UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Title: BRIEFING BY COMBUSTION ENGINEERING ON ALWR SYSTEM 80+

Location: ROCKVILLE, MARYLAND

Date: NOVEMBER 1, 1989

Pages: 42 PAGES

SECRETARIAT RECORD COPY

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PUBLIC MEETING

Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

Wednesday, November 1, 1989

The Commission met in open session, pursuant to notice, at 1:00 p.m., Thomas M. Roberts, Commissioner presiding.

COMMISSIONERS PRESENT:

THOMAS M. ROBERTS, Commissioner
KENNETH C. ROGERS, Commissioner
JAMES R. CURTISS, Commissioner

STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

SAMUEL J. CHILK, Secretary
WILLIAM C. PARLER, General Counsel

SHELBY BREWER, President, Nuclear Business, Combustion Engineering

ED SCHERER, Director, Nuclear Licensing, Combustion Engineering

Dr. Regis Matzie, Director, Advanced Water Reactor Projects, Combustion Engineering

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

1:02 p.m.

CHAIRMAN ROBERTS: Good afternoon, ladies and gentlemen. The Chairman will not be with us. He is participating in an exercise on a simulated radiological event at one of our licensees. He regrets he's not here. He asked me to assure you that his absence in no way indicates any lack of interest in the subject matter. His staff is well represented, and he will review the transcript.

Does anyone have any opening remarks?

COMMISSIONER CURTISS: Not me, Tom.

CHAIRMAN ROBERTS: Well, we are here, this is one of a series of meetings today, to hear about next generation reactors, and now we'll hear from Combustion Engineering, Doctor Brewer.

DOCTOR BREWER: Thank you very much, Mr. Chairman.

CHAIRMAN ROBERTS: I'm not the Chairman.

DOCTOR BREWER: Acting Chairman.

CHAIRMAN ROBERTS: I'm chairing this meeting.

DOCTOR BREWER: I'm Shelby Brewer, President, Nuclear Power Businesses at Combustion Engineering, Inc., and I'm pleased to be here today to talk about certification of our System 80 Plus advanced pressurized water reactor plant design.

It's been almost two years since we last discussed this subject with the Commission, and much has been accomplished since then.

I have with me today Ed Scherer on my right, our Director of Nuclear Licensing, Doctor Regis Matzie on my left, our Director of Advanced Water Reactor Projects. In the time that we have this afternoon, we would like to touch on three very important points.

The first point is, I would like to share with you my perspective on the direction of the nuclear industry and why I believe that the System 80 Plus design will play a very essential and leading role in the industry's future.

Second, we want to point out some of the new design features that we have incorporated into System 80 Plus -- including those specifically directed at meeting EPRI requirements and resolving severe accident concerns.

Third, we will review the current status of our design certification application and the progress of the Staff's review toward our goal of design certification in 1992.

We would, of course, welcome any questions or comments that you might have during the course of, or after, our presentation.

I would like to set the stage for this discussion by sharing with you some of my thoughts on the future of the nuclear industry.

Part of my perspective is derived from Combustion Engineering's broad participation in the nuclear market, including the supply of nuclear steam supply systems, fuel and nuclear services. This is consistent with our support -- company wide -- for all segments of the power generating industry. You can see from this slide, Slide 2 please, that although our domestic construction backlog has nearly been completed, we are still engaged in a wide range of nuclear system design activities.

Development of our System 80 Plus design is geared toward the future domestic market, and is shaped by our perspective of market requirements, both in the near term and the long term. In addition, it supports our design and construction activities in the Republic of Korea. The two units to be constructed at Yonggwang are based on our System 80 design and will contain some of the System 80 Plus features. Furthermore, in partnership with Combustion Engineering, the Koreans are embarking on a standardization program, and we fully expect that System 80 Plus will serve as the model for the next light water reactors to be built in Korea.

The certification of our System 80 Plus design under the new licensing format, 10 CFR 52, is our top priority in terms of preparing for a nuclear future.

We are also engaged in design of certain more advanced designs, together with Rolls Royce, Stone and Webster, and the U.K. Atomic Energy Authority, we are developing a smaller reactor that emphasizes passive safety features: the SIR design. Plans are being developed for construction of this reactor in the United Kingdom in the mid-1990's.

In the development of the commercial modular HTGR, we hold a prime contract from DOE as well as two subcontracts for substantial parts of the design. And we are heavily involved in activities leading to construction of two new production reactors for the Department of Energy: a gas-cooled reactor and a heavy water reactor.

So, as you can see, Combustion Engineering is involved in all of the major reactor technologies, and I believe that each of them, in time, can satisfy particular demands and fit into a unique niches in the future market.

My perspective of the industry's future is also colored by observing first hand the nuclear recession in the mid-1970's. That recession ended the first nuclear era.

That recession, Slide 3 please, did not result from any inherent deficiency in the technology, but instead resulted from a labyrinth of institutional, political, regulatory, economic and financial forces. This particular litany of problems is well known and I will not dwell on them here at this session. Nonetheless, the experiences of the 1970's and 80's reinforce my belief that it is the institutional problems that we must solve if we are to see a resurgence of nuclear orders. Technological improvement alone will not suffice, and a completely new reactor type is neither necessary nor sufficient to bring about further deployment of nuclear power in the United States.

I do not believe that a utility will consider ordering a nuclear power plant unless it is a standardized design, based on proven technology, and is pre-licensed by the Nuclear Regulatory Commission. The evolutionary ALWR -- like System 80 Plus -- is the only reactor species that can meet these requirements in the near term, and these are plain realities of the marketplace.

System 80 Plus is responsive to these market realities.

The design emphasis, Slide 4 please, on evolutionary improvements to proven technology will provide the confidence in the constructability and operability of the plant that utilities will demand. Its large power rating will make the most of increasingly scarce siting opportunities and take advantage of economies of scale. We must also keep in mind that the Nuclear Regulatory Commission certification requires that detailed design work be completed. Because System 80 Plus is an evolutionary change from previous designs, most of the detailed design information necessary to support the certification application is already available.

System 80 Plus can be certified by the Commission and be available for widespread deployment in the early 1990s.

Next slide please. Design certification of System 80 Plus is, foremost, a demonstration that institutional obstacles can be overcome and that the new licensing process can be made to work. This institutional demonstration can proceed on System 80

Plus, without the complications of technical novelties that might lead the Nuclear Regulatory Commission to require -- or, for that matter, utilities to demand-- construction and operation of a lead unit.

Let me emphasize that I am totally committed to the certification process. I intend, with the support of the Department of Energy, to carry it through to completion. I believe that it is an essential element in preserving the nuclear option in this country. Our expenditures at Combustion Engineering for the development of design information supporting the System 80 Plus application is in excess of $200 million. Support from the Department of Energy for certification of this design is over $10 million. Certainly we would not be pursuing this path if we did not believe that it will meet the demands of the marketplace and meet the demands of the marketplace in the 1990's.

I would like now to ask Ed Scherer for some remarks on NRC's review of advanced reactors.

Ed?

MR. SCHERER: Good afternoon. My name is Ed Scherer and I am Combustion Engineering's Director of Nuclear Licensing.

The reactor designs being developed today by

Combustion Engineering and others fall into three general categories:

Slide 6 please. The evolutionary ALWR's, such as our System 80 Plus; the smaller, passive ALWR's, such as our Safe Integral Reactor; and the non-water reactors such as the HTGR and the LMR.

