UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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Ann Riley & Associates
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1625 I Street, N.W., Suite 921
Washington, D.C. 20006
(202) 293-3950

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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BRIEFING ON ADVANCED LIGHT WATER REACTORS BY EPRI

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PUBLIC MEETING

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Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

THURSDAY, JUNE 16, 1988

The Commission met in open session, pursuant to notice, at 2:03 p.m., the Honorable LANDO W. ZECH, Chairman of the Commission, presiding.

COMMISSIONERS PRESENT:

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

STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

S. CHILK

W. PARLER

E. KINTNER

J. DeVINE, JR.

K. STAHLKOPF

J. TAYLOR

AUDIENCE SPEAKERS:

R. B. LOWTON, G.E.

P R O C E E D I N G S

[2:03 p.m.]

CHAIRMAN ZECH: Good afternoon, ladies and gentlemen.

Today the Commission will be briefed on the Electric Power Research Institute's advanced light water reactor program. The Commission will hear both the Advanced Light Water Reactor Steering Committee, represented by Edward Kintner and the Executive Vice President of GPU Nuclear, and representatives of EPRI led by Mr. John Taylor, Vice President of the Nuclear Power Division.

It is my understanding this is a two phase program with the first phase being the development of the Utility Requirements Document for the evolutionary development of an advanced light water reactor based on current light water reactor designs, and the second phase would be the development of a similar document for a smaller plant size, utilizing various passive means for accident prevention and mitigation.

The Commission has in the recent past been briefed by the General Electric Company, Westinghouse and Combustion Engineering on their programs to certify their standard plant designs.

Today's briefing will provide the Commission with a better understanding of how these various activities relate and possibly converge.

The Commission is also interested in hearing how the

interactions between NRC's staff and EPRI are going in the review of the various sections of the Utility Requirements Document.

This is an information briefing and no Commission vote is expected this afternoon. I understand slides have been available at the entrance way to the room.

Are there any comments from my fellow Commissioners before we begin?

[No response.]

CHAIRMAN ZECH: If not, Mr. Kintner, will you begin, please?

MR. KINTNER: We are very glad to be here to talk to you in person about the advanced light water reactor program. We have had meetings with Vic Stello, Tom Murley and their staffs. These have been very helpful. I think the process of review of the documents which we are producing is going along well. Significant issues are being raised and discussed and I think resolved reasonably well.

We met twice with the ACRS on the subjection of the ALWR program and now it seems timely that we should meet with you and tell you where we stand and what we propose to do.

We have a very simple agenda for this program.

[Slide.]

MR. KINTNER: Contracting for additional nuclear power plants has been in a hiatus for a long time, but there

are many of us who believe as we here do that there must be within the not too far distant future, some innovations in nuclear power for the future for reasons of environmental protection, for economic well being and military safety.

We believe that will be encouraged if we are able to do two things. First, have continued stable and reliable operation of the present plants, an objective which the NRC and INPO and the utility industry are devoting major efforts to that end. Second, the conceptualization of a next generation of improved plants evolved from the experience gained, both good and bad experience over the last 20 years.

Almost six years ago, the Electric Power Research Institute commenced discussions with senior utility executives on the question of whether there was a need to prepare for further development of nuclear power engineering, and if so, what direction that should take. The conclusion then was that steps should be taken toward a second generation of light water reactors and that the most important objective of that effort should be increased margins of safety through additional engineering margins in the reactor and significant simplification of the plant as a whole.

The resulting ALWR program has now been underway for four years. It has several years more to go but we think we have made significant progress. In carrying out the program, we have been greatly encouraged by and we have adhered very

closely to, we believe, the Commission's statement on the policy on regulation of advanced nuclear power plants.

The ALWR program is aimed at improving the application of light water reactor technology rather than starting over with a new technology, a new coolant, because we now have a very large body of experience from more than 100 plants in this country and 400 worldwide.

If you develop any other reactor system to a similar level of understanding and maturity, and consider that includes development of the subsystems of fuel and waste disposal and the extensive set of codes, procedures, regulations, that's an effort which would be very difficult to carry out and I don't see anybody who is willing to undertake it at the moment, if they fully understand the entire magnitude of such an undertaking.

Notwithstanding all the criticisms the industry and regulators have had, the safety record of light water reactors has been remarkable. We have had only one serious accident and that did not cause harm to the operators or the public.

This effort is sponsored by and managed by the utilities through EPRI. The first generation reactors was primarily the intellectual product of reactor suppliers, engineers and constructed by architect engineers, and contracted for by utilities with widely different backgrounds, neither the AE's nor the utilities themselves had much

experience in nuclear technology.

That balance has now been reversed. It is the utilities who not only have the operating experience but bear the moral and financial weight of the nuclear design, construction and operations. The utilities have said emphatically that they want something better than they have.

Nuclear utilities are beginning to speak with a single voice on the subject of the next generation of reactors and the fact that they are speaking with a single voice should increasingly help avoid commercial pressures and competition which might compromise safety.

There was, of course, initial resistance to re-thinking plant designs. It took the form of arguing that if you do anything different from what has been done before, you cast doubt on what has been done. That's a false argument in a technology as new as this one.

I'm pleased to say the U.S. reactor suppliers and major architect engineers are now working constructively toward the common goals of the program.

The Department of Energy is providing major support especially in funding developmental aspects of the program and in design certification work which is an adjunct to this program.

Additional financial support and experience is coming from overseas, Korea, Japan, Taiwan, the Netherlands, Italy,

support we are receiving from all over the world is steadily increasing.

We are not saying that what has been done is not safe and useful. LWR's are obviously providing larger amounts of electricity in many nations more cheaply and reliably than other energy sources. What we are saying, however, is that with the experience of the last two decades, it should be possible and we believe it is possible to make design changes of a fundamental nature which will have positive effects on both safety and economics.

The basic principles by which we propose to gain safety margin and improve overall operating characteristics are to increase the engineering margins and significantly simplify the plants. Some examples of the way we are headed are we have limited T-H to below the levels which previously have been thought to be acceptable. We have increased reactor heat transfer margins by 15 percent. We have lengthened transient times in the plant as a whole by increasing water inventories and pressurizer sizes.

We have removed neutron sensitive welds in the mid-section of reactor vessels. We have specified reactor vessel materials which are less sensitive to neutron embrittlement.

We have importantly increased dependence on fundamental physical properties such as negative temperature of power co-efficients and natural circulation for removal of

decay heat. We are making major efforts at the same time of reducing demands on the operators by simplifying the man-machine interface.

In many of these areas, we are going well beyond existing regulatory requirements and that should ease the burden on your staff in arriving at licensing decisions.

Further, we are applying these principles throughout the plant, not just to the primary reactor system. We believe this is the best way to achieve greater safety in operations as well as reduce costs and construction times overall.

While we are doing this, we expect to achieve what Pierre Tanguy of Electricite de France says is an important objective of the new French design effort, the so-called REP-2000, and that is provide coherence in a total plant sense, rather than just design a primary plant and then a secondary plant, tie them in with a control system, put a containment around them. That's an idea, the word never occurred to me until I heard him use it and I think it makes a lot of sense in terms of this massive experience we have from the previous 20 years.

Carrying out this work, we hope to avoid what to many of us seems to have been counterproductive in terms of true safety in the development of commercial reactors, that is overemphasizing mitigation of consequences of severe accidents to the detriment of the prevention of small events which could

lead to severe results.

We are not ignoring severe accidents but we are putting emphasis in the first case on designing plants so "ifs" do not occur rather than on "what if" they do occur.

That requires a leap of faith of a sort but many of us know instinctively that is the way to really improve safety in a low risk, high consequence technology, which this one is.

Overall guidance of the ALWR program is by the Utility Steering Committee whose membership is shown on Attachment A. I believe we have a viewgraph which shows that.

[Slide.]

MR. KINTNER: We have three members of that committee with us here today, Bill Cahill of Gulf States; Lou DelGeorge of Commonwealth and Charles Jackson of Consolidated Edison. I would point out that active members of this group include representatives from Italy, Taiwan and from the Netherlands. These members are in fact participating fully in the activities and many times have contributed significantly important questions.

Not all of these people are at the meetings but there is sufficient participation ensuring utility viewpoints and experience of nuclear operators are fully addressed, and each of these individuals gets some help from within his organization as a whole. Jack, I guess in one case, you had 800 comments on one chapter coming for the utilities, comments

and questions. It is not just a matter of the individuals commenting on what is being done, we really are getting detailed review from an operating experienced point of view on the design requirements we are providing.

Karl Stahlkopf and Jack DeVine will explain many of the details of the program. Jack, on my left, is the Program Manager at EPRI. He is a nuclear submariner. He has been with the general public utilities organization from before the TMI-II accident. He has been in charge of this program for two and half years. He adds additional utility experience to the center of the work.

CHAIRMAN ZECH: Thank you very much. You may proceed.

MR. STAHLKOPF: This program has its antecedents, as Ed said, some five and a half years ago, when the Utility Advisory Committee that provides advice and also programmatic guidance to the Nuclear Power Division, asked that EPRI develop with them a program that would ensure that the nuclear power option would be available for the next ordering of central station power. Working with them, we formulated the ALWR program.

[Slide.]

MR. STAHLKOPF: We formulated it really with several goals. One was it was clear that the utilities understood that they had the responsibility for owning and operating the plants

and they felt they gained much knowledge and understanding about the things that were right and the things that weren't quite right with the current generation power plants. Consequently, they wanted to establish their readership in the design of the next generation. That became a premiere goal in our effort and I think Ed Kintner and the other members of the Steering Committee here today show the continuing interest of the utilities in this program.

When we looked at the program, we said to ourselves, is the light water reactor the right reactor. We went into a study and looked at the variety of alternatives that were available at the time and we came to the conclusion that in fact a goal of the program should be that the next generation should be a generation of light water reactors and the program should build the foundation for those reactors to be certified and to be ready in the 1990 timeframe.

With those two major goals, we then formulated three specific objectives of the program which is shown on the next slide.

[Slide.]

MR. STAHLKOPF: The first one of these has largely been completed. We went to Harold Denton and discussed with him our interest in formulating an advanced light water reactor program. At that time, the industry was still in some change as a result of many of the TMI backfits and I think it is not

an understatement to say that the regulatory basis for the next generation was not really clear. Working in conjunction with NRC staff, the EPRI staff developed a list of outstanding potential safety and licensing items which might confront any new design.

