

# UNITED STATES OF AMERICA NUCLEAR REGULATORY COMMISSION

Title: BRIEFING BY COMBUSTION ENGINEERING ON ALWR  
SYSTEM 80+

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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BRIEFING BY COMBUSTION ENGINEERING ON ALWR SYSTEM 80+

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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

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## 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

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## 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

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1 talk about certification of our System 80 Plus  
2 advanced pressurized water reactor plant design.

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

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

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

16 Second, we want to point out some of the new  
17 design features that we have incorporated into System  
18 80 Plus -- including those specifically directed at  
19 meeting EPRI requirements and resolving severe  
20 accident concerns.

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

25 We would, of course, welcome any questions

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1 or comments that you might have during the course of,  
2 or after, our presentation.

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

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

16 Development of our System 80 Plus design is  
17 geared toward the future domestic market, and is  
18 shaped by our perspective of market requirements, both  
19 in the near term and the long term. In addition, it  
20 supports our design and construction activities in the  
21 Republic of Korea. The two units to be constructed at  
22 Yonggwang are based on our System 80 design and will  
23 contain some of the System 80 Plus features.  
24 Furthermore, in partnership with Combustion  
25 Engineering, the Koreans are embarking on a

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1 standardization program, and we fully expect that  
2 System 80 Plus will serve as the model for the next  
3 light water reactors to be built in Korea.

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

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

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

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

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1 future market.

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

6 That recession, Slide 3 please, did not  
7 result from any inherent deficiency in the technology,  
8 but instead resulted from a labyrinth of  
9 institutional, political, regulatory, economic and  
10 financial forces. This particular litany of problems  
11 is well known and I will not dwell on them here at  
12 this session. Nonetheless, the experiences of the  
13 1970's and 80's reinforce my belief that it is the  
14 institutional problems that we must solve if we are to  
15 see a resurgence of nuclear orders. Technological  
16 improvement alone will not suffice, and a completely  
17 new reactor type is neither necessary nor sufficient  
18 to bring about further deployment of nuclear power in  
19 the United States.

20 I do not believe that a utility will  
21 consider ordering a nuclear power plant unless it is a  
22 standardized design, based on proven technology, and  
23 is pre-licensed by the Nuclear Regulatory Commission.  
24 The evolutionary ALWR -- like System 80 Plus -- is the  
25 only reactor species that can meet these requirements

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1 in the near term, and these are plain realities of the  
2 marketplace.

3 System 80 Plus is responsive to these market  
4 realities.

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

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

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

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

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

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

21 Ed?

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

25 The reactor designs being developed today by

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1 Combustion Engineering and others fall into three  
2 general categories:

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

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

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

19 In what I see or have been calling a second  
20 phase -- the review of the passive reactors -- the  
21 Commission will not only have to deal with the first  
22 set of questions, but with some additional fundamental  
23 issues. For example, what are the appropriate trade-  
24 offs between reliance on "passive" safety features and  
25 the traditional emphasis that has heretofore been

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1 placed on diversity? Questions such as, does the fact  
2 that passive safety systems cannot be used to achieve  
3 cold shutdown, as currently defined, and in the same  
4 manner as active systems require us to redefine the  
5 concept of "safe shutdown" for passive plants?

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

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

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

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

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

7 Slide 8. The evolutionary ALWR's -- such as  
8 System 80 Plus and the others you are hearing about  
9 today -- are the only technology that is in a position  
10 to complete the certification process by the early  
11 1990's. The passive ALWR's can follow in the mid to  
12 late 1990's, and the HTGR's and LMR's probably  
13 sometime after the year 2000.

14 Slide 9 please. Our approach to the System  
15 80 Plus design is straightforward. System 80 Plus is  
16 a complete nuclear power plant in full compliance with  
17 Part 52. Let me emphasize that, it's a complete  
18 nuclear power plant in full compliance with Part 52.  
19 We have actively participated in the development of  
20 the EPRI Requirements document and have reflected  
21 those requirements in the design. We have attempted  
22 to avoid the future regulatory hair-splitting by  
23 simply overwhelming issues with design features,  
24 particularly those associated with severe accidents  
25 and Unresolved Safety issues. We intend to increase

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1 the safety margin such that there is no question as to  
2 its acceptability to the regulator or the marketplace.

3 To describe how we have accomplished this  
4 effort, Doctor Matzie will review our design process  
5 and describe some of the new design features of System  
6 80 Plus and how they have contributed to improved  
7 safety and performance.

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

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

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

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

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

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

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

22 The next two slides show that the System 80  
23 Plus design is an essentially complete nuclear power  
24 plant. Everything required by 10 CFR, Part 52, and  
25 that which the staff will need to review the design

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1 under the Standard Review Plan, is included.

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

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

16 Maintenance requirements have dictated  
17 system design aspects and plant arrangement.

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

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

25 I will touch on these integration aspects in

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1 the following slides.

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

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

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

23 To the safety systems, we have made even  
24 more dramatic changes. First, the emergency core  
25 cooling system now has four trains instead of the two

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1 in our System 80 design, and the four trains, each  
2 train of which has the same capacity as the individual  
3 trains previously.

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

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

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

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1 pathway.

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

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

15 Next slide please. Another area where we  
16 have placed a great deal of emphasis is in the  
17 containment design. The System 80 Plus containment is  
18 a large spherical steel containment, based on the  
19 partially constructed Cherokee/Perkins containment.  
20 It is a dual containment, with 1-3/4 inch steel ASME  
21 code stamped vessel with a 53 PSIG design pressure,  
22 and an ultimate strength of over 200 PSIG. It has a  
23 three-foot thick concrete reinforced shield building  
24 outside of this steel pressure vessel. The diameter  
25 of the containment has increased to 200 feet, which

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1 increases the free volume of the containment  
2 approximately 30 percent greater than our currently  
3 operating System 80 plant.

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

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

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

25 This slide shows a cross-sectional view of

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1 the lowest level of the subsphere region, where all  
2 the safeguard's equipment is located. The upper half  
3 of the containment shown in two colors of blue, or two  
4 shades of blue, represents one division of safeguard  
5 systems. The lower half of the figure represents a  
6 second division of safeguard systems. Each of these  
7 is divided in half to show the mechanical trains that  
8 are associated with our four train system.

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

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

19 Next slide please. The main design emphasis  
20 in the instrumentation and controls area has been  
21 human factors engineering. Our advanced control  
22 complex, which I'll show in more detail on the  
23 subsequent slide after I've gone through these points,  
24 has a large display screen which provides an overview  
25 of the plant readily readable anywhere in the control

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1 room and adjoining offices, and shows the major plant  
2 parameters indicating trends in the availability of  
3 success paths.

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

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

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

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

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

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

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

25           The figure also shows to the left of the

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1 screen the offices on the lower level which provide  
2 working space for the shift supervisor, the technical  
3 advisor and the nuclear equipment operators. All have  
4 a direct visual contact with the overview display at  
5 the front of the control room where all the major  
6 plant parameters and trends can be seen from their  
7 offices.

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

14 The next slide please. As I have mentioned  
15 earlier, PRA was used during the design process to  
16 evaluate alternatives. We have been successful in  
17 making dramatic improvements in safety. Although  
18 these two pie charts are not to scale, the left pie  
19 chart represents major contributions to core melt or  
20 core damage frequency, which has a value of  $8 \times 10^{-5}$ , making for our reference plant the design  
21 improvements that we have incorporated into the System  
22 80 Plus design have resulted in a factor of greater  
23 than 100 reduction in the core damage frequency from  
24 the various improvements that I've mentioned thus far.  
25

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1 So that, the number now is less than  $8 \times 10^{-7}$ .

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

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

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

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

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

23 We have, of course, had extended discussions  
24 with the staff on a Combustion Engineering Licensing  
25 Review Basis document. We have substantially revised

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1 it this year to reflect the requirements of Part 52.  
2 Based on our most recent discussions, we have not  
3 identified any significant differences between  
4 ourselves and the staff and we are looking forward to  
5 the issuance of a Licensing Review Basis document in  
6 the near future. In any event, we are proceeding to  
7 complete the remaining segments of CESSAR-DC.

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

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

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

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

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

3 The next slide shows our overall schedule.

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

10 The material submitted so far is under  
11 intense staff review. To date we have received some  
12 277 questions from the staff and we have responded to  
13 186. We expect that the pace of this staff review  
14 will accelerate in the coming months.

15 To summarize then:

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

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

24 NRC review of our application is in  
25 progress. We have identified no insurmountable

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1 obstacles, but the bulk of the technical review is  
2 still ahead of us.

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

7 Doctor Brewer?

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

11 CHAIRMAN ROBERTS: Ken?

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

16 DOCTOR MATZIE: Okay. The principal factors  
17 are the following: the addition of the alternate AC  
18 power supply at the combustion turbine; the addition  
19 of a safety depressurization system; the increase in  
20 the number of trains of safety injection and emergency  
21 core cooling; and, other improvements to the  
22 electrical system, such as additional batteries,  
23 additional on-site feeders and the addition of a  
24 breaker on the turbine. That set of items -- excuse  
25 me, one other, it was the incorporation of the

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1 refueling water storage tank in containment.

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

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

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

16 COMMISSIONER ROGERS: Yes.

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

19 DOCTOR MATZIE: Okay. The philosophy has  
20 many aspects, all of which were put before a  
21 interdisciplinary review team consisting of INC  
22 people, nuclear designers, operators, human factors  
23 engineers, but the various philosophies were, (1)  
24 let's reduce the burden of the operator, and that  
25 comes through a number of items which I alluded to,

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1 and I can list a few of them. Let's reduce the number  
2 of indications to the operator which are identical but  
3 which he has to sort through to come to the conclusion  
4 of what the parameter really is. As an example, there  
5 are something like 16 pressurizer level indications in  
6 a conventional control room for System 80. We have  
7 reduced that down to one, so that he has an  
8 unambiguous indication.

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

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

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

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1 valid signals.

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

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

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

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

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1 power.

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

5 COMMISSIONER ROGERS: Basically, a manually  
6 operated plant.

7 DOCTOR MATZIE: That's correct.

8 COMMISSIONER ROGERS: Yes.

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

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

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

23 COMMISSIONER ROGERS: Uh-huh.

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

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1 articulate your criterion?

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

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

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

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

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1 COMMISSIONER ROGERS: Thank you.

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

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

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

23 MR. SCHERER: Commissioner Curtiss, I think  
24 it provides a generic resolution basis for the staff's  
25 approval of both the GE, Combustion Engineering and,

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1 perhaps, later Westinghouse design.

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

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

20 COMMISSIONER CURTISS: Is the generic  
21 benefit that you've described where you document the  
22 basis for the staff's conclusions with respect to a  
23 particular design, is that so significant that you  
24 think that the Commission ought to complete its review  
25 of the EPRI Requirements document before we move

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1 forward on individual designs, or is that simply sort  
2 of a looking back benefit, it documents it for the  
3 sake of regulatory history?

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

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

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

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1 Does that follow?

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

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

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

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

16           COMMISSIONER CURTISS: Okay.

17           Just a quick couple of other questions. In  
18 the Chairman's absence, let me follow up on a question  
19 that he raised this morning with the GE  
20 representatives, a question put to how we as an agency  
21 ensure some degree of standardization between and  
22 among the various vendor designs. I don't know if you  
23 were here this morning, but he asked the question, how  
24 do we ensure in our interest in enhancing  
25 standardization that with the three different designs

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1 that we may have in the evolutionary class, and the  
2 three that we may have in the passive class, and then  
3 the advanced light water reactors, together with PIUS  
4 and CANDU, that we achieve some degree of  
5 standardization, not only by the individual utilities  
6 that build one design, but between and among the  
7 various designs. Does the EPRI Requirements document  
8 accomplish that? Does your Licensing Review Basis do  
9 that, or how would you propose accomplishing that  
10 objective?

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

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

22 So, I think this is also another reason for  
23 a sequential approach for NRC reviewing certification  
24 proposals, because it takes less resources from an NRC  
25 point of view to accomplish. That is why Mr. Scherer

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1 and I have recommended a sequential approach to these  
2 reviews. Don't put all eight on the table at one  
3 time, or skip jump over the evolutionary designs, or  
4 whatever.

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

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

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

25 COMMISSIONER CURTISS: That's all I have.

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1           CHAIRMAN ROBERTS: Let me ask you a couple  
2 questions about your Korean project. Is that a System  
3 80 or a System 80 Plus, or somewhere in between?

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

7           CHAIRMAN ROBERTS: If the happy circumstance  
8 occurs that somebody walked in your office and said,  
9 all right, I want a GE, could you give them a System  
10 80 Plus now? Not really, based on the timetable you  
11 have given us.

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

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

16          DOCTOR BREWER: The Korean project contracts  
17 were signed in 1987, the spring of '87. The project  
18 is on schedule. We have just about completed the  
19 technology transfer part of the agreements, and the  
20 Koreans have indicated that they will use the System  
21 80 basic design as a basis for standardizing their  
22 future nuclear units.

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

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1 CHAIRMAN ROBERTS: Essentially, the Palo  
2 Verde.

3 MR. SCHERER: Essentially, the Palo Verde.

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

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

14 CHAIRMAN ROBERTS: Does anybody have  
15 anything to ask?

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

19 DOCTOR MATZIE: 60.

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

23 DOCTOR MATZIE: No. The materials selected,  
24 or specified I should say, for the reactor pressure  
25 vessel, and the construction technique, which is a

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1 ring forge reactor vessel, rather than a vended plate  
2 and welded vessel, result in a RTNDT at end of life  
3 well below screening criteria. It's on the order of  
4 100 degrees, whereas the screening criteria is over  
5 200 degrees.

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

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

12 (Whereupon, at 2:02 p.m., the meeting was  
13 adjourned.)  
14  
15  
16  
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25

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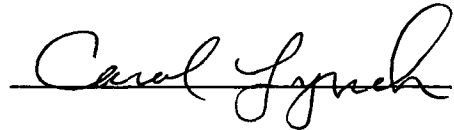
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TITLE OF MEETING: BRIEFING BY COMBUSTION ENGINEERING ON ALWR  
SYSTEM 80+

PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: NOVEMBER 1, 1989

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11/1/89

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



**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**



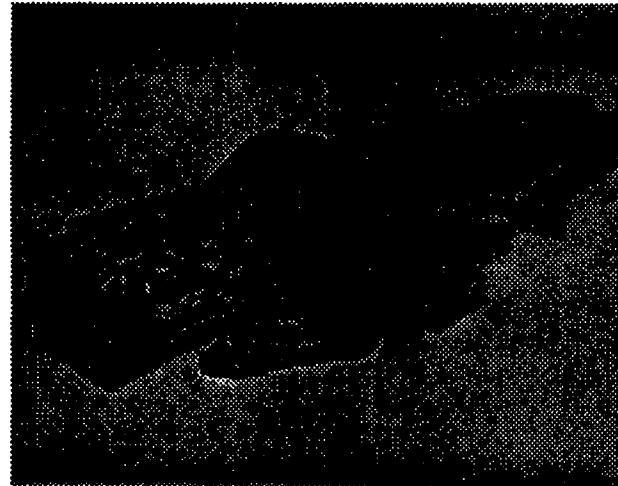
## **System 80 Plus Design**

- **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 Requirements 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)**

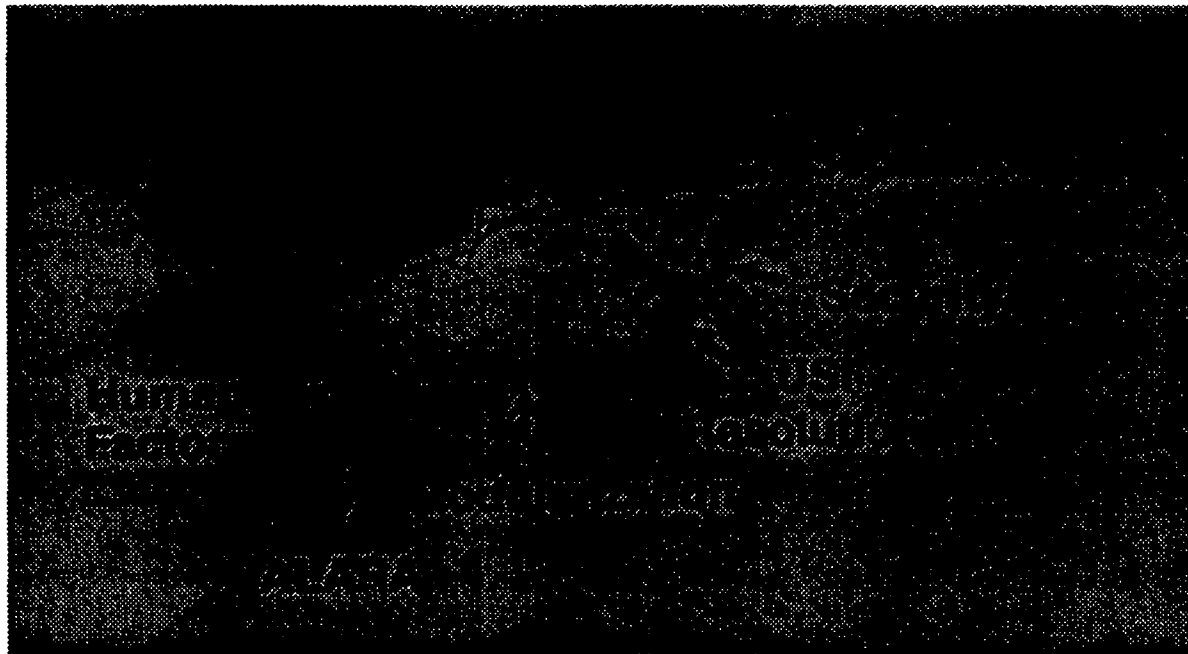
- **Onsite Power System**
- **Containment Structure and Support Systems**
- **Cooling Water Systems**
- **Support Systems**
- **Control Buildings**
- **Other Buildings and Structures**