It seems to me that the Commission is correct in approaching the review of these three categories of designs in a roughly sequential fashion.

In the first category -- the evolutionary ALWR's -- the Commission and the Staff will be dealing with technology that is well known. There is essentially only one issue that must be dealt with, and that is "What is the appropriate level of safety for future reactors?" If you will, how safe is safe enough and how do we approach the regime of severe accident phenomenon? I think it is wise to grapple with these questions first.

In what I see or have been calling a second phase -- the review of the passive reactors -- the Commission will not only have to deal with the first set of questions, but with some additional fundamental issues. For example, what are the appropriate trade-offs between reliance on "passive" safety features and the traditional emphasis that has heretofore been placed on diversity? Questions such as, does the fact that passive safety systems cannot be used to achieve cold shutdown, as currently defined, and in the same manner as active systems require us to redefine the concept of "safe shutdown" for passive plants?

As to the non-water reactors -- HTGR's and LMR's -- these involved still another dimension. All of the policy questions raised in the review of evolutionary and all of the policy questions raised in the review of the passive ALWR's will also have to be considered with the additional complexity of a reactor design that is phenomenologically different.

It is for these reasons and others that we believe that the Commission staff is on the right track in its current phased regulatory approach. Important policy issues will be addressed in a manageable manner and with the appropriate industry and regulatory focus. To attempt to move in too many directions simultaneously will simply stall the process to everyone's ultimate disadvantage.

Fortunately the phased regulatory approach also mirrors the probable commercial development of the different designs.

Slide 7 please. Let me emphasize our conviction that each technology has its own merits.

But there is a significant variation in the degree of technology development, the extent of commercial application and a demonstrated record of regulatory acceptability. This variation will, to a large extent, drive the development, certification and deployment schedules for these reactors.

Slide 8. The evolutionary ALWR's -- such as System 80 Plus and the others you are hearing about today -- are the only technology that is in a position to complete the certification process by the early 1990's. The passive ALWR's can follow in the mid to late 1990's, and the HTGR's and LMR's probably sometime after the year 2000.

Slide 9 please. Our approach to the System 80 Plus design is straightforward. System 80 Plus is a complete nuclear power plant in full compliance with Part 52. Let me emphasize that, it's a complete nuclear power plant in full compliance with Part 52. We have actively participated in the development of the EPRI Requirements document and have reflected those requirements in the design. We have attempted to avoid the future regulatory hair-splitting by simply overwhelming issues with design features, particularly those associated with severe accidents and Unresolved Safety issues. We intend to increase the safety margin such that there is no question as to its acceptability to the regulator or the marketplace.

To describe how we have accomplished this effort, Doctor Matzie will review our design process and describe some of the new design features of System 80 Plus and how they have contributed to improved safety and performance.

DOCTOR MATZIE: Good afternoon, gentlemen. My name is Regis Matzie and I'm the Director of Advanced Water Reactor Projects at Combustion Engineering.

Slide 10 please. The development of Combustion Engineering's evolutionary advanced light water reactor, System 80 Plus, started with a reference plant System 80, for which there is substantial design detail available, including start-up and operating experience from our Palo Verde units, which experience has been fed back into our design of System 80 Plus.

To this nuclear steam supply system starting point, we have chosen the Duke Power Company's Cherokee/Perkins Balance of Plant, because we felt that this BOP was the most advanced of the five Balance of Plants that were mated to the System 80 NSSS during the 1970's.

Combustion Engineering first teamed with Duke Power in 1985 as the principal PWR contracting team on the EPRI ALWR program. It was natural for us to continue this relationship for the development of the System 80 Plus design.

We have made significant design changes to the starting point that I've just described, to: (1) implement the EPRI ALWR design requirements; and (2) to address severe accident issues. When we started, our intention was that the EPRI ALWR Requirements document would precede review of the System 80 Plus design, and in some cases it has.

However, the process is becoming more contemporaneous with the review in parallel. This carries some advantages to the overall process, namely, an explicit design implementation of generic design requirements.

In the area of severe accident issues, we have made significant design changes, including the addition of additional components and systems to the original starting point design.

The next two slides show that the System 80 Plus design is an essentially complete nuclear power plant. Everything required by 10 CFR, Part 52, and that which the staff will need to review the design under the Standard Review Plan, is included.

Next slide please. Of course, Part 52 recognizes that certain site-specific features should be addressed only by presentation at the conceptual design level. To this end, conceptual design descriptions and interface requirements are being provided in our licensing document, CESSAR-DC, for the following systems and structures consistent with the requirements of 10 CFR, Part 52.

Next slide please. Designing the essentially complete plant has allowed us to take an integrated approach in considering the important aspects of the design. Probabilistic risk assessment has been used to help determine system configurations to achieve improved reliability and safety.

Maintenance requirements have dictated system design aspects and plant arrangement.

Fire protection and security have led us to physical separation and isolation by division and train.

Human factors considerations have made us concentrate on the man/machine interface as a principal consideration for the successful operation of the plant.

I will touch on these integration aspects in the following slides.

Next slide please. Let me categorically state that some substantial improvements have been made to CE's design. The improvements are listed on this slide. First, we have increased inventories of fluids. As an example, the pressurizer has been increased 33 percent in size, and the steam generator's secondary volume has increased approximately 25 percent. This increases the response times available to the operator before actions must be taken.

We have made substantial increases in the margins of the plant. The core over power margin has been increased to 15 percent, the two plugging margin in the steam generator has been increased to 10 percent, and the primary coolant temperatures have been lowered.

We've made improvements to the materials of the plant. The steam generators now have Inconel 690 tubes and the reactor pressure vessel material has been chosen to have much lower initial and final anneal ductility transition temperatures.

To the safety systems, we have made even more dramatic changes. First, the emergency core cooling system now has four trains instead of the two in our System 80 design, and the four trains, each train of which has the same capacity as the individual trains previously.

Our emergency feed water system is now a dedicated safety system, only used for safety functions. It has four trains, each of 100 percent capacity, two electric and two steam driven.

We have incorporated the refueling water storage tank inside containment to obtain a guaranteed water supply in containment for use in safety functions. By doing this, we have eliminated the necessity to switch from an external water supply to the sump on the initiation of ECCS to provide continued recirculation. This provides us a guaranteed water supply in containment for flooding the reactor cavity if needed during the recovery stages from a severe accident. It allows us to have a sparging and scrubbing media for pressurizer relief valves and our safety depressurization system, both of which can reduce releases to the environment.

We have added the new safety depressurization system. It's a new dedicated system to provide the capability to depressurize the reactor coolant system if impending vessel melt through was determined, and to provide an alternate decay removal pathway.

And, finally, another very major system improvement that has significantly contributed to safety, as you'll see in a later slide, is the addition of an alternate emergency AC power supply. This is a combustion turbine, which is diverse from the emergency diesels normally provided with light water reactors, and has been added primarily to address station black out concerns.

The above design features are highly compliant with the EPRI ALWR design requirements for evolutionary plants. They have been confirmed with PRA techniques and by transient performance methods. They help overwhelm severe accident issues.