The initial list was really a clearing of the drawers of all the people in the Commission along with a compilation of what was on the books at that time and it came to some 550 potential issues. Since that time, the list has grown to almost some 700 issues but through the work of your staff and ours, we have brought that down to 62 specific issues, which now serve as the basis of regulation between EPRI and NRC. That work has largely been done.

The next two objectives of the program deal first with the development of a specific set of design and performance requirements for the next generation reactors and you will hear us talking about the Requirements Document, and that is what the Requirements Document really is, setting down what the utilities feel should be the basis and the performance requirements for their next plants.

Finally, we wanted to take perhaps a step forward or a step into the future from the present systems which use active components for ECCS, for cooling of the core, for decay heat removal and for removal of heat from the containment, and see what could be done in terms of developing a light water

reactor which would use passive instead of active components. That became the third objective of our program. We will talk about all three of those as we go through the presentation today.

CHAIRMAN ZECH: Does the design consideration in your Requirements Document face up to the issue of whether the balance of plant should be included in the standardization program?

MR. STAHLKOPF: It very clearly does. The Requirements Document is written for a total integrated plant and it does not make a distinction between a balance of plant and a nuclear steam supply system which are cut along some finally defined line. We try to look at the machine as a total machine and that is reflected in the Requirements Document.

CHAIRMAN ZECH: Good.

[Slide.]

MR. STAHLKOPF: One of the things we are seeing as we move forward with our effort is a heightening of interest in nuclear power and in particular, a new generation of nuclear power plants. Bennett Johnston presently has an initiative which he has been discussing on the Hill. He held hearings two weeks ago about how the Government might support such an effort. DOE has a major program going on, both for the certification of what we call evolutionary plants, which are active safety system plants, and is moving in its follow-up

phase for development of passive plants. I'm pleased to say the EPRI and DOE programs are very closely tied together and have a very definite symbiosis.

We are seeing increasingly positive media coverage. You may have seen the Omni article last month which was very positive on nuclear power and the advanced light water reactor program. We expect a major article to be coming out in Fortune within the next several months which we think will also be positive on this subject. There have been numerous newspaper articles. The media is becoming awakened to this. I think you can see from the presence of Ed Kintner and the other members of our Utility Steering Committee that the utilities are in support of the efforts that we have ongoing today.

The program expands beyond the shores of the United States.

[Slide.]

MR. STAHLKOPF: This slide shows the partners that we presently have in place. Presently, we have as paying members of the program, and that is paying through both hard currency and staff, we have staff in-house from all our partners, from Korea Electric Power, Taiwan Power, Kansai Electric in Japan, ENEL in Italy, and KEMA in the Netherlands.

I am pleased to say that Taiwan Power has chosen to use the Requirements Document as the basis of their bid specification for their next two power plants.

We are presently in negotiation with Korea Electric Power to prepare a modification to the Requirements Document to do the same thing for them.

We are also in negotiations with CEGB in England and CRIEPI in Japan and hope we will be able to conclude agreements with them to bring them within the next several months into the fold of the program.

[Slide.]

MR. STAHLKOPF: This speaks to the two concepts which are being developed within the program. The evolutionary ALWR, which you have heard Ed speak to, which we feel should have the features of ruggedness, simplicity, reliability and certainly increased margins in terms of lower core power densities, greater primary and secondary water inventories, and you will hear more about that as Jack DeVine makes his presentation.

Of course, this evolutionary ALWR is tied in with the certification program, which you have heard both CE and GE speak to. We in fact are tied in a joint Memorandum of Understanding between EPRI, DOE and the reactor vendors, that the Requirements Document will serve as the basis for the submittals to the NRC for those certifications.

On the passive plant, we are looking at using passive systems, not only because we feel they might offer something in terms of safety that the active systems don't, but also because they hold the promise of significantly simplifying the plants.

You will have an opportunity today to see in some more detail what some of the early versions of that design look like.

[Slide.]

MR. STAHLKOPF: This speaks to the Utility Requirements Document. What we are doing with the Requirements Document is establishing top tier, functional and component design requirements for both the evolutionary plant and more recently as the designs have become more mature, the passive plants. This is for BWR and PWR.

Mr. Chairman, speaking to your question, we are looking at the entire total plant as an integrated system. We feel this is a necessary part of our program.

CHAIRMAN ZECH: Fine.

MR. STAHLKOPF: We seek to incorporate the resolutions of generic safety issues in this as well as a new term which we have coined for this program called optimization issues. Optimization issues are issues where we take some question as to whether the current NRC regulations are perhaps not over conservative, particularly on the basis of the fact that we are adding more conservatism in the designs of these plants.

We are looking at both meeting your issues and we are raising some issues of our own.

We feel that since we have all elements of the industry working within this Requirements Document, the

utilities, the NSSS vendors, the architect engineers, the Nuclear Regulatory Commission, that between all quadrants of the industry, that this document reflects the consensus of the United States on what the principal safety, performance and design requirements for the next generation of light water reactors should be.

We look at this document every bit as much as your document as our document, because we feel it needs to reflect the total U.S. position. I would like to note at this juncture that the working relationship between EPRI and NRC has been very constructive on this program. We would like to thank that you and the staff, Les Rubenstein in particular, for the help they have given us on this program. This is not to say they haven't given us a hard time. They are and they do. It has been very constructive so far.

[Slide.]

MR. STAHLKOPF: The next slide shows the status of the Requirements Document. For the evolutionary plant, we plan a 13 chapter Requirements Document. Of these, the Utility Steering Committee has approved and we have submitted to you five chapters covering overall plant, power generation systems, reactor, reactor, fuel and auxiliaries is another chapter, reactor coolant system is a fourth, and safety systems is the fifth.

We have draft SERs in hand for the first four. The

remaining chapters, 6 through 13, are in preparation and if we are able to stay on the ambitious schedule we have set for ourselves, we hope they will be completed this year.

Obviously, the passive plant lags behind. We felt it was necessary to get some maturity to the conceptual designs of the passive plant before we could begin the Requirements Document phase. Now, we feel that the designs are far enough along that we can actually start looking at the requirements which will be somewhat based on the foundations that we have seen from the evolutionary plant, but obviously, some great areas of difference, particularly in the safety systems.

We think it will take about two years to get through the development of those Requirements Documents.

[Slide.]

MR. STAHLKOPF: The next slide talks about what is ahead in the future. Clearly, the next year will be the completion for the evolutionary plant of chapters 6 through 13, a continuation of the type of interaction that we have had with the staff in resolution of safety issues and finally proceeding into what we call a roll-up phase. That is since we have submitted the Requirements Documents in a sequential manner, obviously, some things in chapter one may not reflect decisions which were made in chapter 13. We feel it is necessary to take the document as a whole once it has been through your review and roll that up into an integrated piece that shows internal

self consistency and reflects in fact the resolution of issues which clearly we didn't know the resolution of when we started in with the program.

For the passive plant, we will look at the continuing development of the requirements and the design concepts and it is our hope that we will continue an early and frequent interaction with you to establish the regulatory foundation for the passive safety concepts. Clearly, the use of passive safety concepts will require some regulatory changes from what we anticipate we will see for the active plants.

With that, I would like to turn it over to my colleague, Jack DeVine, who is the Senior Program Manager for this effort, who will be talking about some of the ALWR safety aspects and give you a closer look at the passive plant.

CHAIRMAN ZECH: Thank you. You may proceed.

[Slide.]

MR. DeVINE: Thank you. Good afternoon.

In trying to use our limited time effectively this afternoon, we chose two topics which we thought would be of particular interest to the Commission. I will touch upon those fairly briefly. As you wish, certainly we can explore them in more detail.

The first of those is ALWR safety requirements. In recent months, a topic of great interest and attention within the Commission and in our effort as well, just last week, for

example, we provided information at the NRC research meeting on severe accident treatment and advised the attendees at that meeting of our treatment of severe accidents in the ALWR Requirements Document. Before that, John Taylor and Karl Stahlkopf met with Vic Stello and Tom Murley and others on the staff on general issues related to the ALWR program. I understand severe accident treatment was the topic of most interest at that meeting as well.

Let me try to brief you on the approach we have taken in the ALWR Requirements Document.

A point I would like to make initially there is simply that we have been struggling with this for a long time and in fact the position which I will describe has been articulated in our chapter five of the Requirements Document. It is the chapter which addresses engined safety systems. It has been in the hands of the staff for several months now. We are in the process of comment resolution. We would hope within the next few months it will lead to the development of a draft SER for that topic. We are at the point of groping with the issues with the staff and hopefully reaching closure sometime soon.

The document addresses both policy and principles and then specific numerical and technical requirements. The policies and principles basically define our approach to safety. We thought it was very important in the document to

not simply list a bunch of rules for the designers to follow but an underlying logic for that approach.

The top tier requirements and these really are stated in chapter one of the Requirements Document, which has already been endorsed by a draft SER from the Commission staff, include two numerical ones of significant importance, core damage frequency less than ten to the minus five events per reactor year and a personnel protection criterion of less than 25R dose at site boundary, that is half a mile, for any event or for the aggregate events with probabilities greater than ten to the minus six events per year.

These are certainly building on the severe accident policy statement. These are more strict requirements than we understand you are currently envisioning. Our philosophy in fact is across the board to establish rules in the Requirements Document for the designers which in fact leaves some margin to the regulation. That is an important part of the philosophy.

[Slide.]

MR. DeVINE: In a nutshell, the principles laid out in the Requirements Document involve achievement of safety in a very straightforward way. First of all, and certainly as a manifestation of the philosophy that Ed Kintner described a few minutes ago, we emphasize greatly reliance on fundamentals, of the design of the ALWR from its overall requirements down to specific system and functional and component requirements,

emphasize simplicity, straightforward operations, systems which the operators can understand, which will not give ambiguous indications which he can deal with in upset conditions as well as normal operations, that sort of thing.

Ruggedness is another aspect of simplicity in general terms. In every occasion where we are faced with building a system or specifying a system which could be analyzed in a very complex way to serve its function versus one which can be shown to be clearly on the rugged side, on the overdesigned side, if I can use that term, is the direction we have been taking.

