4/30/82

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
U.S. DEPARTMENT OF ENERGY	)	Docket No. 50-537
PROJECT MANAGEMENT CORPORATION	)	
TENNESSEE VALLEY AUTHORITY	)	
	)	
(Clinch River Breeder Reactor Plant)	)	

NRC STAFF'S UPDATED ANSWERS TO NATURAL RESOURCES DEFENSE COUNCIL, INC. AND THE SIERRA CLUB SEVENTH SET OF INTERROGATORIES TO NUCLEAR REGULATORY COMMISSION STAFF DATED FEBRUARY 12, 1976

Pursuant to the Licensing Board's Prehearing Conference Order of February 11, 1982, the Nuclear Regulatory Commission Staff (Staff) hereby updates its April 7, 1976 and November 19, 1976 responses to Intervenors' Natural Resources Council, Inc. and the Sierra Club Seventh Set of Interrogatories to the Nuclear Regulatory Commission Staff filed on February 12, 1976. Attached hereto are NRC Staff's answers to NRDC's and the Sierra Club's interrogatories, together with the affidavit of Mr. John Long[1/] who prepared the answers.

1/ The affidavit of Mr. Long is unsigned. However, a copy of his signed and notarized affidavit will be filed shortly.

Respectfully submitted,

Daniel T. Swanson

Daniel T. Swanson
Counsel for NRC Staff

Dated at Bethesda, Maryland
this 30 day of April, 1982

NRC STAFF'S ANSWERS TO NRDC'S AND
THE SIERRA CLUB'S INTERROGATORIES

With respect to the following requests for information we are concerned with four distinct validations relative to the models and computer codes:

i) Validation that the code's output is the correct numerical calculation that should result from a given set of input data and the model assumptions;

ii) Validation of the models against actual experimental data;

iii) Validation that the models can be extended to the CRBR; and

iv) Validation that the input assumptions for the CRBR case are adequate with respect to the CDA analysis, i.e., are supported by expertimental evidence. By "adequate" here and below, we mean that the calculations will not underestimate the CDA work potential (i.e., forces and resulting energetics of a CDA) or overestimate the containment capability of the reactor with respect to a CDA.

I. With respect to each of the following codes and each subroutine of each of the following codes:

(A) COMRADEX - II

(B) HAA-3

please provide the following information:

Interrogatory 1

Is the Staff (including consultants to the Staff) utilizing the code (or subroutine) in its CDA analyses of the CRBR?

Interrogatory 2

If not, why not?

Interrogatory 3

If not, identify the code or codes (subroutine or subroutines) that the Staff (including consultant(s)) is utilizing in lieu of the rejected codes.

Interrogatory 4

If the code (subroutine) is being utilized identify all codes (subroutines) that the Staff (including consultant(s)) is utilizing to augment the analyses performed by the code (subroutine) in question.

With respect to each of the codes and each subroutine of each of the codes utilized by the Staff (including those identified above as (A) and (B) and those identified in 3) and 4) above) please provide the following information:

Interrogatory 5

Complete, current documentation (i.e., a writeup) of the codes and the subroutines.

Interrogatory 6

Identify, by name and affiliation, the author, or authors, of each model, subroutine, or portion of each subroutine, which each contributed or worked on.

Interrogatory 7

Identify by name affiliation (including organization, division, branch, title, etc.) each Staff member or consultant that has intimate working knowledge of the code and each subroutine, or parts thereof, including its validity. Where more than one person is involved, delineate which portion of the code or subroutine with which each has an intimate working knowledge.

Interrogatory 8

Describe fully the procedures by which the Staff has assured itself and continues to assure itself, that the various computer programs (codes) accurately reproduces the the models (see, Validation i) above).

Interrogatory 9

Indicate which models (including subroutines, or portions of subroutines) have not been validated as described in Validation i).

Interrogatory 10

Indicate the models (including subroutines, or portions of subroutines) or assumptions that have not been validated as described in Validation ii).

Interrogatory 11

For each model, portion of the model, or assumption that has been validated (against experimental (or other) data, see Validation ii above) describe fully the procedure by which it was validated, and the results, including all uncertainties and limitations of the validation. Indicate the source of the experimental, or other data, that was used in the validation.