## **System 80 Plus: Conceptual Design Only**

### **Site – Specific Features, e.g.:**

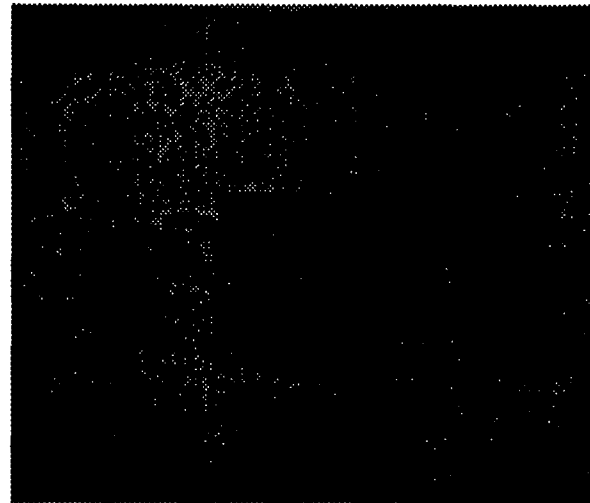
- **Offsite Power (Switchyard)**
- **Training Facilities**
- **Ultimate Heat Sink**
- **Warehouses**
- **Normal Heat Sink & Intakes**
- **Security System**

# 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**

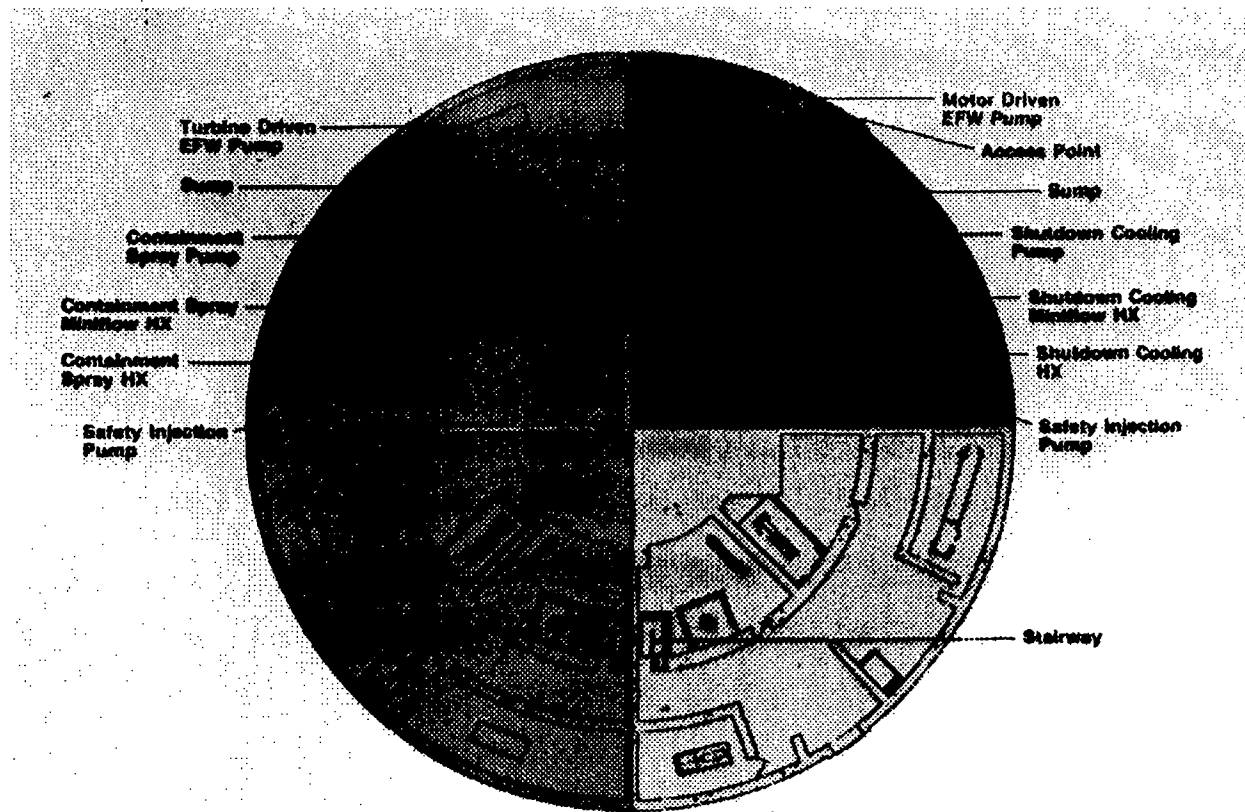




## **Large, Steel Spherical Containment**

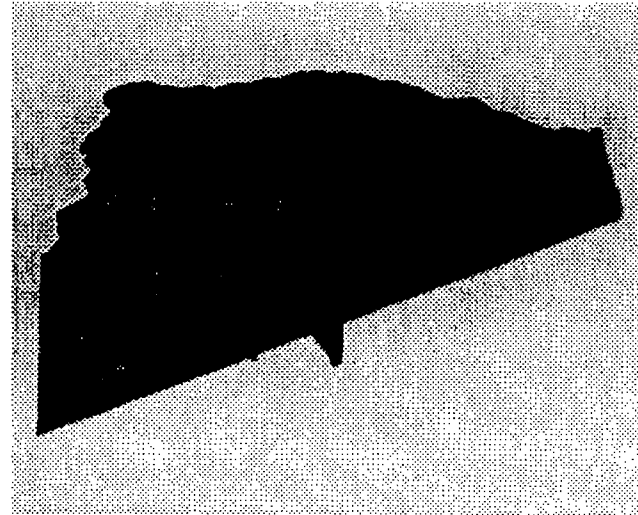
- **Dual Containment**
- **200 Ft. Diameter**
- **Increased Space  
for Maintenance  
and Access**
- **Designed to  
Mitigate Severe  
Core Damage**
- **Subsphere Space  
Houses Safeguard Systems**

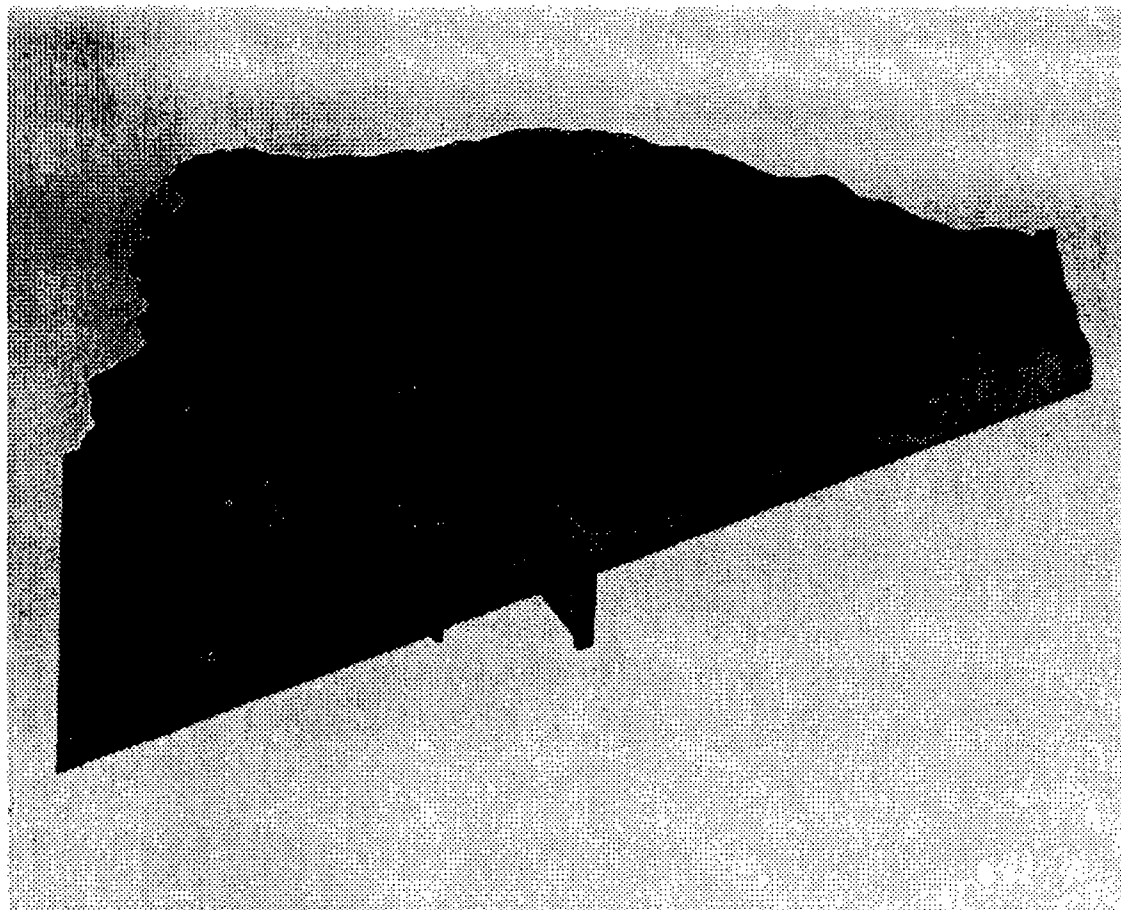




## **Advanced Control Room**

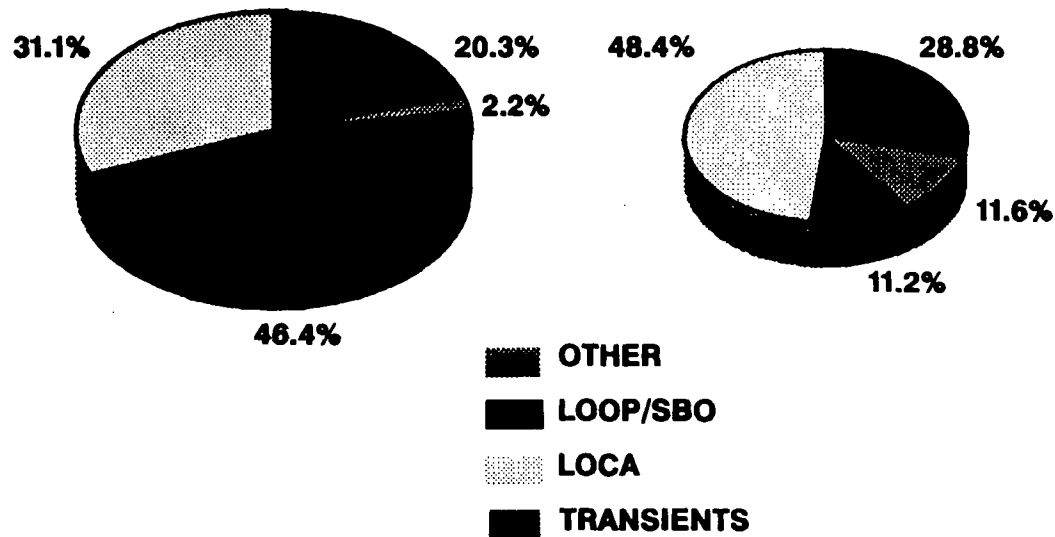
- **Large Display Screen**
- **Touch – Sensitive CRT & Plasma Displays**
- **Microprocessors Reduce Operator Burden**
- **Hierarchy of Information**
- **Prioritized Alarms**
- **Multiplexing**
- **Off – The – Shelf Equipment**
- **Self – Testing Features**





# Dominant Contributors to Severe Accident Risk (Core Damage Frequency, Internal Events)

**SYSTEM 80** -  $8.14\text{E}-5$       Factor of ~ 100 Reduction      **SYSTEM 80+** -  $7.87\text{E}-7$



**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**

<b>Date</b>	<b>Major Items</b>
<b>November 1987</b>	<ul style="list-style-type: none"><li>– <b>General Description</b></li><li>– <b>Power Conversion System</b></li></ul>
<b>April 1988</b>	<ul style="list-style-type: none"><li>– <b>Reactor Core &amp; Coolant System</b></li><li>– <b>Chemical &amp; Volume Control System</b></li><li>– <b>Process Sampling System</b></li></ul>
<b>June 1988</b>	<ul style="list-style-type: none"><li>– <b>Shutdown Cooling System</b></li><li>– <b>Safety Injection System</b></li><li>– <b>Emergency Feedwater System</b></li></ul>



## **CESSAR – DC**

### **Submittals Completed**

<b>Date</b>	<b>Major Items</b>
<b>September 1988</b>	<ul style="list-style-type: none"><li>– <b>Site Envelope</b></li><li>– <b>Safety Depressurization System</b></li><li>– <b>I&amp;C Systems</b></li><li>– <b>Human Factors Engineering</b></li></ul>
<b>March 1989</b>	<ul style="list-style-type: none"><li>– <b>Leak – Before – Break Analysis</b></li><li>– <b>Balance of Plant Descriptions</b></li><li>– <b>Electrical Power Distribution</b></li><li>– <b>Reactor Protection System</b></li><li>– <b>Fuel Handling System</b></li><li>– <b>Radwaste Systems</b></li><li>– <b>Building and Site Arrangements</b></li><li>– <b>Containment Systems</b></li><li>– <b>Sabotage Protection Program</b></li></ul>

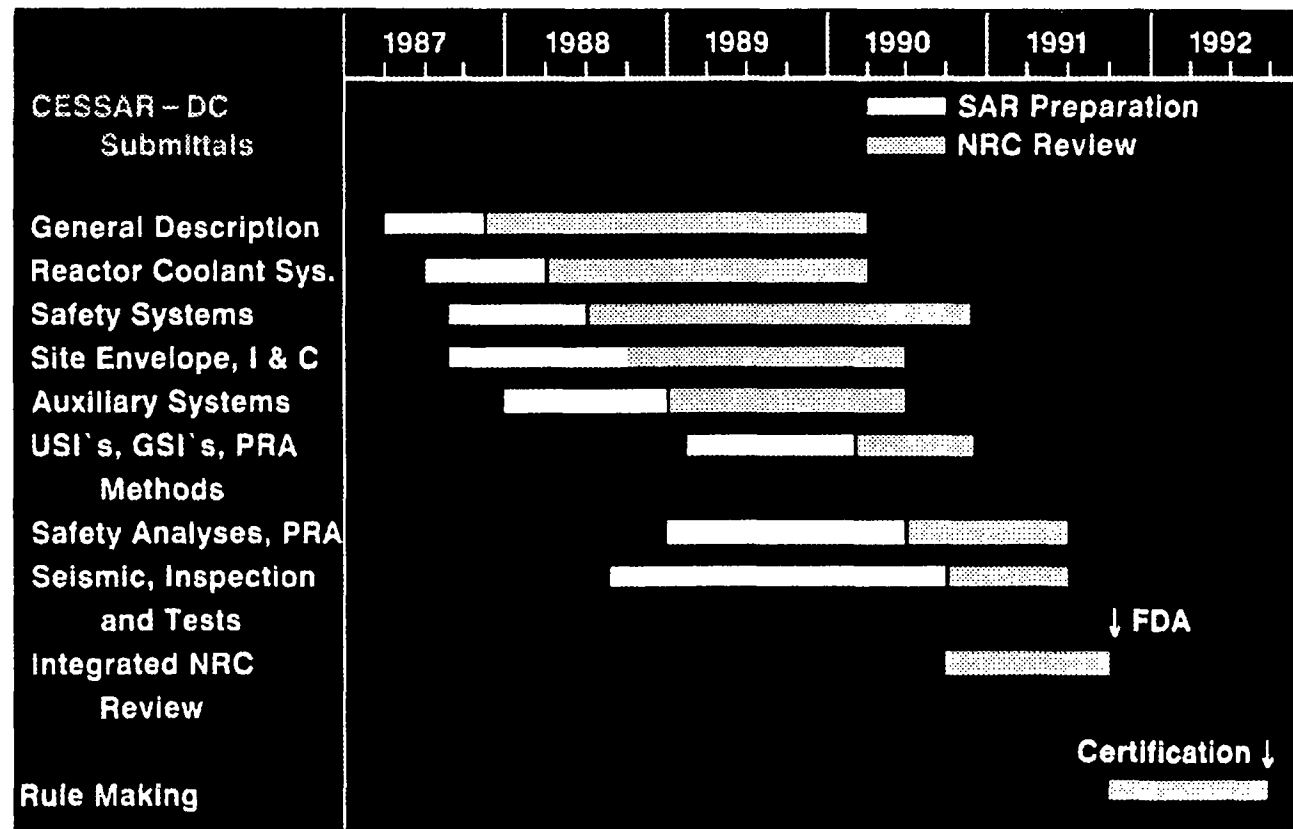
## **CESSAR – DC Planned Submittals**

<b>Date</b>	<b>Major Items</b>
<b>December 1989</b>	<ul style="list-style-type: none"><li>– Resolutions to 60 USIs/GSIs</li><li>– PRA Methodology</li></ul>
<b>March 1990</b>	<ul style="list-style-type: none"><li>– Remaining USI/GSI Resolutions (60)</li><li>– Equipment Qualification Envelopes</li><li>– Additional System Information</li></ul>

## **CESSAR – DC Planned Submittals**

<b>Date</b>	<b>Major Items</b>
<b>June 1990</b>	<ul style="list-style-type: none"><li>– <b>Safety Analysis</b></li><li>– <b>PRA &amp; Severe Accident Results</b></li><li>– <b>Seismic Methods</b></li><li>– <b>Building Layouts</b></li></ul>
<b>September 1990</b>	<ul style="list-style-type: none"><li>– <b>Seismic Results</b></li><li>– <b>Technical Specifications</b></li><li>– <b>Inspections, Tests, Maintenance &amp; Reliability Guidelines</b></li></ul>

# 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**