Secondly, defense in-depth, and I mean that in several respects. Certainly, the traditional approach of multiple barriers to fission products which is codified in the regulations but also defense in-depth in the sense I will describe in a minute, which is a progressive reliance on solid design principles, extensive steps to prevent accidents and then finally mitigation of accidents.

Thirdly, a balance between prevention and mitigation. Again, Ed Kintner touched on that in his opening remarks. The guidance we have gotten loud and clear from our Steering Committee is they don't want a severe accident to happen, rather than designing -- for us to design a plant which performs excellently once one does take place.

Reasonable consideration of severe accident events outside the licensing design basis. This is a somewhat touchy

issue. Certainly it is clear that there is concern on the part of plant designers and plant owners that the more attention that is paid to severe accidents, the more very restrictive, very extreme and very expensive requirements will end up being built into the plants.

Our approach is to provide a measured, focused attention on severe accident scenarios, but to do that in a balanced way, not to provide the level of redundancy and conservatism which one might apply and which the rules require to be applied to events which are much closer to reality and deserve much higher attention.

CHAIRMAN ZECH: Could you talk a little more about mitigation and prevention? I'm curious to know, did you discuss criteria or did you have any kind of discussion on specifics, just how far you might go to make that balance?

MR. DeVINE: Yes, sir. First of all, the core damage frequency requirement which was noted on the earlier slide, ten to the minus five, we believe is significantly more severe than most operating plants. That is not rooted in the regulations anywhere. That is imposed by the utilities via the Utility Requirements Document. It provides a large measure of the protection which we would hope to achieve for the overall plant.

CHAIRMAN ZECH: Your goal for prevention, moving it out to ten to the minus five, not to elaborate too much, are

you going to tell us the specific things you had in mind to try to approach that goal?

MR. DeVINE: Yes. As I go through, I will be giving you examples.

CHAIRMAN ZECH: Fine. I would appreciate it.

MR. DeVINE: I will try to think of examples.

CHAIRMAN ZECH: Thank you.

[Slide.]

MR. DeVINE: The next two pages are a bit tedious perhaps but they are useful in particular, I think, because they are extracted from our Requirements Document, chapter five, in explanation of the philosophy which I described a minute ago.

First, in the subject of defense in-depth, again, manifesting the philosophy that Ed Kintner outlined, first of all, specification of designs which we feel are highly accident resistant, and that means accident resistant to a greater extent than one would achieve simply by complying with the regulations.

Design margins, and this fits into your question as well. A 15 percent thermal margin built into our chapter four. We have just recently received a draft SER just last week from the staff on that chapter.

Frankly, we got some argument from the vendors on that point because they made it clear that did not appear to be

optimum from an economic standpoint. Our feeling was from an investor protection standpoint and from a philosophical standpoint in the lines we have already described, that margin was well worth the incremental cost. The 600 degree T-H Ed described as well.

There is a requirement, for example, not rooted in the regulation for no core damage for a six inch loss of coolant accident with the target of a 12 inch effective break size for loss of coolant accident. All of these were designed to provide the owner confidence that he could build a plant which would have a very low likelihood of an event which could cause major and expensive damage or certainly which could lead progressively to a severe accident.

Simplicity, we have mentioned. Best materials. Across the board in the Requirements Document we specify Cadillac materials. In some cases, again, we have had some disagreement from some quarters that will drive the cost up and it will cause us to be unable to meet our cost targets but our thinking was first and foremost, we have to find a way to build a plant which is resistant to accidents, then beyond that and mainly by improving constructability, we are going to have to make that plant affordable.

Extended operator response times. We have specified targets. We are just developing the man-machine interface systems now, but across the board and I also think it fits into

the context of your question. We have established requirements that give the operator more time to diagnose what is going on and an easier job in diagnosing what is going on, by virtue of simpler systems and better instrumentation.

CHAIRMAN ZECH: Quality products?

MR. DeVINE: Absolutely, without hesitation.

MR. KINTNER: Not just the manufacture, quality in original design and engineering.

CHAIRMAN ZECH: I can't find the slide that you showed me earlier that talks about some of the conservatism you have built into the plant.

MR. DeVINE: That was a good list, in Ed's presentation.

CHAIRMAN ZECH: You mentioned the T-H, limiting T-H. Also the second one I was looking for, to increase reactor heat transfer margins. That is important. It shows conservatism, I think. Lengthening transient time constants by increasing water inventories and pressurizer sizes.

You have discussed all these with suppliers and with utility people?

MR. DeVINE: Yes, sir.

CHAIRMAN ZECH: What did they have to say about that?

MR. DeVINE: Actually, I have to say that as we have gone through the process, I think we have gained some enthusiasm and support from the vendors. I think initially

they were somewhat skeptical. I remember one of the vendor program managers advising they tried to put lots of margin in fuel and the net result was nobody bought their fuel because it was more expensive than the other guy's.

Our feeling is if it is codified in the requirements and in fact if it truly represents a consensus of the industry and the utility industry is willing to buy products to that Requirements Document, that permits the vendors to supply that quality product and not lose their competitive edge.

CHAIRMAN ZECH: Yes.

MR. KINTNER: That goes to another point which underlies this, which is a belief or maybe not a belief as much as a sense that the economics of nuclear power were not understood when the present plants were designed. Reliability, safe operation, capacity factors, ease of operation, low maintenance costs, operating maintenance costs, all those factors were not included in the equation when people took more and more power out of a liter, higher temperatures, increased the pressures and so forth.

The fact is that fuel is a small part, a much smaller part of the cost of operating a reactor as compared to a fossil plant and the fossil economics and fossil approaches were carried over. What we are trying to do is say if you can get another one, two or five percent capacity factor or save a year in initial construction or reduce the number of valves and

pumps you have to maintain, by giving up five degrees or ten degrees or 15 degrees on T-H or 15 percent on the thermal margins in the reactor, you have gained overall in the economics. That is what we are trying to achieve. We do not agree that making a reactor vessel out of material which does require a special system to relieve pressure, if you pressurize it at a low temperature, is more expensive than building one out of material that doesn't require that.

This is by no means proven. A lot of people don't agree with it yet. I believe that there is a sense and an understanding and agreement on the part of the Utility Steering Committee because I'm fairly sure they are very much a part of the conclusion that this is the way we ought to go. They can speak for themselves.

CHAIRMAN ZECH: I believe it very strongly. I don't know if you have been reading my speeches recently or not.

MR. KINTNER: Most of them. Memorizing them.

[Laughter.]

CHAIRMAN ZECH: I'm glad. I have been saying for a long time and I keep wondering if people understand it, but you have given a very clear background description of what I am trying to say and I am trying to say it clearly and concisely and succinctly so perhaps people understand. You have filled in a lot of the background.

A safe plant is a reliable plant is an economic

plant.

MR. KINTNER: Exactly.

CHAIRMAN ZECH: That is what it is all about.

MR. KINTNER: Safest plants at 100 percent power steady state for two years.

CHAIRMAN ZECH: If you want it economical, and most utilities do, you better make it reliable and safe. You cannot separate them.

MR. KINTNER: Absolutely.

CHAIRMAN ZECH: What you are saying I think here is certainly what I believe and also it costs money. You have to buy quality, like Mr. DeVine is telling us and you have to put it in there. You have to make it conservative. That costs money, too. I submit, if you build it conservatively, with quality material and quality workmanship, your chances of getting a safe plant and a reliable plant and an economic plant are an awful lot better than if you don't put those factors altogether.

MR. KINTNER: Absolutely. That is exactly what we are trying to say is a principle in this program.

CHAIRMAN ZECH: It sounds like it. It is encouraging. Proceed, please.

MR. DeVINE: Working down the chart on our defense in-depth approach, beyond all of those items which frankly we think deserve highest attention and has been receiving it, are

two layers of accident consideration systems. First, those for core damage prevention in the traditional way. These are the engineering and safety features, the safety injection systems and the spray systems and those systems.

In that respect, in the case of those systems, again, we have tried to walk the extra mile and provide systems which really are responsive to the learning experience of the last 30 years, and which will be easier to operate, generally more dedicated systems than we have seen before, systems which provide better capability in areas that have proven to be hard spots in the existing PRAs which have been done and also demonstrated by incidents at various plants.

As an example, the feed system requirements in the PWR are substantially more restrictive than I think in any plant in the field right now, basically a feed system with two motor driven, two steam driven pumps, dedicated to loops; much less complicated in terms of cross ties. No sharing of its job with the start-up system. It is a straightforward system for emergency protection. We think that is an improvement.

The final layer, mitigation systems, systems to contain fission products released as a result of core damage accidents. We haven't scrimped on those but we consider those systems which are much less likely to come into play and in evaluating severe accidents, we are really looking at the aggregate of these three layers, not just the mitigation

systems.

[Slide.]

MR. DeVINE: I will touch on this only briefly. It introduces a concept we think is intriguing. It is in front of the staff right now. Basically, it attacks the concern that perhaps the illogical approach which has been followed in the past in a sense that one provides a tremendous amount of attention to a rigidly defined list of threats, protecting against those with redundancy and a great deal of conservatism, and then does not look beyond that envelope at all because those things are considered improbable to the point of impossibility.

We are providing more of a graded approach in which we address licensing bases events, using conservative NRC methods. Going to the righthand side of the page, we have added a category of design bases called performance evaluation basis, and these include a strict set of performance events, of investment protection events. I mentioned the LOCA criterion which is more restrictive than the rules require.

In these areas, we are giving the designer more flexibility in developing the methods and the margins which ought to apply.

Finally, a risk evaluation basis which really permits a PRA system to be used to evaluate full spectrum of core damage events using PRA methods. We had a lengthy discussion

last week with the regulation folks about whether or not a PRA limit ought to be written into the rules. Our feeling was it is a very complicated device, certainly the precision is not what everybody would understand, but it is a useful tool to design the plant and to evaluate the performance of the plant and we would propose to use it in that way but not be saddled with a very rigid regulation basis for it.

CHAIRMAN ZECH: In all of your review of this advanced light water reactor design, from the utilities' standpoint, I would expect there has been a reasonably good input from the operators themselves, the SROs and others.

Have you had supervisors and SROs and people like that look at the design at this early stage? What kind of input have the operators had?

MR. DeVINE: So far, that input has been limited to the structure of Steering Committee reviews that Ed described. We certainly are getting extensive input from some of the utilities and it is quite clear that they have distributed our draft sections among their departments. I would expect that some of those comments are actually filtering up from an SRO level.