Interrogatory 12

Explain fully all instabilities in the numerical performance in the models, what causes them, and now they are avoided, and the extent to which this introduces uncertainties in the calculations and limits the validity of the model (cf. p. F6.2-10, par. 2).

Interrogatory 13

To the extent that any answers to the above questions are based on referenced material not previously provided, please supply the references.

Interrogatory 14

Explain whether NRC is presently engaged in or intends to engage in any further research or work which may affect the answer. Identify such research or work.

Response to Interrogatories I 1-14

Comradex II - The staff has not employed the COMRADEX code. Doses presented in the FES are largely the result of hand calculations as illustrated in Reg. Guide 1.109. The solutions to the equations are explicit and not subject to instability or error propagation. The modeling is given in Reg. Guide 1.109.

The hand calculations have been compiled in a program called TACT which was also used in preparation of the SSR. The TACT code is now used generally at NRC for these types of dose estimates. The TACT code follows exactly the hand methods of calculation, but reduces the necessary hand operations. Documentation of the TACT code in underway and will be provided with the SER. The key parameters used in the Calculations published in Table 7.2 of the FES and Table IV of the SSR are provided in those documents in detail.

HAA-3 - No update required.

Interrogatory 15

Identify the expert(s), if any, whom the Staff intends to have testify on the subject matter questioned. State qualifications of each such expert.

Response

(A) At this time, the Staff has not determined who will testify on the subject matter questioned. Reasonable notice will be given to all parties after the Staff has made this determination. At that time, a statement of professional qualifications will be provided for each witness.

II. With respect to the following requests for information we are concerned primarily with the fourth validation -- validation that the input assumptions for the CRBR case are adequate with respect to the source term and site suitability radiological analysis. Here we are not so much concerned with the validity of the model expressions as with the uncertainties in the site boundary and low population zone doses due to propagation of uncertainties in a) the parameters used, and b) the model input data and due to any synergisms among these uncertainties and the model assumptions.

With respect to each site suitability source term radiological dose (site boundary and low population zone) calculation considered by the Staff (and consultants to the Staff) in its analysis of the CRBR site suitability, please provide the following information:

Interrogatory 1

List and identify all model input data (exclusive of coding flags and inputs that specify coding options, criteria, printout formats, etc.) and all model parameters that come into play in each of the models utilized in the site suitability radiological analysis, e.g., including but not limited to input data and parameters in COMRADEX-II and HAA-3 (or codes used in lieu of or to augment these). Exclude parameters not called into use because a subroutine, or part thereof, was not utilized.

Interrogatory 2

Describe in detail the basis for the choice of each input datum and model parameter listed above, and

(i) In each case quantify the uncertainty in the value selected;

(ii) In each case indicate whether the value is based on first principles, experimental measurements, unvalidated hypothesis, output of other models, arbitrary assumptions, etc.;

(iii) In each case indicate whether the choice of the input datum or model parameter was selected to represent the "best estimate," or a bounding or "conservative value" where "conservative value" here means a value chosen so as not to underestimate the accident conseqences, e.g., site boundary and low population zone radiological doses.

Interrgatory 3

For each input datum and model parameter with uncertainty listed in 1) above, indicate in quantitative terms the magnitude of the uncertainty introduced into the final calculation of the site boundary 2 hour and the low population zone accident duration doses, respectively, due to the uncertainty in the input datum or model parameter. In addition, discuss in detail any synergistic effects resulting from combinations of uncertainties in the input values, model parameters, and model assumptions. In each case discuss the basis for the estimate of how the uncertainties propagate, e.g., include and discuss all parametric analyses used to test the effect of uncertainties.

Interrogatory 4

Identify by name, affiliation (including organization, division, branch, title, etc.) each Staff member or consultant that has intimate working knowledge of the basis for the selection of the parameter or input datum.

Interrogatory 5

To the extent that any answers to the above questions are based on referenced material not previously supplied, please supply the references.

Interrogatory 6

Explain whether the Staff is presently engaged in or intends to engage in any further research or work which may affect Applicant's answer. Identify such research work.

