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T E S T I M O N Y

before

House Committee on Science and Technology

Subcommittee on Fossil & Nuclear Energy R&D

by

Thomas B. Cochran

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Mr. Chairman, and members of the Committee, my name is Thomas B. Cochran. I have a Ph.D in Physics from Vanderbilt University. I am presently a Staff Scientist at Natural Resources Defense Council. For the past 5 years I have been closely following Federal energy R&D policy, focusing principally on the breeder reactor program, and other plutonium related issues.

I have recently prepared "An Analysis of the Carter Administration's FY-1978 ERDA Budget to Congress". I would like to have this included in the record and to take this opportunity to present some of the highlights of this analysis.

ERDA's proposed FY 1978 energy R&D budget under the new Administration continues the Ford Administration's heavy emphasis on nuclear power development, at least pending promised reviews of the Liquid Metal Fast Breeder Reactor (LMFBR) Program and ERDA's program for the development of the nuclear fuel cycle. Approximately 40%-45% of ERDA's proposed R&D budget is allocated to fission power development. Approximately one-half of this amount (20% to 25% of the total ERDA budget) is for one program -- the LMFBR. In contrast only 21% is allocated to conservation, solar and geothermal combined.

Admirably the Carter Administration has doubled the funding for energy conservation and restored the Ford Administration cuts in the funding requested by the conservation division within ERDA.

While President Carter called in the campaign for a strong shift in energy R&D towards solar energy and conservation, the Carter Administration has given the solar program a mere cost of living increase over FY 1977 funding levels. While there have been shifts of funds within the solar program proposed budget authority for all solar programs for FY 1978 is increased only 5% over FY 1977.

The Ford Administration cut the R&D funding requested by the geothermal division by 29% (budget outlays). The Carter Administration restored none of it. The geothermal program funding is increased by 3.3% over FY 1977, not even a cost of living increase.

ERDA is poised to launch a massive new program to subsidize the back end of the nuclear fuel cycle. Pending the outcome of a Carter Administration review of non-proliferation policy, funding in FY 1978 could be directed toward launching the plutonium economy by "demonstrating" plutonium reprocessing and plutonium recycle programs. Alternatively, if the new Administration decides to postpone plutonium recycle, these funds would be used principally for the management and long-term storage of used reactor fuel.

At the direction of President Carter, ERDA has initiated an intensive review of the LMFBR program, and the Clinch River Breeder Reactor (CRBR) project in particular. Pending this review President Carter has reduced the FY-1978 LMFBR funding by $200 million in Authority and $85 million in Outlays from the funding level recommended by the Ford Administration. The recommended FY-1978 budget authority for the LMFBR is presently $30 million (4.3%) less than the FY-1977 level and the outlays are $57 million (9.5%) higher. I do not believe these cuts represent "the severe reduction in our excessive emphasis on this project" as called for by President Carter during the campaign. To the contrary, I believe they simply trim some of the fat from the LMFBR budget without any significant effect on the momentum of the program. In fact, it has been reported that ERDA believes that the effect of these cuts has been to slip the optimistic February 1984 criticality date for CRBR by only 4 to 5 months. If the committee desires, I will be pleased to discuss in more detail where these

budget cuts were made within the LMFBR program and comment on their significance.

I would like at this time to submit for the record a separate report where I have set forth an alternative LMFBR Program that I believe represents a vast improvement over the present program. The rationale for the option I propose is based on the following considerations each of which is discussed in more detail in the report.

1. The risks of making massive investments in a plutonium-based energy technology and moving rapidly towards a U.S. and world commitments to a plutonium economy;
2. The present misplaced energy R&D priorities characterized by an excessive emphasis on commercialization of the LMFBR technology, neglect of energy conservation potential, and underfunding of alternative non-nuclear supply technologies;
3. The enormous cost overruns which the LMFBR program is experiencing;
4. Obsolete design of the CRBR -- a design that does not contain features that could considerably enhance the safety of the CRBR and the commercial viability of the LMFBR;
5. The inconsistency of the present LMFBR program structure, focused on commercialization, with ERDA policy to postpone a decision on commercialization for at least a decade until key issues related to safeguarding special nuclear material, breeder reactor safety, waste management and uranium availability are resolved; and
6. The lack of a clear economic incentive to continue the LMFBR program at the current pace.

Of these six considerations, by far the most important is the first, the risks associated with the proliferation of nuclear weapons.

In a third report "Nuclear Weapons Proliferation - The State Threat and the Non-State Adversary", which I would also like to submit for the record, NRDC presents a detailed analysis supporting why it is of utmost importance and urgency for the U.S. to unequivocally reject the idea of reprocessing nuclear fuel for plutonium recovery in the foreseeable future either here or abroad.

An often repeated argument for proceeding with the plutonium economy is that the genie is out of the bottle and any country that wants a weapons option can build the necessary facilities dedicated to achieving that option. This argument fails to recognize that if reprocessing, and recovery and stockpiling of plutonium are permitted by non-weapons states, then without violating any of the international safeguards agreements and treaties, any non-weapons state could move to a point of being as little as hours away from having nuclear weapons, perhaps needing only to cast the plutonium and place it into the weapon. The non-weapons state in such an event would have all its options open. Like Israel, it could declare itself a non-weapons state, yet, at any time, it would be only moments away from having a weapons option. Under these conditions, the international safeguards regime serves nothing more than a cover for nascent weapons states, concealing the signs of critical changes taking place prior to the actual diversion.

Furthermore, once reprocessing large flows of recovered plutonium and plutonium stockpiles become a worldwide reality, the shortest road to a weapons option is no longer the time-consuming and obvious construction of dedicated facilities. Instead, the preferred route would be through the civilian nuclear power program, through the peaceful atom.

Several proposals, the possibility of multinational ownership of fuel reprocessing facilities, "co-processing" of breeder fuel, and restricting breeders to weapons states have been suggested as a means to curb their proliferation potential. These concepts offer little, even if they could be shown to be practicable.

Multinational facilities would legitimize the argument of non-participating countries that their national plutonium facilities and stockpiles are peaceful. They would supply participating non-weapons states with large amounts of usable plutonium in the form of fresh fuel. And they would provide opportunities for the clandestine diversion of plutonium, targets for expropriation, and the means of spreading reprocessing technology. Similar arguments apply to the concept of restricting breeders to weapons states. It is unrealistic to believe that separated plutonium can be restricted to nuclear weapons states in a world heavily dependent on plutonium fuel with reprocessing.

Co-processing of breeder fuel has been proposed by ERDA as an approach that "could potentially eliminate separated plutonium from the reprocessing and recycle scheme". A country with such a facility would need only to change the solvents used in the reprocessing operation, a trivial exercise in chemistry, to convert the facility to the production of pure plutonium. Furthermore, it is a simple chemical operation to separate the plutonium from the co-processed plutonium and uranium mixture. Thus a non-weapons state would still be only a matter of days away from having weapons usable material in hand.

It is essential that the U.S. breeder effort, if allowed to proceed, be restructured to pursue only breeder and near-breeder technologies that are more proliferation resistant. A minimum criterion for acceptability in this regard would be that the technology must be as proliferation resistant as existing light water reactors operating in

the once-through fuel cycle mode, that is, without reprocessing, and with the additional constraint that no spent fuel storage would be permitted in non-weapons states. In other words, the development and commercial utilization of such technologies by a non-weapons state must leave that state months to years away from obtaining weapons usable material. Thus, the shortest route to a weapons option would still be the time-consuming development of a dedicated facility.

Thus, under the alternative LMFBR program I am proposing the commercial component of the present LMFBR program would be cancelled and commercialization of this technology postponed indefinitely; the breeder option would be preserved, however, as an alternative for the "post fossil fuel era" by continuing a basic R&D effort; but the R&D would be redirected toward breeder and near-breeder concepts that are instrinsically more proliferation resistant than the present plutonium based technologies and this effort would be at a much reduced funding level.

In its immediate effect, the CRBR demonstration plant is cancelled and the LMFBR priority, in terms of funding, is substantially reduced. In the near term, the program is focused on advanced design work, basic safety research in support facilities, and advanced fuels research in the Fast Flux Test Facility (FFTF).

The following questions are intended to provide an examination of alternatives for the Clinch River Breeder Reactor Project. They focus on expanded use of presently planned facilities and minimizing any financial and/or technical losses that will be incurred by termination of the Clinch River project. In particular, the questions address utilization of the FFTF, activities involved in Clinch River which are of general value to LMFBR development, the concept of an International Nonproliferation Development Facility, development of advanced breeder fuels, and the use of SAREF as an international safety facility.

1. Can the (1) steam generators and (2) sodium pumps being fabricated for the CRBR be included as part of a restructured LMFBR base program? What funding levels by fiscal year are required to complete procurement of these test articles?

2(a). Can the FFTF be modified to test the critical components of steam generators and sodium pumps, as part of the LMFBR base program? What modifications must be incorporated into FFTF so that generic LMFBR testing can be accomplished with the facility?

2(b). What are the advantages which would accrue from testing components at FFTF as well as the Liquid Metal Engineering Center (LMEC)?

2(c). Please supply funding requirements over the next three years for (a) and (b).

2(d). List the critical technology items which will pace the program, and key facility modifications involved with the required funding levels for (a) and (b).

3. Can the advanced breeder fuel development program be restructured to obtain generic information about advanced carbide/nitride/oxide fuels? Can it be expanded to accommodate studies of the thorium/uranium proliferation-resistant fuels? Please supply details and funding requirements for the next three fiscal years.

4. Provide information on key features of a study to define an international program for design, construction, and operation of a fuel cycle facility which minimizes risk of proliferation: please discuss in your answer a facility which incorporates a reactor power facility, fuel fabrication facility and fuel reprocessing facility. What funding level would be required to conduct such a study in FY 1978?

5. Describe the potential role of SAREF as an international test facility to expanded safety research, particularly for alternative fuel systems. Please supply funding level requirements to retain a construction schedule which will provide for experimental verification at a base safety program for breeder technology in a timely manner.

6. The subcommittee is concerned about the potential cost to the government if the existing procurements for all CRBR components are halted. Please provide a detailed list of each procurement, the cost to date, total cost, and the termination cost. Please identify those procurements which would be continued if a decision were made to pursue component R&D in a restructured LMFBR base program. What authorizations would have to be made in which years in order to continue each of these procurement contracts?

7. Can you outline the program logic for a restructured LMFBR base program which incorporates the following features:

- Increased utilization of FFTF to accommodate critical component testing.
- Retention of CRBR plant R&D activities of generic value.
- Advanced Breeder Fuel Development focused on nonproliferation cycles.
- Ultimate demonstration of Fabrication, Reactor, and Reprocessing Technology via the International Nonproliferation Development Facility.

8. What would be the cost of modifying FFTF (two loops) to accommodate improved component testing? What is the quickest schedule for accomplishing these modifications without limiting the usefulness of FFTF for fast flux testing?

9. What are the advantages and disadvantages of FFTF for component testing vs. CRBR as a component test facility? Please provide figures of merit to indicate the relative value of the two facilities for component testing.

10. The current stated policy of the Administration requires the termination of the Clinch River Breeder Project. In addition to affecting the work and the work force currently engaged at Clinch River, a number of other facilities and subprograms that have supported the Clinch River project will be affected by this decision.

Please provide in both tabular and narrative form by subprogram down to the project level and by each facility, the effects of the change in the program and/or the descriptions should include the dollars for each category as requested for Fiscal Year 1976, Fiscal Year 1977, and Fiscal Year 1978. All changes for the requested amounts should be clearly identified in a separate column. In the narrative please indicate the dates by which these changes have or will have occurred. If equipment or specific testing tasks associated with the CRBR are involved, indicate these as well. Also indicate manpower changes.

11. One option proposed that the Clinch River Breeder Reactor Project be redesignated as the Oak Ridge Breeder Technology Test Facility. Under this proposal," ERDA shall proceed with the development of breeder technology on a research and development level only and shall postpone indefinitely efforts to commercialize breeder technology. ERDA shall parallel this R&D effort with accelerated programs for evaluation of alternate fuel cycles and alternate breeder technologies. This facility shall be

constructed and utilized as a test facility for alternate breeder fuel cycles. It shall be constructed to utilize liquid metal coolant and non-plutonium core with a non-breeding blanket to provide experimental, research and operational data."

Under such a proposal, it would be possible that construction of the facility continue as planned but with changes in internal design to accommodate its new mission. 1) What alternate fuel cycles is the Clinch River facility capable of testing? 2) What is a non-breeding blanket composed of and would its presence decrease the electrical output of the reactor? 3) Would the reactor recast as a test facility still put power onto the local power grid? 4) Would the reactor still be subject to NRC licensing requirements set forth in P.L. 93-438, The Energy Reorganization Act of 1974? What effect would this have on ultimate commercialization of the technology?

12. What kind of LMFBR Base Programs (with funding levels) are required to support the following four technology development options through initiation of integrated technology demonstration (i.e. Clinch River type demo of commercial feasibility).

A. Clinch River Breeder Reactor Project on present schedule.

B. Generic R&D Program using modified FFTF as major facility with CRBRP type demo deferred until late 1980's.

C. CRBRP cancellation with minimum R&D program to provide "insurance policy" for breeder technology with demo at latest possible date and no "mods" to FFTF.

D. Generic R&D program with CRBR as a major test facility with some slip in present schedule and some limitations as a demonstration of commercial viability.

13. How will the objectives of CRBRP listed below be modified if the Clinch River Reactor is designed to be a test facility for breeder technology with a deferral of integrated technology demonstration and emphasis on serving as a versatile component test bed?

- Act as LMFBR Building Block
  - Low risk scale-up from FFTF
  - Low risk scale-up to large LMFBRs
- Develop Industrial and Utility Capability thru Plant Design, License, Build and Test
  - Design teams form experience base
  - Fabrication, construction, testing experience
- Extensive Utility Involvement
  - Early involvement to establish criteria
  - Participate in design decisions
- Demonstrate Satisfactory Operation
  - On utility network
  - With utility personnel and procedures

. Demonstrate LMFBR Advantages and Potential
  - Safe, clean, relable energy option
  - Basis for risk acceptability
  - Means for providing essentially limitless and economical energy
  - Performance characteristics

. Provide Test Bed for Advanced Cores and Components
  - Advanced fuels and cores
  - Pumps and other components

. Provide Large Quantity of Fuel for Reprocessing
  - Assist in establishing safeguards

Questions 14 - 30 relate to the CRBR

14. What are the objectives of the CRBR(Clinch River Breeder Reactor) Project?

15. How is the CRBR Project managed?

16. What work has been accomplished to date in the following:

Planning
Special Stuides
Conceptual design
Title I and II design
Licensing
Public Relations
Procurement

17. How much in Federal money has been expended? How much has been obligated? How much has been expended by private industry, by whom and for what purposes?

18. What is our legal contractual relationship with the project management corporation, Westinghouse, and the breeder reactor corporation? What are the legal implications of terminating the CRBR? What are the projected costs if the project is terminated? If these do not include law suits that could be filed, please indicate.

19. What equipment is on order? How much money has been committed to these procurements? What penalties are involved in termination? What will be the total cost of termination?

20. What was to have been accomplished under the original President Ford budget for FY 1978?

21. What can be accomplished for $150 million in FY 1978, for $33 million?

22. What was the original cost estimate for CRBR? What increases have been made? Why have the estimates been increased? What do the higher figures provide for?

23. How firm are the current estimates?

24. What is the present project schedule for design construction, by major item? a. What would a 1, 2 and 3-year delay cost? b. Would additonal licenses be needed if the project were delayed?

25. Is the design sufficiently advanced to make the CRBR a credible facility?

26. Is there sufficient flexibility in the design and layout to accommodate future advancements, particularly in regard to steam generators? How is this flexibility provided?

27. What are the problems anticipated with the steam generators in light of the French experience on Phoenix or generally anticipated?

28. What pump problems are anticipated?

29. What safety reliability features are included in the plant design?

30. What facilities are dependent on the plutonium to be produced in the CRBR?

31. If the breeder option is to be maintained as insurance, how do you propose keeping enough of the present highly skilled breeder team together?

32. During the interim between now and the "pay off point", what can we expect to have been achieved towards resolution of the plutonium economy problem?

Is it reasonable to expect that resolution of such a complex problem can be achieved through a "base technology" program?

Should we depend on the existence of a "more favorable climate" in which to resolve the problem?

33. If we adopt the "insurance" goal, don't we need the pay off to be: The ability to deploy, when required, a high confidence breeder system complete with its fuel supply?

34. If we assume that the signal for the insurance policy to pay off is the refusal of utilities to buy more non-breeder reactors based on the fact that we have committed all of the economical and environmentally acceptable uranium, we may have about 20 years of nuclear power capability left. At this point, don't we have to be in a position to deploy full size breeders that we are sure will work in every respect (technical, economics, licensing, fabrication, construction, maintenance, etc.) on the first try? If we try to bring several concepts to this status (e.g., molten salt, HTGR, GCFR, etc.,), how much will that cost?

35. Assuming the early commercialization is not justified, is termination of CRBR the proper action simply because its stated goals are premature? What is there to preclude CRBR from satisfying valid restated goals associated with the "insurance policy" or contributing to an orderly progression to a commercial plant?

36. If we decide to defer the present Fast Breeder Reactor program, what measures should we use to determine if and when to start it up again?

37. If competitiveness is to be demonstrated for the breeder, can this be done without proceeding with demonstration-scale breeders and fuel cycle pilot plants? Should we delay these demonstrations of the breeder option of a more constrained uranium ore availability is assumed?

Responses to selected questions prepared for the hearings on breeder technology by the House Committee on Science and Technology

By Thomas B. Cochran

1-2, 6-9. Steam generators and sodium pumps being fabricated for the CRBR could be included as part of a restructured LMFBR base program and the FFTF could be modified to test critical components of steam generators and sodium pumps as part of this program. It would be a mistake, however, to do so at this time. ERDA's advanced reactor program should be directed toward fuel cycles that are far more proliferation-resistant than the fuel cycle founded on the use of plutonium in LMFBRs and far more uranium-conserving than the current once-through fuel cycle employed by today's LWR technology. (See the attached April 12, letter from Drs. von Hippel and Williams to Dr. Schlesinger.)

Because the LMFBR is technologically unsuited to operate on the denatured uranium-thorium cycle and because it does not provide any non-proliferation advantages, further development of hardware for this liquid metal cooled fast reactor should be held in abeyance.

3. The FFTF is being built at great expense expressly for the purpose of obtaining generic information about advanced carbide/nitride/oxide fuel. The FFTF can just as easily accomodate studies of the thorium/uranium proliferation-resistant fuels. It would be foolish to duplicate this capability by building the CRBR to serve as test bed for advanced fuels.

4. ERDA's preliminary program plan for its Nonproliferation Alternative Systems Assessment Program (NASAP) is undergoing interagency review at this time. The Administration currently is meeting with other countries to define the International Fuel Cycle Evaluation Program (IFCEP). NASAP is an ERDA effort to provide technical support to IFCEP.

11, 13. The Lloyd amendment would convert the Clinch River Breeder Reactor Project (CRBRP) into the Oak Ridge Breeder Technology Test Facility (ORBTTF). This new facility would have the purpose of using liquid metal coolant with alternate breeder fuel cycles. This amendment has little, if any face value and if passed would only be duplicative, wasteful and counterproductive.

First, building the CRBR hardware and continuing its licensing as a ORBTTF would only represent a duplication of ERDA's Fast Flux Test Facility (FFTF) at Hanford which is being constructed at a great expense for the same purposes purposed for the ORBTTF. All efforts to study the utility of alternate fuel cycles in fast reactors at the ORBTTF could be conducted in the FFTF.

Second, the liquid metal coolant would cause the ORBTTF to be, like the FFTF, a fast neutron reactor. Since fast neutron reactors inherently produce large quantities of plutonium and other weapons usable material, the use of alternate fuel cycles in a fast reactor would not result in an acceptable proliferation resistant fuel cycle.

Third, a mere shift of the CRBR to a thorium-based fuel cycle would not provide a clear signal of U.S. intentions to develop proliferation-resistant nuclear technologies but would likely be perceived both here and abroad as foolish or dishonest or both.

Because this fuel cycle is technologically unsuited for the LMFBR and because it does not provide clear non-proliferation advantages, this move would likely be viewed as a marking of time until a new Administration or Congress more tolerant of plutonium use would allow the operation of LMFBR's on the uranium-plutonium fuel cycle, for which the technology was originally designed.

A detailed basis for the above criticism of the Lloyd Amendment can be found in the following documents:

1) Letter to Schlesinger from von Hippel and Williams, April 12, 1977, (attached hereto), and

2) Report by four members of the LMFBR Review Steering Committee (Cochran, Train, von Hippel and Williams), April 6, 1977, (attached hereto).

22. The first official estimate of the CRBR cost was $400 million. In a 1972 Memorandum of Understanding the CRBR cost was estimated at $700 million. The cost is now over $2 billion.

23. I am confident that the CRBR is unlicensable at the Clinch River site. I doubt it will be built anywhere for less than $3 billion and it could go higher. Much of the FFTF cost overruns (its costs are now 5-10 times higher than the original estimate) came after construction commenced. The CRBR construction hasn't begun.

31, 33-35. The LMFBR option doesn't make sense as an "insurance policy", the light water reactor operated in the spectral shift mode can provide the needed insurance more quickly and cheaply.

36. The non-proliferation criteria presented on pp. II-4 to II-8 in " Proliferation Resistant Nuclear Power Technologies: Preferred Alternatives To The Plutonium Breeder" lists in detail the measures which should be used.

37. See response to 31, 33-35.