Next slide please. Another area where we have placed a great deal of emphasis is in the containment design. The System 80 Plus containment is a large spherical steel containment, based on the partially constructed Cherokee/Perkins containment. It is a dual containment, with 1-3/4 inch steel ASME code stamped vessel with a 53 PSIG design pressure, and an ultimate strength of over 200 PSIG. It has a three-foot thick concrete reinforced shield building outside of this steel pressure vessel. The diameter of the containment has increased to 200 feet, which increases the free volume of the containment approximately 30 percent greater than our currently operating System 80 plant.

To accommodate the greater mass energy release that is associated with the ALWR, because of the greater inventories of coolant that I mentioned to you before, and the potential hydrogen generated during a severe accident, there is increased space for maintenance and access. As an example, the operating floor area, which can be used for lay down space during maintenance, is approximately 75 percent greater than the currently operating System 80 plant.

We have made specific design changes or added features to mitigate severe core damage. These include a specific reactor vessel cavity design, the capability to flood the cavity in the event of an impending core melt through, and the ability to externally cool the steel pressure vessel of the containment.

The subsphere space below the spherical steel containment houses the safeguard systems. This gives excellent separation for fire protection, flooding, and sabotage resistance, as shown in the next slide.

This slide shows a cross-sectional view of the lowest level of the subsphere region, where all the safeguard's equipment is located. The upper half of the containment shown in two colors of blue, or two shades of blue, represents one division of safeguard systems. The lower half of the figure represents a second division of safeguard systems. Each of these is divided in half to show the mechanical trains that are associated with our four train system.

The entire area shown in this figure is enclosed within the shield building, which, again, is a three-foot thick reinforced concrete structure, with access specifically controlled for each of the divisions.

Each of the divisions is completely segregated by wall structure through all levels of the subsphere region, and each of the mechanical trains is separated at this particular level to provide a strict barrier for fire protection and flooding.

Next slide please. The main design emphasis in the instrumentation and controls area has been human factors engineering. Our advanced control complex, which I'll show in more detail on the subsequent slide after I've gone through these points, has a large display screen which provides an overview of the plant readily readable anywhere in the control room and adjoining offices, and shows the major plant parameters indicating trends in the availability of success paths.

We are using touch sensitive CRT and plasma displays to allow the operators to control at the same location where they are observing the plant performance. We are using microprocessors to reduce the operator's burden. It provides validated information to reduce the number of indications the operator must cue to determine what action to take.

It allows mode dependent information and specific operator aids, such as warning of inoperable equipment.

We are using a hierarchy of information, a layered approach to diagnostics, going from the general to the specific, with the overview display which I mentioned earlier representing the top or highest level of information, going through multiple layers to a very specific set of information on the systems and equipment.

We are prioritizing alarms, which dramatically reduce the number of alarms that the operator must deal with, and allows the operator to concentrate on the most important alarms which require his immediate attention.

We are using multiplexing and off-the-shelf equipment to reduce plant costs, and we are using the off-the-shelf equipment and self-testing features to help reduce operator errors during maintenance and testing, thereby, avoiding reactor trips and challenges to safety systems.

An important feature of our design is that we have retained significant diversity and not sacrificed this in moving to an advanced system. Our discreet indication and alarm system is totally diverse from our CRT data processing system, and it's safety grade.

A better view of our advanced control room is shown on the next slide. It's still a little hard to see. At the front of the control room, which is to your right on the tan wall, is a picture of our overview display. Just in front of that is the master control console, where the reactor operator sits. The plant is designed to be able to operate the plant during normal operating conditions by a single operator. However, the normal staffing level is assumed to be three operators and the maximum continuous operation personnel in the control room has been used as ten for sizing the control room.

The figure also shows to the left of the screen the offices on the lower level which provide working space for the shift supervisor, the technical advisor and the nuclear equipment operators. All have a direct visual contact with the overview display at the front of the control room where all the major plant parameters and trends can be seen from their offices.

In the second level of this picture above these offices, is the technical support center, with its viewing gallery. The viewing gallery has been placed there to allow visitors to observe the control room operations without interfering in the operations or interfering with the reactor operators.

The next slide please. As I have mentioned earlier, PRA was used during the design process to evaluate alternatives. We have been successful in making dramatic improvements in safety. Although these two pie charts are not to scale, the left pie chart represents major contributions to core melt or core damage frequency, which has a value of 8 x 10(-5), making for our reference plant the design improvements that we have incorporated into the System 80 Plus design have resulted in a factor of greater than 100 reduction in the core damage frequency from the various improvements that I've mentioned thus far.

So that, the number now is less than 8 x 10(-7).

This figure clearly shows that we have made significant improvements to the plant, and that the improvements have resulted in a design which is both safer and more reliable to operate.

I'd now like to turn over the rest of the presentation to Ed Scherer.

MR. SCHERER: Thank you, Regis. I would now like to summarize where we stand in the certification process.

Next slide please. We started with our approved System 80 design as described in our standard safety analysis report -- CESSAR-F -- and have been submitting amendments to the NRC describing the design improvements incorporated in System 80 Plus. The revised document is being referred to as CESSAR-DC, or the Combustion Engineering Standard Safety Analysis Report -- Design Certification.

Our first submittal was made two years ago in November of 1987, with our formal application for certification being made in March of 1989, in parallel with your issuance of Part 52.

We have, of course, had extended discussions with the staff on a Combustion Engineering Licensing Review Basis document. We have substantially revised it this year to reflect the requirements of Part 52. Based on our most recent discussions, we have not identified any significant differences between ourselves and the staff and we are looking forward to the issuance of a Licensing Review Basis document in the near future. In any event, we are proceeding to complete the remaining segments of CESSAR-DC.

Next slide please. Just for a brief review, we began our submittals in 1987 and into the first half of 1988 with the major reactor systems and safety systems.

Next slide please. We continued in 1988 with the site envelope and Instrumentation and Control sections. In 1989 we began implementing the requirements of Part 52 concerning an essentially complete plant. Here you will see that we are including balance of plant systems.

Next slide please. Our schedule calls for us to begin submitting our proposed resolutions to Unresolved Safety Issue and high and medium Generic Safety Issues at the end of the year, and continuing into the first quarter of 1990.

Next slide please. In June of 1990, we plan to submit the integrated safety analyses, seismic methods, and the final results of our PRA analyses.

And, in September, we would provide the final information as required by Part 52.

The next slide shows our overall schedule.

We plan to complete our submittals in September of 1990, working towards issuance of a final Design Approval one year later in 1991. We would then anticipate that public hearings would be conducted on the design and that the design certification would be completed and issued in September of 1992.

The material submitted so far is under intense staff review. To date we have received some 277 questions from the staff and we have responded to 186. We expect that the pace of this staff review will accelerate in the coming months.

To summarize then:

Next slide. We believe System 80 Plus is a dramatically improved reactor, with 100-fold decrease in core-damage frequency.

We believe that the System 80 Plus is responsive to market demands. We firmly believe that utilities are not only interested in evolutionary light water reactors, but that many will, in fact, insist on them.

NRC review of our application is in progress. We have identified no insurmountable obstacles, but the bulk of the technical review is still ahead of us.

We believe that the schedule for design certification of System 80 Plus is realistic and achievable, and Combustion Engineering, as you have heard, is committed to that goal.

Doctor Brewer?

DOCTOR BREWER: Gentlemen, this concludes our formal presentation. We would be more than happy to answer any questions that you might have.

CHAIRMAN ROBERTS: Ken?

COMMISSIONER ROGERS: Yes. Could you elaborate a little bit on how you reduce the core damage frequency by two orders of magnitude? What were the principal factors that led to that?