Response to Interrogatories II 1-6

Comradex II - Uncertainties in dose calculations are greater than those of some engineering calculations. The staff does not have a breakdown of the uncertainties in the format requested, but expects the

overall results to be within an order of magnitude; i.e., reasonable changes in modeling would usually not alter the results by more than a factor of ten. A change of a factor of two due to an alternate modeling scheme would not be considered very significant.

HAA-3 - The staff does not have a tabulation of uncertainties in the format requested. The validation of the codes against experiments is well documented, as noted in the previous answer to part I regarding this code.

Interrogatory 7

Identify the expert(s), if any, whom the Staff intends to have testify on the subject matter questioned. State the qualifications of each such expert.

Response

At this time, the Staff has not determined who will testify on the subject matter questioned. Reasonable notice will be given to all parties after the Staff has made this determination. At that time, a statement of professional qualifications will be provided for each witness.

In providing the information above, it is not necessary to duplicate information where the same information has been previously provided with respect to other cases considered, for example, in parametric analyses where only one changes.

III. Request for the following informaiton is based on our concerns with respect to validations (iii) and (iv) above. In the Staff answers to the

generic questions (b) - (e) below, the Staff is requested to be responsive to these concerns.

With respect to each statement, assertion or assumption (primarily from 15.A in Part II of Appendix F of the PSAR) identified below, please provide the following information (unless noted otherwise). [NOTE: the following numbered Interrogatories are identified in parentheses by the page and/or paragraph number from Appendix F, Part II of the PSAR (yellow pages)].

(a) Identify by name and affiliation (including organization, division, branch, title, etc.) each Staff employee or consultant that has the expert knowledge concerning the subject matter of the statement, assertion, or assumption; (b) Does the Staff agree with the statement, assertion or assumption?; (c) If not, why not?; (d) If the Staff agrees with the statement, assertion, or assumption, describe in detail the supporting evidence for it and where appropriate the rationale for the approach taken;

(e) Provide any additional information requested following each statement, assertion, or assumption; (f) To the extent that any answers to the above questions are based on reference material, please supply the references; (g) Explain whether NRC Staff are presently engaged in or intend to engage in any further research or work which may affect the Staff's answer. Identify such research or work; and (h) Identify the expert(s), if any, whom the

Staff intend to have testify on the subject matter questioned. State the qualifications of each such expert.

For all the responses to interrogatories in this set the following are the answers to the requested subparts.

(g) The Staff is not presently engaged in nor intends to engage in any further, on-going research program which may affect the Staff's answer unless otherwise noted.

(h) At this time, the Staff has not determined who will testify on the subject matter questioned. Reasonable notice will be given to all parties after the Staff has made this determination. At that time, a statement of professional qualifications will be provided for each witness.

Introduction

Interrogatory 1

(15.A-1, par. 5) The primary criterion used in defining the radiological source term is: The source term must be hypothesized in such a manner as to result in potential hazards not exceeded by those from any accident considered credible.

(e) Define precisely (quantitatively) what is meant by credible. In this definition, indicate the acceptance criteria (proof) that is required to assign an accident to other than credible.

Source Term Description

Interrogatory 2

(15.A-2, par. 2) The SHAA will constitute a containment barrier;...

Interrogatory 3

(15.A-2, par. 2) For the Parallel Design, the RC will be sealed and will constitute a containment barrier.

Interrogatory 4

(15.A-2, par. 2) It is further [conservatively] assumed that 10% of the molten fuel is vaporized.

Interrogatory 6

Generic answers (b) - (d) are not required.

(e) In the "Source Term" meeting with the Applicant on January 22, 1976, the Staff indicated that, for the Parallel Design source term analysis, the airborne releases available for leakage into the first containment should be:

100% of the noble gases
100% of the halogens
100% of the volitile fission products
10% of the fuel and solid fission products.

(i) What is the basis for the Staff's choice of 10% for the airborne release of fuel and solid fission products? Explain in detail why a higher release fraction would not be appropriate. In other words, explain in detail why the Staff feels 10% is a conservative estimate.