CHAIRMAN ZECH: I would strongly recommend that you make sure you get that input.

MR. DeVINE: We do have the intent as we develop the man-machine interface systems, which includes the control room

requirements and instrumentation requirements, to involve people with hands-on instrumentation and controls experience in that aspect of the Requirements Document.

CHAIRMAN ZECH: Human factors part of it; all that.

MR. STAHLKOPF: And INPO.

MR. DeVINE: In fact, they are providing extensive input now.

CHAIRMAN ZECH: I just want to emphasize that I think it is important that whatever stage you see fit, but it has been my experience, the earlier the better, to get the operators involved. It makes them feel an ownership to the thing, let them make comments and recommendations and treat them seriously. The earlier the better in my judgment.

Proceed.

[Slide.]

MR. DeVINE: This slide summarizes what I think I have already said. In a chronological sense, it describes how we are treating accidents across the board and ultimately how we are treating severe accidents. We think it is a reasonable approach.

Designing for licensing design bases events, which by itself imparts substantial margins to the design, we are adding of our own volition additional margin and features, first to provide further prevention of core damage. We are then conducting evaluations of dominant severe accident scenarios on

a realistic basis. We are using a PRA methodology to do that. We are accounting for the whole rack up of systems and components requirements established, including some common sense requirements which we provided to permit sensible coping with severe accidents, such as requirements on the configuration of the cavity below the reactor vessel and that sort of thing.

As a whole, we think this sequence provides a measured attention to severe accidents and will provide much better confidence than we have had before that severe accidents can be dealt with.

[Slide.]

MR. DeVINE: The other topic I would like to discuss and I will try to do it quickly because I have used up more time than I was allocated in the first part, is the passive plant concepts.

In summary, both Karl and Ed spoke to this, the passive plant is one which will use primarily passive means for accident prevention and mitigation. The target is to keep the core protected without operator action for three days. That is a major step in the right direction in terms of reactor safety.

It would be greatly simplified compared to existing plants; could be a PWR or BWR. We have chosen a reference size of 600 megawatts because the early examination work suggests that plants may be impractical to build beyond that size range,

although there doesn't seem to be a hard stop that we are up against. The Japanese right now are looking at 900 megawatts for possible application of passive safety.

It could be constructed in three years with extensive modularization and prefabrication. That is really an economics target but it turns out that it fits rather nicely with the rest of the package.

We are looking hard for ways to make this very attractive smaller passive plant, economically competitive with the bigger plants which would appear to have an economy of scale benefit.

The link there would be to build them in a short period of time, with a short predictable construction schedule, made possible by modularization, that three years really looks achievable and that would be a tremendous incentive for utilities to proceed with that system.

COMMISSIONER ROBERTS: Don't misconstrue this as being critical in any way of what you are doing. Are these things that you ticked off on this slide, are these anything more than concepts at this moment?

MR. DeVINE: Yes, they are. I will be showing you a real quick slide show in a few minutes that will give you an idea of how they are developing. They are moving energetically and in very specific directions.

[Slide.]

MR. DeVINE: Benefits of the passive plant. It provides a basis for renewed public, government and investor confidence across the board. That is important. People's confidence has been shaken, certainly in the investor community and the public community in existing designs.

Fundamental advances in safety, simplicity and constructability. The simplicity is astounding, at least at the preliminary engineering stage. I will be showing some slides of the Westinghouse PWR AP-600. They have sponsored some comparisons with an existing Westinghouse 600 megawatt two loop plant and showed reductions by about a factor of two in numbers of valves and components and in some respects, even greater reductions.

I wouldn't take that to the bank yet but it certainly is looking like a major advantage.

Lower rating looks particularly attractive in the U.S. in terms of matching utilities' demand to supply. It permits a smaller capital investment, fewer eggs in one basket. Historically, smaller, simpler plants have had very high capacity factors. Just yesterday, Bob Lowton of GE mentioned to me, and this is a rather extreme example, but the natural circulation BWR, and I believe it is a 60 megawatt plant, has been operating over a 90 percent capacity factor for something like the last ten years.

That design is a base model for the SBWR 600 megawatt

plant and in fact, some KEMA designers are working at GE's shop right now to help them develop the core design for the SBWR.

MR. KINTNER: No pumps, no circ pumps. It is all natural circulation, full power.

[Slide.]

MR. DeVINE: The way we have approached the problem, this was a conceptual idea. Commissioner Roberts, picking up on your comment, a few years ago, it really was sort of a hazy concept and in fact maybe a curiosity in our program, there was some serious consideration of not proceeding beyond an early study phase when we first began this program. Because of the interest and enthusiasm and technical success that has been generated, it has now become a main feature of the program.

The Department of Energy has been sponsoring an extensive program which is very compatible with our more analytical one. It is particularly strong in the area of system and component design verification and testing. I have a few photographs of some testing going on. Basically they are testing hardware in key areas of this plant.

There is the Westinghouse AP-600, that has canned rotor pumps. They require for loss of flow accidents either mechanical or electrical inertial. There has been a test program to evaluate use of a bearing design which applies high inertial to that system. That is an important testing step. GE has been testing gravity during cooling. They have been

testing the steam injector, which is an important safety feature in that system. These are hardware tests going on today and many to be finished this year.

Expanded emphasis in our phase two effort based on the success in phase one, evaluating technical issues. We agreed to develop a Requirements Documents. Karl described that. I would point out that was not initially in our scope and it is only because of the excitement generated by this thing and the promise it holds that we have decided to put that additional resource on a Requirements Document.

Two design teams working right now, GE/Bechtel/MIT on the BWR version and Westinghouse with Burns & Roe and Avondale on the PRW version. We have also involved Combustion Engineering in some analytical work in support of the PRW area.

COMMISSIONER ROBERTS: I am going to show my ignorance. Who is Avondale?

MR. DeVINE: Avondale is a shipyard in New Orleans. They are the guys who are designing or developing the constructability aspects and modularization. I have some photographs that will show a piece of that. It is really an intriguing aspect.

I should point out by the way that there is nothing magical here that limits modularization to passive plants. In fact, the attractiveness of this feature suggests we probably ought to be looking harder at that for the evolutionary plants

as well.

[Slide.]

MR. DeVINE: Some regulatory issues not covered specifically. The point of this slide is simply that by definition, some portions of the existing body of regulations won't apply. For example, it is our belief that if we can demonstrate there is no need for operator action and no need for AC systems to operate in a period of like three days, we no longer have to have a safety grade electrical power supply. Diesel generators, short start time, all those kinds of things. Those regulations would not apply.

Certainly, there may be some other areas in regulatory areas covering gravity driven cooling systems which don't exist right now. There is a need for a new body of information, at least a substantially amended body of regulatory requirements to cover this design.

Status of the passive plant right now, as I mentioned, it really has emerged as a major element in the ALWR program. We think it may well be the concept which best fulfills the vision that Ed outlined.

Vendors, with DOE and EPRI support, are making real progress in developing both the PWR and BWR versions of the passive plant.

[Slide.]

MR. DeVINE: This slide show will be very brief.

Frankly, the intent was to give you an impression that a lot of things are happening rather than a tutorial on the design. There are a lot of things that we simply won't have time to cover. Let me just give you a quick walk through.

This is showing the BWR side first. Features on the BWR, to implement those general features which I described. It is a fully natural circulation reactor. No pumps at all, both in normal and operating mode. Gravity driven cooling system, depressurization system, somewhat different than the current BWR depressurization system that basically permits the plant to get down close to ambient pressure real quick, so that the gravity driven systems can work. A steam injector system which provides a passive means of dealing with small break LOCA or generally loss of condenser, loss of feed type events. A substantially modified containment. The main feature of which is a passive cooling system. It requires no safety grade active systems.

[Slide.]

MR. DeVINE: I know this is hard to see. I would suggest perhaps if you would be interested at another meeting, we can get a much more detailed presentation or send you information. Just to cover some high spots right now, reactor vessel in the middle.

MR. LOWTON: It is about 251 inches which is the largest size in our current product line.

CHAIRMAN ZECH: Would you identify yourself, please?

MR. LOWTON: My name is R. B. Lowton with General Electric. It is equivalent to the largest sized vessel in our current product line.

CHAIRMAN ZECH: Thank you very much. Let's make sure the Reporter picked that up. It is easier if you come up to the microphone. The Reporter indicated she got most of it. I think that's probably satisfactory. Let's proceed.

251 inches is the answer.

MR. DeVINE: This is a low power density core and because of its natural circulation, obviously requires a very large vessel. As you can see, no recirculation loops, no pumps on the bottom. There is an elevated suppression pool with an isolation condenser. The isolation condenser permits natural circulation, decay heat removal. There is a depressurization system, series of valves coming off the yellow main steam line.

There is a steam injector system which is this non-visible red dot which provides motor force for feed without electricity. Finally, there is a water wall concept which provides overall passive cooling of the containment building or the containment structure, I should say, in the case of BWR. This is shown schematically as a water filled wall, an annular one around the outside diameter of the elevated suppression pool although it is one of the test areas that GE is looking at, at a number of different concepts including submersible

cooling bundles which could be removed and maintained.

The key obviously to this whole thing is to be able to get the heat that the passive cooling systems deliver to the suppression pool out of the containment without creating a pressure situation.

[Slide.]

MR. DeVINE: Very quickly, just as an example, the steam injector system is fundamentally a simple injector system but it requires adaptation of that simple concept to substantially higher pressures and flow rates than have been demonstrated so far. We believe it is a simple safety device.

[Slide.]

MR. DeVINE: This is an ongoing test program. This is shown schematically, simply it takes cold water supply, uses the steam from the primary system, the reactor system, to give it enough boost to get back in as a feed. It can take water from the condenser, from the storage tank or from the fuel pool, all without AC power.

[Slide.]

MR. DeVINE: The Department of Energy has been sponsoring a test program involving a series of tests, small scale tests and large scale tests, to test the system. The first part of the test program which is going on now and GE is testing, too, commercially available small scale steam injectors, really to get a better handle on the principles

involved, the variables, the effect of injection temperature, how the system works as steam pressure decays and that sort of thing.

[Slide.]

MR. DeVINE: This is just a photograph of the injection system test going on at San Jose. There is a follow up test in the preparation stage right now.

[Slide.]

MR. DeVINE: Of a full scale prototype injector system at the ETEC facility at Rockwell's facilities outside of Los Angeles. This will ultimately be a large scale test.

COMMISSIONER ROBERTS: Are these all DOE funded projects?

MR. DeVINE: These are DOE funded projects; yes. DOE's part of the program as we have worked out to be as compatible as possible involves primarily in the passive plant area, equipment verification and testing. Our work has been overall requirements setting, analysis and that sort of thing. They are both moving ahead.

GE is also working with the Japanese to develop systems. Other work going on includes development of the core design. I understand that is going quite well. They have settled at least preliminarily on a basic configuration of the core. A gravity driven cooling system is going on, the containment cooling system is a key area of importance.

[Slide.]

MR. DeVINE: I have a few pictures here also of the AP 600. Next slide, please.

[Slide.]

MR. DeVINE: I neglected to bring a diagram of the RCS which would have been interesting and I apologize for that, but I'll describe it.

It's a simplified reactor coolant loop with canned motor pumps. Basically two steam generators, standard Westinghouse Model F generators, two canned rotor pumps inverted and attached to the lower head of each generator. So it's got four pumps.

There is not a separate cold leg loop and, as I say, the pumps do actually take suction on the lower head, which really cleans up the RCS and makes it much simpler.

The reactor coolant system supports are much cleaner. It's basically a very neat system. Some questions about maintainability and access to the lower head for reactor coolant pump maintenance, but on balance it sure looks like an attractive tradeoff right now.

Lower power density core. Passive safety systems throughout, again, for removal of heat from the primary system and the removal of heat from the containment.

Simplified systems throughout the plant. It was the Westinghouse work which came up with the preliminary body count

on the valves and pumps and that sort of thing, which looks very attractive.

And this part of the program has really examined the modular construction work extensively. Next slide, please.

[Slide.]

MR. DeVINE: Diagrammatically, the two slides simply show the main features of the passive safeguards, and they involve an accumulator, two high pressure accumulators, two core drain tanks, and an in-containment refueling water storage tank.

All three of these are passive sources of water. The core flood tank basically rises and consist of pressure. The accumulators are charged for dealing with higher pressure requirements and larger breaks.

And the in-containment refueling water storage tank is a large volume of water which acts as a heat sink for a natural circulation RHR system, shown in this little white blob there, and also as an ultimate water supply to keep the core covered for an uncontrollable event. Next slide, please.

[Slide.]

MR. DeVINE: This slide simply shows the ultimate extent of a loss of coolant event in which all the water was used and no external source is available.

As you can see, the geometries are set such that water will remain above the core, even in that case. The

containment, in turn, has passive capability to reject heat by means of basically a chimney effect.

Water is drained from a tank on top of the containment vessel, around the steel containment, and the shield building acts as a chimney and draws cool air around it to reject heat.

This has been demonstrated by analysis at 600 megawatts and, as I said, in looking at the same principle for 900 megawatts. Next slide, please.

[Slide.]

MR. DeVINE: We're just going to walk through these -- no. Go on to the next one. I know you can't see that.

[Slide.]

MR. DeVINE: Just in answer to your question about how much has been done, there was a very extensive body of work done to develop this modular concept using shipyard techniques, and really carry it to the point of specific layout and sizing of modules, identification of how those modules would be constructed, establishing size requirements so it will be real shippable, so size and weight requirements, systems and concepts to deal with structural modules which have to handle shielding with piping and equipment modules for cable carrying modules that cables actually would be strung in the plant, but cable trays and condoms would be pre-fabbed and those kinds of things.

[Series of slides.]

MR. DeVINE: I've pulled out a set of slides that simply show the detail that's been developed in a model form to show how this works. So Paul, at this point could you just work through those slides at a few second intervals.

You'll see the plant building up in a modular way. Each of these layers coming up on the Aux building. That's the fuel handling building on the left and the Aux building on the right.

Access building toward the front with the diesels in it. Each of those areas has been developed with -- hold it right there, please. Sorry. Moved too fast. Followed instructions. Don't worry about going back.

Basically that last slide showed the configuration of the containment building and then the steel containment. And this slide shows the concrete shield building and chimney around it.

Obviously, this is plastic, not steel, and it's small scale, but we were impressed by the depth of detail in not just plastic models, but detailed schedules, very clear lists of materials and sizes and shapes for a number of those modules.

This is preceding way beyond the conceptual stage. I've taken much too much time, I apologize, but let me ask John Taylor to finish.

CHAIRMAN ZECH: Thank you very much. John, welcome.

You may proceed.

MR. TAYLOR: Thank you, Mr. Chairman. In summary, we're defining a future advanced light water reactor with the tremendous infusion of experience from the couple of decades of extensive operation of the present plants.

And with some infusion also of creativity and innovation to gain substantial further improvement. We've increased the margins for safety and reliability.

We've put tremendous emphasis and will continue on human factors, both in making the equipment and the subsystems more forgiving, and increasing the passive safety features so that reactors aren't expected to operate very rapidly in the event of an abnormal accidental condition.

And we're putting in our continuing work great emphasis on advanced I&C and control room systems to further aid the operator.

The whole effort encompasses an integrated plant design, so we understand all the relations among all aspects of the design.

All of this experience leads us to believe we can achieve a major improvement in reducing the chance of any severe accident for these plants.

We have, however, our infusing experience to assure that we can meet containment integrity requirements. The experience gained from the TMI-1 accident and the extensive R&D

work that is followed up from it, and the major experimentation carried out by NRC and by the industry and by DOE, and the accompanying analyses of severe accident conditions and containment burdens in the event of such an accident.

And finally, that experience is of enormous importance in assuring standardization. The fundamental base is the Utility Requirements which will standardize requirements for those who wish to supply the utilities with a nuclear plant in the future.

It would go without saying that we have not neglected the issue of getting the costs of these systems down from the present experience, without which there's going to be no interest in nuclear power in the future.

However, as I think has been described to you already, this will be through simplification, through standardization, through improved reliability, gaining of higher capacity factors, and through shorter construction times as a result of the simplification and the modularization steps that have been discussed with you.

Not through higher performance, such as higher specific power densities or higher or improved heat rates. Now, this leaves us, I think all of us, with a real challenge.

We believe that NRC has to establish a regulatory framework and make the regulatory decisions which will lead the utilities to feel that a predictable construction operation

schedule and cost is in the cards for them.

Without that, I don't think they would be willing to proceed. We also are well aware that you would not be interested in undertaking that kind of challenge if we would not provide you with the technical basis for review so that you can establish that regulatory framework and make those decisions.

And we intend to do that to meet the demanding standards the utilities have set on this program and do it in conformance with your advanced reactor policy and severe accident policy statements.

And we intend to provide, as a result of the extensive support from DOE, with hard test data to establish that the performance features, the passive capabilities we talk about, are real and can be depended upon.

I'd like to end simply by saying that your staff has been working with us in a highly constructive manner, has been giving us guidance.

We feel very strongly that we must present to them our work as we do it so we can get the feedback from the beginning and as we go to develop these designs and approaches.

And we thank you, in turn, for the support you're providing in those staff resources and the stimulation you have provided to achieve the severe accident policy and importantly to the advanced reactor policy statements.

We would not end up without very clearly thanking DOE also for the extensive support they are providing for the testing and constructability effort to make this program real.

I'd like now to open the table to any questions you might have.

CHAIRMAN ZECH: Thank you very much. Questions from my fellow Commissioners? Commissioner Roberts?

COMMISSIONER ROBERTS: I don't have a question and don't answer, but it sure does make me wonder how in the world you sought out your limited resources between PWR's and BWR's.

MR. KINTNER: Did you ever hear of the lows in fishes?

CHAIRMAN ZECH: Commissioner Carr?

COMMISSIONER CARR: Well, I just want to commend you on the effort. I think it's long overdue and I'm sorry it took so long to get here. It should have been done a long time ago.

I think you're going the right way. Certainly safety margins and simpler plants are the right way to go, and I certainly, personally, am not convinced of the economies of scale yet.

If I can help in part of the challenge, well, I'll be in there pushing it.

CHAIRMAN ZECH: Commissioner Rogers?

COMMISSIONER ROGERS: Yes. Well, I think we're all impressed with what you've had to tell us. I didn't hear

specifically about questions of, I think somebody mentioned it, but maintenance and surveillance.

From a human factors point of view, we've seen that as such a big problem over the years. And it's really just a comment, I guess, because I know that's something that would have to come somewhat later in some ways.

But I would hope that if we get to the point of actually constructing something new that the small aspects, the small maintenance and surveillance aspects of these plants is looked at from the human factors point of view and that we don't wind up by building back into the systems the standard problems that have existed in just about every plant in the country that when a technician goes to make a measurement, he or she can knock the plant off line.

And that nobody really thought about it from that point of view, that we just sort of regarded it as a routine way to install a rack with some equipment in it and so on and so forth.

MR. KINTNER: I think that is a very important point. So far what we've done is to some degree motherhood but it is clear in instrumentation control, computers and so forth, there has been almost a revolution since the present plants were designed.

And many of them were, I think, putting it in an extreme sense, they knew they needed a measurement off some

component.

They put an instrument there. They'd run a line in a control and put an instrument there. And that's not quite all that's needed.

What's needed now is a very comprehensive re-look at the whole question of how information is obtained, digested, and presented to the operators.

And we're in the middle of writing that chapter now. The man-machine -- as a matter of fact, we call it the man-machine interface chapter and not instrumentation of control, to underline the fact that we don't want it to be --

COMMISSIONER ROGERS: Of course, as you know, it's not just in the control room.

MR. KINTNER: Oh, no, no, no.

COMMISSIONER ROGERS: It's everyplace in the plant.

MR. TAYLOR: In the modularization program, there's a potential trap there that you end up with a lower capital cost, shop-fabricated subsystem which is extremely difficult to maintain.

And we consciously examine maintenance issues in that constructability program already. But NRC will begin to see this work as it is described in the very near future as we generate it and transmit it.

MR. KINTNER: We will follow through on that.

MR. DeVINE: Our current Chapter 6 work in the

Requirements Document involves actually developing layouts for the illusionary P&B, with requirements that are quite severe and also specific in terms of space allocated for access lanes, you know, for access to equipment, for transfer of materials and all those kinds of things.

So it is specifically being implemented in the current chapter.

CHAIRMAN ZECH: At that particular time, too, you should involve operators as well maintenance people and let them look at what you're doing.

As Commissioner Carr points out, you have to leave room for maintenance and I certainly agree with that. These are the kind of people who are going to do the job, you want to get out there and look at the concepts and look at your layout.

MR. DeVINE: We've just set up a meeting, not scheduled yet, but the people have been identified and some have been invited, of operations managers of a number of plants around the country to review the plant layout work before Chapter 6 is completed.

CHAIRMAN ZECH: Very good. Get some supervisors, too.

MR. DeVINE: Yes.

COMMISSIONER ROGERS: Also, is it your intent to check out plant performance using engineering plant simulators as part of the design process? That's, you know, a very

powerful tool that, rather than just a simulator for training purposes, put an engineering simulator to really look at extreme conditions, set them up and see how the design functions in detail.

MR. DeVINE: We don't have plans to do that within our current scope of work. However, we already specified the requirement in Chapter 1 that two levels of simulation be included by the designer, and they're the ones you mentioned, principals or a simulator to evaluate basic dynamic responses of the plant, and then a complete control room simulator which can be used to develop procedures and finalize the design of the control room and that sort of thing, both mandated by the Requirements Document.

COMMISSIONER CARR: Do you foresee being able to do this without a pilot plant?

MR. KINTNER: Yes. One of the requirements that was written is we will not require a prototype plant, and that does, in fact, to some degree limit the degree of innovation.

COMMISSIONER CARR: But no lockup or simulator?

MR. KINTNER: Yes. But individual parts can be locked up. One of the thoughts I had, and in answer to your question, Mr. Roberts, was how much -- to what degree is this proven developmental, what is just ideas.

Oyster Creek and many of those early BWR's have isolation condensers which are an actual circulation laser

moving heat on the primary side. And that's not a very difficult thing to see.

COMMISSIONER ROBERTS: Well, let me amplify the purpose of my question. I had a presentation three or four years ago, not just I, the Commission, about a reactor concept and it seemed quite interesting.

And afterwards I inquired of more information. I was told, well, you've seen everything. This package of slides is it. It was a concept.

MR. KINTNER: We're beyond that. It's not a finished product and it won't be until it's engineered.

COMMISSIONER ROBERTS: I understand.

MR. KINTNER: I think we're identifying those issues which are developmental, and we're taking steps to see that they are checked out.

COMMISSIONER ROGERS: Just on this engineering, increase of engineering margins. It's my impression that there are some very large engineering margins built into existing plants, just because that's been standard engineering practice in a number of different areas, but it's not uniform.

It's not always studied and it's not balanced. It's not coherent in a sense, to use that term. I would just think that it might be a good idea to, while you're focusing on the increase in engineering margins, to not give the impression that present day plants don't have substantial engineering

margins built into them, because they do.

They do in many, many important systems. But it hasn't been actually included in the analyses very often of these plants' behavior.

MR. STAHLKOPF: As a matter of fact, that's what I was referring to when I talked about optimization issues early in my presentation.

There are areas that we feel that margins, present regulatory margins perhaps are too great, and that we can understand, as our analysis techniques become better, to identify what those margins are.

Perhaps it's appropriate to remove some of that margin and put it somewhere else because we now better understand it.

I think Appendix K analysis is a prime example of that.

COMMISSIONER ROGERS: Good.

CHAIRMAN ZECH: Let me just say I agree with my colleagues that some of the things you've told us are very encouraging.

I particularly appreciate your emphasis on quality and, of course, safety. Also the conservative approach you've taken and the simplification approach that you've emphasized, and the passive features.

We have learned a lot over the years and we should

bring those lessons to bear now in looking at advanced light water reactor programs.

And I think it's important that you mentioned integrated. We didn't talk about that too much more, but I didn't miss that point.

You talked about integrated programs. That's very important. I think you talked about Pierre Tanguy's reference to coherent.

But it's my view that some of the problems we have are because we haven't integrated, we haven't brought it all together.

And here you have a chance to do that now when you're making an advanced design, and so you should emphasize that integration of the plant, and that means that you should think about maintenance, you should think about the human factors.

As we all know, we still make too many mistakes, people make mistakes. Not they're trying to make mistakes, they just make mistakes.

And there are good people doing that, too. So we've got to factor that in and try to factor into the design itself the ability to maintain the equipment and the ability to operate it safely, to test it and surveillance it and so forth.

I hope that one thing that you can think about as you design it is some of the surveillance and testing, perhaps won't have to do as much at power as we do now, and I'd just

throw that at you for something to think about because we do too much of that in my judgment now, and give the plant every opportunity to have a problem.

And perhaps in your new design you could figure out some way to do a considerable amount of the testing and surveillance when the plant isn't operating.

I'd just give you that as a challenge because I think that would be a significant contribution. That would not only contribute, in my view, to simplification, but it would contribute the human factor considerations.

I appreciate the emphasis you're bringing to standardization and John Taylor mentioned that. And we all know the benefits that brings to safe operations.

But also, your very clear concept that we discussed that a safe plant is a reliable plant is an economical plant. And that has simply just got to be factored into what you're doing and I very much appreciate, Mr. Kintner, your emphasis on that very feature and your description of how you're going to do those things and your commitment to that, because I certainly agree with that.

Well, let me thank all of you for a very fine presentation and for your contribution that you're making to the future of nuclear energy in our country, because I think that's what you're really doing.

You're making that possibility, that benefit to the

American people, real. You're trying to bring forth something that would be reasonable.

I'm particularly encouraged by the progress that you are making in the Advanced Light Water Reactor Program and the possibility that we can move ahead with some kind of a standardization program as a result.

As you know, we are interested in standardization and I would say that the Commission accepts your challenge to do what we can to further make predictability and the licensing process more predictable and more achievable.

As you are aware, the Commission has a policy statement on standardization right now and we're currently working on a rule being prepared by the Office of General Council and it's working closely with the technical staff, to develop a proposed rule for standardization which would reflect pre-selected sites and also involve single-stage licensing to the effect we can do so within our own authority.

That's being worked on now and we hope to have that rule available for public comment by the end of this summer. So we've already accepted your challenge to see what we can do to the licensing process and we are, as I say, working very hard to bring that about.

And again, I'd emphasize that that rulemaking would, to the extent that existing statutes would permit, would bring us closer to the combined construction permit and operating

license and allow design certification and pre-approved sites to minimize the uncertainty that we know exists now with the regulatory process.

So we're already undertaking that initiative. I think it goes hand-in-hand with what you're doing. We feel reasonably optimistic that we'll be able to achieve a certain amount of success in this area.

And I emphasize again, to the extent within our own authority, because some of the things we would need legislative authority for.

We have that proposal, as you already know, too, before Congress. So those are the things that we are doing in order to recognize our responsibilities in this role and we appreciate what you're doing, commend you for your efforts.

I think that the things that you've presented to us today are certainly on the right course. I appreciate, too, your references to the close working relationship you have with our staff and with the support you're getting from DOE.

This is a combined effort that we're all taking with industry, the various utilities involvement, as well as the government.

So I commend you again for an excellent presentation and for the approach you're taking. We'd be interested in hearing from you in the future when you think it's appropriate to come back and give us a progress report.

Thank you very much. We stand adjourned.

[Whereupon, at 3:35 p.m., the briefing was concluded.]

CERTIFICATE OF TRANSCRIBER

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

TITLE OF MEETING: Briefing on Advanced Light Water Reactors by EPRI

PLACE OF MEETING: Washington, D.C.

DATE OF MEETING: Thursday, June 16, 1988

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

Marilynn Nations

Ann Riley & Associates, Ltd.

6/16/88

SCHEDULING NOTES

TITLE:	BRIEFING ON ADVANCED LIGHT WATER REACTORS BY EPRI	
SCHEDULED:	2:00 P.M., THURSDAY, JUNE 16, 1988 (OPEN)	
DURATION:	APPROX 1-1/2 HRS	
PARTICIPANTS:	EPRI	
	- EDWIN KINTNER (GPU NUCLEAR) CHAIRMAN, ALWR STEERING COMMITTEE	10 MINS
	- JACK DEVINE, JR. SENIOR PROGRAM MANAGER, EPRI	25 MINS
	- KARL STAHLKOPF, DIRECTOR MATERIALS & SYSTEMS DEPARTMENT, EPRI	15 MINS
	- JOHN TAYLOR, VICE PRESIDENT NUCLEAR POWER DIVISION, EPRI	10 MINS

THE EPRI ADVANCED LIGHT WATER REACTOR PROGRAM

A PRESENTATION TO THE COMMISSIONERS

E. E. Kintner

J. J. Taylor

K. E. Stahlkopf

J. C. DeVine, Jr.

16 June 1988

Rockville, Maryland

AGENDA

• The Utility Viewpoint	E. E. Kintner
• ALWR Program Overview	K. E. Stahlkopf
• Two High Priority Topics - ALWR Safety - Passive Plant Concept	J. C. DeVine, Jr.
• Challenges to Utilities, Industry and NRC	J. J. Taylor

THE ADVANCED LIGHT WATER REACTOR PROGRAM

THE UTILITY VIEWPOINT

E. E. Kintner
Executive Vice President
GPU Nuclear Corporation

Chairman
ALWR Utility Steering Committee

UTILITY INVOLVEMENT AND SUPPORT

U.S. utilities have the experience and knowledge to establish requirements for the next generation nuclear plants, and they carry ultimate responsibility for their safe, reliable and economic operation

The ALWR Program is an initiative of the U.S. utility industry and is directed by a Utility Steering Committee (USC)

- Senior executives of U.S. and participating international utility companies which own and operate nuclear plants
- USC is an active participant in the program, both on policy and technical issues
- USC approves all submittals to NRC

UTILITY STEERING COMMITTEE

Active members of the Utility Steering Committee include:

Mr. E. E. Kintner, Chairman
GPU Nuclear Corporation

Mr. Angel Broggiato
ENEL/Italy

Mr. William J. Cahill
Gulf States Utilities Co.

Mr. Louis O. DelGeorge
Commonwealth Edison

Mr. Carlyle W. Fay
Wisconsin Electric Power Co.

Dr. Michael High
Tennessee Valley Authority

Mr. Charles W. Jackson
Consolidated Edison Company

Mr. Masahiro Kaino
Kansai Electric Power Co.

Mr. John S. Kemper
(represented by Mr. Steve Gibbon)
Philadelphia Electric Co.

Mr. Eng Lin
Taiwan Power Co.

Mr. R. Pat McDonald
Alabama Power Co.

Mr. Ted C. McMeekin
Duke Power Co.

Mr. Robert Mittl
Public Service Electric & Gas Co.

Prof. ir. Peter Mostert
KEMA, The Netherlands

Dr. James Rhodes
(represented by Mr. Lauren Johnson)
Virginia Electric & Power Co.

Mr. Walter H. Rogers
Florida Power and Light Co.

Mr. Chang Saeng Shim
Korea Electric Power Corp.

ALWR PROGRAM OVERVIEW

K. E. Stahlkopf
Director, Materials & Systems Development
Electric Power Research Institute

ALWR PROGRAM GOALS

- Establish utility leadership and effect positive progress toward a revitalized nuclear power option in the United States

- Formulate a practical and credible foundation for the design of advanced light water reactors for the next decade

ALWR PROGRAM OBJECTIVES

In support of these goals, the ALWR Program objectives are:

- A stabilized regulatory basis, via cooperative effort with NRC to identify and resolve outstanding issues of nuclear plant safety

- Development of a set of specific design and performance requirements for the advanced LWR (The "Requirements Document")

- An assessment of nuclear plant design concepts which would incorporate *greatly simplified, passive safety systems*

IN THE U.S. - AWAKENING INTEREST AND SUPPORT FOR THE ALWR

Indicators:

- Legislative initiatives for advanced reactor development
- **Major DOE effort** underway, with plans for followup phase for passive plant development
- Increasing and positive media coverage
- U.S. utilities actively supporting via EPRI

What's Happening:

U. S. utilities are working together, reaching consensus on requirements and issues; NSSS vendors and A-Es are actively supporting, and their new products are reflecting utilities' input

ALWR PROGRAM - INTERNATIONAL PARTICIPATION

Building Momentum

Partnerships are in place:

- Korea Electric Power Corp.
- Taiwan Power
- Kansai Electric Power Co. (Japan)
- ENEL (Italy)
- KEMA (The Netherlands)

• Prospects are good for new or expanded agreements with:

- CEGB (England) *(final stages of negotiation)*
- CRIEPI (Japan)
- Korea Electric Power Corp

EVOLUTIONARY AND PASSIVE CONCEPTS

In the ALWR Program, two concepts are being developed:

Evolutionary ALWR

- A simple, rugged and reliable advancement of today's LWR designs, using conventional safety system concepts

- NRC Certification Program under sponsorship of DOE

Passive Plant

- A greatly simplified ALWR which employs primarily passive means for accident prevention and mitigation

THE UTILITY REQUIREMENTS DOCUMENT

The Requirements Document is the primary work product in this phase of the ALWR Program

- It establishes top-tier, functional and system/component design requirements for
  - evolutionary and passive plants
  - PWR and BWR, entire plant
- It incorporates resolutions of generic safety issues and optimization issues
- It reflects industry and NRC consensus on the principal safety, performance and design requirements for the ALWR

REQUIREMENTS DOCUMENT STATUS

- For the Evolutionary Plant
  - Five chapters (of 13) completed, approved by USC, submitted to NRC. These cover:
    - -- Overall Plant
    - -- Power Generation Systems
    - -- Reactor, Fuel, RCS and Auxillaries
    - -- Safety Systems
  - NRC draft SERs in hand for the first four chapters
  - The remaining chapters in preparation, to be completed this year
- Passive Plant Requirements
  - Just beginning; will be produced over the next two years

ALWR PROGRAM - WHAT'S AHEAD

Evolutionary Plant

- Complete Requirements Document Chapters 6-13
- Interact with NRC staff in review, comment and resolution of safety issues
- Proceed with integration and rollup phase

Passive Plant

- Develop requirements and design concepts for passive plant
- Interact with NRC in establishing regulatory foundation for passive safety concept

TWO HIGH PRIORITY TOPICS

- ALWR SAFETY
- PASSIVE PLANT CONCEPT

J. C. DeVine, Jr.
Senior Program Manager
Advanced Light Water Reactor Program

ALWR SAFETY REQUIREMENTS

Policy and Principles

The Requirements Document articulates policy and principles which define the ALWR Program approach to nuclear safety, including severe accident protection

Top-Tier Requirements

The ALWR Requirements Document has set demanding, top-level performance targets:

- Core Damage Frequency $<10^{-5}$/yr
- Site Boundary Dose <25R, for events of probability $>10^{-6}$/yr

ALWR PROGRAM - SAFETY PRINCIPLES

The ALWR will achieve its safety criteria (including severe accident protection) by:

- Reliance on **fundamentals** - simple and rugged design
- Defense in-depth
- Balance between **prevention** and **mitigation**
- Reasonable consideration of severe accident events outside of the licensing design basis

ALWR Defense in Depth

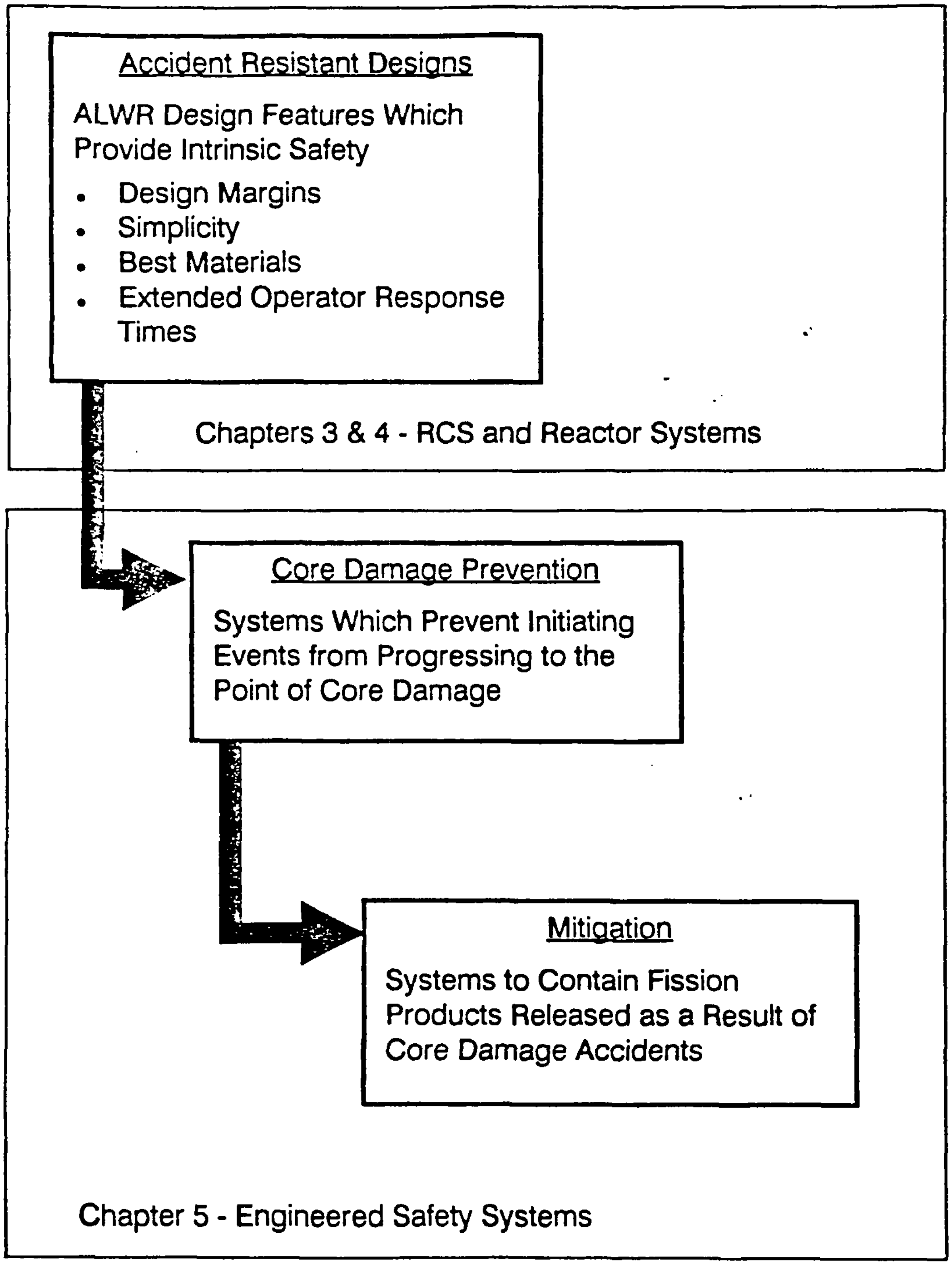

Illustration of the Three Parts That Make Up the ALWR Design Bases

	ALWR Design Bases		
	Licensing Design Basis	**Risk Evaluation Basis**	**Performance Evaluation Basis**
Events	Safety Events (as defined in Chapter 1)	Core Damage Events	Performance Events (Chapter 1, Table 3-6) Investment Protection Events (Chapter 1, Table 3-8)
Analysis Methods	Conservative, NRC-approved Methods	Probabilistic Risk Assesment (PRA) Methods	Designer-selected Methods and Margins

ALWR
TREATMENT OF ACCIDENTS

1. Design for Licensing Design Basis Events - This imparts substantial margin to the design

2. Add margin and features for further prevention of Core Damage

3. Evaluate dominant Severe Accident scenarios on a realistic basis; show sufficient margin to ultimate plant capability

   - demonstrate, by PRA, that top-tier ALWR requirements have been met

   - account for:

     -- ALWR system/component requirements provided for accident prevention and mitigation

     -- other specified ALWR features which enhance severe accident capability

PASSIVE PLANT - CONCEPT

In concept, the ALWR Passive Plant is a design which:

- Utilizes primarily passive means (gravity, natural circulation, stored energy) for accident prevention and mitigation
- Keeps core protected without operator action for about 3 days
- Is greatly simplified compared to existing plants
- Can be PWR or BWR, of reference size 600 MWe
- Can be constructed in three years, with extensive modularization, prefabrication

PASSIVE PLANT - BENEFITS

The ALWR Passive Plant is an attractive concept because:

- It provides a basis for renewed public, government and investor confidence
- It offers fundamental advances in safety, simplicity, constructibility
- Its lower rating:
  - can better match needs of U.S. utilities with low or uncertain demand growth
  - permits smaller capital investment to first power generated
- Smaller, simpler plants have had historically high capacity factors

PASSIVE PLANT - PROGRAM STRATEGY

- EPRI leadership in Phase 1, conceptual development
- Major DOE Program for system component design verification and testing
- Expanded emphasis and resources in EPRI Phase 2
  - technical evaluation of key issues
  - extend utility requirements to cover passive system concepts
- Two design teams:
  - SBWR: GE/Bechtel/MIT
  - AP 600: W/Burns & Roe/Avondale
- Synergism
  - close cooperation between DOE and EPRI programs
  - increasing international cooperation
  - strong utility linvolvement, via ALWR USC

PASSIVE PLANT - REGULATORY ISSUES

The Passive Plant concept effects a new approach to nuclear plant safety. Therefore, some portions of the existing body of detailed regulatory guidance will not be applicable. The NRC Advanced Reactor Policy statement and Severe Accident Policy Statement provide the framework to make appropriate changes. This is an opportunity and a challenge to develop effective regulatory requirements applicable to this concept

PASSIVE PLANT STATUS

- The Passive Plant has emerged as a major element of the ALWR Program. It may prove to be the concept which best fulfills the utilities' vision for a safe, simple, economical ALWR

- U.S. NSSS vendors, with DOE and EPRI support, are making real progress in developing PWR and BWR versions of the passive plant

CHALLENGES -

TO UTILITIES, INDUSTRY AND NRC

J. J. Taylor
Vice President - Nuclear Power
Electric Power Research Institute

CHALLENGE TO INDUSTRY & GOVERNMENT

- NRC must establish the regulatory framework and make the regulatory decisions which will permit predictable construction and operation

- EPRI, DOE, NSSS vendors, architect engineers, constructors and others must work together to meet demanding standards set by the utilities in conformance with NRC Advanced Reactor and Severe Accident Policies.

June 16, 1988

EPRI

Utility Steering Committee

Presentation to Nuclear Regulatory Commission

on the Advanced Light Water Reactor Program

We are very pleased to be able to talk to you in person about the Advanced Light Water Reactor Program. We have had several meetings with Vic Stello and Tom Murley and their staff, and the process of review of ALWR documents with the Commission staff is proceeding. Significant issues are being raised and discussed. We have also met twice with the ACRS. It seems timely that we should meet with the Commissioners and explain the ALWR Program from our perspective.

Contracting for additional nuclear power plants in the U.S. has been in a hiatus for a long time. But there are many who believe, as we do, that there must be within the not too far distant future, for reasons of environmental protection, economic well being, and military safety, a return to nuclear energy as an electric power source. We believe that return will be encouraged and accelerated by two important factors:

First, continued stable and reliable operation of present plants, an objective to which the NRC, INPO, and the utility industry are devoting major efforts; and second, the conceptualization of a next generation of improved plants evolved from the experience gained, both good and bad, over the last twenty years.

Almost six years ago, the Electric Power Research Institute commenced discussing with senior utility executives the question of whether there was a need to prepare for further development of nuclear power engineering, and if so, what direction that development should take. The conclusion was that steps should be taken toward a second generation of light water reactors, and that the most important objective of the effort should be increased margins of safety through additional engineering margins and significant simplification.

The resulting Advanced Light Water Reactor Program has now been underway for four years. It has several years to go, but we have already made significant progress. In carrying out the program we have been greatly encouraged by, and have adhered closely to, the Commission's Statement of Policy on Regulation of Advanced Nuclear Power Plants.

The ALWR Program is aimed at improving the application of light water technology, rather than starting over with a new coolant, because we now have an extensive body of experience from more than 100 plants in the U.S. and almost 400 worldwide. The development of any other reactor system to a similar level of understanding and maturity, including development of the subsystems of fuel manufacture, waste processing and disposal, as well as the extensive set of codes, specifications, and regulations, would be an effort which no one seems prepared to undertake. Moreover, notwithstanding all the criticisms which have been leveled at the industry and at you as regulators, the safety record of light water reactors has been remarkable. Only one serious accident has occurred and that did not cause harm to the operators or the public.

This ALWR effort is sponsored by and managed by the utilities through EPRI. The original generation of reactors was primarily the intellectual product of reactor suppliers, engineered and constructed by architect-engineers for widely diverse utilities. Neither the AE's nor the utilities had much experience in nuclear technology. That balance has now been reversed. It is the utilities who not only have the operating experience but bear the moral and financial weight of nuclear design, construction, and operation. The utilities have said emphatically that they want something better than they have.

The nuclear utilities are beginning to speak with a single voice on these matters through the ALWR Program, and that should increasingly help avoid commercial pressures and competitions which might compromise safety.

There was, of course, initial resistance to rethinking plant designs. It took the form of arguing that if you do anything different you cast doubt on what had been done before. That is a false argument when applied to any new technology, and I am pleased to say that the U.S. reactor suppliers and major AE's are now working constructively toward the common goals of the ALWR Program.

The Department of Energy (DOE) is providing major support, especially in funding developmental aspects and in design certification work. Additional financial support and experience from overseas is being provided from Korea, Japan, Taiwan, the Netherlands, and Italy. The momentum and support of the program is steadily increasing.

We are not saying that what has been done is not safe and useful. LWR's are providing large amounts of electricity in many nations more cheaply and reliably than any other energy source. What we are saying is that, after analyzing the experience of the last two decades, it is possible to make design changes of a fundamental nature which will have positive effects on both safety and economics.

The basic principles by which we propose to gain safety margin and improve overall operating characteristics are to increase engineering margins, and significantly simplify the plant. Some examples are:

a) Limit T_H (PWR).

b) Increase reactor heat transfer margins.

c) Lengthen transient time constants by increasing water inventories and pressurizer sizes.

d) Remove neutron sensitive welds in the mid-section of reactor vessels

e) Specify reactor vessel materials which are less sensitive to neutron embrittlement.

f) Increase dependence on fundamental physical phenomena, such as, negative power and temperature co-efficents, and natural circulation for removal of decay heat.

g) Reduce the demands on the operators by simplifying the man-machine interface.

In many areas we are going well beyond existing regulatory requirements. That should ease the burden on NRC staff in arriving at licensing decisions.

Further, we are applying these principles throughout the entire plant, not just to the primary reactor system.

We believe these are the best ways to achieve greater safety in operation as well as reduce cost and construction time.

We expect by the time we are through to achieve what Pierre Tanguy of Electricite de France says is an important objective of the new French design effort; that is -- provide "coherence" in a total reactor plant sense, rather than design a primary reactor plant, then a turbine-generator system, tie the two together with a system of controls, and fully enclose it in a containment system.

In carrying out our work we hope to avoid what to many of us seems to have been counter productive in terms of true safety in the development of commercial reactors up to this point, that is, overemphasizing <u>mitigation</u> of consequences of severe accidents to the detriment of the <u>prevention</u> of small events which could lead to severe results.

I do not mean that severe accidents are not being considered fully, but that the emphasis from the beginning has been on designing plants so that "ifs" do not occur rather than on "what if."

That requires a leap of faith of a sort, but many of us know instinctively that is the way to really improve safety in a low risk, high consequence technology.

The overall guidance of the ALWR Program is by the Utility Steering Committee whose membership is shown on Attachment A.

Not all of these people are present at all our meetings, but there is sufficient participation to ensure that the utility viewpoints from experienced nuclear operators are fully addressed.

Now Karl Stahlkopf and Jack DeVine will explain many of the details of the program. Jack DeVine is the ALWR Program Manager at EPRI. He is a Naval Academy graduate and has nuclear submarine operating experience. He has been an employee of General Public Utilities from before the TMI-2 accident. He has been in charge of this program for two and a half years, and he brings direct utility experience to the ALWR work at its center.

/2604n

EPRI
ADVANCED LIGHT WATER REACTOR
UTILITY STEERING COMMITTEE

EDWIN E. KINTNER, CHAIRMAN
EXECUTIVE VICE PRESIDENT
GPU NUCLEAR CORPORATION

ANGELO BROGGIATO
DEPUTY MANGER OF ESE, ENEL
ROME, ITALY

WILLIAM J. CAHILL
SENIOR VICE PRESIDENT
GULF STATES UTILITIES

LOUIS O. DELGEORGE
ASSISTANT VICE PRESIDENT
COMMONWEALTH EDISON

MASAHIRO KAINO
GENERAL MANAGER-NUCLEAR
KANSAI ELECTRIC POWER - JAPAN

JOHN S. KEMPER
SENIOR VICE PRESIDENT
ENGINEERING AND PRODUCTION
(REPRESENTED BY MR. STEVE GIBBON)
PHILADELPHIA ELECTRIC CO.

ENG LIN
VICE PRESIDENT
TAIWAN POWER COMPANY

R.P. MCDONALD
SR. VICE PRESIDENT
ALABAMA POWER CO.

ROBERT MITTL
GENERAL MANAGER - NUCLEAR
NUCLEAR ASSURANCE
PUBLIC SERVICE ELECTRIC & GAS

PROF. PETER MOSTERT
DEPUTY HEAD OF RESEARCH/PHYSICS
VAN ELEKTROTECHNISCHE MATERIALEN
THE NETHERLANDS

CARLYLE W. FAY
VICE PRESIDENT, NUCLEAR POWER
WISCONSIN ELECTRIC POWER CO.

DR. MICHAEL HIGH
DIRECTOR ENERGY DEMONTRATION & TECHNOLOGY
TENNESSEE VALLEY AUTHORITY

CHARLES W. JACKSON
TECHNICAL CONSULTANT
CONSOLIDATED EDISON COMPANY

DR. JAMES RHODES
SR. VICE PRESIDENT POWER OPERATIONS
(REPRESENTED BY MR. LAUREN JOHNSON)
VIRGINIA ELECTRIC & POWER COMPANY

WALTER H. ROGERS
CHIEF ENGINEER, POWER PLANTS
FLORIDA POWER AND LIGHT COMPANY

CHANG SAENG SHIM
GENERAL MANAGER
KOREA ELECTRIC POWER CORP.

TED C. MCMEEKIN
CHIEF ENGINEER
DUKE POWER COMPANY