DOCTOR MATZIE: Okay. The principal factors are the following: the addition of the alternate AC power supply at the combustion turbine; the addition of a safety depressurization system; the increase in the number of trains of safety injection and emergency core cooling; and, other improvements to the electrical system, such as additional batteries, additional on-site feeders and the addition of a breaker on the turbine. That set of items -- excuse me, one other, it was the incorporation of the refueling water storage tank in containment.

Those five or so items were the major contributors to the factor of 100 improvement.

COMMISSIONER ROGERS: Could you tell us a little bit more about how the advanced control room philosophy has been developed? How much of that is human factors related, and how much of it involved electronic systems, display systems of a different type? I take it that the objective is to reduce the operator burden. You are only going to have one operator in the control room.

DOCTOR MATZIE: The design base is to have normally three operators in the control room. We've designed the panels to allow one operator to operate the plant during normal operations.

COMMISSIONER ROGERS: Yes.

Can you say a little bit about what the philosophy is that led you to that new design?

DOCTOR MATZIE: Okay. The philosophy has many aspects, all of which were put before a interdisciplinary review team consisting of INC people, nuclear designers, operators, human factors engineers, but the various philosophies were, (1) let's reduce the burden of the operator, and that comes through a number of items which I alluded to, and I can list a few of them. Let's reduce the number of indications to the operator which are identical but which he has to sort through to come to the conclusion of what the parameter really is. As an example, there are something like 16 pressurizer level indications in a conventional control room for System 80. We have reduced that down to one, so that he has an unambiguous indication.

We have reduced the number of alarms that bombard him, and we've done that through grouping like alarms, using mode dependence of alarms, so that if a certain thing is happening or he's in a certain mode, those alarms that would naturally come in are just nuisance alarms we have suppressed.

We have ensured that he has the most important parameters available to him at all times being presented through what we call a discreet indication alarm system, but the number have been reduced through this technique I just mentioned.

One of the things that allow us to do some of these things is the, you know, extensive use of microprocessors, where all these indications and alarms can be compared electronically, looking for deviations, and if there's no deviations then the signals are considered valid and the operator is told, valid signals.

If there is a deviation, the operator is told there's an invalid signal, and then he has a choice of selecting all the same indications he would have in a conventional control room and determine then himself if the deviation is warranted or not.

We have gone through, with these types of techniques that were instituted then, the typical task analysis from a human factors standpoint to determine where the indications and alarms and controls should be, and how many and which ones, and that's basically our process.

COMMISSIONER ROGERS: Have you changed, in any significant way, the degree to which computer controls are built into the operation of the system? In other words, how much of it is pure manual, and to what extent is it computer overrides, or the other way around?

DOCTOR MATZIE: Okay. In general, we do not allow automatic control of the plant. There is one aspect of the design which allows remote dispatching of power level, but it monitors for margins, and if the margins are acceptable, the plant can be maneuvered or change power level remotely. If the margins are not there, the plant cannot increase in power.

So, in terms of automatic operation, the answer is very little additional beyond what's currently the capability of our System 80 design.

COMMISSIONER ROGERS: Basically, a manually operated plant.

DOCTOR MATZIE: That's correct.

COMMISSIONER ROGERS: Yes.

COMMISSIONER ROGERS: Did you do a conditional containment failure probability study?

DOCTOR MATZIE: We have specified in our Licensing Review Basis document a containment conditional failure probability, which we believe is workable, and which we believe preserves the balance between mitigation and prevention.

We are in the process of doing the level 2 PRA calculations, which directly address the capability of the containment, and we believe that these analyses will show that we've met the current criteria that we put in our Licensing Review Basis document, but we have not finished that yet, so I guess the answer is, we haven't verified it yet.

COMMISSIONER ROGERS: Uh-huh.

COMMISSIONER CURTISS: Just out of curiosity, what is your current proposal? How do you articulate your criterion?

DOCTOR MATZIE: Yes. The current proposal, and I don't have the exact wording, but, fundamentally, it's that we believe that with the rugged containment that we have, that the containment will have a 90 percent probability of preventing a large release for realistic initiating events and scenarios, and we have defined what that realistic set of initiating events is, including a cutoff of lower probability on type of events that are considered.

COMMISSIONER ROGERS: Are there any of the EPRI Requirements document items that you don't meet?

DOCTOR MATZIE: Yes. There are some. If you look at the thousands of requirements in the EPRI ALWR Requirements document for evolutionary plants, we are somewhere in the 98 to 99 percent compliance with those thousands. I'm not sure of the exact number of deviations thus far on the approximately nine or ten chapters that we fully looked at, but it's in the area of a few tens.

None of the ones related to safety or the safety resolutions that are being proposed by EPRI are we deviating by. There are some in terms of specific system and structure configurations that we are deviating from.

COMMISSIONER ROGERS: Thank you.

COMMISSIONER CURTISS: I just have a handful of questions here.

Let me pick up on the EPRI Requirements document issue that Commissioner Rogers raised. GE was in this morning and briefed us on the status of their application. Obviously, they are somewhat further along than you all are in terms of at least the procedural approval of that application by the Commission, but you are, nevertheless, quite a ways down the pike here.

What benefit does the Requirements document for the evolutionary plants provide you at this point? What benefit is to be accrued, if you will, by the Commission going forward at this stage and formally approving each of the chapters in the roll-up document, and putting its final stamp of approval, if you are essentially to the stage here where you've gone as far as you have with the design, you've evaluated its acceptability against the Requirements document, and you are prepared with your schedule to move on forward?

MR. SCHERER: Commissioner Curtiss, I think it provides a generic resolution basis for the staff's approval of both the GE, Combustion Engineering and, perhaps, later Westinghouse design.

If you think back to my earlier presentation that you are building from evolutionary, to passive to advanced non-water, it is not useful to just simply have a data point that a plant is for some reason acceptable or not acceptable, without understanding the generic position of the staff, and then looking at the plant specific approvals that the staff has granted based on that generic position.

So, it lets the staff establish a generic position for their approval, hydrogen generation, unresolved safety issues, severe accident issues, and then plant specific approvals. That provides you the building block that you are talking about for benefit for the later reviews when you add additional dimensions, and it can be all accomplished with a contemporaneous review of both the EPRI Requirements document and the General Electric and Combustion Engineering plants.

COMMISSIONER CURTISS: Is the generic benefit that you've described where you document the basis for the staff's conclusions with respect to a particular design, is that so significant that you think that the Commission ought to complete its review of the EPRI Requirements document before we move forward on individual designs, or is that simply sort of a looking back benefit, it documents it for the sake of regulatory history?

MR. SCHERER: I think you get all that benefit with a contemporaneous review. I think the benefit is worthwhile, but I don't think you lose significant benefit by having a contemporaneous review. In fact, I think you actually gain something by a contemporaneous review.

Personally, I believe that by having both the generic requirements and several examples in front of the staff, you get more meaningful and stable regulatory positions that can be taken.

COMMISSIONER CURTISS: Let's take one issue, the chapter on instrumentation and control, and control room design is the last one to be submitted by EPRI. We haven't seen that yet, and it may, in turn, reflect some continuing discussion within EPRI. You've described what you are doing here on your control room. In saying that you'd like to see those documents reviewed contemporaneously, I take it you are saying, at least with respect to the INC issues, the control room issues, that we at least like to have the EPRI chapter in on that before we move forward on giving you any final sign off on control room issues.

Does that follow?

MR. SCHERER: You will have all of the EPRI Requirements well in advance of when we're expecting the design certification of the System 80 Plus design, so I don't think there is a schedule of conflict for having the EPRI Requirements document in front of you ahead of the final approval of the System 80 Plus design, nor do I think you have any schedule conflicts with some of the design that precedes us.

COMMISSIONER CURTISS: If we took the-- let's take that example again -- if we took -- got the chapter from EPRI and, let's say, on a particular issue, the question of the safety rate status of the control room and the need for a back up control room or shutdown panel, if for some reason we decided in the context of the EPRI document to do something different from what you are doing here, are you saying that you'd change your design to reflect the decision made in the context of the Requirements document?

MR. SCHERER: Well, I will talk first about the issues that I'm aware of thus far. None of the areas under discussion between the staff and EPRI would frustrate Combustion Engineering's ability to obtain design certification, regardless of the way the debate comes out.

As to other issues, I'd have to wait and see, but, certainly, there is nothing that would say that once the staff has established its generic position, vis-à-vis the EPRI Requirements document, that they could not expect one vendor for good and sufficient reason to provide more or less in their plant specific design. That's the benefit of having a generic position. It explains the rationale that, while we establish X as a standard, for good and sufficient reason the Combustion Engineering design must have either more or less in that standard, and have the staff justify it. Otherwise, it's essentially giving you a data point out of the blue, saying we think this design is safe enough without establishing where it comes, vis-à-vis that standard.

COMMISSIONER CURTISS: Okay.

Just a quick couple of other questions. In the Chairman's absence, let me follow up on a question that he raised this morning with the GE representatives, a question put to how we as an agency ensure some degree of standardization between and among the various vendor designs. I don't know if you were here this morning, but he asked the question, how do we ensure in our interest in enhancing standardization that with the three different designs that we may have in the evolutionary class, and the three that we may have in the passive class, and then the advanced light water reactors, together with PIUS and CANDU, that we achieve some degree of standardization, not only by the individual utilities that build one design, but between and among the various designs. Does the EPRI Requirements document accomplish that? Does your Licensing Review Basis do that, or how would you propose accomplishing that objective?

DOCTOR BREWER: Well, first of all, Commissioner, eight standard designs is probably an improvement over what we now have, which is 110, something or other.

I think the economics of the marketplace will dictate how many of those eight will actually proceed to certification. A $200 million price tag for producing a standard design which is reviewable by the Commission is a pretty large barrier for a company to reach. So, the number is apt to be less than eight, or six, or whatever the Chairman mentioned.

So, I think this is also another reason for a sequential approach for NRC reviewing certification proposals, because it takes less resources from an NRC point of view to accomplish. That is why Mr. Scherer and I have recommended a sequential approach to these reviews. Don't put all eight on the table at one time, or skip jump over the evolutionary designs, or whatever.

MR. SCHERER: I won't speak for EPRI, but it is my opinion that the EPRI Requirements document was not meant to describe a standard design. I believe it is more appropriate to say that it tries to establish a design standard, for the next generation of plants to meet, and I think that's an appropriate role.

COMMISSIONER CURTISS: One final question. You've had a chance now to take a look at Part 52, which was put on the books earlier this year, and you'll be reaching the point here where you'll be submitting your formal information to seek design certification. Based upon what you've seen so far in Part 52, and your review of that, are there potential hard spots in the rule, areas that you think we ought to pay particular attention to as we now get into the process of actually taking that rule and applying it to specific designs in the certification area?

DOCTOR BREWER: I think the rule, Commissioner, is quite adequate, in the certification area, and we can live with it.

COMMISSIONER CURTISS: That's all I have.

CHAIRMAN ROBERTS: Let me ask you a couple questions about your Korean project. Is that a System 80 or a System 80 Plus, or somewhere in between?

DOCTOR BREWER: It's a System 80 design based on the Palo Verde design down rated to 1000 megawatts.

CHAIRMAN ROBERTS: If the happy circumstance occurs that somebody walked in your office and said, all right, I want a GE, could you give them a System 80 Plus now? Not really, based on the timetable you have given us.

DOCTOR BREWER: We are trying to get a certification from NRC for System 80 Plus.

CHAIRMAN ROBERTS: What is the status of the Korean project?

DOCTOR BREWER: The Korean project contracts were signed in 1987, the spring of '87. The project is on schedule. We have just about completed the technology transfer part of the agreements, and the Koreans have indicated that they will use the System 80 basic design as a basis for standardizing their future nuclear units.

MR. SCHERER: The two units that we have in Korea are System 80 design, as Doctor Brewer indicated.

CHAIRMAN ROBERTS: Essentially, the Palo Verde.

MR. SCHERER: Essentially, the Palo Verde.

However, to the extent that the next two light water reactors in Korea are System 80 Pluses, as opposed to System 80's, I think will depend on the quickness and decisiveness of the NRC review.

There is great weight given in South Korea to the U.S. Nuclear Regulatory Commission opinion and approval status of our design, and our schedule is consistent with trying to assure that the next two units in Korea are System 80 Pluses, as opposed to System 80's.

CHAIRMAN ROBERTS: Does anybody have anything to ask?

COMMISSIONER ROGERS: Yes, just, what is the expected lifetime of this design? Is this a 60 year life design?

DOCTOR MATZIE: 60.

COMMISSIONER ROGERS: Are you having any provisions for reactor vessel annealing? Do you think -- are you contemplating that in the design?

DOCTOR MATZIE: No. The materials selected, or specified I should say, for the reactor pressure vessel, and the construction technique, which is a ring forge reactor vessel, rather than a vended plate and welded vessel, result in a RTNDT at end of life well below screening criteria. It's on the order of 100 degrees, whereas the screening criteria is over 200 degrees.

So, we do not see any need for annealing, and have made no provisions to do that.

CHAIRMAN ROBERTS: Well, we thank you very much. It's been quite interesting, and thank you very much. We'll stand adjourned. We'll reconvene at 2:30 for our third presentation.

(Whereupon, at 2:02 p.m., the meeting was adjourned.)

CERTIFICATE OF TRANSCRIBER

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

TITLE OF MEETING: BRIEFING BY COMBUSTION ENGINEERING ON ALWR SYSTEM 80+

PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: NOVEMBER 1, 1989

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

Carol Lynch

Reporter's name: Peter Lynch

SCHEDULING NOTES

Title: Briefing by Combustion Engineering on ALWR System 80+

Scheduled: 1:00 p.m., Wednesday, November 1, 1989 (OPEN)

Duration: Approx 1 hr

Participants: Combustion Engineering — 60 mins

- Dr. Shelby T. Brewer, President
  Nuclear Power Businesses

- A. Ed Scherer, Director
  Nuclear Licensing

- Dr. Regis A. Matzie, Director
  Advanced Water Reactor Projects

Discussion Topics:

- System 80+
  - . Scope of Design
  - . Significant New Features
  - . Utility Needs
  - . Certification Schedule

SYSTEM 80+™

Advanced Nuclear Power Plant

Meeting with
The Nuclear Regulatory Commission
November 1, 1989

Combustion Engineering, Inc.