(ii) Does the Staff believe that by using 10% for the fuel and solid fission products, the source term is "decoupled" from the design? Explain in detail the basis for your answer, particularly in light of the fact that the NRC Staff hasn't resolved the basic energetics of the CDA;

(iii) Does the Staff in suggesting the use of 10% of the fuel and solid fission products conclude, assume or confirm that the core catcher will be effective in reestablishing a coolable geometry? Explain in detail the basis for your answer and discuss in detail the consequences of a failure of the core catcher in terms of the source term;

(iv) In the "Source Term" meeting of January 22, 1976, Mr. Denise noted that "We [the Staff] don't look upon a factor of 5 or 10 as being extremely conservative given the unknowns." In the site suitability analyses to estimate the radiological source term doses, what quantitative criteria does the Staff use to determine what represents a conservative value?;

(v) With regard to the above question, we are particularly interested in the quantitative criteria the Staff feels should be used to determine conservative values of the CDA energetics and the source term? What quantitative factors of conservatism does the Staff believe are sufficient with regard to these?

Interrogatory 7

(15.A-2, par. 4) The contents of the vapor bubble formed in the core are as follows: 10% of the core inventory of fuel material, (including plutonium) 100% of the noble gases and volatile fission products (Cessium Rubidium, Tellurium, Selenium, and Antimony), 100% of the halogens, and 11% of the solid fission products.

(e) Define precisely what the Staff considers as an appropriate definition of "volatile" and "solid"? Describe in detail and provide the appropriate experimental, or other basis, for the assignment (or exclusion) of each and every fission product to the two categories "volitile" and "solid" fission products.

Interrogatory 8

(15.A-2, par. 5) The release of 1% of the non-volatile solid fission product from the molten fuel . . .

(e) Does the Staff agree that Reference 1 adequately demonstrates that this represents a reasonable (or conservative) value for this contributor to the bubble source term? If not, why not?

Interrogatory 9

(15.A-3, par. 1) For the solid fission products and fuel materials, a factor of 10 reduction in the core source term is used in determining

the SHAA source term . . . Consequently, the overall reduction by a factor of 10 assumed for the solid fission products and fuel materials is judged to be appropriately conservative.

Interrogatory 10

(15.A-3, par. 2) This factor of 20 reduction for the invessel halogen source is a conservative estimate of the actual reduction expected to result from the high affinity of halogens and sodium.

(e) Does the Staff believe the experiments (References 3 and 4) are adequate to show that a factor of 20 reduction is conservative? If not, why not?

Interrogatory 11

(15.A-3, par. 3) This is highly conservative since no substantial head leak paths are expected to result from the postulated core disruptive accidents.

Interrogatory 12

(15.A-3, par. 4) . . . the reactor internal debris retention capacity is insufficient to contain the molten debris . . .

Interrogatory 13

(15.A-3, par. 4 to next page) . . . and that molten material melts through the reactor vessel and guard vessel and is contained in the ex-vessel core catcher (EVCC) located in the RC.

Comparison of Source Terms

Interrogatory 14

(15.A-4, par. 4) Specifically, the fuel vapor fraction (the controlling parameter for initial core release) used to define the source term conservatively bounds the consequences resulting from more mechanistically evaluated CDAs.

Interrogatory 15

(15.A-5, par. 1) In addition, other pertinent accident parameters (containment barrier pressure histories, leak rates, etc.) used in evaluating the potential consequences of the site suitability source

term, have been consistently defined to insure the conservatism of the analysis.

Interrogatory 16

(15.A-6, par. 2) Experiments performed in the Large Test Vessel such that the product $(\alpha\varepsilon)$ - 0.33 . . . . This value would be applicable and somewhat conservative (based on aerosol sensitivity studies . . . , reference 8) for the SHAA since the height of the LTV is approximately twice the height of the SHAA (30' vs. 15') . . . . To assure the conservatism of the SHAA aerosol depletion analysis, values of α and ε were chosen such that $\alpha\varepsilon$ = 0.25.

Interrogatory 17

(15.A-6, par. 2) Assuming no sodium in the SHAA source thus results in a conservative prediction of aerosol attenuation.

Reactor Cavity (RC)

Interrogatory 18

(15.A-7, par. 2) Evaluation of ex-vessel core catcher concepts show that peak sodium temperatures can be maintained below 1200°F even from a conservative melt through time for the reactor vessel and guard vessel (e.g., 1000 seconds).

