

May 6, 1932

Before Administrative Judges:
Marshall E. Miller, Chairman
Gustave A. Linenberger, Jr.
Dr. Cadet H. Hand, Jr.



Docket No. 50-537

RESPONSE OF INTERVENORS, NATURAL RESOURCES
DEFENSE COUNCIL, INC. AND THE SIERRA CLUB,
TO APPLICANTS' FOURTH SET OF INTERROGATORIES

Pursuant to 10 CFR §2.740b, and in accordance with the Board's Prehearing Conference Order (Schedule) of February 11, 1982, Intervenor, Natural Resources Defense Council, Inc. and the Sierra Club, hereby respond to Applicants' Fourth Set of Interrogatories to Intervenor, dated April 15, 1982.* /

*/ Applicants and Intervenor met on April 23, 1982, at which time Applicants withdrew the questions indicated below.

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The direct answer to each Interrogatory is provided below under each question. The requested additional information for each Interrogatory is as follows:

(a) All documents and studies, and the particular parts thereof, relied upon by Intervenor, now or in the past, which serve as the basis for the answer are referenced in the direct answer unless otherwise noted.

(b) There were no principal documents and studies specifically examined but not cited in (b) unless otherwise noted.

(c) Dr. Thomas B. Cochran is the primary Intervenor employee who provided the answer to the question, unless otherwise noted.

(d) Dr. Thomas B. Cochran is the only expert witness Intervenor have identified to date.

INTERROGATORY

1. For each admitted contention:

(a) Please identify any documents, by author, title, publisher and date of publication which have come to the attention of Intervenor since this proceeding was suspended in 1977 and which Intervenor intend to rely upon, in preparation for or at the hearing in this proceeding.

RESPONSE

1(a) No decision has been made as to which documents Intervenor will rely upon in preparation for the LWA-1 hearing

other than those which are part of the CRBR docket, Staff minutes of Staff/Applicants meetings, ACRS testimony, documents cited by Intervenor in "New Information Relevant to Intervenor's Contentions" (attached to the March 12, 1982, letter to Staff and Applicants' counsel from Intervenor), and documents cited by Intervenor in response to Staff and Applicants' discovery requests.

INTERROGATORY

(b) Please identify the expert(s), if any, who Intervenor intend to have testify on the subject matter of the contention and state the qualifications of each expert in terms of education and/or experience.

(c) Please identify any ongoing research or analysis of which Intervenor are aware which relate to the subject matter of the contention.

RESPONSE

1(b), (c) These Interrogatories duplicate Interrogatory 1 of Applicants' First Set of Interrogatories to Intervenor. The responses are the same as given there.

INTERROGATORY

2. For Contention 1 (Old 2)

(a) This interrogatory has been withdrawn by Applicants as duplicative of Staff's discovery request to Intervenor.

(b) As to each "CDA initiator" identified in response to 2(a) above, including anticipated transients without scram, please provide a description of the minimum scope and detail of reliable data (including analyses, tests, data, compilations thereof, facts, opinions, or assumptions) which you consider to be necessary and sufficient to demonstrate that such "CDA initiator" has a sufficiently low probability that it may be excluded from the design bases for CRBR.

RESPONSE

2(b) CDA initiators other than anticipated transients without scram include events in the "unlikely" and "extremely unlikely" categories in Table 15.1.3-2 of the PSAR. There may be other such initiators. Indeed, we would expect this to be the case. A sophisticated and comprehensive fault-tree/event-tree analysis would be required to reliably identify CDA initiators. With regard to the minimum scope and detail required, Applicants appear to misunderstand the Contention:

Neither Applicants nor Staff have demonstrated through reliable data that the probability of anticipated transients without scram or other CDA initiators is sufficiently low to enable CDAs to be excluded from the envelope of DBAs.

Intervenors do not assert that each "CDA initiator" must be excluded from the design basis. (See also response to Interrogatory 2(a) of Applicants' First Set of Interrogatories to NRDC, et al.

INTERROGATORY

2(c), (d), (e), (f) Withdrawn by Applicants, based on the Board's Order of April 22, 1982 deferring Contention 1(b) "for purposes of discovery and litigation until after the LWA-1 evidentiary hearing and partial initial decision."

INTERROGATORY

2(q) Please describe specifically the "implications of the TMI-2 accident, particularly regarding the effects of human error in failure to scram" in relation to the CRBR.

RESPONSE

2(q) The response to this question is provided at pp. 3-4 of Natural Resources Defense Council's Response to Objections to Contentions, March 31, 1982.

INTERROGATORY

3. For Contention 2 (Old 3)

(a), (b) Withdrawn by Applicants, as duplicative of Staff's discovery request to Intervenors.

INTERROGATORY

3(c) Please identify and describe in detail each specific element of the analyses of CDAs and their consequences by Applicants and Staff which you consider to be inadequate for demonstrating that the radiological source term for CRBRP would

result in potential hazards not excluded by those from any accident considered credible. The answer to this interrogatory must include a detailed description or explanation of the inadequacies in the analysis.

RESPONSE

3(c) Intervenors cannot fully answer this question because we have not completed our analysis. Our current position on these matters has been set forth in updated responses to Interrogatories 2, 3, and 4 of Applicants' First Set of Interrogatories to NRDC, et al., and Interrogatory 3(f) below.

INTERROGATORY

3(d) Please identify all changes in reactor vessel and core design which have not been included in Applicants' accident modeling, and which you believe should have been so included.

RESPONSE

3(d) Intervenors are extremely talented but are not mind readers. Consequently, we simply don't know. Even if the question were more limited in scope, we would have to await and analyze updated responses of Applicants to identify what was included in Applicants' models.

INTERROGATORY

3(e) Withdrawn by Applicants.

INTERROGATORY

3(f) Please describe in detail the specific technical bases for Intervenor's contention that "radiological source term analysis should be based on the assumption that CDAs (failure to scram with substantial core description [sic]) are credible accidents within the DBA envelope, should place an upper bound on the explosive potential of a CDA, and should then derive a conservative estimate of the fission product release from such an accident."

RESPONSE

3(f) 10 CFR 100.11 requires that a fission product release (source term) be hypothesized for purposes of site analysis; and that this release not be exceeded by the release from any accident considered credible.

Intervenor's believe CDAs are credible events. There are at least several fundamental reasons for this view: (1) CDAs or CDA initiators have occurred in Clementine, EBR-I and FERMI-I; (2) CDAs have been treated as design basis events in safety analyses of previous reactors, e.g., EBR-II, SEFOR, FFTF; (3) some members of the technical community believe CDAs are credible events and should be design basis events; and (4) neither Applicants nor Staff have demonstrated otherwise for either CRBR or a reactor of this general size and type.

Intervenor's believe that, once a CDA has been initiated, it is prudent to assume that it will progress to whole core

involvement (see CRBRP-1); i.e., substantial core disruption. Intervenor's view that CDAs should be included in the design basis envelope is based on prudence and circumspection.

Intervenor's view that the upper bound on the explosive potential of CDAs should be used to establish the source term follows from the language of 10 CFR 100 and the fact that the sequence of events as the accident progresses following substantial core disruption is so poorly understood that this is the prudent course to take.

See US AEC, "Safety Evaluation of the Fast Flux Test Facility," Project 448, October 31, 1972; ANL, "Hazard Summary Report, EPR-II, ANL-5719, May 1957; T. J. Thompson and J. G. Beckerley,, The Technology of Nuclear Reactor Safety, 1964; Richard E. Webb, The Accident Hazards of Nuclear Power Plants, 1976; John G. Fuller, We Almost Lost Detroit, 1975; ACRS, Transcript of Meetings on March 30-31, 1982, and prior ACRS meetings on fast reactor safety issues.

INTERROGATORY

3(g) Please identify and explain specifically why you believe the radiological source term analysis has inadequately considered (1) the release of fission products and core materials, and (2) the environmental conditions in the reactor building created by release of substantial quantities of sodium. The discussion of deficiencies in the analysis must include any analytical standards which have not been met.

RESPONSE

3(g) The stated rationale for the "source term" currently used by the Staff and Applicants is presented in the May 6, 1976, Denise to Caffey letter, along with the basis for its selection (i.e., CDAs can and must be excluded from the DBA envelope, use of a non-mechanistic analysis, extrapolation from LWR data). Intervenors do not agree with the assertion that CDAs can be excluded from the DBA envelope. A consequence of including CDAs in the DBA envelope is to force the use of more conservative assumptions regarding the CDA energetics, i.e., larger "bounding" consequences (see ACRS Transcripts, March 30-31). Intervenors believe such bounding releases would lead to very different assumptions regarding the environmental conditions in the reactor building, primarily due to the assumption that substantially more than 1000 lbs. of sodium would be released.

INTERROGATORY

3(h) Please list any fission products and core materials other than halogens, iodine, and plutonium which must be considered in the radiological source term analysis.

RESPONSE

3(h) All core materials and fission products must be considered. Applicants and Staff reach the same conclusion. The principal issue is the percentage of fission product

and fuel (other than noble gases and halogens) that should be considered as part of the source term. This issue was the subject of several meetings and exchanges of correspondence between Staff and Applicants in 1975-76.

INTERROGATORY

3(i) Please describe in detail the environmental conditions in the reactor containment building created by the release of substantial quantities of sodium which you believe were not adequately considered in the radiological source term analysis.

RESPONSE

3(i) Intervenors have not performed the analysis that we believe Applicants and Staff should conduct to identify such environmental conditions. See response to Interrogatory 2-10.d. of NRC Staff First Round of Discovery to NRDC, et al.

INTERROGATORY

3(j) Please describe in detail the inadequacies in the Applicants' or Staff's analysis of containment design.

RESPONSE

3(j) To date Intervenors have not performed any analysis that would lead them to challenge the leak rate assumptions appearing on p. III-19 of the SSR for the assumed core fraction released to containment. We question whether Staff/Applicants

have demonstrated that the filters will perform at the stated efficiencies in an environment where large quantities of sodium have been released and sodium and hydrogen combustion have taken place. Intervenors believe that venting is an unacceptable method of accommodating severe CDAs.

INTERROGATORY

4. For Contention 3 (Old 4)

(a) Please identify and describe in detail all accidents associated with core meltthrough following loss of core geometry and sodium-concrete interactions which you believe have not been adequately analyzed. The answer to this interrogatory must include a detailed description or explanation of all bases for Intervenors' assertion that such accidents have not been adequately analyzed.

RESPONSE

4(a) Intervenors do not believe any accidents associated with core meltthrough or sodium-concrete interactions have been adequately analyzed, primarily because CDAs are not treated by either Staff or Applicant as DBAs. See response to Interrogatory 3-3 of Staff's First Round of Discovery to NRDC, et al.

INTERROGATORY

4(b) Please identify and describe in detail all human errors which can initiate, exacerbate, or interfere with the

mitigation of CRBR accidents and which you believe have not been adequately analyzed by Applicants and Staff. The answer to this interrogatory must include a detailed description or explanation of all bases for Intervenors' assertion that such human errors have not been adequately analyzed.

RESPONSE

4(b) See response to Interrogatory 2(g) above.

INTERROGATORY

4(c) Please identify and describe in detail any accident possibilities of greater frequency or consequence than the accident scenarios analyzed by Applicants and Staff.

RESPONSE

4(c) Our analysis is incomplete; however, see updated responses to Interrogatories 15, 16, and 21 of the Staff's Third Set of Interrogatories to NRDC, et al., and response to Interrogatory 2(b) above.

INTERROGATORY

4(d) Please furnish a copy of the January 27, 1982, letter from Richard Shikiar to Thomas Cochran to which Intervenors refer on page 28 of their Revised Statement of Contentions and Bases.

RESPONSE

4(d) This document was provided to Applicants on April 23, 1982.

INTERROGATORY5. For Contention 5 (Old 6)

(a) Please identify and describe in detail the population characteristics of the CRBR site which you consider sufficiently unfavorable that an alternative site should be selected.

RESPONSE

5(a) Intervenors are referring to comparison of the dose to the maximum exposed individual in the general public and the population dose commitment at the CRBR site as compared to other reasonable alternatives. Intervenors also believe that in light of the lessons learned from the TMI accident, in comparing the proposed site with alternatives, the site selection should be weighted heavily in favor of sites where the maximum exposed individual and the population dose commitment due to accidents are substantially smaller due to more favorable population and meteorological conditions (i.e., favor remote sites). In effect, siting should be treated as though it were an independent "barrier" or "safeguard" as part of the defense-in-depth approach to reactor safety, as opposed to the historical approach of allowing poor site characteristics to be accommodated by engineering features associated with the containment; that is, with the limitation on siting being defined only by 10 CFR 100 requirements.

INTERROGATORY

5(b) Please identify the several alternative sites which you consider to have population densities which are more favorable than the population density of the CRBR.

RESPONSE

5(b) Hanford Reservation, Idaho National Engineering Laboratory. Other sites should be included when meteorological characteristics are also factored in (see response to Interrogatory 5(a) above). Staff has identified several such sites in the FES. The answer to this question should logically flow from an analysis of alternative CRBR sites on properties owned or controlled by DOE and TVA in an adequate NEPA review of the CRBR by the Staff.

INTERROGATORY

5(c) As to each alternative site identified in response to 5(b) above, describe in detail the population characteristics of that alternative site.

RESPONSE

5(c) Intervenors have not analyzed in detail the population densities or meteorology around these sites. We must rely on an adequate FES.

INTERROGATORY

5(d) Please list all "other proposed fuel cycle facilities" referred to in Contention 5(b).

RESPONSE

5(d) The only other proposed fuel cycle facility of which Intervenorors are now aware is the Koppers (Tennessee Synfuels Association) Coal-to-Gasoline Project at Oak Ridge.

INTERROGATORY

6. For Contention 11 (Old 8)

(a) Please describe in detail the approach which you believe should be used in establishing guideline values for permissible organ doses.

RESPONSE

6(a) Intervenorors have not made a final decision on which approach should be adopted. Intervenorors provided their current views on this matter in "Natural Resources Defense Council's Response to Objections to Contentions," March 31, 1982, pp. 9-13. On the basis of additional analysis, Intervenorors would modify the conclusion on p. 13 of that document in the following respects. Regarding the ICRP Publication 26 approach, Intervenorors currently believe the weighting factors and organ dose limits ("caps" to prevent non-stochastic effects) recommended by EPA should be used rather than those recommended by ICRP 26. (See EPA, "Proposed Federal Radiation Protection Guidance for Occupational Exposure," EPA 520/4-81-003, Jan. 16, 1981, particularly at p. 10.) With regard to the approach favored by Applicants, Intervenorors note

that, if Applicants used 40 CFR 190.11 rather than 10 CFR 20 to identify the lung and bone dose "equivalent" to 25 rem whole body, the result would be 25 rem to both lung and bone. This is comparable to the 30 rem "cap" assumed by EPA to prevent non-stochastic effects.

In addition to the above, Intervenors believe that transuranium elements deserve special consideration due to their relatively long half-lives and would use 1 mrad to lung and 3 mrad to the bone from exposure to transuranics as equivalent to 170 mrem to the whole body, based on considerations in EPA, "Proposed Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment," EPA 520/5-77-016, September 1977. See particularly pp. 2, 21, 23.

INTERROGATORY

6(b) Please identify all "important organs" which you believe should be considered in establishing dose guidelines.

RESPONSE

6(b) All organs are considered important under the ICRP 26 approach. The ICRP 26 approach recognizes some organs as more sensitive than others (e.g., breast, lung, bone marrow) and also considers five "other organs" with the highest doses. See EPA 520/4-81-003, p. 10 and response to Interrogatory 6(a) above.

INTERROGATORY

6(c) Identify and describe in detail all "new knowledge" which you believe should be considered in establishing dose guidelines.

RESPONSE

6(c) The primary documents Intervenors currently believe should be considered are ICRP 26, ICRP 30, 40 CFR 190.10 and EPA 520/4-77-016.

INTERROGATORY

6(d) Please explain specifically the basis for your assertion that Applicants and Staff have not adequately assessed the residual risks associated with genetic effects from radiation exposure in compliance with existing NRC standards. The answer to this interrogatory must include a detailed description or explanation of Intervenors' view as to why the assessment is not adequate.

RESPONSE

6(d) Applicants and Staff have not demonstrated that proposed radiation protection procedures, which do not limit exposures of workers in the child-bearing age to an amount that is less than that permitted for older workers (e.g., those over 45 years of age), are consistent with the ALARA principle. See NRDC, "Radiation Standards for Occupational Whole Body Exposure," Thomas B. Cochran and Arthur R. Tamplin, Sept. 25,

1975. See also Response to Interrogatory 6(e) below; Updated Responses to Interrogatories 4-7 under Contention 8 (New 11) of Staff's Fourth Set of Interrogatories to NRDC, et al; and part (3) of Updated Response to Interrogatory 2 under Contention 9 (New 6) of Staff's Fourth Set of Interrogatories to NRDC, et al.

INTERROGATORY

6(e) Please identify and describe in detail the basis for your assertion that Applicants and Staff have not adequately assessed the residual risks associated with induction of cancer from the exposure of plant employees and the public in compliance with existing NRC standards.

RESPONSE

6(e) See Response to Interrogatory 6(d) above. In addition, because Staff and Applicants do not report risk, but only dose, the discussion fails to adequately characterize the widely divergent views of experts regarding risks, e.g., the views of BEIR III, Edward Radford, Karl Z. Morgan, and John Gofman. Finally, Contention 11(d) is part of the basis for this assertion. See also updated response to Interrogatory 8 under Contention 8 (New 11) of the Staff's Fourth Set of Interrogatories to Intervenors.

INTERROGATORY7. For Contention 8 (Old 14)

(a) Please identify and describe in detail the unavoidable adverse environmental effects associated with the decommissioning of the CRBR which you believe have not been adequately analyzed. The answer to this interrogatory must include a detailed description or explanation of the specific elements of the analyses which you assert are inadequate and the bases for that assertion.

RESPONSE

7(a) Intervenors know of no practical means of preventing the radioactive decay of unstable isotopes produced in reactor components through neutron activation during the operation of a reactor, hence the term "unavoidable." Intervenors are aware of four principal modes of decommissioning: dismantlement, entombment, mothballing, and, possibly in the future, disposal at sea. Each presents "adverse environmental effects," although these effects are not necessarily or always the same. The decommissioning method chosen and its cost will depend in part on the nature of the neutron activation products presented by the reactor operation. Intervenors in Contention 8 claim that a systematic analysis of all neutron activation production for CRBR has not been performed; a comprehensive analysis of CRBR decommissioning analogous to NUREG/CR-0570 (1980) for boiling water reactors, or NUREG/CR-1756 (1982) for research reactors, has not been performed; there is no showing

of which aspects of the EIS on Decommissioning of Nuclear Facilities (NUREG-0586, 1981) are applicable, and the discussion at pp. 10-3, 4 in the FES is superficial and out of date.

With regard to further specificity as to the elements of the analysis that are deficient, we remind Applicants that it is not Intervenor's responsibility to perform Applicants' or Staff's work in preparing an adequate EIS.

See also Harwood, et al., "The Cost of Turning It Off," Environment 18, Dec. 1976, pp. 17-26, Science, 215 (5 March 1982), pp. 1217-1219; Stephens, et al., "Trace Elements in Reactor Steels: Implications for Decommissioning," Cornell Univ., Aug. 1977, published in Nuclear Engineering Design (circa 1978).

INTERROGATORY

7(b) Please identify and describe in detail the costs associated with the decommissioned CRBR which you assert are not adequately assessed in the NEPA cost/benefit balancing of the CRBR. The answer to this interrogatory must include a detailed description or explanation of the specific elements of the analysis which you assert are inadequate and the bases for that assertion.

RESPONSE

7(b) Those identified in §10.2.4.3 of the FES. See also response to Interrogatory 7(a) above.

INTERROGATORY

7(c) Please state whether it is your view that the CRBR FES is inadequate due in part to recently discovered omissions in regard to the subject matter of contention 8, and, if so, identify and describe all such "recently discovered omissions."

RESPONSE

7(c) Yes: Analysis of Nickel-59 and Niobium 94. The FES is also inadequate for reasons stated in response to 7(a) above.

INTERROGATORY

7(d) Please state whether it is your view that the CRBR FES is inadequate for reasons other than "recently discovered omissions" and, if so, identify and describe all such inadequacies in the CRBR FES.

RESPONSE

7(d) Yes. See response to Interrogatory 7(a) above.

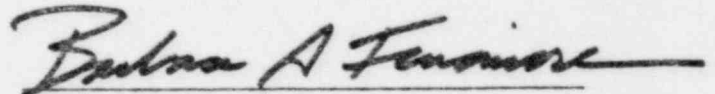
INTERROGATORY

7(e) Please identify specifically any and all neutron activation products, other than nickel 59 and niobium 94, which you assert have not been adequately analyzed for the decommissioning of the CRBR and/or which you believe must be so analyzed.

RESPONSE

7(e) There is no hidden agenda here. If there are other omissions, they can be expected to be discovered through a systematic analysis of all neutron activation products for CRBR. None have been adequately analyzed for reasons stated in response to 7(a) above.

Respectfully submitted,



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Sierra Club

May 6, 1982
Washington, D.C.

BEFORE THE UNITED STATES
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD

In The Matter of

UNITED STATES DEPARTMENT OF ENERGY
PROJECT MANAGEMENT CORPORATION
TENNESSEE VALLEY AUTHORITY

Clinch River Breeder Reactor Plant

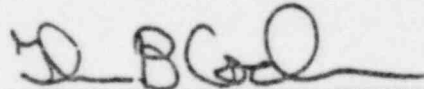
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AFFIDAVIT OF DR. THOMAS B. COCHRAN

I, Dr. Thomas B. Cochran, being duly sworn, depose and say:

1. I am employed as a Senior Staff Scientist by the Natural Resources Defense Council, Inc., and, as such, I am duly authorized to execute the foregoing answers to interrogatories.

2. The foregoing answers are true and correct to the best of my knowledge and belief.



Dr. Thomas B. Cochran

Subscribed and sworn to before me
this 5th day of May 1982.


Notary Public

October 1, 1981

RESUME

Thomas B. Cochran, Ph.D.

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EMPLOYMENT HISTORY

April 1973-present: Natural Resources Defense Council, Inc.

Senior Staff Scientist, focusing on national energy R&D policy, principally nuclear energy issues, the breeder reactor, plutonium recycle, nuclear weapons proliferation, safeguards, and radiation exposure standards. Consultant to the U.S. Department of Energy (DOE) on nuclear nonproliferation and nuclear R&D strategy; consultant to the Comptroller General on (a) U.S. and international controls over the peaceful uses of nuclear energy, (b) Advanced Nuclear Technologies, and (c) U.S. Liquid Metal Fast Breeder Reactor Program; consultant to the Office of Technology Assessment (OTA); Member of DOE's Energy Research Advisory Board, DOE's Nonproliferation Advisory Panel, OTA's Advisory Panel on Nuclear Proliferation and Safeguards, the Nuclear Task Group of OTA's Analyses of the ERDA Plan and Program, and OTA's Gas Curtailment Study Review Panel. Consultant to Governor of Lower Saxony, West Germany, to serve as an International Expert in the Review of the Gorleben Nuclear Fuel Cycle Center. Served as a member of ERDA's LMFBR Review Steering Committee, the National Academy of Sciences' Panel on Strategy for Developing Nuclear Merchant Ships, the Task Force on Energy Conversion Research and Development of the Federal Power Survey, the United Nations' Environment Programme's International Panel of Experts on Energy and the Environment, the National Council of Churches' Energy Study Panel and the World Council of Churches Consultation on Ecumenical Concerns in Relation to Nuclear Energy. Also served as a consultant to Resources for the Future and numerous environmental organizations. Testified before Congress and federal agency hearings on numerous occasions, including testimony before the Joint Committee on Atomic Energy, the House Committee on Interior and Insular Affairs, the Joint Economic Committee, the House Committee on Small Business, and the Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards.

June 1971-April 1973: Resources for the Future, Inc.
Washington, D.C.

Senior Research Associate, Quality of the Environment Program.
Studying environmental effects of the U.S. civilian nuclear power industry, residuals management in the nuclear fuel cycle, liquid metal fast breeder reactor program, national energy policy, and radiation standards. Wrote a book, The Liquid Metal Fast Breeder Reactor: An Environmental and Economic Critique.

1969-1981: Litton Mellonics Division, Scientific Support Laboratory
Fort Ord. California

Modeling and Simulation Group Supervisor. Supervised the activities of 10 operation research analysts engaged in military research pertinent to the evaluation of proposed U.S. Army concepts and material by U.S. Army CDCEC.

1967-1969: U.S. Naval Postgraduate School
Monterey, California

Lt-USNR, Active Duty; Assistant Professor of Physics; Radiation Safety Committee; part-time research involving computer studies of synchrotron radiation production in beam transport systems at Stanford Linear Accelerator, Stanford, California.

EDUCATION

Summer 1969: University of Colorado, Boulder. Postdoctorate.
Summer Institute of Theoretical Physics.

1965-1967: Vanderbilt University, Nashville, TN. Doctorate.
Major: Physics. Minor: Mathematics. Research in high energy (bubble chamber) physics. NASA Fellowship. Guest Research Associate in Physics Department at Brookhaven National Laboratory, Upton, NY, studying synchrotron radiation shielding problems.

1962-1965: Vanderbilt University. MS degree in Physics.
Research in radiation chemistry; AEC Health Physics Fellow; applied health physics training, Oak Ridge National Laboratory; Vanderbilt University Campus Radiation Safety Officer.

1958-1962: Vanderbilt University. BE degree in Electrical Engineering, cum laude. NROTC.

PROFESSIONAL AFFILIATIONS

American Physical Society
Maerican Nuclear Society

Health Physics Society
Sigma Xi

PERSONAL

Age: 40. Birth date: 18 November 1940. Birth place: Wash. DC.
Wife: Carol J. Cochran. Two children.

CERTIFICATE OF SERVICE

'82 MAY -6 P3:23

I hereby certify that copies of RESPONSE OF INTERVENORS, NATURAL RESOURCES DEFENSE COUNCIL, INC. AND THE SIERRA CLUB, TO NRC STAFF FIRST ROUND OF DISCOVERY TO NRDC, ET AL., and RESPONSE OF NATURAL RESOURCES DEFENSE COUNCIL, INC. AND THE SIERRA CLUB TO APPLICANTS' FOURTH SET OF INTERROGATORIES were served this 6th day of May 1982 on the following:

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Nashville, Tennessee 37219

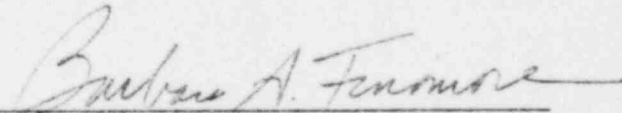
Lawson McGhee Public Library
500 West Church Street
Knoxville, Tennessee 37902

William E. Lantrip, Esquire
City Attorney
Municipal Building
P.O. Box 1
Oak Ridge, Tennessee 37830

Oak Ridge Public Library
Civic Center
Oak Ridge, Tennessee 37820

Mr. Joe H. Walker
401 Roane Street
Harriman, Tennessee 37748

Commissioner James Cotham
Tennessee Department of Economic
and Community Development
Andrew Jackson Building, Suite 1007
Nashville, Tennessee 32219


Barbara A. Finamore

* Denotes hand delivery.