Dr. Shelby T. Brewer

President

Nuclear Power Businesses

Overview of Combustion Engineering Nuclear Systems Design Activities

- System 80 Plus™ Standardized Nuclear Power Plant
- The Safe Integral Reactor (SIR)
- Commercial HTGR
- New Production Reactors
  - HTGR
  - Heavy Water Reactor

Nuclear Recession of the 70`s Institutional, Not Technological

System 80 Plus:
Responsive to Market Realities

- Evolutionary Improvements
- Proven Technology
- Economy of Scale
- Design Detail Available to Support Certification
- Available in the Early 1990`s

System 80 Plus
Design Certification

- Demonstrates that Institutional Obstacles Can Be Overcome
- No Lead (or Demonstration) Unit Required
- C – E is Committed to the Process

Mr. A. Edward Scherer
Director
Nuclear Licensing

Advanced Reactors
Regulatory Review

Evolutionary ALWR`s	**Phase I**
Passive ALWR`s	**Phase II**
"Advanced" (Non – Water) Reactors	**Phase III**

- **Each Reactor Technology Has Merit**

- **Significant Variation in Technology Development, Commercial Application, and Regulatory Experience**

Achieve Certification; Available for Deployment

Evolutionary ALWR`s	Early 1990`s
Passive ALWR`s	Late 1990`s
"Advanced" (Non – Water) Reactors	Beyond 2000

System 80 Plus
Design

- Full Compliance with 10CFR52
- Incorporate EPRI Requirements
- Overwhelm Outstanding Regulatory Issues by Design
  - Severe Accidents
  - USI`s, GI`s, etc.

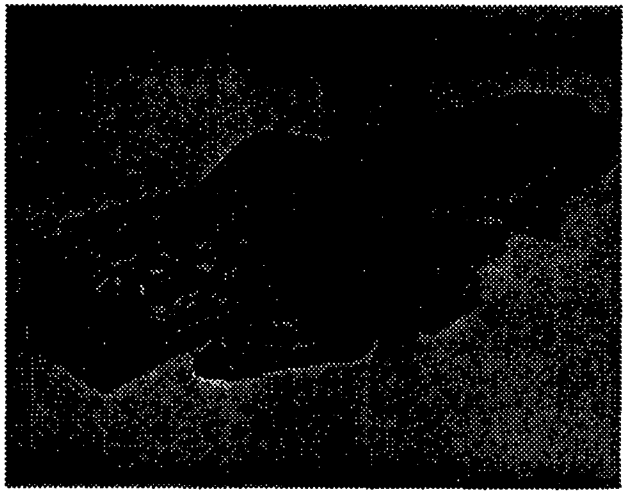
Dr. Regis A. Matzie

Director

Advanced Water Reactor Projects

Combustion Engineering`s ALWR Program

- Start with C–E`s System 80 NSSS and Duke Power`s Cherokee/Perkins BOP
- Make Significant Design Changes
  - Implement EPRI-ALWR Require–ments Document
  - Address Severe Accident Issues
- Obtain NRC Design Certification



System 80 Plus is an Essentially Complete Nuclear Power Plant

- Reactor Systems
- Safeguards Systems
- Steam and Power Conversion Systems
- Turbine Generator Systems
- Waste Management Systems

System 80 Plus is an Essentially Complete Nuclear Power Plant (Continued)

- Onsite Power System
- Containment Structure and Support Systems
- Cooling Water Systems
- Support Systems
- Control Buildings
- Other Buildings and Structures

System 80 Plus:
Conceptual Design Only

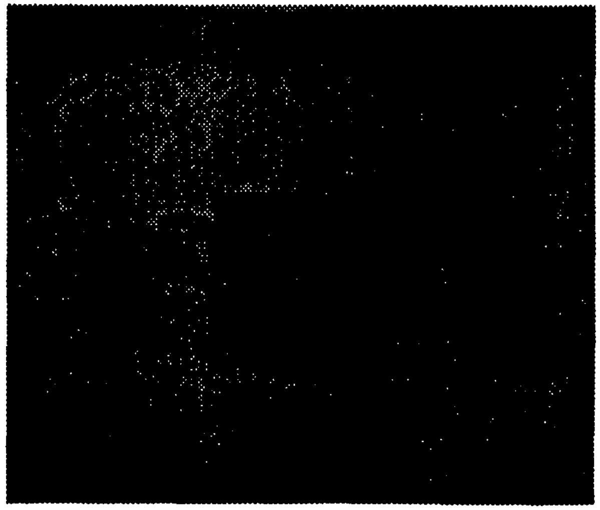
Site – Specific Features, e.g.:

- Offsite Power (Switchyard)
- Training Facilities
- Ultimate Heat Sink
- Warehouses
- Normal Heat Sink & Intakes
- Security System

Integrated Design Approach

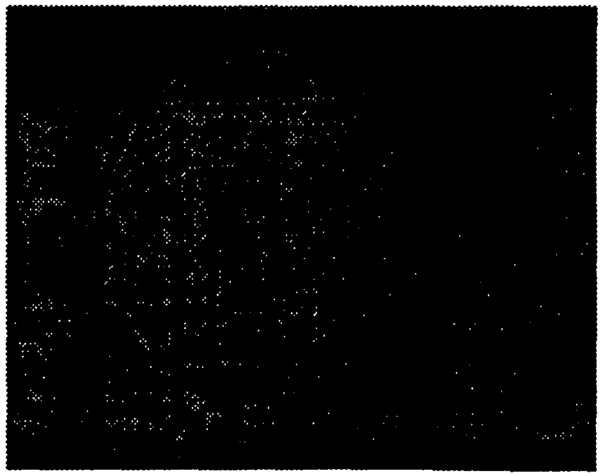
Improved Reactor Coolant System & Safeguards

- Increased Inventories
- Increased Margins
- Improved Materials
- 4 Train ECCS
- 4 Train EFWS
- In – Containment RWT
- Safety Depres – surization System
- Alternate Emergency Power Supplies