(e)(i) Is a melt through time of 100 seconds conservative?;

(ii) Is it not possible that a melt through or break through could occur in some localized area at appreciably shorter times?

Interrogatory 19

(15.A-7, par. 2) Some of the volatile fission products may escape to the RC during the transition of the fuel from the vessel to the core catcher but this will not affect the results significantly since these will contribute to the equilibrium concentration which will be established between the isotopes in the sodium and in the atmosphere.

Interrogatory 20

(15.A-7, par. 4) The equilibrium concentration in the atmosphere above the sodium pool was determined according to the following

relationships which are based on data published by Castleman (10 Catton (11) and Kunkel (4).

$$S_{Cs} = 1.5 \times 10^{-9} f_{Cs} A_{Cs}$$

$$S_{Rb} = 1.0 \times 10^{-9} g_{Rb} A_{Rb}$$

$$S_{I} = 1.6 \times 10^{-11} f_{I} A_{I}$$

$$S_{Sr} = 9.2 \times 10^{-13} f_{Sr} A_{Sr}$$

$$S_{Ba} = 4.5 \times 10^{-14} f_{Ba} A_{BA}$$

S = Equilibrium concentration in gas (Ci/l)

f = Fraction released from fuel to sodium

A = Activity in fuel in core catcher (Ci)

(e) What is the basis for assuming equilibrium conditions exists?

Interrogatory 21

(15.A-9, par. 3) The use of the containment design leak rate (0.1% Vol/Day) for the duration of the site suitability source term evaluation is conservative.

(e)(i) What is the basis for assuming the core catcher will work?;

(ii) 10 C.F.R. § 100.11(a)(2) defines for a LWR the low population zone in terms of exposure "(during the entire period of its [the radioactive cloud] passage)." For an LMFBR how does the Staff define the accident duration be defined if core catcher failure were assumed (postulated)?;

(iii) What would be the release rate and the subsequent effects on radiological doses at the site boundary and low population zone in the event of core catcher failure?

Off-Site Exposure

Interrogatory 22

Generic answers (b) - (d) are not required.

(e) In the site suitability evaluations, the Applicant used a set of F-factors in the equations for calculating dose. What F-factors does the Staff consider appropriate? What is the basis for these and the basis for the Staff view that they are conservative?

Response to Interrogatories III 1-22

Comradex II and HAA-3 - These interrogatories refer to very specific statements in Appendix F which has been withdrawn, according to amendment 60 to the PSAR. Therefore no further answers to these interrogatories have been developed.

IV. With respect to each of the Interrogatories in I, II, and III above, where final information cannot be provided at this time, please provide the following information:

(i) what is the Staff's present (preliminary) assessment in these areas?;

(ii) What are the uncertainties that prevent the Staff from making a final assessment in these areas?'

(iii) What is the precise information that the Staff requires to resolve these uncertainties?;

(iv) What are the outstanding questions or requests for information to the Applicant in these areas?;

(v) In addition to the request for information from the Applicant, is the NRC presently engaged in other research related to these areas? Does the NRC intend to engage in such research in the future?

Response to Interrogatories IV i-v

A) Comradex II and HHA-3 - i, ii, iii are not applicable. The results given in the FES and SSR are considered final, for a reactor of this general size and type.

iv. The staff is not aware of outstanding requested for information on this subject.

v. There is no research contemplated in these areas that would be specifically applicable to CRBR. There may be generic research going on in many of the biological and meteorlogical areas. The same situation holds for the aerosol codes.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
U.S. DEPARTMENT OF ENERGY	)	Docket No. 50-537
PROJECT MANAGEMENT CORPORATION	)	
TENNESSEE VALLEY AUTHORITY	)	
	)	
(Clinch River Breeder Reactor Plant)	)	

AFFIDAVIT OF JOHN K. LONG

I, John K. Long, being duly sworn, state as follows:

1. I am employed by the U. S. Nuclear Regulatory Commission as a Nuclear Engineer, Research Systems Branch, Office of Nuclear Reactor Regulation.

2. I am duly authorized to participate in answering the Interrogatories in the 7th Set and I hereby certify that the answers given are true to the best of my knowledge.

JOHN K. LONG

Subscribed and sworn to before me
this day of April, 1982.

Notary Public

My Commission expires: