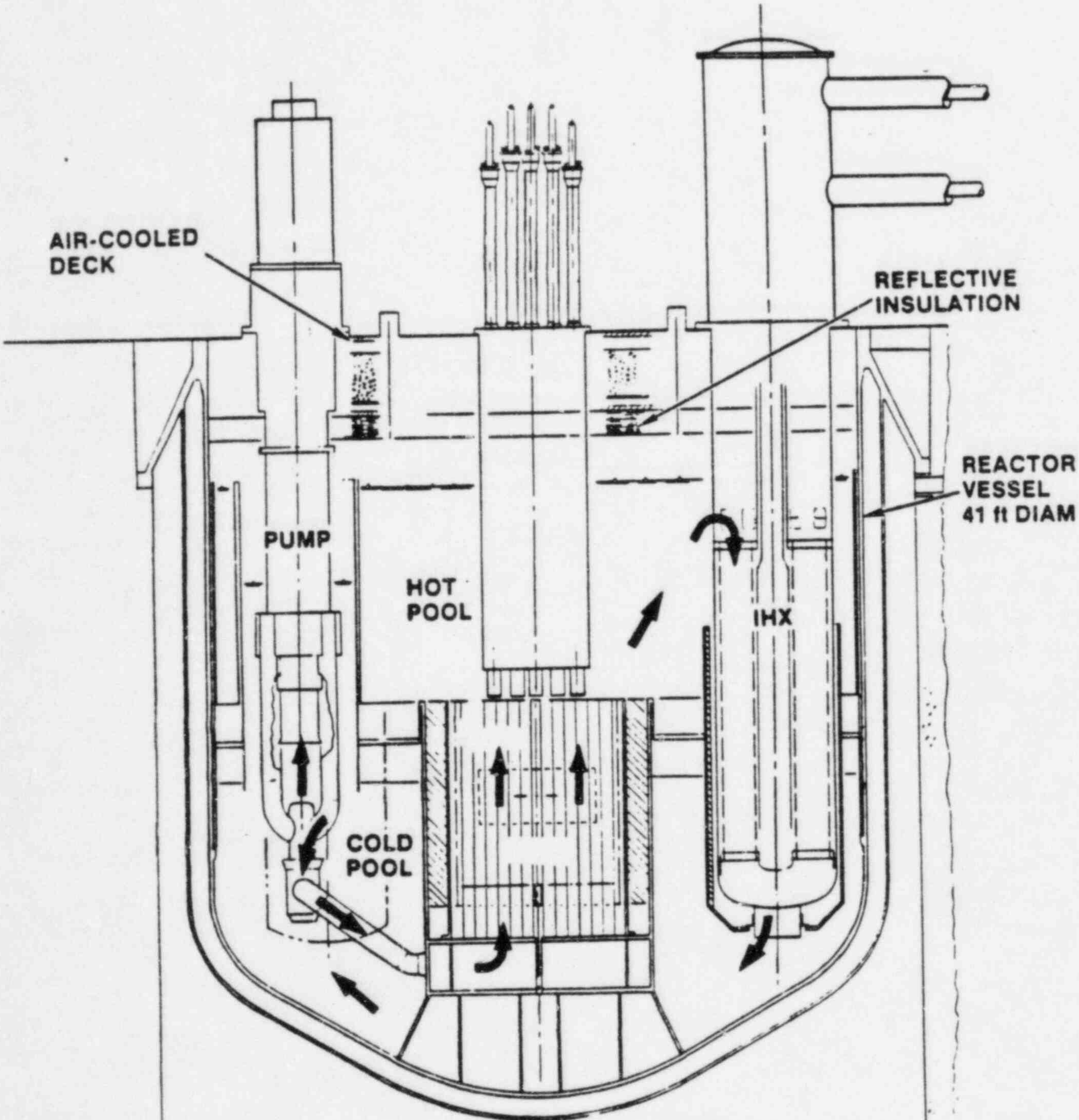
SAFR CONCEPT

- o DESIGNERS - ROCKWELL INTERNATIONAL/BECHTEL/CE.
- o 900 MWT (350 MWE), MODULAR DESIGN, POOL TYPE LMR WITH REACIOR VESSEL AND STEAM GENERATORS ABOVE GRADE.
- o HOMOGENEOUS CORE DESIGN WITH METAL FUEL AS REFERENCE WITH CAPABILITY RETAINED TO ALSO USE OXIDE FUEL.
- o TWO LOOPS PER MODULE.
- o ONE TURBINE-GENERATOR PER MODULE.
- o REACTOR GUARD VESSEL USED AS CONTAINMENT BOUNDARY.
- o PASSIVE DECAY HEAT REMOVAL AND SHUTDOWN SYSTEMS.
- o NON-SAFETY GRADE BOP.
- o 60 YEAR MODULE LIFETIME.

SODIUM ADVANCED FAST REACTOR
(SAFR)



POOL CONFIGURATION



FUTURE PLANS/SCHEDULES

OVERALL DOE PLAN

- o HAVE NRC CONDUCT OVER THE NEXT 2-3 YEARS A REVIEW OF THE HTGR AND LMR CONCEPTUAL DESIGNS:
  - PSID
  - SER AND LICENSABILITY LETTER
- o 1989 THRU LATE 1990s PURSUE STANDARD DESIGN APPROVAL AND CERTIFICATION OF THE DESIGN THROUGH RULEMAKING.

NEAR TERM PLANS

HTGR

- 10/8/85 - MEETING ON DESIGN STATUS AND SELECTION OF DESIGN BASIS EVENTS.

LMRs

- 9/26/85 - MEETING ON DECAY HEAT REMOVAL REQUIREMENTS.
- 10/11/85 - MEETING ON SAFR CRANE DESIGN.
- 11/20/85 - MEETING ON SAFR SAFEGUARDS & SECURITY PLUS SAFETY TEST PLAN.

IT IS EXPECTED THAT FORMAL SUBMITTALS ON VARIOUS HTGR AND LMR DESIGN ISSUES WILL BE RECEIVED IN THE NEAR FUTURE.

SUMMARY OF REVIEW PLAN FOR HTGR CONCEPTUAL DESIGN

ITEM		SCHEDULED SUBMITTAL	STAFF REVIEW COMPLETE
o	TOP LEVEL CRITERIA	8/85	10/85
o	BRIDGING METHODS	10/85	12/85
o	LOWER LEVEL CRITERIA, INCLUDING GDCs	10/85	12/85
o	INTERACT ON KEY ISSUES:		
	- CRITERIA FOR ACCIDENT SELECTION/EVALUATION (INCLUDING SEVERE ACCIDENTS)	10/85	2 MONTHS AFTER SUBMITTAL
	- MULTIPLE MODULE CONTROL	FY 86	"
	- DECAY HEAT REMOVAL	"	"
	- CONTAINMENT/CONFINEMENT	"	"
	- REACTOR SHUTDOWN	"	"
	- FUEL	"	"
	- ISI	"	"
	- WATER/AIR INGRESS	"	"
	- CORE SUPPORT STRUCTURE	"	"
	- ISSUES RELATED TO STANDARD PLANT APPROVAL	"	"
o	REVIEW R&D PROGRAM	9/86	6/87
o	FINAL PSID	9/86	6/87
o	FINAL PRA	9/86	6/87

SUMMARY OF LONG TERM HTGR LICENSING PLAN

o SUBMIT PSSAR	-	1989
o PDA REQUESTED	-	1991
o SUBMIT FSSAR	-	1993
o FDA REQUESTED	-	1995
o DESIGN APPROVAL REQUESTED VIA RULEMAKING	-	1998

SUMMARY OF REVIEW PLAN FOR LMR CONCEPTUAL DESIGNS

ITEM		SCHEDULED SUBMITTAL	STAFF REVIEW COMPLETE
o	INTERACT ON KEY ISSUES:		
	- STATION BLACKOUT	FY 86	2 MONTHS AFTER SUBMITTAL
	- DECAY HEAT REMOVAL (SHRS)	"	"
	- NA LEAK ACCOMMODATION	"	"
	- CONTAINMENT/CONFINEMENT	"	"
	- REACTOR SHUTDOWN	"	"
	- METAL FUEL	"	"
	- MULTIPLE MODULE CONTROL	"	"
	- CRITERIA FOR ACCIDENT SELECTION/EVALUATION (INCLUDING SEVERE ACCIDENTS)	"	"
	- ISI	"	"
	- ISSUES RELATED TO STANDARD PLANT APPROVAL	"	"
o	REVIEW R&D PROGRAM	FY 86/FY 87	
o	REVIEW SAFETY TEST PLAN	SUMMER 1986	1/87
o	FINAL PSID	12/86	12/87
o	FINAL PRA	12/86	12/87

SUMMARY OF LONG TERM LMR LICENSING PLAN

	SAFR	PRISM
o SUBMIT PSSAR	1989	1991
o PDA REQUESTED		
o SUBMIT FSSAR	1992	1995
o FDA REQUESTED	1996	
o DESIGN APPROVAL REQUESTED VIA RULEMAKING	1996	

NRR RESOURCES REQUIRED

OUTSIDE TECHNICAL ASSISTANCE:

FUNDS REQUIRED:	FY 86	FY 87	FY 88
HTGR	650 K	550 K	0
LMR	600 K	600 K	200 K
	1250 K	1150 K	200 K

FUNDS ALLOCATED:			
BNL	600 K	550 K	50 K
ORNL	400 K	350 K	—
UNDESIGNATED	250 K	250 K	150 K
	1250 K	1150 K	200 K

NRR MANPOWER:

	FY 86	FY 87	FY 88
PSY	3.7	5.7	3.2

ASSUMPTIONS:

- NO SUPPORT FROM RES.
- NO CHANGES IN SCOPE OR SCHEDULE FROM WHAT HAS BEEN REQUESTED BY DOE.

BNL - FY 86 TASKS

I) HTGR

- DEVELOP ANALYTICAL CAPABILITY FOR AIR/WATER INGRESS ACCIDENT ANALYSIS FOR MODULAR CONCEPT.

- DEVELOP ANALYTICAL CAPABILITY FOR MODELING RELEASES FROM THE REACTOR BUILDING AFTER BLOWDOWN ACCIDENTS.

- ASSIST NRC IN EVALUATING WHAT SHOULD BE USED FOR HTGR SSST.

- ASSIST NRC IN REVIEWING DOE BASE TECHNOLOGY WORK ON GRAPHITE OXIDATION.

- PREFORM INDEPENDENT ANALYSIS ON THE MODULAR CONCEPT IN THE FOLLOWING AREAS:

  o EXAMINE A RANGE OF AIR/WATER INGRESS ACCIDENTS AND THE RESULTING FP RELEASE, STRUCTURAL GRAPHITE DEGRADATION.

  o EXAMINE A RANGE OF BLOWDOWN ACCIDENTS AND THE RESULTING SITE BOUNDARY DOSE RATES.

BNL - FY 86 TASKS (CONTINUED)

II) LMR

- ADAPT SSC TO PRISM/SAFR.
- ADAPT COMMIX TO PRISM/SAFR.
- DEVELOP ANALYSIS TOOLS TO MODEL INHERENT REACTIVITY FEEDBACKS IN PRISM/SAFR.
- ASSIST NRC IN EVALUATING WHAT SHOULD BE USED FOR LMR SOURCE TERM (SSST PLUS DBAs, BDBAs).
- ASSIST NRC IN REVIEWING DOE REPORTS ON LMR SAFETY ISSUES.
- ASSIST NRC IN REVIEWING DOE BASE TECHNOLOGY WORK ON LMRs.
- PERFORM INDEPENDENT ANALYSIS ON PRISM/SAFR IN THE FOLLOWING AREAS:
  - o RANGE OF PIPE BREAKS FOR AFFECT ON CORE TEMPERATURE.
  - o RANGE OF DECAY HEAT REMOVAL SCENARIOS (I.E., ASSUME CERTAIN COMPONENTS/SYSTEMS OUT OF SERVICE).
  - o RANGE OF REACTIVITY INSERTIONS.
  - o RANGE OF SEVERE ACCIDENT (LOHS W/FAILURE TO SCRAM, LOF W/FAILURE TO SCRAM, REACTIVITY INSERTION W/FAILURE TO SCRAM).
  - o NA FIRE IN CONTAINMENT TO EVALUATE CONTAINMENT DESIGN BASIS.

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- DEVELOP CALCULATIONAL TOOLS FOR THE MODULAR CONCEPT TO ANALYZE:
  - o REACTIVITY INSERTION TRANSIENTS.
  - o LOSS OF FLOW TRANSIENTS.
  - o LOSS OF HEAT SINK TRANSIENTS.
  - o DEPRESSURIZATION ACCIDENTS.

  INCLUDE CAPABILITY TO CALCULATE FUEL TEMPERATURE, LOOP TEMPERATURES, INHERENT REACTIVITY FEEDBACK, FP RELEASE. (WILL BE DEPENDENT ON DESIGN DETAIL AVAILABLE.)
- ASSIST NRC IN EVALUATING WHAT SHOULD BE USED FOR THE HTGR SSST AND SOURCE TERMS FOR DBAs, BDBAs.
- ASSIST NRC IN REVIEWING DOE BASE TECHNOLOGY WORK ON HTGRs.
- ASSIST NRC IN REVIEWING DOE REPORTS ON HTGR SAFETY ISSUES.
- PERFORM INDEPENDENT ANALYSIS ON MODULAR CONCEPT IN THE FOLLOWING AREAS:
  - o RANGE OF DEPRESSURIZATION ACCIDENTS.
  - o RANGE OF DECAY HEAT REMOVAL SCENARIOS (I.E., ASSUME CERTAIN COMPONENTS/SYSTEMS OUT OF SERVICE).
  - o RANGE OF REACTIVITY INSERTIONS.
  - o RANGE OF SEVERE ACCIDENTS (LOHS W/FAILURE TO SCRAM, LOF W/FAILURE TO SCRAM, REACTIVITY INSERTION W/FAILURE TO SCRAM).
- ASSIST NRC IN THE REVIEW OF THE CONTROL SYSTEM AND STRATEGY FOR THE MODULAR CONCEPT.

PROPOSED INTERACTIONS WITH ACRS

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- o PRESENT PROPOSED CONTAINMENT/CONFINEMENT DESIGN AND DESIGN CRITERIA, INCLUDING SSST, FOR HTGR AND LMRS.

- o PRESENT PROPOSED DESIGN BASIS ACCIDENT ENVELOPES FOR HTGR AND LMRS, INCLUDING HOW THEY WERE SELECTED.

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- o PROVIDE DESCRIPTION OF KEY HTGR AND LMR SYSTEMS, BASED UPON PSID.

- o PROVIDE STAFF EVALUATION OF HTGR CONCEPT.

- o RECEIVE ACRS LETTER ON THE HTGR CONCEPT.

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- o PROVIDE STAFF EVALUATION OF LMR CONCEPTS.

- o RECEIVE ACRS LETTER ON LMR CONCEPTS.

PURPOSE

TO RECEIVE ACRS FEEDBACK REGARDING THE SAFETY OF THE PROPOSED CONCEPTS.

COMMISSION POLICY STATEMENT ON THE REGULATION OF ADVANCED REACTORS

IMPLEMENTATION OF ADVANCED REACTOR POLICY

- PLAN FOR REVIEW

- TECHNICAL APPROACH

PLAN FOR ADVANCED REACTOR REVIEW

- o BECOME FAMILIAR WITH CONCEPTS UNDER EVALUATION.

- o INTERACT WITH DESIGNERS ON CRITERIA, MAJOR ISSUES AND SUPPORTING BASE TECHNOLOGY PROGRAMS.

  - DESIGNERS TO PROPOSE.

  - NRC TO REVIEW (THIS WILL INCLUDE INDEPENDENT ANALYSIS).

  - DESIGNER IS RESPONSIBLE FOR DEVELOPING COMPLETE SET OF ANALYTICAL TOOLS AND BASE TECHNOLOGY.

- o DOCUMENT CRITERIA AND GUIDANCE REGARDING MAJOR ISSUES.

- o PERFORM SAFETY REVIEW OF DESIGN VIA PSID REVIEW.

- o ISSUE SER AND LICENSABILITY LETTER.

TECHNICAL APPROACH

- o BUILD UPON LWR FRAMEWORK, WHERE PRACTICAL.

- o DEVELOP NEW CRITERIA AND GUIDELINES FOR EACH CONCEPT WHICH:
  - ADDRESS CHARACTERISTICS OF THE DESIGN WHICH DIFFER FROM LWRs.
  - ADDRESS UNIQUE SAFETY CHARACTERISTICS OF THE DESIGN.

- o CONSIDER GIVING CREDIT FOR INHERENT SAFETY CHARACTERISTICS INCORPORATED INTO THE DES[illegible]

- o ADVANCED REACTORS MUST BE AT LEAST AS SAFE AS CURRENT GENERATION LWRs.
  - EVALUATE EQUIVALENCY WITH LWRs IN DEFENSE IN DEPTH.
  - PREVIOUS EXPERIENCE.
  - SUFFICIENT R&D PROGRAMS.
  - APPLICATION OF TMI AND USI ISSUES.
  - COMPARISON AGAINST THE COMMISSION'S PROPOSED SAFETY GOALS.
  - ETC.

PROPOSED COMMISSION POLICY STATEMENT

- o REDRAFTED BY NRR TO:

  - PROVIDE BETTER ORGANIZATION AND CLARIFICATION.
  - INCORPORATE PUBLIC COMMENTS AND PROVIDE RESPONSES TO SIX QUESTIONS AT THE END OF THE POLICY STATEMENT.

- o MAIN POINTS INCLUDED IN REDRAFT:

  - ENCOURAGES EARLY INTERACTION BETWEEN NRC AND REACTOR DESIGNERS ON LICENSING CRITERIA.
  - ENCOURAGES CERTAIN FEATURES AND CHARACTERISTICS BE INCLUDED IN ADVANCED DESIGNS.
  - ENCOURAGES EARLY DISCUSSION ON THE USE OF PROVEN TECHNOLOGY OR TECHNOLOGY DEVELOPMENT PROGRAMS AND THEIR AFFECT ON REGULATORY REQUIREMENTS.
  - STATES THAT ADVANCED REACTORS MUST PROVIDE THE SAME DEGREE OF PROTECTION TO THE PUBLIC AND THE ENVIRONMENT AS DO CURRENT GENERATION LWRs.
  - STATES THAT LICENSING GUIDANCE FOR ADVANCED REACTORS WILL BUILD UPON THE CRITERIA AND REGULATIONS DEVELOPED FOR LWRs.

PUBLIC COMMENTS

- COMMENTS RECEIVED FROM 20 PARTIES:
  - 7 UTILITIES
  - 6 VENDORS
  - 2 NATIONAL LABS
  - 5 OTHER

- MAIN POINTS RAISED IN PUBLIC COMMENTS:
  - REDUCE PRESCRIPTIVE NATURE OF NRC REGULATIONS.
  - ENCOURAGE GREATER INHERENT SAFETY/SAFETY MARGIN THAN PROVIDED IN LWRs BUT DON'T REQUIRE IT.
  - NEW SET OF GDCs FOR ADVANCED REACTORS SHOULD BE DEVELOPED:
    - LESS PRESCRIPTIVE.
    - GENERIC SET VS. SPECIFIC SET FOR EACH REACTOR TYPE.
  - NRC SHOULD NOT FAVOR ANY DESIGN, DESIGN FEATURE OR DESIGN APPROACH OVER ANOTHER.
  - NRC SHOULD NOT REQUIRE A PROTOTYPE DEMONSTRATION PLANT.

COMMENT RESOLUTION

1) COMMENT: REDUCE PRESCRIPTIVE NATURE OF NRC REGULATIONS

STAFF POSITION:

- EVEN THOUGH A LARGE NUMBER OF EXISTING CRITERIA AND REGULATIONS FOR CURRENT GENERATION LWRs ARE PRESCRIPTIVE, THERE STILL REMAINS MUCH FLEXIBILITY FOR THE TREATMENT OF TRULY DIFFERENT DESIGNS.

- THOSE PORTIONS OF EXISTING CRITERIA AND REGULATIONS WHICH APPLY TO THE DIFFERENT DESIGNS SHOULD BE RETAINED. BY THEIR VERY NATURE THEY WILL TEND TO BE NON-PRESCRIPTIVE.

- WHERE NEW CRITERIA ARE NEEDED THESE CAN BE DEVELOPED FOR THE DESIGN IN QUESTION.

- NON-PRESCRIPTIVE APPROACHES TO THESE NEW CRITERIA WILL BE CONSIDERED.

- REACTOR DESIGNERS ARE ENCOURAGED TO SUGGEST THE NEW CRITERIA THEY WOULD LIKE TO TO APPLY.

COMMENT RESOLUTION (CONTINUED)

2) COMMENT: DON'T REQUIRE GREATER SAFETY THAN LWRs

STAFF POSITION:

- NO BASIS COULD BE DEVELOPED TO REQUIRE GREATER SAFETY OR DESIGNS WITH GREATER INHERENT SAFETY. RATHER, THESE WILL BE ENCOURAGED BY GIVING CREDIT IN THE DESIGN.

- DOSE GUIDELINES IN REGULATIONS AND PROPOSED SAFETY GOALS DEFINE AN ACCEPTABLE LEVEL OF SAFETY IN A GENERIC SENSE AND ADVANCED REACTORS SHOULD MEET THESE.

COMMENT RESOLUTION (CONTINUED)

3) COMMENT: NEW SET OF GDCs SHOULD BE DEVELOPED FOR ADVANCED REACTORS

STAFF POSITION:

- GDCs WILL BE DEVELOPED BUT WILL BUILD UPON LWR GDCs.

- GDCs WILL BE DEVELOPED FOR EACH REACTOR CONCEPT REVIEWED AND MAY BE EXPANDED TO A GENERIC SET FOR EACH REACTOR TYPE.

COMMENT RESOLUTION (CONTINUED)

4) COMMENT: NRC SHOULD NOT FAVOR ANY DESIGN, DESIGN FEATURE OR DESIGN APPROACH OVER ANOTHER

STAFF POSITION:

- THE STAFF WILL ENCOURAGE THE USE OF SIMPLIFIED DESIGNS THAT RELY ON INHERENT SAFETY CHARACTERISTICS BUT WILL NOT FAVOR ONE OVER THE OTHER.

- THE STAFF WILL PROVIDE AN OBJECTIVE EVALUATION OF EACH DESIGN.

COMMENT RESOLUTION (CONTINUED)

5) COMMENT: NRC SHOULD NOT REQUIRE A PROTOTYPE DEMONSTRATION PLANT

STAFF POSITION:

- A PROTOTYPE DEMONSTRATION PLANT WILL NOT BE REQUIRED.