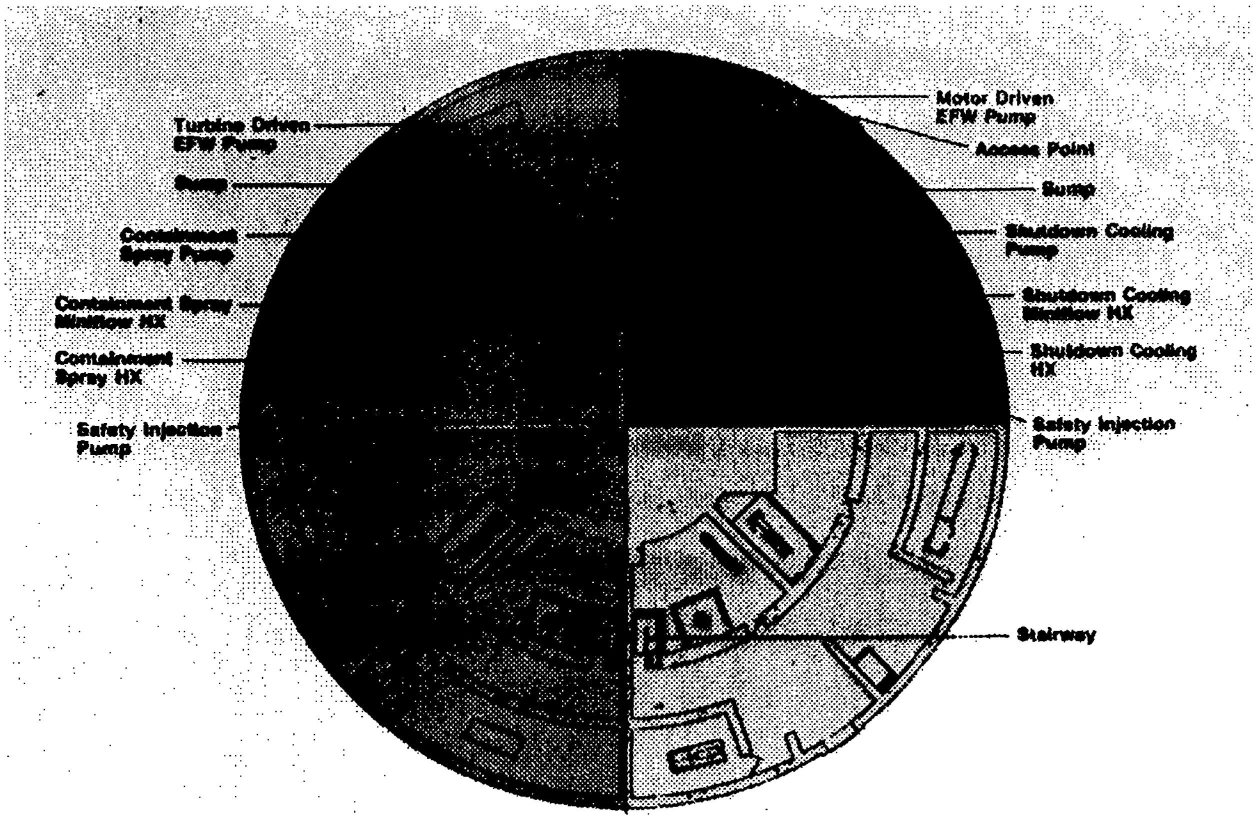


Large, Steel Spherical Containment

- Dual Containment
- 200 Ft. Diameter



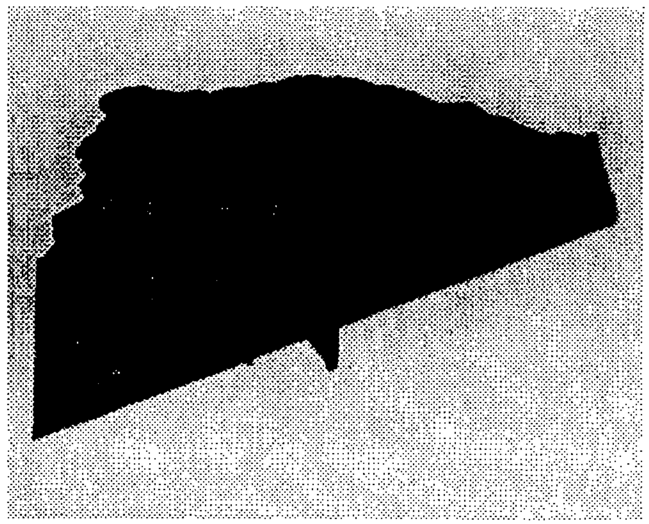
- Increased Space for Maintenance and Access
- Designed to Mitigate Severe Core Damage
- Subsphere Space Houses Safeguard Systems



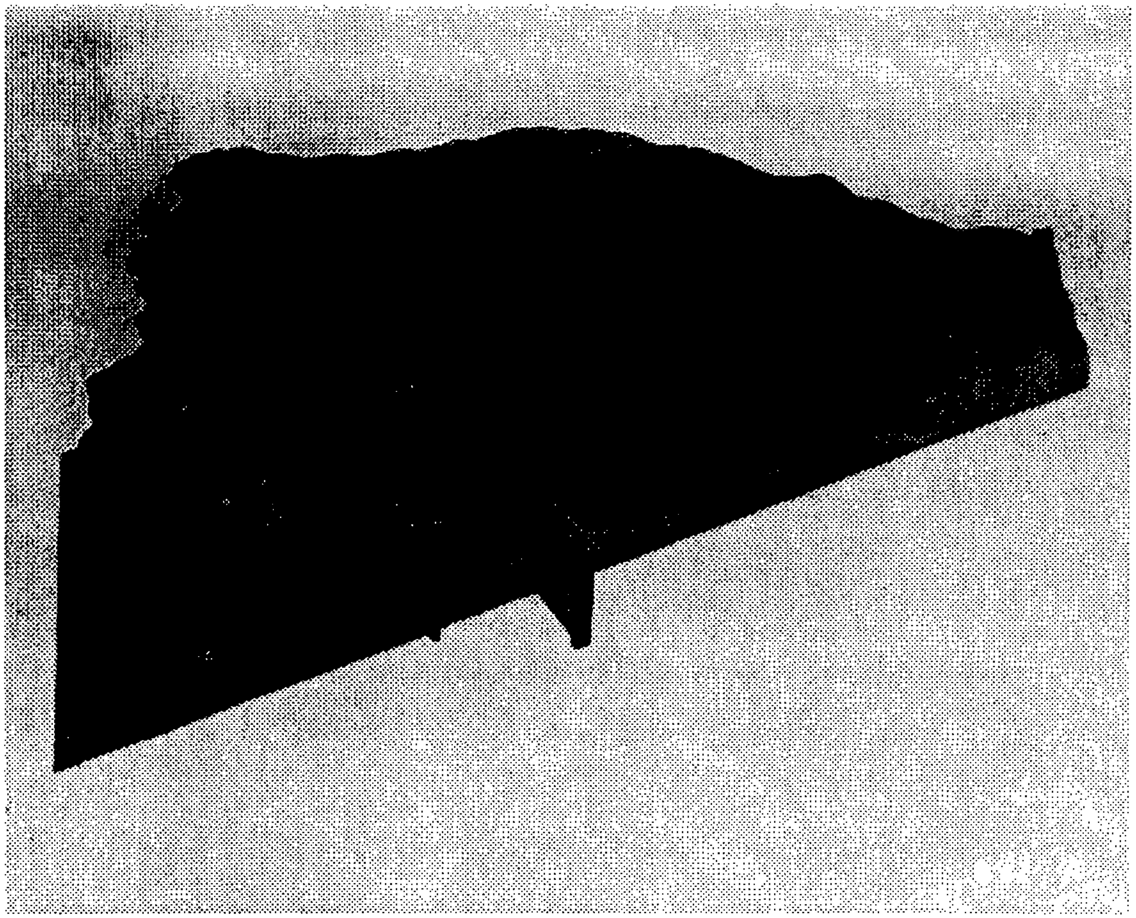
Turbine Driven EFW Pump
Sump
Containment Spray Pump
Containment Spray Miniflow HX
Containment Spray HX
Safety Injection Pump
Motor Driven EFW Pump
Access Point
Sump
Shutdown Cooling Pump
Shutdown Cooling Miniflow HX
Shutdown Cooling HX
Safety Injection Pump
Stairway

Advanced Control Room

- Large Display Screen
- Touch – Sensitive CRT & Plasma Displays
- Microprocessors Reduce Operator Burden
- Hierarchy of Information



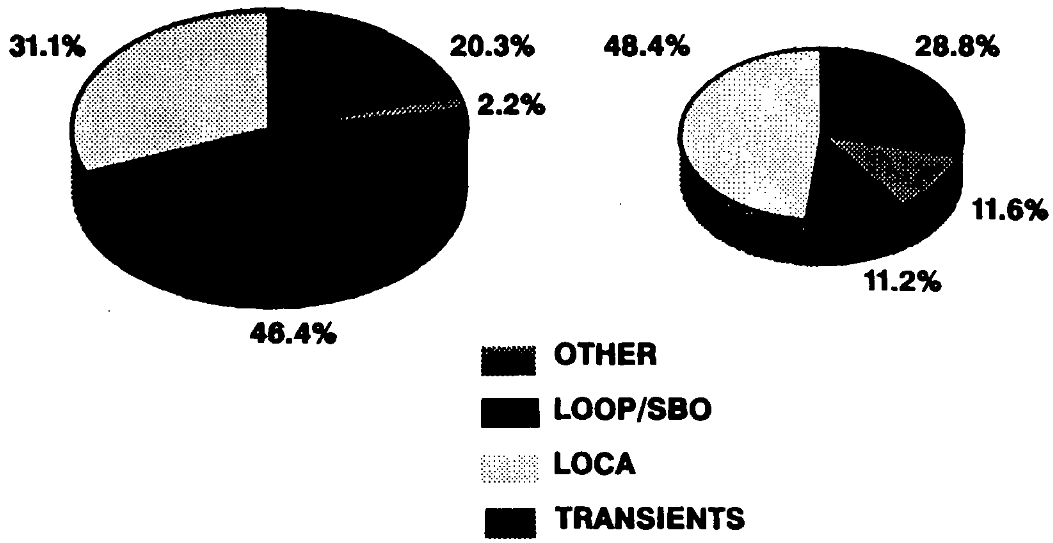
- Prioritized Alarms
- Multiplexing
- Off – The – Shelf Equipment
- Self – Testing Features



Dominant Contributors to Severe Accident Risk

(Core Damage Frequency, Internal Events)

SYSTEM 80 – 8.14E – 5   Factor of ~ 100 Reduction →   SYSTEM 80+ – 7.87E – 7



Mr. A. Edward Scherer
Director
Nuclear Licensing

Design Certification

- First Submittal:
  November, 1987

- Formal Application for Certification Under Part 52
  March, 1989

- Licensing Review Basis Document Still Under Staff Review

CESSAR – DC
Submittals Completed

Date	Major Items
November 1987	– General Description – Power Conversion System
April 1988	– Reactor Core & Coolant System – Chemical & Volume Control System – Process Sampling System
June 1988	– Shutdown Cooling System – Safety Injection System – Emergency Feedwater System

CESSAR – DC
Submittals Completed

Date	Major Items
September 1988	– Site Envelope
	– Safety Depressurization System
	– I&C Systems
	– Human Factors Engineering
March 1989	– Leak – Before – Break Analysis
	– Balance of Plant Descriptions
	– Electrical Power Distribution
	– Reactor Protection System
	– Fuel Handling System
	– Radwaste Systems
	– Building and Site Arrangements
	– Containment Systems
	– Sabotage Protection Program

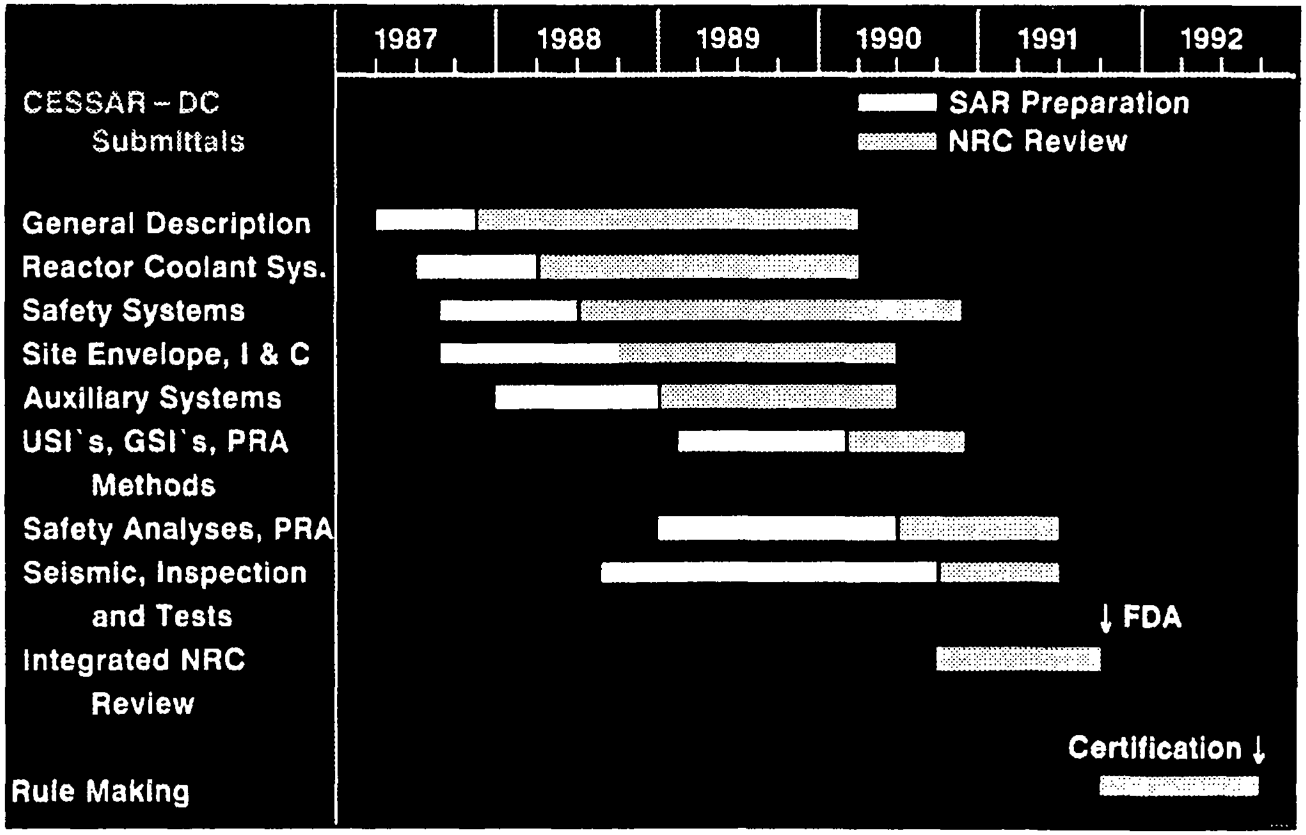
CESSAR – DC
Planned Submittals

Date	Major Items
December 1989	– Resolutions to 60 USIs/GSIs
	– PRA Methodology
March 1990	– Remaining USI/GSI Resolutions (60)
	– Equipment Qualification Envelopes
	– Additional System Information

CESSAR – DC
Planned Submittals

Date	Major Items
June 1990	– Safety Anaysis
	– PRA & Severe Accident Results
	– Seismic Methods
	– Building Layouts
September 1990	– Seismic Results
	– Technical Specifications
	– Inspections, Tests, Maintenance & Reliabilty Guidelines

System 80+ Certification Schedule



Summary

- System 80 Plus is a Dramatically Improved Advanced Reactor
- System 80 Plus is Responsive to Market Demands
- NRC Review in Progress
- Schedule is Realistic and Achievable

FDA: 1991
Certification: 1992